HUCKSTEP AND GEHR'S ORTHOPAEDICS AND TRAUMA

Introduction

Authors

This book is based upon the two classic textbooks of Prof RL Huckstep, RLH, 1926-2015, A Simple Guide to Orthopaedics and A Simple Guide to Trauma. These texts have been in print for over 50 yrs; so passing the test of time. They have provided fundamental orthopaedic education to many thousands of medical students and junior doctors in training around the world.

RLH gave the copyright to me, EG, in order to keep the texts in print and updated. In the interest of brevity I have clipped his Oxbridge style in places (eg. XR appearance of to X ray of; Osteoarthritis to OA).

RLH is one of the giants of the 20th century, born in China where his parents were missionaries, educated at Cambridge, who provided orthopaedic care in Uganda and then later Sydney, Australia.

He provided extensive orthopaedic care for polio victims in Africa (surgical procedures and mobility devices). Where Jonas Salk developed the vaccine to prevent polio; RLH developed the treatment for polio victims.

He invented many devices (implants, trauma devices, skelecasts, established the top Orthopaedic Dept at the UNSW and co-established WorldOrtho. He was described as a Surgeon, Humanitarian and Educator.

Eugene Gehr, MBChB MPH MD FRACS, is a consultant orthopaedic surgeon in Sydney, Australia, who was RLH's registrar. He was Chief Resident in Anaesthesiology at Harvard then trained in orthopaedics in Sydney. He has written several textbooks, invented new systems for arthroplasty and co-developed WorldOrtho. He has treated over 150,000 orthopaedic injuries/conditions.

To keep costs down this book has been edited tightly, so making it the cheapest text in print/online and so readily available.

This book can be supplemented with WorldOrtho, OrthoInfo. AAOS.org and Chat GPT (a very useful AI tool).

2022

EG

Cogito et seco

Dedicated to John Hunter (1728-1793), the most famous surgeon of modern times who established the scientific basis of surgery and Galen (129-216), surgeon to the gladiators of Rome, whose writings dominated medical practice for over 1000 yrs (I wonder how long the internet will last).

Essential Background to Orthopaedics

Orthopaedics deals with mechanical failure of the human body. The body wears out (from big mileage or age, like a car) and you replace the worn-out part (hip or knee replacement) or it fails/breaks (from a fall or car accident) and you fix it up (treat the fracture). The human body is not so well built (it would not get through quality control these days), one fall and you are suffering a limb- or life- threatening emergency (imagine if this happened to your Porsche after you go over a small speed bump and it is written-off).

Orthopaedic surgeons need to be good with their hands which they used to learn from building yachts or their home or nowadays from a lot of reading, study and workshops. They prefer to go to a hardware store rather than the opera. But there is no substitute for seeing a lot of cases with hands on work (experience).

Regardless of which specialty you are in, it is important to know something about orthopaedics as nearly one third of all medical problems are related to the musculoskeletal system. You might be a psychiatrist on the ski slopes but everyone will expect you to know something about fracture management.

The primacy of our work is the doctor-patient relationship; patients go to a hospital to see a doctor for treatment NOT to see an administrator. But at most hospitals the latter is increasing in number at a greater rate than doctors (just look at the size of the car park outside the admin offices). Remember it was not so long ago that doctors built and ran large successful departments; you can still do it.

Diagnosis- is most important

Clinical Practice requires that you arrive at a diagnosis as soon as possible so treatment can be started. The diagnosis is invariably based on a good history and examination; blood tests and imaging should mainly be done to confirm your diagnosis. A not so skillful clinician relies upon imaging, such as MRI to arrive at a diagnosis most times. It is said that you should only order a test when you know what you expect to find and know what you are going to do with the result. I teach students to try to arrive at the diagnosis upon first seeing the patient as a mental skill test; you will be surprised how accurate you soon become.

In multi trauma you can have a car accident victim presenting with multiple injuries; you have to think fast, simplify your treatment plan, and put it into action asap to save life and limb. Think fast and act.

History and Physical Examination leads to DIAGNOSIS, confirmed by Imaging and Blood tests.

What is the purpose of a Doctor?

I often ask medical students what does getting your medical degree and being licensed allow you to do what other citizens are not allowed to do. A lot of the time they are puzzled by the question which is strange after having spent 8 to 10 years arriving at this point in your career and you do not really know what you trying to achieve. So here it is:

1. You are allowed to write a prescription for potentially dangerous drugs (say for hypertension or chemotherapy) and for addictive drugs (called S 8 I Australia).
2. You are allowed to operate (allowing for body piercing).
3. You are allowed to set (treat) fractures (allowing for the traditional role of bone setters in (Ancient Cultures).
4. Giving medical advice is NOT your preserve, just go into any health food store and hear a sales person advising on all range of medical problems.
5. Write a death certificate. Few students ever get this one but it is the orderly keeping of death certificates which is the sign of a well-organized society where every citizens’ death has to be accounted for. Quite a responsibility. Don’t take it casually because the legal system certainly does not

   Can you think of anymore?

What is the job of a doctor?

- Heal the patient (if at all possible)
- Alleviate pain and suffering (if healing not possible)
- Console where all is lost; at least do not abandon the patient and family and remain available to talk and advise. Often these are the most grateful patients.

What does it take to be a surgeon?

1. You need the mind of Asclepius
2. The eyes of an eagle

3. The hands of a woman
4. and the heart of a lion

The One-minute Fracture talk

I used to give this talk to medical students where I covered all of trauma in one minute; with the years it has stretched to 3 minutes.

FIRST DO ABC, then

-What is a fracture. It's a break in the bone

-Why treat a fracture. To prevent malunion and relive muscle spasm

-How to treat a fracture. Reduce (closed or open) and hold (closed with a plaster or external fixateur or internally with plate, nail, rods).

-How to describe a Fx (which bone, which end, open/closed, tilt (angulation), shift (end to end apposition) and twist (rotation-hard)

-What sort of fractures do you nearly always operate on - Multi trauma, pathological fractures, those involving joints, those of the femur, forearm, elbow, ankle.

-What fractures do you try to avoid operating on. Where the patient does not understand what you are doing. Where the patient is unlikely to turn up for follow up.

-What are the complications of fractures. Skin (breakdown, ulcer, infection), fat (fat embolism), veins(DVT), arteries (entanglement, compression), muscle (compartment syndrome) (slow to heal/delayed union, won't heal/non-union, crooked/ malunion, dies/AVN).

-How are children's fractures different. Children's fractures are different as they have a growth plate prone to growth arrest with deformity or shortening.

-Common Dislocations. Shoulder, reduce asap and digits, same.

Fractures of the arm-

Shoulder ORIF, not in children,

Humerus ORIF, not in children

Elbow- ORIF for all

Forearm, ORIF, children try closed reduction if possible. Wrist, closed reduction

Scaphoid usually ORIF, full of trouble

Ulnar side of wrist not too much to worry about

Metacarpals usually ORIF (take care with CMC jnts)

PIP jnt prone to stiffness

Fracture of the leg

Femur-ORIF, seldom in children

Knee ORIF, sometimes in children

Tibia sometimes ORKIF, seldom in children

Ankle ORIF

Talus sometimes ORIF

Calcaneous difficult to ORIF

Midfoot take care not to miss

Metatarsals, toes, sometimes ORIF

Pelvis - can bleed out

Acetabulum ORIF

Whole of spine ORIF where unstable and neuro problem. Other-

Don’t miss cauda equina

How do fractures heal (common exam question).

1. Haematoma formation, within minutes
2. Granulation tissue within hours
3. Immature callus, within days
4. Mature callus, within weeks
5. Re modelling within months.

Why Actually Orthopaedic Surgery is so impossible; It is for (far too) many reasons.

Firstly - poorly designed from the start.

The impossible bodily system you are dealing with. The musculoskeletal system of our body (our skeleton) is highly flawed/faulty. Very poorly designed. Evolution did a poor job. Think of your body as a car (it does huge mileage and wears out, so you do a hip or knee replacement; it breaks-down or fractures, you fix it up). If Porsche built a Porsche Boxster that way, they would soon be out of business. Our body is more like that notorious East German car called the Trabant (slow, uncomfortable, noisy, Smokey and dirty) which was produced up until the Berlin Wall fell and all East Germans then had access to wonderful well-engineered West German cars such as Mercedes or Porsche. The Trabant was a smoking lawnmower of a car which seldom started or budged. But it was cheap (and nasty) and within reach of poor East Germans (after a long wait).

We can be walking along, in our 60s, a small fall or slip, and then have a life-threatening fractured hip which has a 50% mortality. In fact, a well-known “youngish’’ Sydney journalist fell while jogging in 2015, slipped and dislocated and fractured her hip. She would have required a big and difficult operation straight away and then with a high likelihood of early osteoarthritis requiring a hip replacement in 2 to 5 years. What a disaster. Would you accept your Porsche Boxster going over a speed hump and the chassis collapsing with a 50% likelihood that the car is then written off? There is no genius design about the human body. We want the body to be a Porsche but it's just a crappie Trabant.

It's all because the upright posture is a disaster for human beings. We would have been better off continuing to walk like gorillas or like a red crab on Christmas Island with a much more stable infrastructure or chassis. I just laugh when numb-skulls at dinner parties, or presenters on morning TV shows, swoon about how wonderfully designed the human body is. This is just group speak or group non-thinking. They need to sober up or attempt to think clearly about the facts of our existence. Perhaps we need to look at the co-ordination systems of goats walking high on rock cliffs.

In car accidents, the skeleton breaks in many places, it is called multi-trauma. In a high- velocity car crash, there may be one head injury, one organ injury (e.g., ruptured spleen) but multiple (5 or more fractures). The orthopaedic surgeons are flat out putting patients back together after car accidents, much busier than all the other surgeons combined, getting tired and bad-tempered in the process.

So focusing on the musculoskeletal system, it is so poorly designed, and that is the very reason orthopaedic surgeons are kept so busy, as the mechanical engineers of the human body, always having to fix up or the body when it wears out or fails/breaks down (i.e., fractures).

Secondly - a system prone to failure.

The skeletal system fails frequently. Just too easily and then is just as difficult, if not impossible, to fix up.

The bones which break so readily are difficult to repair or put back together. Every case of patients over 65 is like working with Humpty Dumpty. It takes very expensive special plates (locking plates), nails, and screws to hold the fragments after you have pieced it back as closely as possible into anatomic position. One slip after hours of work on your jigsaw puzzle, and it falls apart again.

You could think of elderly bone being like wood infected with termites or mulch. It just crumbles in your hands.

Even where the bone is healthy as in younger patients and children, bone is very difficult and unforgiving. It is technically challenging to put many fractures back into anatomic position. It just won't fall back into position easily. It's a complicated giant jig saw or lego which won't interlock/fit. Because of the giant and powerful muscles around the bone, especially in the thigh covering the femur and, in the shoulder, just cause the leg or arm to the telescope, angulate and shorten when fractures occur.

There are approximately 326 different fractures, each and all with their peculiarities which must be learned for both adults and children-each quite different (Miller's Review of Orthopaedics, 8th Edition). No orthopaedic surgeon could answer this for you. Before I even started my training as an orthopaedic surgeon, I had treated over 10,000 skiing injuries on the ski fields of NSW. Since then, I have treated over 150,000 injuries; the most in Australia.

No other surgical disciple has such a huge clinical database to treat. Fractures alone could be a separate specialty (as it is in Europe with a well-described Trauma Specialty which mainly deals with fractures). There are children's fractures, all based around the problems with inuring the growth plates and so affecting growth with shortening of limbs and deformity, and older patient fractures, which are really fragile and crumble just looking at them and take special plates to fix them.

Outside Europe, each surgical specialty treats both the emergency and elective work around that specialty.

Thirdly - a whole lot of learning to do.

The equipment details you must know and master. Look inside an orthopaedic OT, and you will see instruments trays almost stacked to the ceiling. No other surgical specialty has this. Most apart from using a microscope, which is also used in orthopaedic hand surgery, have one or two neat trays of instruments. The scrub nurses know this very well. They also have the task of familiarity with the instruments and like to specialize in orthopaedics because of the excitement of the specialty but the need to focus and lean the required huge amount for the speciality.

There are over 200 different plating and fixation systems to learn how to use, so you have more systems in your armenatium to deal with all the different fracture configurations.

There are over 600 different knee replacement implants and over 600 hip replacement implants. You don't need to know them all in detail but at least 20 of each. By now, I mean the materials they are made of (with their wear characteristics), the design features, how to surgically implant the implant with all their peculiarities and the long-term survival details of the impala see with them know complications and failures so you can work out how to repair them when this occurs.

Fourthly - just does not want to heal.

Bone heals poorly, hard to put back together. For example, infections have a poor bloody supply, so it heals slowly and poorly.

It's the ultimate ego disaster. Nothing fits or holds together and it seldom heals smoothly. Complications are common and can be disastrous. If bone becomes infected, it is almost impossible to get rid of it. So, is infection around plates or implants — an infected hip replacement subjects the patient to multiple operations, years of high doses antibiotics with a lot of complications? The costs of such care spiral tenfold. Orthopods fear infections and go to extraordinary lengths to avoid it (extreme discipline in the OT, strict hand washing and sterility techniques in the OT as well as often wearing space suits in the OT. No other surgical specialty has such fears about infection. It's soul destroying see a patient's life wasted away by a chronic joint or bone infection; their life becomes an endless downward spiral of body destroying antibiotics, visits to hospitals and endless useless operations. They become imprisoned by the health care system.

There is hope with the new concept of the Interstitium. The fascial highway. We have been looking at it for the last 500 years of the enlightenment but did not realize what it was. It is the byway or hallways of the body to give our surgical access to all al areas. It is our new OT.

Fifthly- and what about the personalities involved?

The personalities it inculcates that are needed to practice it. Drilled honed, never distracted by life, family, human personal contact.

They are robots, soft flesh wrapped around a cold life-sucking AI device. Often thoughtless (i.e., devoid of original ideas), devoid of sophisticated conversation. You could characterize them as those pokie machines in gaming clubs, always ready for more work (cash input), performing a service and about to consume you and their own lives.

It all makes for a sorry ending with no family, no loving wife and in a retirement water front community friendless (i.e., no longer of value to the industrial, medical complex or cash primed orthopaedic world).

To live and work this way, you have to be fearless, more easily achieved when you are young, too much testosterone, some commentators would say clueless.

Time and dedication, pure focus to learn the above, not just from the textbooks but by seeing and treating a wide spectrum of fractures during 5 yrs. of formal training; throw in another 3 to 6 years.

Three of the most common questions asked at Med School.

1. What metabolic condition does this patient have? (it is usually diabetes mellitus).
2. Look at this X ray, what bony conditions does this patient have? (usually Paget's Disease, osteitis deformans).
3. What are the ten most common side effects of steroids (now you really need to be able to rattle these off like a machine gun).

Dedicated to my wife, Raquel

PART 1 : ORTHOPAEDICS

History, Examination, Investigations and Treatment

Orthopaedic History

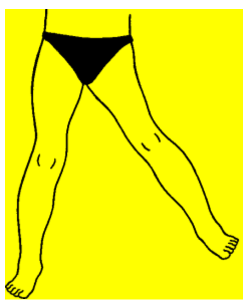
Orthopaedic Examination

1 History and Examination

2 A Simple Guide to Orthopaedics

Chapter 1

History and Examination



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3 **History and Examination**

Orthopaedic History*

An adequate history is essential before the patient is examined. This will give a clue to the diagnosis. It will also ensure that the most relevant part of the patient is examined. It may be categorised as is shown on the opposite page.

History of presenting illness

The present history should include questions about any pain, swelling, deformity, limitation of movement and also if these restrict normal activities.

The type of pain may be relevant, as well as its radiation proximally or distally, and any associated sensory or motor disturbances. It is also important to ask whether pain is increased by exercise and if it keeps the patient awake or interrupts sleep.

Questions should be asked about the parts distal and proximal to the affected area. Any extension of pain, numbness, weakness, temperature change or swelling distally should be noted. Any disabilities, pain or swelling elsewhere in the body should also be noted.

The patient should be asked about any treatment for a current complaint, its effectiveness, possible side effects, and an assessment made of compliance.

Finally, general and specific questions about other systems likely to be affected should be asked.

*Orthopaedic surgeons are very well trained in precise history taking and expeditious physical examination. There is a need to focus and simplify as there are many operations and fractures, Fxs to learn. For example, when a multi-trauma comes in, 5 or 10 or 20injuries in the one patient need to be sorted. More so than other specialties.

General Medical History

Identifying data: name, age, address, occupation

Presenting symptom(s)

History of present illness

Current treatment: effectiveness, side effects and compliance

Past medical and surgical history

Family history

Social and occupational history

Systems review

Past history

This should include questions regarding previous operations, illnesses or injuries, and also general health.

Family history

Details of the immediate family's health is an important part of the history. This should include medical and surgical illnesses in the patient's parents, siblings and children.

Social and occupational history

A social history should make brief reference to domestic, interpersonal, legal and financial matters. An occupational history is important since it has a bearing on the likely risk factors, approach to treatment and patient compliance.

A history of alcohol and other drug consumption is an essential part of the social history. An alcoholic, overweight, heavy smoker is much more likely to develop conditions such as lung carcinoma and hepatic cirrhosis. This patient is also more likely to have post- operative complications from surgery. The way in which the patient gives a history, and even the past history, can provide a good indication as to whether the symptoms described are genuine, and the likelihood of patient response to treatment. The type of treatment given and the availability of domiciliary care may alter the necessity for hospitalisation.

Obtaining a history from a young child may be difficult. Parents may provide some information, and more reliance will need to be placed on physical examination*.

Systems Review

Cardiovascular system

Chest pain, dyspnoea, swollen ankles

Respiratory system

Cough, sputum, dyspnoea, fever

Central nervous system

Headaches, weakness, altered consciousness

Gastrointestinal system

Nausea, vomiting, abdominal pain, altered bowel habits

Genitourinary system

Frequency, dysuria, discharge, haematuria

Musculoskeletal system

Pain, restricted movement, past trauma General

Weight loss, weakness, mental state

A patient's occupation and ability to work may be relevant. A patient complaining of back pain, for instance may relate this to lifting heavy weights at work. This may in turn be exaggerated, with a view to compensation payments or extended time off duty.

The type of work carried out by the patient may also be relevant to possible treatment. For example, the management of back pain in someone in a sedentary occupation, who takes little exercise, may be viewed differently from that of someone whose job involves heavy lifting.

*For children, observation is much more important- the so called “hands-off” technique. Sit the child on the mother’s knee while you examine. One technique is to ask a walking child to sit on the floor and get up as quick as possible; if they can leap up quickly then the child is very unlikely to have any cerebral, spinal or lower limb problem (or probably any upper limb problem).

Ask the mother to place the child at one end of the room and observe the child run to their mum. Also check if the child’s spine is straight, pelvis level and feet plantigrade.

Aetiology
Orthopaedic Conditions

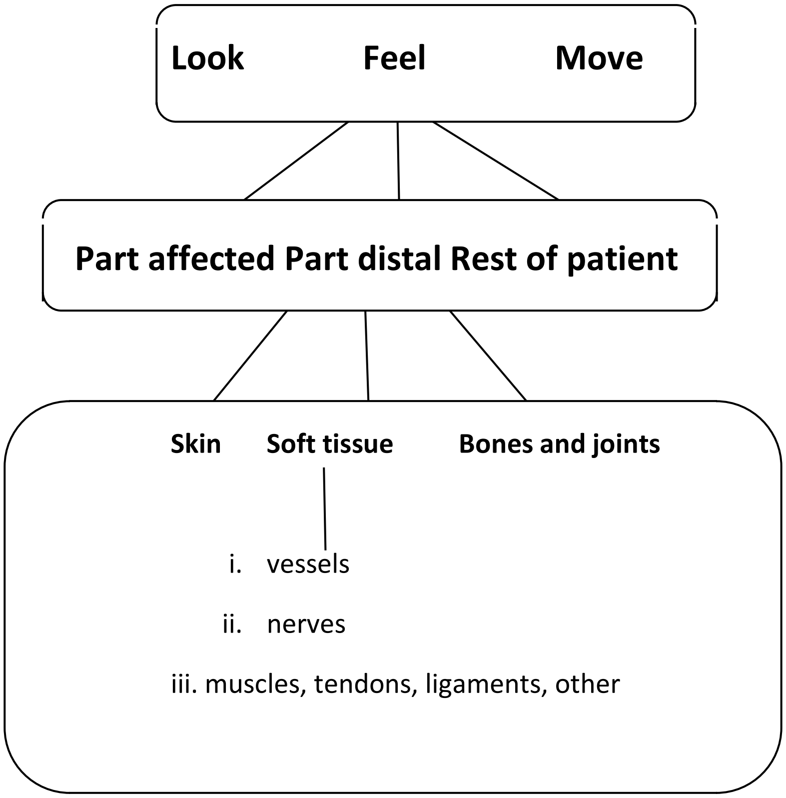
Congenital

1. Genetic e.g., achondroplasia
2. Infection e e.g., rubella
3. Drugs e.g., thalidomide
4. Radiation e.g., X-rays
5. Trauma

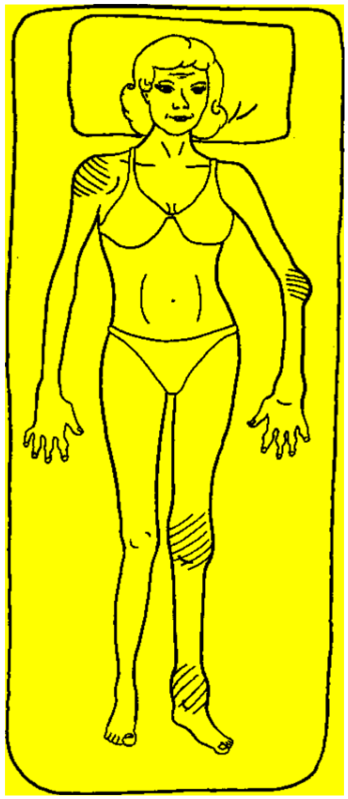
Acquired

1. Neoplasia - benign malignant
2. Trauma - soft tissue fracture and dislocation
3. Infection - acute chronic
4. Arthritis - degenerative autoimmune metabolic
5. Paralysis - cerebral spinal peripheral
6. Miscellaneous - Paget's disease

Orthopaedic Examination (as per Apley*)



*Dr Graeme Apley (1914-1996),English Orthopaedic Surgeon, the greatest educator of Orthopaedic Surgeons for nearly 50 years, of the last century. His book, Apley & Solomon's System of Orthopaedics and Trauma, 10thEd., remains in print.



11 **History and Examination**

Examination Principles*

1. Try not to hurt your patient and watch the patient's face, not the umbilicus.

2. Always carry a tape measure and torch.

3. Examine the relevant part of the body gently, systematically and thoroughly.

4. Examine anything else which may be of direct relevance.

*In the US, the examination table/couch is often at doctor's waist level; elsewhere lower. It's up to you, but being able to sit on a lower chair to examine the lower limbs is very useful. Use a small set of steps or an electronic couch to allow the patient to get onto the couch easier.

Examination of a Child: THREE ESSENTIAL QUESTIONS.

Is the spine straight?

Is the pelvis level?

Are the feet plantigrade?

The Part Affected

Look

1. Skin

2. Soft tissues — vessels nerves other e.g., muscles, tendons, ligaments, fat, fascia, lymph nodes

3. Bone and joint including synovia and ligaments

Feel Skin

The skin should be felt for - tenderness temperature fluctuation sensory disturbance

It is important to compare both sides of the body, and to feel the front, back, and sides of the part affected.

Soft tissue

Soft tissue should be carefully palpated and abnormalities noted. Soft tissue examination can be divided into three sections:

Vessels

Nerves

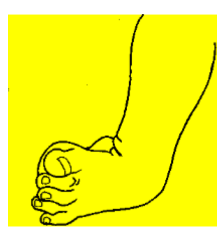
Other - muscle, tendons, ligaments fat, fascia, lymph nodes

Vessels

Abnormal or absent pulsation should be noted. An aneurysm can usually be moved from side to side rather than longitudinally, it may pulsate, and a bruit may

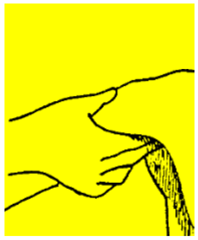
Look

Rheumatoid hands

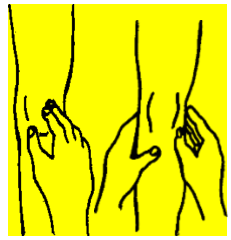


Talipes varus deformity

Feel

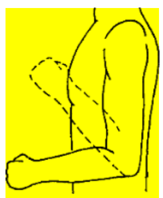


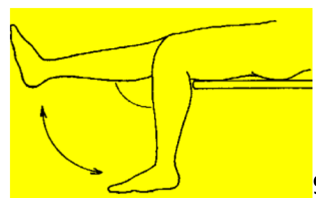
Axillary lymph nodes



Patella and joint margins

Move





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be heard on auscultation. Examination of the distal part of the limb may highlight differences in appearance and temperature.

Nerves

Nerves can sometimes be palpated and may be enlarged. In some cases, the nerves may be tender, for instance following trauma, or due to pressure from underlying structures. They may also be enlarged with a tumour such as a neuro fibroma. As with vessels, they can be moved from side to side rather than longitudinally. Sensory loss, hyperaesthesia or paralysis may be present in the distal part of the limb in nerve injuries.

Other structures

Muscles and tendons should be palpated for tender-ness. Tendons may be shortened or ruptured.

A ganglion is an overgrowth of synovial tissue. Ganglia often trans illuminate and their size often varies as joints are moved.

Benign lipomas are very soft with an indefinite edge and transilluminate. Malignant soft tissue tumours include liposarcoma, rhabdomyosarcoma and fibro sarcoma.

Regional lymph nodes should always be palpated for enlargement in all cases where there is a possibility of infection or neoplastic disease.

Bones and joints

These should be carefully palpated for:

1. Abnormal anatomy, swelling and deformity

2. Tenderness

3. Comparison with the opposite side

The joint should be palpated in different degrees of flexion. Swellings in the joint may become more obvious with flexion or extension. Swellings may be bony, or soft tissue, or both. If the swelling is soft tissue, it should be assessed as to whether it is:

1. Synovial tissue

2. Fluid - synovial fluid blood pus

3. Both

Move

As well as testing the muscles, ligaments should be assessed where possible. This is particularly important in the knee and the ankle, where ligament laxity compromises weight bearing.

Detailed examination of joints is discussed in sub-sequent pages. In children or apprehensive adults, active movements should be carried out before passive. Passive movements (movements gently carried out by the examiner) should always be assessed in addition, to active movements,(carried out by the patient).

Individual joints have different types of movement. Most joint movements, however, can be divided into3 major components:

1. Flexion/extension

2.Abduction/adduction

3. Internal/external rotation

After assessing active and passive movements, the power of relevant muscle groups should be assessed.

The Part Distal

Look

The limb should be inspected for scars, deformities and also for any obvious shortening. It is important to examine the sides, back and front of the limb, and also to compare the opposite limb. Small differences in colour, swelling, wasting and deformity can only be noticed by careful comparison of the two sides.

Feel

A systematic examination of the limb affected will mean that nothing important is missed. The skin is felt for warmth. Any difference in sensation is com-pared with the opposite side and tender areas noted. The arterial pulses are palpated and compared, when appropriate, with the opposite side.

Move

The joint should be moved through its full range of movements:

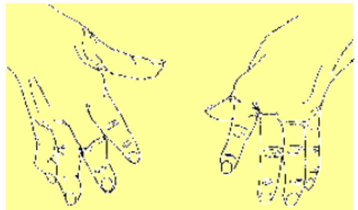
1. Active movement — movement by the patient. In children, apprehensive patients, or in cases of suspected spinal injury, always carry out active movement before passive.

2. Passive movement — movement by the examiner

3. Power

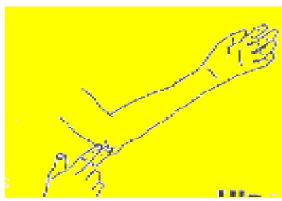
4. Ligamentous stability

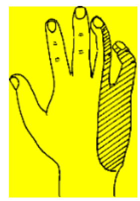
Look



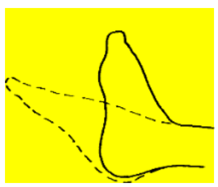
Rheumatoid hand

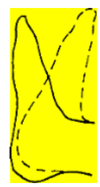
Feel





Move





Ankle plantar flexion & dorsiflexion

The Rest of the Patient

Look

1. Opposite side

2.Head and neck

3.Trunk, spine and abdomen4. Other limbs

Feel

1. Temperature

2. Tenderness

3.Abnormal masses

Move

1. Active

2. Passive

3. Ligamentous stability

Overall Examination

Head and neck

General inspection

Swellings, wasting, deformity, skin

Eyes

Pupils, conjuctivae, fundi

Ear, nose and throat Neck

JVP, carotids, thyroid, lymph nodes, trachea

Upper limb

General inspection

Swelling, wasting, deformity

Pulse and blood pressure Neurological examination

Tone, power, reflexes, sensation, co-ordination

Bone and joint examination

Precordium

General inspection

Swellings, wasting, deformity

Heart

Size, heart sounds, murmurs

Lungs

Breath sounds, additional sounds

Overall Examination

Rib cage and breasts Back

General inspection

Swelling, wasting, deformity

Lungs Spine

Scoliosis, kyphosis, tenderness Movements

Abdomen

General inspection Palpation

Liver, spleen, kidneys, other masses

Percussion and auscultation Perineum

Herniae, lymph nodes (inguinal and femoral), rectal and genital examination (if relevant)

Lower limb

General inspection

Swelling, wasting, deformity Neurological examination

Tone, power, reflexes, sensation, co-ordination

Vascular examination

Pulses, temperature, ulceration, trophic changes

Bone and joint examination Shortening and gait disturbance

Chapter 2

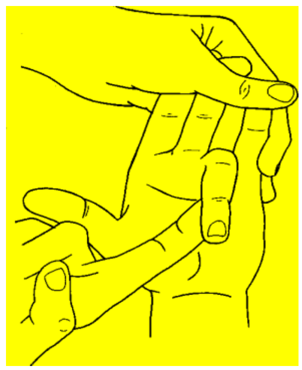
Examination of the Upper Limb

Hand and wrist

Elbow and forearm

Shoulders and humerus

Neurological examination



Hand and Wrist Examination

The function of the upper limb is to position the hand in space (where it needs to be). The hand is used to write, hold tools and carry weights.

Look

1. General inspection

Look for any signs of asymmetry, abnormal posture, deformity or wasting.

2. Skin

Look for scars’ sinuses or colour changes. Observe the nails for clubbing, pitting or other deformity.

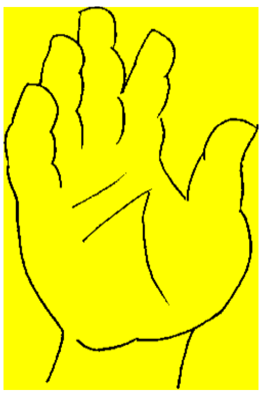
3. Soft tissue

Look for wasting of the thenar and hypothenar eminences and other small muscles of the hand. Dupuytren's contracture presents with thickening of the palmar fascia. Abnormal posture may be congenital or due to a traumatic bone, nerve or muscle injury. Note whether there is symmetry as this may help in determining the cause. Look for localised swellings over the wrist and hand.

4. Bone and joint

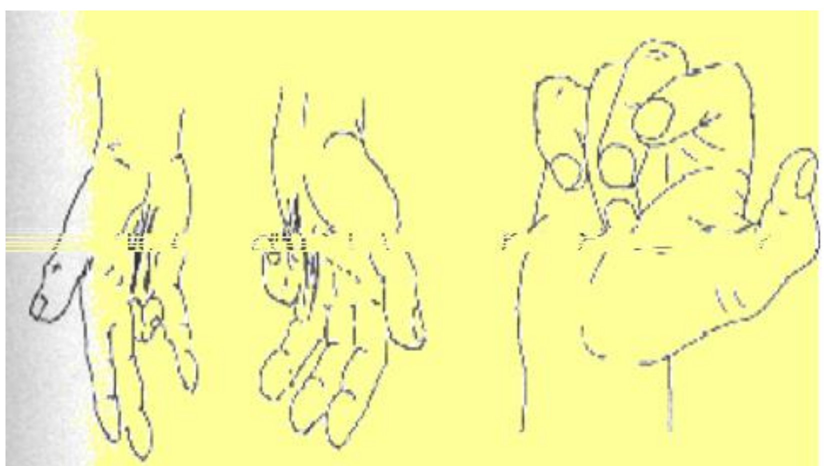
Look for swelling of the wrist, metacarpals, phalanges and inter phalangeal joints. In RA, the wrist, metacarpophalangeal and proximal inter- phalangeal joints are involved, whilst in OA the distal inter phalangeal joints are mainly affected. A ganglion overlying the wrist will be a firm, smooth, slightly mobile swelling. A bony swelling may indicate are cent or old fracture, rarely a tumour.

Hand and Wrist Examination



Swelling

Ganglion

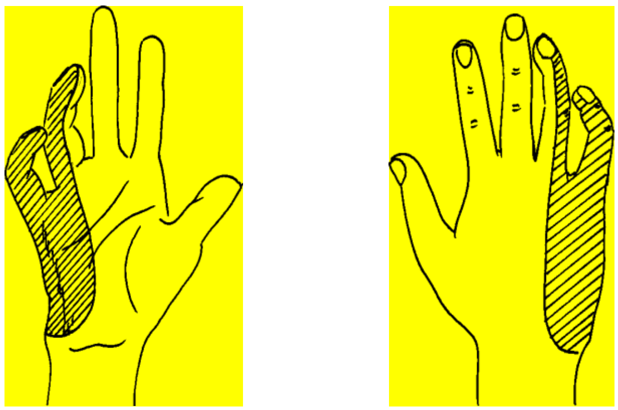


Contracture

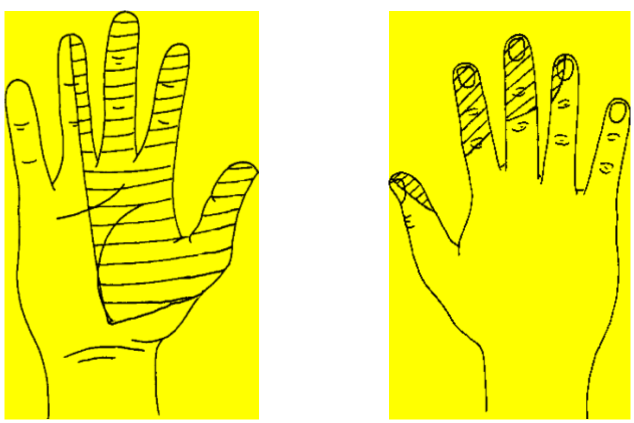
Feel

The joint should be carefully palpated for any tender-ness. Swellings should be palpated for consistency, con-tour and attachments, both superficial and deep. If mobile, the direction of movement should be noted. In a vascular or neurological swelling, or in a swelling attached to a tendon, the lesion will move from side to side but not longitudinally. Pulsation is suggestive of an aneurysm, whilst radiating tenderness or tingling on tapping the nerve (Tinnel's sign), may be due to a neuroma (a small neuroma can be extremely painful and disabling). The relationship of the swelling to a joint should be noted. In particular it should be noted whether the swelling disappears or changes size with movement of the adjoining joint, as may occur with a ganglion. The hand and wrist should be felt for any evidence of vascular or neurological impairment, and the pulses felt. Always compare with the opposite side.

Hand and Wrist Examination



Ulnar nerve palsy, clawing, sensory loss, wasting



Median nerve palsy, sensory loss, wasting of thenar muscles

Move

1. Movements of the fingers and thumb

2. Movements of the wrist

3. Power (check hand grip strength)

Movements of the fingers and thumb

The movements of the fingers should be assessed together and then individually, as necessary. The patient should be asked to make a fist, and the grip felt for strength. The metacarpophalangeal joints are assessed as well as the inter phalangeal joints. Flexion at the distal phalanx is carried out by flexor profundus and at the middle phalanx by flexor superficial is. Flex or profundus is assessed by flexion of the distal interphalangeal joint of the fingers.

Flexor superficialis is tested by putting the profundus out of action by extending the fingers other than the one being assessed. The ability to flex the middle phalanx then signifies an intact superficial is tendon to that finger. This is because the tendons of profundus divide very low in the forearm and their muscle bellies are joined together.

Remember that weakness may be due to a problem in the muscle such as a rupture of the extensor tendon, or due to paralysis of the nerves.

The thumb is the most mobile digit, and impaired thumb function is very disabling. The movements to be tested are:

1. Extension and flexion

2. Abduction and adduction

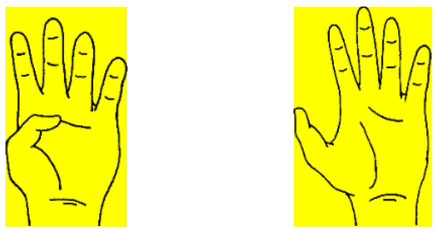
3. Circumduction (circular movement of the thumb at the first metacarpophalangeal joint)

Hand and Wrist Examination

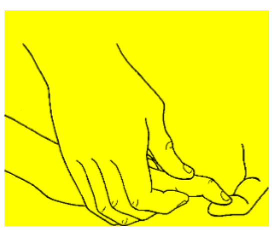
Making a fist

Finger extension

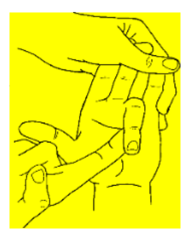
Abduction and adduction



Thumb flexion and extension



Flexor



Flexor superficialis profundus

Movements of the wrist

The important movements of the wrist are:

1. Flexion and extension

2. Abduction and adduction

3. Supination and pronation

Flexion and extension

The degree of dorsi flexion and palmar flexion of the wrist should be assessed, neutral being the wrist in a straight position, as illustrated. Active movements should normally be carried out before passive, especially in children and in apprehensive patients.

Abduction and adduction

Abduction and adduction are less important but should also be assessed. The amount of movement from neutral is assessed and compared with the opposite side.

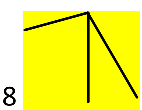
Pronation and supination

Rotation is assessed at the wrist in the same way as at the elbow. The elbows should be tucked into the side of the body with the thumbs pointing upwards and the elbow at a right angle. Normal rotation is 90° of supination and 90° of pronation.

Hand and Wrist Examination

Flexion and extension

8



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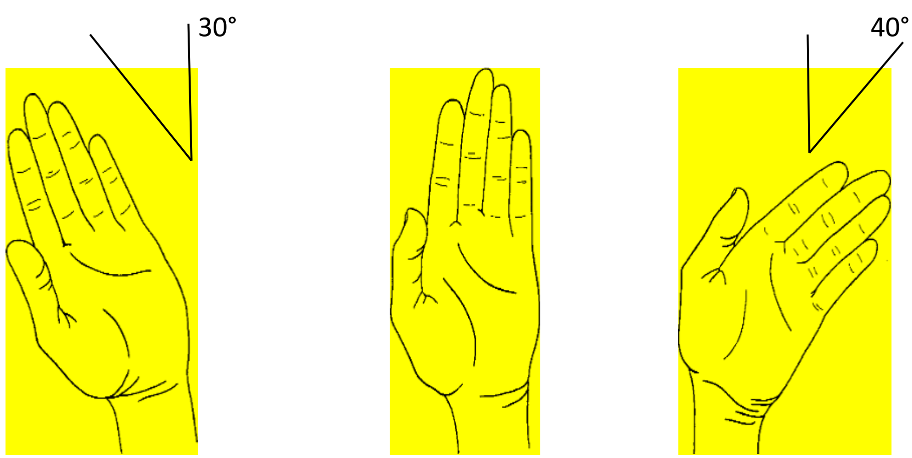
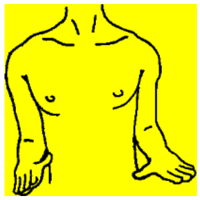
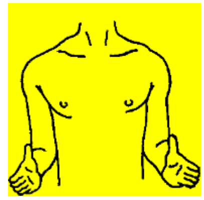
Abduction and adduction



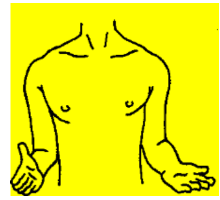
Pronation and supination



Limited on right



Neutral



Limited on right

Hand and Wrist Conditions

Congenital abnormalities

Deformities of a hand should always be compared to the other side. Bilateral deformity frequently signifies a congenital problem. These include:

Madelung’s deformity — shortening or absence of the radius (affects growth plate radius)

Polysyndactyly — fusion of the fingers.

Phocomelia — deficiency or shortening of one or more digits, or even of the whole limb (Amelia). The

drug thalidomide was the commonest cause*.

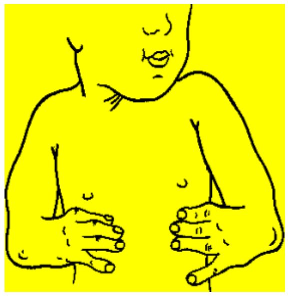
Neoplasia

Neoplasms of the hand and wrist are uncommon. They include benign neoplasms such as a ganglion, which is an out pouching of hypertrophied synovia, or a malignant chondrosarcoma of a metacarpal. Neoplasms of muscles (rhabdomyosarcoma) and neoplasms of fibrous tissue (fibro sarcoma) are both very rare.

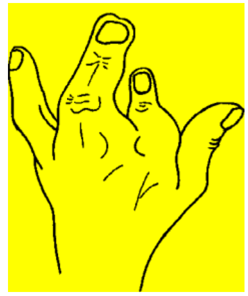
A swelling of the synovia of the wrist on tendon sheaths, if increasing in size, may indicate malignant change into a synoviosarcoma. It should be differentiated from an inflammatory swelling which is usually much more tender, and in the case of rheumatoid synovitis other evidence of the disease may be evident.

Malignant neoplasia of the whole musculoskeletal system are VERY RARE; clinical symptoms and signs are subtle; imaging can be difficult to interpret and yet the out come from such neoplasms can be devastating.

Congenital abnormalities

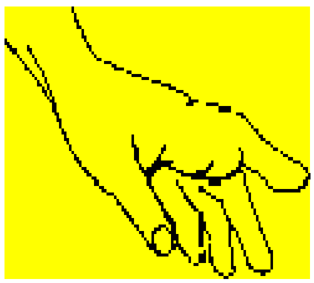


Madelung's deformity

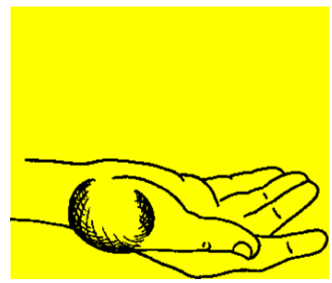


Polysyndactyly

Neoplasia



finger



Chondrosarcoma of the first metacarpal

Trauma

Injuries to the hand and wrist are very common. Old fractures of the wrist are particularly common. There may be residual paralysis, scarring and ulceration as well as evidence of infection and sinuses.

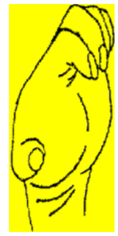
Infection

Infections of the hand may be localised or generalised. Infection of the fingers or wrist may be seen as a swelling of the affected joint. It is important to localise both the site of infection and the cause, which is usually, but not always, an abrasion or a foreign body. Infection of the nail bed, which may be associated with a chronically damp nail bed, is called a paronychia. It usually causes redness and swelling at the base or along one edge of the nail. An injury to the finger may cause considerable pain, particularly in the pulp of the finger. This infection may spread to the tendon sheath, and, if untreated, particularly in a flexor tendon, may cause infection of the individual or the common flexor sheath with considerable swelling in the palm and dorsum of the hand. Infections of the hand and wrist are usually due to local trauma but are sometimes blood-borne, particularly in the wrist where it may be part of a generalized septicaemia. Other joints may also be involved. Enlargement of the supratrochlea and axillary lymph nodes should be looked for, as should a focus of primary infection such as the throat or genitourinary tract.

Hand and Wrist Conditions

Trauma

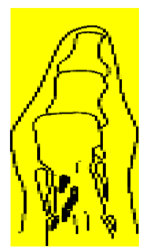
Amputation



Division of extensor digitorum tendons

Infection

Swollen hand due to infection



X-ray of osteomyelitis

Arthritis

Arthritis may be subdivided as:

1. Autoimmune e.g., rheumatoid arthritis(RA)

2. Degenerative e.g., Osteoarthritis(OA)

3. Metabolic e.g., Gout* (tophi can be quite large)

RA commonly affects both hands and wrists symmetrically. There is normally swelling of the wrist, metacarpophalangeal joints and proximal interphalangeal joints, but only rarely the distal interphalangeal joints with warmth, tenderness and limitation of movement. In the latter stages there may be deformity with ulnar deviation and palmar dislocation or subluxation of the metacarpophalangeal joints, rupture of the extensor tendons and stiffness, deformity and pain in the wrist. Other joints such as the elbows, knees, ankles and feet are often involved.

In OA, the distal interphalangeal joints are commonly affected (Heberden's nodes). This is in contrast to RA.

Miscellaneous conditions

Many other conditions affect the wrist and hand. These include Dupuytren's contracture and skin malignancies such as squamous cell carcinoma, basal cell carcinoma and melanoma.

Paralysis of the hand may occur due to nerve injuries (impaired sensation) or poliomyelitis (normal sensation), and this is discussed in detail in the relevant sections of this book.

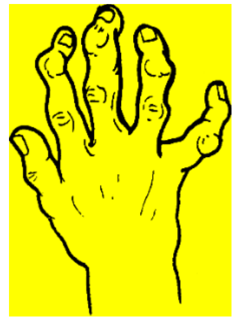
Australian obstetrician, Dr William McBride (1927-2018), pointed out the association between thalidomide and limb deformities in a brief letter totheLancetinthe1960s. As a result, thousands of children worldwide, especially in Australia and the USA were saved.

*Gout is where mono sodium urate crystals are deposited into and around synovial jnts. On XRs-see punched out lesions. Diagnosis is made by as pirating negative birefringent crystals. Pseudo gout-crystals are positive birefringent.

Hand and Wrist Conditions

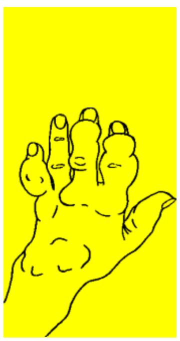
Arthritis

RA

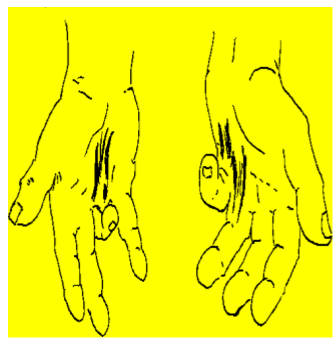


OA

Miscellaneous



Severe tophaceous gout



Dupuytren's contracture

Elbow and Forearm Examination

Look

1. General inspection

Look for any obvious asymmetry, abnormal posture deformity or wasting.

2. Skin

Look at all aspects of the elbow and forearm for scars, sinuses and colour changes.

3. Soft tissue

Look for, and note the location of any localised or generalised swelling. Localised swelling may be due to an enlarged olecranon bursa, rheumatoid nodules, gouty tophi or arise from the underlying bone. General swelling may be due to infection or trauma. Look for any wasting of the forearm muscles.

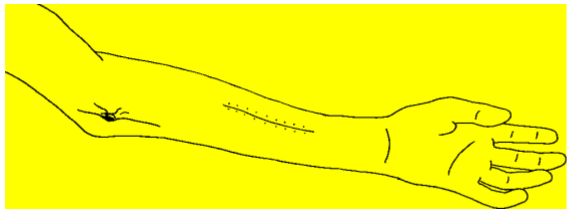
4. Bone and joint

Look for bony deformity which may include swelling, absence of all or part of a bone, malalignment or posterior dislocation of the olecranon. Assess the carrying angle of the elbow.

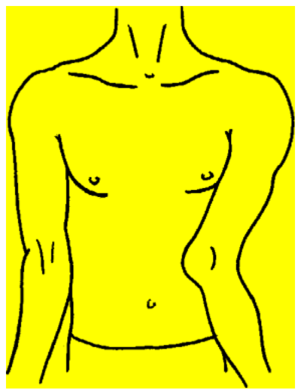
*Note the typical appearance of a rheumatoid hand (involves wrist, thumb, MCP and PIP jnts) versus the arthritic hand (the thumb and DCP jnts), see the pictures here. This is a common exam question.

Elbow and Forearm

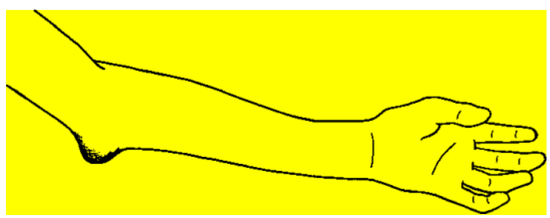
Examination



Scars and sinuses



Cubitus valgus



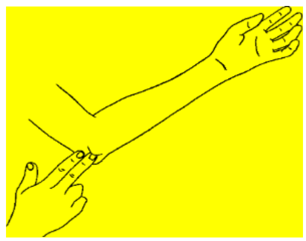
Olecranon

Bursitis (sterile/septic or gout)

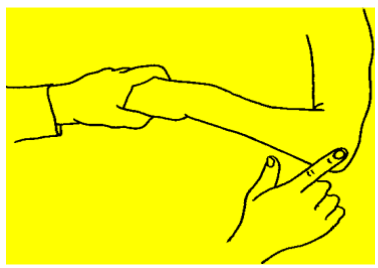
Feel

The elbow should be felt carefully for tender are as which usually gives a clue to the diagnosis. Tenderness over the lateral epicondyle itself may indicate a tennis elbow. Tenderness over the head of the radius may signify a fracture. Tenderness in the extensor muscles themselves below the lateral epicondyle maybe associated with cervical spondylosis. The opposite side should always be compared, exerting the same amount of pressure. The elbow should be palpated for warmth and, if indicated, for any sensory abnormalities. Any swellings or deformities should be gently pal-pated to determine their consistency and whether they are soft tissue or bony in origin. Their attachments, margins and contents should be evaluated. Fluctuation and pulsation should also be looked for. One should attempt to transilluminate all soft tissue swellings, especially if soft, as ganglia and lipomata, will usually transilluminate.

Elbow and Forearm Examination



Medial aspect, tender, thickened ulnar nerve



Lateral aspect, site of tenderness of a tennis elbow

Rheumatoid nodules (med. students- look up the histology; often in exams)

Move

Elbow movements which should be examined are:

1. Flexion

2. Extension

3. Rotation

Flexion

Full flexion should be approximately 150°–160°. It should always be compared to the opposite side if there is any limitation.

Extension

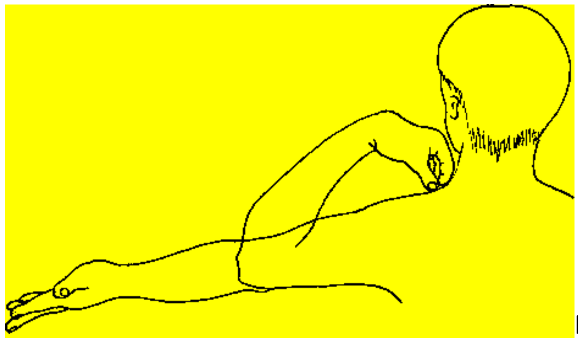
Full extension is 0°. Occasionally the elbow may hyper-extend.

Rotation

Rotation of the forearm at the elbow is assessed by having both elbows close to the sides of the body with the thumbs facing upwards and the elbow flexed to approximately 90°. Pronation and supination of the two sides are compared. These should normally be90° of pronation and 90° of supination. Rotation may be limited, not only by elbow joint conditions including arthritis, infection and trauma but also by injury to the lower radioulnar joint*. Deformity of either the radius or ulna due to a fracture, Paget's disease or other causes will also limit rotation. *Subluxation or dislocation of the radioulnar jnt can be difficult to detect and even harder to treat. Specialized imaging is required and the assistance of a specialist colleague.

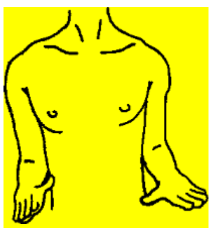
Elbow and Forearm Examination

Flexion and Extension

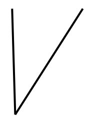


Movement — 0°to 130°

Rotation

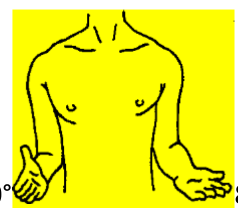


20°



°

Pronation limited on right



Neutral — 0

30° 80°

Supination limited on right

Elbow and Forearm Conditions

Congenital abnormalities

Congenital elbow conditions are uncommon. They include congenital fusion of the radius and ulna, fusion of the elbow joint and congenital webbing of the elbow.

Neoplasia

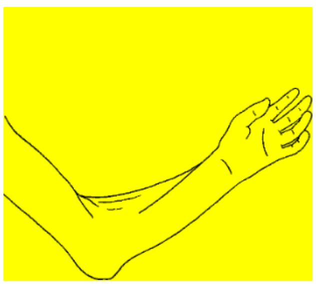
Primary neoplasms around the elbow are rare, but osteochondromata in diaphyseal aclasia may occur. Secondary neoplasms of the lower humerus may also occur and occasionally soft tissue tumours such as synovioma, synovial sarcoma, rhabdomyosarcoma and malignant fibro histiocytoma.

Trauma*

A fracture or dislocation of the lower humerus or of the olecranon or head of the radius can cause deformity or swelling of the elbow. A recent fracture or dislocation will be associated with pain, swelling, deformity and often bruising and discolouration. There will be limitation of elbow movements. In an old fracture or dislocation, deformity is often present and there may be callus or new bone formation. The actual fracture site is often painless unless there is established non-union. Movements are usually limited and evidence of vascular or neurological involvement should be sought in the forearm and hand.

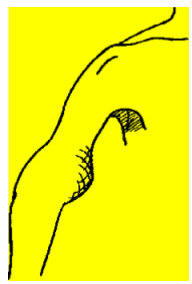
Elbow and Forearm Conditions

Congenital abnormalities



Webbing

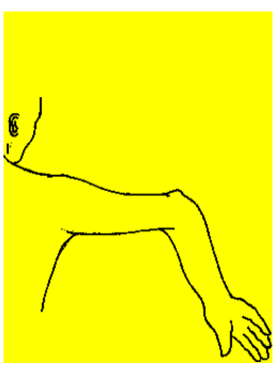
Neoplasia



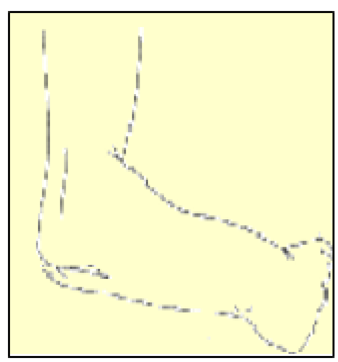
Malignant
fibro histiocytoma

Trauma

Fracture



Dislocation



Infection

Infection of the elbow joint may be associated with a compound fracture of the radius, ulna or lower humerus, or pyogenic arthritis (haematogenous spread or infection from an infected bursa). The whole elbow is often swollen and there may be redness and discharging sinuses.

Arthritis

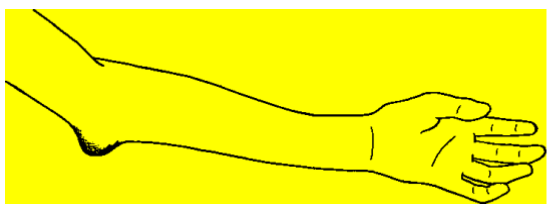
Apart from pyogenic arthritis and osteomyelitis, the elbow may be swollen and painful in rheumatoid arthritis and gout. Severe OA may lead to swelling and limitation of movement.

Miscellaneous conditions

Paget's disease

Paget's disease may be localised or generalised and often causes thickening and bowing of the radius or ulna. In the later stages the bone may be tender but usually it is merely deformed and slightly warmer than the opposite side, which must always be com-pared.

Elbow and Forearm Conditions Infection



Olecranon bursitis

Arthritis

Rheumatoid nodules (extensor surfaces)

Paget's disease

Enlargement bowing and elongation of radius

Shoulder and Humerus Examination

Look

1. General inspection

Observe any obvious abnormal posture, deformity or wasting.

2.Skin

Look at all aspects of the shoulder and arm, remembering the axilla and noting scars, sinuses or colour changes.

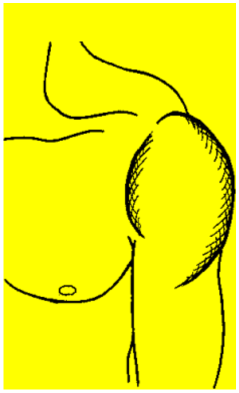
3. Soft tissues

Compare both shoulders looking for local or generalised swelling or change in muscle mass in the affected shoulder. Swelling may be due to infection, tumour or trauma. Muscle wasting sometimes occurs in nerve or muscle lesions or frozen shoulder. If a nerve lesion is involved then there may also be signs more distally. In a rotator cuff muscle tear or frozen shoulder there may be disuse atrophyofthedeltoidmuscle.Itisimportanttolookatwastingfromtheback, sides and front and to compare the two sides.

4. Bone and joint

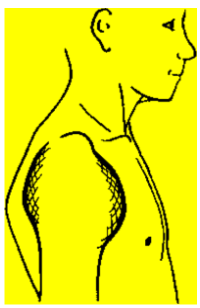
Look at the anterior and posterior aspects of the shoulders to note symmetry, size and position of the clavicles and scapulae. Look for swelling in the anteromedial aspect of the shoulder which may indicate anterior dislocation. Prominence of the lateral end of the clavicle may indicate subluxation or dislocation of the acromioclavicular joint. Similarly, prominence of the medial end may indicate a past injury to the sternoclavicular joint, clavicle and occasionally, tumour or infection.

Shoulder and Humerus Examination



Soft tissue swelling

Anterior dislocation

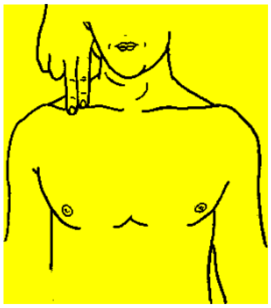


Osteosarcoma

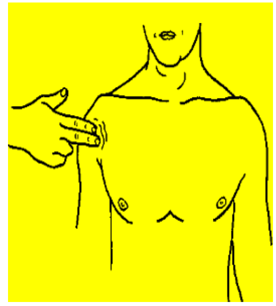
Sprengel's shoulder

Feel

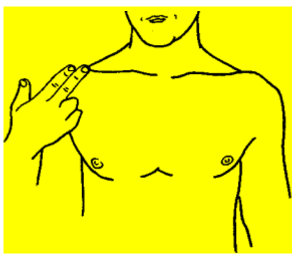
After the shoulder has been inspected it should be systematically palpated. The patient should be asked to indicate any tender are as which should be gently palpated. The examiner should feel the skin for warmth using the dorsal surface of the fingers, and any redness or other discolouration should be noted and the opposite side compared. The sensation over the shoulder is important, particularly the sensation over the insertion of the deltoid if a fracture or dislocation of the shoulder has occurred. Any swelling should be carefully and gently palpated for tenderness, consistency and fluctuation. The edge of the swelling should be felt carefully. In the case of a suspected infection or neoplastic lesion, regional lymph nodes, both in the axilla and the neck should be carefully palpated. No examination of the shoulder is complete with-out a systematic examination of the neck. This is discussed specifically under, 'Examination of the Cervical Spine.' The limb distal should also be examined.



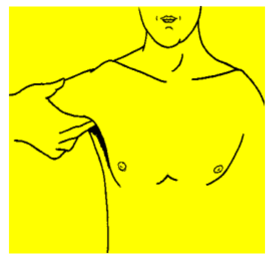
Clavicle



Glenohumeral joint



Tenderness



Upper humeral shaft

Move

Done best by standing behind and just to the outer side. In a child or apprehensive patient, the patient should be asked to move the arm gently out wards to gain confidence (active movements) before passive movements are commenced. Passive movements (performed by the examiner) should always be carried out in addition to active movements (performed by the patient).

The three most important movements are:

1. Abduction

2. External Rotation

3. Internal Rotation

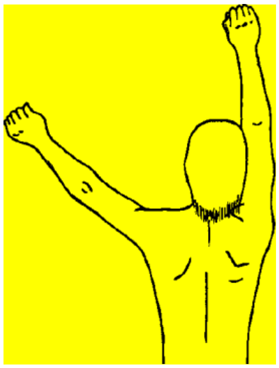
Forward flexion and backward extension should also be assessed.

Abduction

Normally 90° of abduction occurs at the glenohumeral joint and 90° at the scapulothoracic, a total of 180°. It is important to assess how much movement is occurring at each joint. The blade of the scapula should be palpated to assess limitation of abduction. The degree of glenohumeral movement is first felt with the scapula stabilised with the hand. This is followed by scapulothoracic examination when the extreme of glenohumeral movement is reached and the scapula begins to move.

Shoulder and Humerus Examination

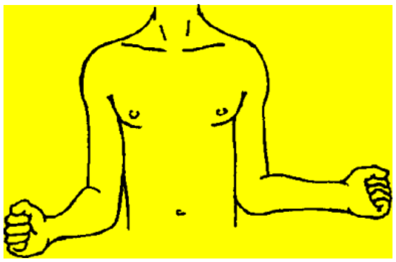
Abduction and Adduction



150°
(limited)
90° scapulothoracic
glenohumeral

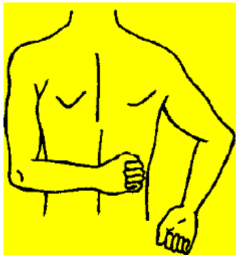
180°
(normal)
60° 90° scapulothoracic 90°
glenohumeral

External Rotation



30° 90°

Internal Rotation



100° 80°

Rotation

The elbows are placed firmly into the sides, flexed at right angles, with the hands facing forwards. This is regarded as the neutral position. The degree of internal rotation and external rotation can then be assessed by comparing the two sides, as illustrated.

A less accurate method of assessment of internal rotation is made by comparing the two sides, and by seeing how far the back of the hand can be lifted up the lumbar or thoracic spine.

External rotation in 90½ of abduction is assessed by asking the patient to put the palms of both hands on the back of the head and externally rotate the arms. This is usually limited in recurrent dislocation of the shoulder and is called the apprehension test. Care should be taken to avoid another dislocation.

Forward flexion and backward extension

The extent of forward flexion should be assessed with the arm lifted up in the line of the body. It may be possible to lift the arm fully to 180½ in the line of body where it is limited in abduction due to the greater tuberosity of the humerus impinging on the acromion. Movement should always be compared to the opposite side and both the passive and active range assessed if there is any limitation. Similarly, the range of extension in the line of the body should be compared with the opposite side.

Shoulder and Humerus Conditions

Congenital abnormalities

These conditions are usually, but not always, bilateral. Examples include craniocleidodysostosis and Sprengel's shoulder.

Neoplasia

Primary tumours of the shoulder include osteogenic sarcoma, chondrosarcoma, aneurysmal bone cysts, and giant cell tumours (GCT). Other primary tumours may also affect the shoulder but are rare. Secondary deposits involving the shaft of the humerus are much more common than primary tumours.

Trauma

The most common injuries of the shoulder are dislocations and fractures*. In dislocations, the head of the humerus is usually displaced anteriorly in the subcoracoid region. In a fracture the whole shoulder is swollen and often deformed. There may also be associated deltoid wasting after damage to the circumflex nerve. Other injuries around the shoulder joint include acromioclavicular subluxation and dislocation, and open wounds.

As well as the shoulder, it is important to examine the neck, chest and shaft of the humerus. The forearm and hand must also be carefully examined for weakness, sensory loss, vascular insufficiency or any other abnormalities and compared with the opposite side.

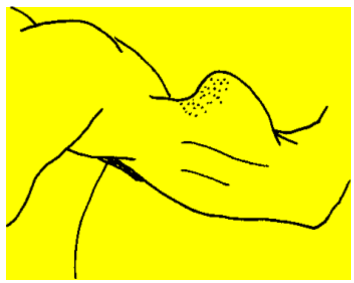
Shoulder and Humerus Conditions

Congenital abnormalities

Neoplasia

Craniocleidodysostosis X-ray of an osteogenic sarcoma

Trauma



Ruptured biceps tendon

Infection**

The shoulder may show considerable swelling, together with redness and pain. Infection may involve the entire shoulder or be localised.

Paralysis

The shoulder may be paralysed from a brachial plex-us palsy or other nerve injuries. Other paralytic conditions include poliomyelitis and nerve injuries(which may be secondary to fractures) such as a circumflex (axillary) nerve damage in fractures and dislocations. It is important to assess whether there is any associated sensory loss implying peripheral nerve injury, as opposed to poliomyelitis where sensation is preserved. Flaccid paralysis indicates a lower motor neurone lesion whereas spastic paralysis is characteristic of upper motor neurone involvement.

Miscellaneous conditions

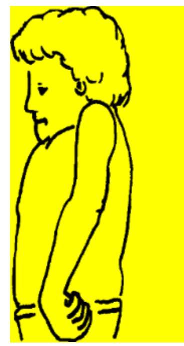
Other shoulder conditions include frozen shoulder, OA and RA. Frozen shoulder may lead to rapid muscle wasting and is often associated with cervical spondylosis. OA may be primary (unknown cause) or secondary to injury. In the case of RA there is usually evidence of disease elsewhere together with considerable wasting of the muscles. When assessing individual conditions of the shoulder it is important always to compare with the opposite side. Always look for associated conditions providing a clue to diagnosis, such as congenital conditions, RA and trauma or infection.

Shoulder and Humerus Conditions

Infection

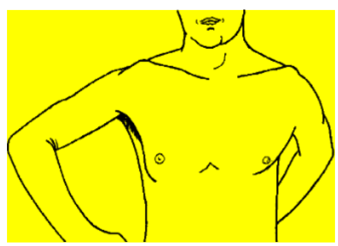
X-ray of chronic osteomyelitis

Paralysis



Erb's palsy

Miscellaneous conditions



Frozen shoulder

*As surprising as it may sound, shoulder dislocations, especially posterior, can be easily missed. Just remember, the sequence: injury with resulting pain, patient cannot move shoulder, imaging for posterior dislocation may appear "normal" but trust your clinical instincts and go discuss with a senior colleague or the radiologist. Don't send the patient home with a painful shoulder and no clear diagnosis. An X ray will show a symmetrical appearance of the humeral head with a posterior dislocation and the arm will be locked in internal rotation. Do a CT scan. With repeat dislocations or a previously missed dislocation the clinical signs may be more subtle.

**For shoulder infections, the patient will be feeling quite unwell, along with painful swelling of the shoulder.

Neurological Examination of the Upper Limb

Neurological assessment

1. Look

2. Feel — sensation

3.Move — tone power reflexes co-ordination

Brachial plexus lesions

1. Complete — C5 to T12. Upper — C5,6

3. Lower — C7,8,T1

Peripheral nerve lesions

1. Axillary

2.Median

3. Ulnar

4. Radial

Neurological Assessment

The upper limb may be paralysed by a lesion in the brain, the spinal cord or in the peripheral nerves. Assessment should include examination for sensory impairment i.e., light touch pain and proprioception and motor involvement i.e., tone, power and reflexes. Paralysis may be spastic (that is, an upper motor neurone due to cerebral or upper cervical cord involvement) or flaccid (that is, a lower motor neurone paralysis due to damage of the spinal roots, spinal cord or peripheral nerves).Upper and lower motor neurone damage sometimes co-exist.

Look

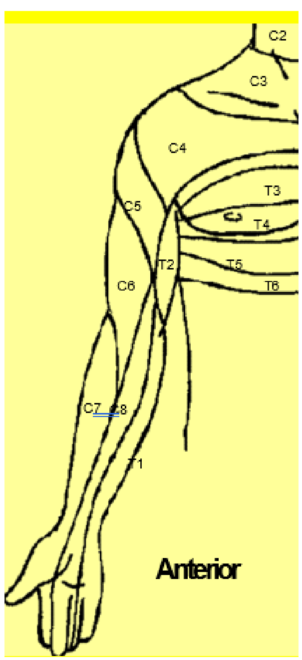
The affected limb must be compared with the opposite limb, together with the rest of the body, if indicated. Inspectionofthelimbaffectedshouldincludelookingparticularlyforwasting,posture of the limb and deformity. Involuntary movements or a limb held in a flexed position, for instance, may indicate a spastic paralysis or a contracture. Muscle fasciculation, if present, should be noted. This is a sign of a lower motor neurone lesion. Lack of sweating and hair loss should be noted.

Feel

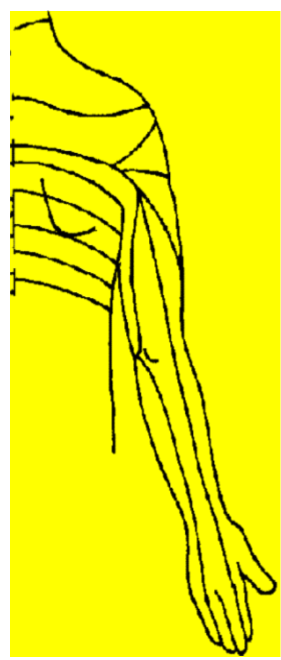
Muscle bulk and temperature changes should be compared by palpation of both upper limbs. Sensation

Upper Limb Dermatomes

(Sensory dermatomes are notoriously variable and cannot be relied upon to identify a dermatome level)



Anterior



Posterior

The dermatomes of the upper limb are illustrated, but it should be noted that there is often considerable sensory overlap. Sensory testing should include light touch, pinprick (pain), and proprioception, as a minimum for every patient with a possible neurological lesion.

Proprioception, or joint position sense is examined by holding the lateral aspects of the digit and passively dorsiflexing and extending it, while the patient, with eyes closed, nominates whether he or she thinks the digit has been moved up or down. More specialized tests of sensory function include examination of temperature perception and vibration sense. Sensory examination should always include comparison with the opposite, 'normal' limb.

Move

Tone

The limb should be moved passively through its full range of motion, at varying speeds. Tone maybe normal, increased, or decreased. Hypertonia is seen with upper motor neurone lesions, and may be pyramidal or extrapyramidal, the former typically producing ‘clasp knife’ rigidity, and the latter producing ‘lead pipe’ rigidity. A tremors upper imposed on an extra pyramidal lesion may cause ‘cog-wheel’ rigidity. This is most commonly seen in Parkinson's disease.

Muscle power

The power of individual muscles is graded from 0 to 5 (Oxford scale):

0 — complete paralysis

1 — a flicker of movement only

2 — able to move when gravity is eliminated

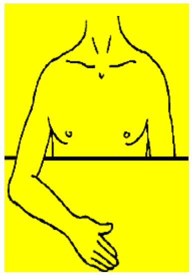
3 — just able to move against gravity

4 — able to move against gravity with some resistance

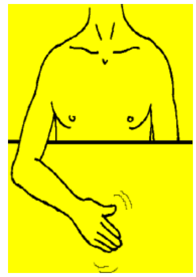
5 — normal

Muscle Power

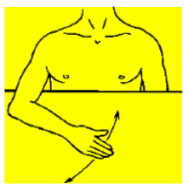
Grade 0



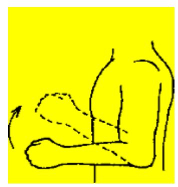
Grade 1



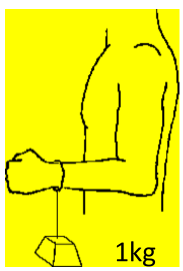
Grade 2



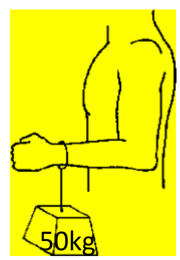
Grade 3



Grade 4



Grade 5



Adding ‘1/2’ or ‘+’ signifies a power in between two grades. A detailed assessment of sensory deficit should always be considered with motor power to assess the probable neurological deficit, and its site.

Reflexes

Deep tendon reflexes to be assessed in the upper limb are the biceps jerk (C 5,6), triceps jerk (C 7,8), and supinator jerk (C 6,7). Clinically reflex activity may be graded as:

+	— hyporeflexia
++	— normal
+++	— hyperreflexia

Clonus, which may be sustained or unsustained should be noted separately. Hyperreflexia and clonus are indicative of an upper motor neurone spastic paralysis. It is also important to assess whether movement is voluntary, or involuntary as in an upper motor neuronal spastic paralysis.

Co-ordination

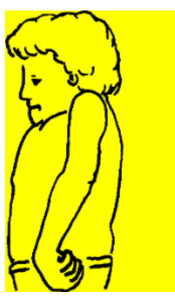
Tests of co-ordination in the upper limb include the 'finger-to-nose test', looking for intention tremor and past pointing, as well as the ability to perform rapidly alternating movements of the hands, the absence of which is known as dysdiadochokynesia.

Brachial plexus lesions*

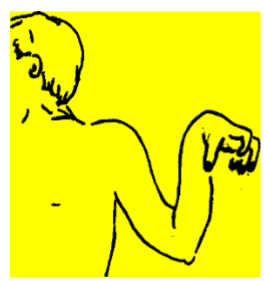
Damage to the brachial plexus is often due to a fall on the shoulder, motor bike accident or a birth injury and may be complete or incomplete. If it involves the upper part (C5, 6) of the brachial plexus, the shoulder girdle and biceps are paralysed or weak, and the arm is usually held in extension and internal rotation, which is known as Erb's palsy.

Brachial Plexus Lesions

Birth injuries (most recover)

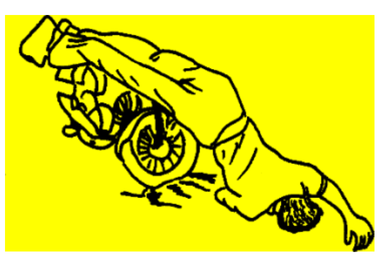


Erb's palsy

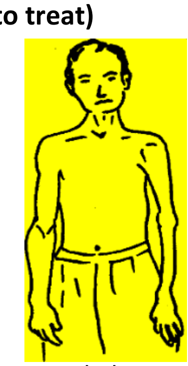


Klumpke's palsy

Trauma (difficult to treat)



Fall on point of shoulder



Flail arm

Involvement of the lower brachial plexus (C7, 8 and T1) will cause paralysis of the triceps, forearmandsmallmusclesofthehand.ThisisknownasaKlumpketypeofparalysis, and is less common. In a complete palsy, the whole arm is paralysed and the only movement possible is shrugging of the shoulder carried out by the trapezius. In all injuries of the brachial plexus there is sensory loss. It is important also to examine the cervical spine and the other three limbs, as an associated neck injury and other trauma are commonly found. In high lesions of the brachial plexus the cervical sympathetic nerves may be involved, producing a Horner's syndrome. This is characterised by some or all of the following features (which are always ipsilateral to the lesion): ptosis (‘dropped’ lid), miosis (papillary constriction), anhydrosis (lack of sweating), and enophthalmos.

Peripheral Nerve Lesions Axillary nerve

The axillary nerve may be damaged as it winds round the neck of the humerus by fractures or dislocations of the shoulder. There will be paralysis of the deltoid muscle and an area of numbness over the insertion of the deltoid.

Median nerve, carpal tunnel syndrome, CTS*

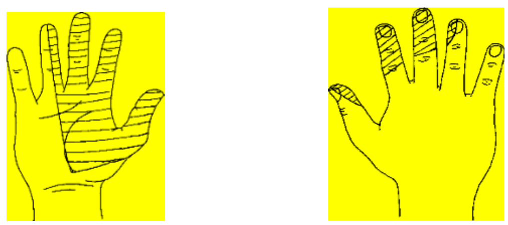
The median nerve supplies the muscles of the thenar eminence and also the radial two lumbricals. The easiest method of testing the median nerve is to ask the patient to abduct the thumb at right angles to the palm. Strength is then assessed and compared to that of the opposite side.

Median Nerve Lesions

Look

Thenar wasting

Feel



Move

Thumb abduction

UPDATE. 2022. Also note:- night

symptoms, +ve Tinel's test, +ve Phalen test, loss of two point sensory discrimination. Anterior interosseous nerve syndrome, AIN: motor loss of FPL, index +/- index FDPs, PQ. Cannot do OK sign. No sensory loss.

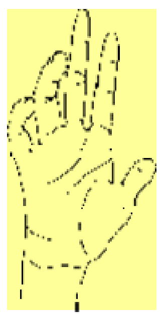
The median nerve is usually partially paralysed in a carpal tunnel syndrome. This occurs in situations where there is oedema in the carpal tunnel, such as in pregnancy, and RA and also where there is narrowing of the carpal tunnel such as following wrist fractures. In particular, a Colles' fracture or dislocation of the lunate (when acute) may cause narrowing of the carpal tunnel. Sensory loss in a median nerve palsy involves the radial three and a half fingers and thumb as illustrated. Associated with vibratory exposure. Is most common neuropathy. Treat-steroid injection, surgical release (beware recurrent motor branch of medial n. or ulnar n.) and don't wait until thenar muscle wasting.

Ulnar nerve

The ulnar nerve supplies all the small muscles of the hand, with the exception of the lateral two lumbricals and the muscles of the thenar eminence. Wasting should be looked for in the hypothenar eminence and in the interossei. The adductor of the thumb is also paralysed. Gross wasting of the muscles may occur and a comparison of the two hands should be made. The affected hand is usually held in a semi-clawed position. The ring and the little finger are slightly flexed at the interphalangeal joints and the metacarpophalangeal joint is hyper-extended. The index

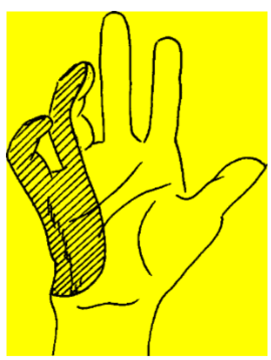
Ulnar Nerve Lesions

Look



Hypothenar and interosseous wasting together with clawing of the ring and little fingers

Feel — Sensation



Froment's sign is a test of adductor pollicis. A card is held between the thumb and the forefingers of both hands, and the examiner pulls the card away while the patient resists. If the ulnar nerve is paralysed, the inter phalangeal joint of the thumb will flex fully to hold the card, whilst on the opposite side the inter phalangeal joint is extended. This is because the long flexor of the thumb is brought into play to hold the card to the forefinger. There is also wasting of the adductor pollicis and interossei in the web space between the 1st & 2nd metacarpals. That the patient cannot hold a card between these two fingers. There is also weakness or complete paralysis of finger abduction. Jeanne sign +ve (hyper-extension thumb MCP during pinch test). Wartenberg +ve (abduction/extension small digit during attempted adduction).

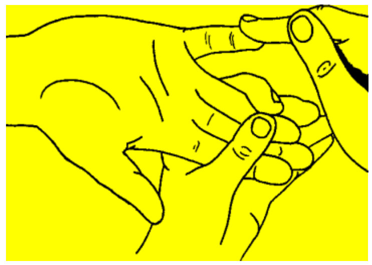
Sensory disturbance in an ulnar nerve palsy involves one and a half fingers on the ulnar side of the hand as illustrated. It may also extend up the ulnar side of the lower fore arm in high nerve palsies. In addition, there may be a lack of sweating of the affected hand, which feels drier than normal. In long standing cases there will also be loss of hair, lack of skin wrinkling and a shiny appearance. These are known as trophic changes.

UPDATE, 2022. Cubital tunnel syndrome, compression ulnar nerve by medial elbow (AO team-compressed at Arcade Struthers, Osborne's ligament, medial head triceps, anconeus epitrochlearis, medial epicondyle + FCU). Above features by tinels +ve medial elbow, +ve provocative test, and ulnar paradox (where clawing is less). May need decompression/transfer. Guyon's Canal/Ulnar Tunnel Syndrome is where the ulnar nerve is compressed in a small canal just distal to the wrist and ulnar ward (usually by a ganglion). It may need to be decompressed directly or when releasing CTS.

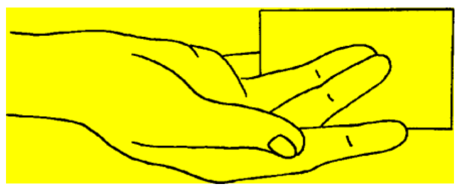
***Examination of the patient with brachial plexus injuries is adaunting task for a student**.

Ulnar Nerve Lesions

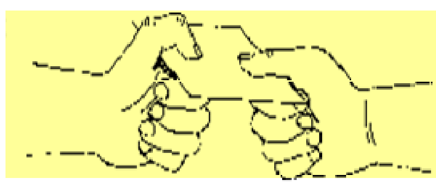
Move



Abduction of little finger in line of palm



Testing finger adduction



Froment's sign

Radial nerve

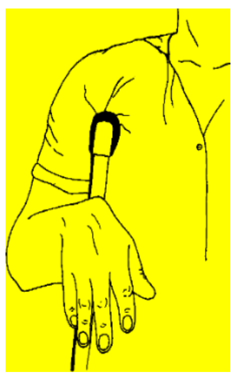
Radial nerve palsy is commonly caused by a fracture of the mid-shaft of the humerus. Other causes include pressure in the axilla by crutches that are too long (crutch palsy), and falling asleep in a drunken stupor with one's arm over the back of a chair (Saturday night palsy!). The quickest method of testing for a radial nerve palsy is to assess the power of extension of the thumb in the line of the palm. Another less accurate method includes extension of the wrist against resistance. Extension of the interphalangeal joints of the fingers themselves, however, is performed by the interossei and lumbricals which are not supplied by the radial nerve. This is a common trap for the un wary examiner and many radial nerve palsies have been missed as a result. A high lesion will result in a complete wrist drop while a low lesion, or one affecting the posterior interosseous nerve (PIN) alone may affect dorsiflexion of the thumb and the fingers at the metacarpophalangeal joints alone. The sensory loss in a radial nerve injury is a small area at the base of the thumb but this may extend to the back of the hand.

UPDATE, 2022. Radial tunnel syndrome lateral forearm pain rather than hand/wrist weakness. Cheiralgia paraesthetica (Wartenberg syndrome)or “wrist watch” pain, cannot wear wrist watch, compression of subcut. branch radial n.

Thoracic Outlet Syndrome Vascular (compr. Subclavian v.), use Adson test (Hyper extend neck & rotate and + with decr. pulse with inhalation) AND Neurogenic (entrapment lower brachial plexus). Roos test, +ve, heaviness in hands, paraesthesias, exclude Pancoast Tumour with CXR, rarely need to excide a cervical rib.

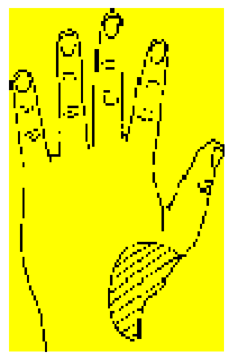
Radial Nerve Lesions

Look



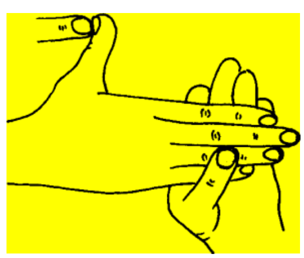
Wrist drop

Feel



Sensory deficit

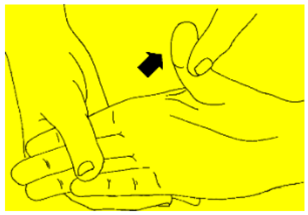
Move

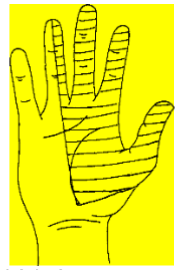


Testing thumb extension

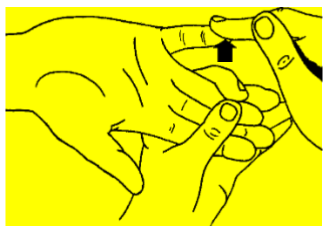
Assessment of Peripheral Nerve Lesions — Summary

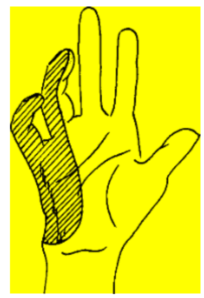
Power Sensation **Median nerve**



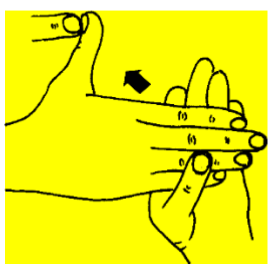


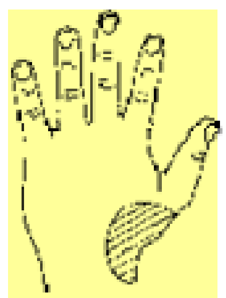
Ulnar **nerve**





Radial nerve



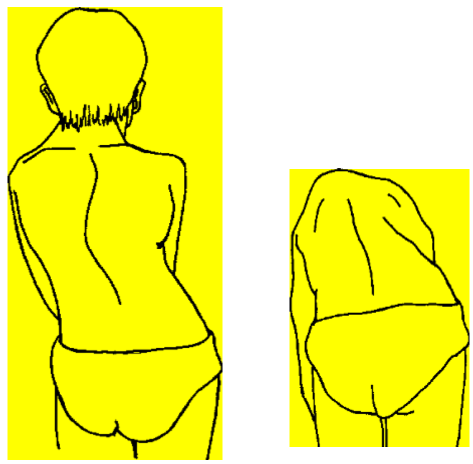


Chapter 3

Examination of the Spine

Cervical Spine

Thoracic and Lumbar Spine



79 Examination of the Spine

Cervical Spine Examination

Look

1. General inspection

Inspect the neck for any obvious swelling or deformity from the front, back and sides. The patient may also be in obvious pain.

2. Skin

Look for any evidence of scars, sinuses or color change. There may be congenital webbing of the neck.

3. Soft tissue

Observe the muscles for spasm or shortening. Shortening of the sternomastoid may be due to spasm, trauma or a congenital cause. The latter may result in a torticollis, in which the patient holds the neck rotated to the side opposite the lesion. An enlarged thyroid gland or cervical lymph nodes may be visible. An abscess may point in part of the neck.

4. Bone and joint

Abnormal posture of the neck may be due to fracture of a vertebra, be the result of trauma, osteomyelitis or a secondary tumour. The neck may also be held in an abnormal posture because of disc prolapse or RA.

Cervical Spine Examination

Torticollis or ‘wryneck’ — may be secondary to prolapsed disc

Congenital webbing of the neck

Feel

The neck should be felt for tenderness and swellings. The front of the neck should be felt for the thyroid, the anterior and posterior cervical triangles for lymph nodes, and the back of the neck for tender areas and swellings. Localised areas of tenderness at the base of the neck may be present in cervical spondylosis. There may also be ‘radiation’ of pain down one or both arms to the fingers. Classically in cervical spondylosis, three tender areas, representing the ‘Huck step tender triad’, should be felt for. These are:

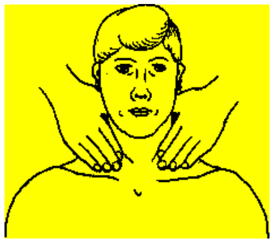
1. At the base of the neck anterior to the trapezius

2. Over the insertion of the deltoid

3.In the extensor mass of the forearm(not the origin of the extensors which usually suggests tennis elbow).

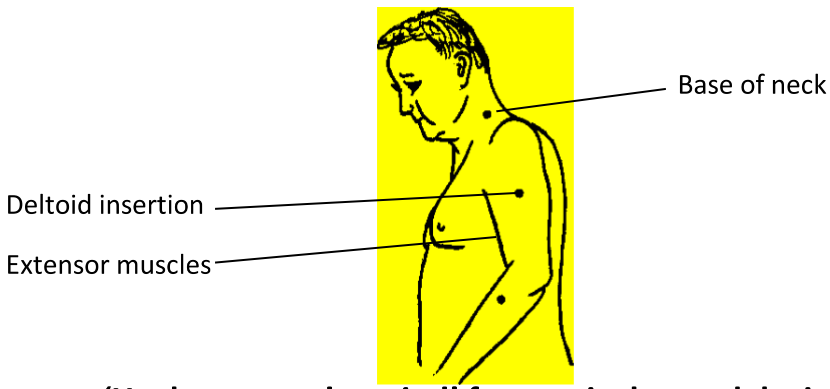
The consistency of any swelling felt should then be noted. If it is fluctuant then it may be an abscess, if firm, lymph nodes, or if of bony consistency, it is possibly a cervical rib.

Cervical Spine Examination



Prominence of cervical rib

Tenderness in base of neck — cervical **spondylosis**



‘Huckstep tender triad’ for cervical spondylosis

Move

The neck movements to be examined are:

1. Rotation
2. Flexion and extension
3. Lateral flexion

Rotation

Rotation should be equal, and about 70°–90°to each side as illustrated. The neck should best aright with out either flexion or extension and the patient asked to look as far as possible to one side and then the other. This should be followed by passive rotation to each side.

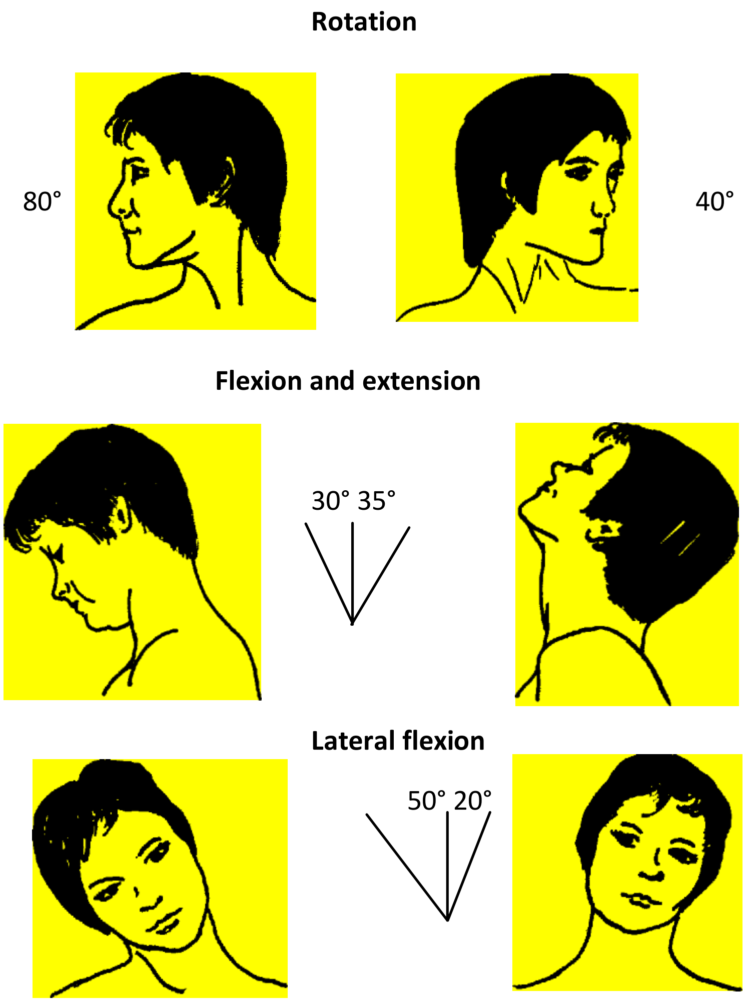
Flexion and extension

Full forward flexion is present when the chin touches the chest. Full extension of at least 30° beyond the horizontal should be possible, and is usually greater in young people.

Lateral flexion

Lateral flexion should be at least 40° to each side. Again, starting from the neutral position, the head is tilted first to one side and then the other.

Cervical Spine Examination



Cervical Spine Conditions

Congenital abnormalities

Are not common and are usually associated with abnormalities of the cervical vertebrae. These may be fused or deficient. A spinal bifida is a deficiency of the laminae and pedicles to a varying degree. An accessory rib may be attached to the 7th cervical vertebra and this may be a rudimentary fibrous band, or even a complete rib. Soft issue abnormalities include a Sprengel's shoulder, with one or both scapulae higher than normal. Both this and congenital webbing of the neck may be associated with cervical vertebral abnormalities or other congenital abnormalities such as cardiac defects.

Neoplasia

Most neoplasms of the cervical spine are due to secondary deposits from the breast, thyroid, lung, kidney, prostate or cervix. These may produce vertebral collapse and cord or root compression, with partial or complete paralysis. Radiological examination may show involvement of the vertebral bodies; laminae and pedicles may be involved but the disc spaces are usually spared. Neurofibromata of the spinal roots may also cause nerve or spinal cord compression. This is in contradistinction to an infection or disc degeneration where the inter vertebral discs are initially much more involved than the vertebral bodies.

Cervical Spine Conditions

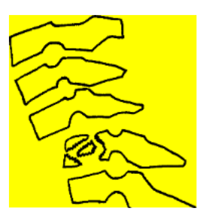
Congenital abnormalities

Congenital webbing of the neck

Neoplasia

X-ray of a secondary Deposit

Trauma



X-ray of a fracture dislocation

Trauma

There may be severe root or spinal cord compression following dislocation or fracture dislocation of the cervical vertebrae, including the odontoid process of C2.

Infection

Infection of the cervical spine usually involves the disc spaces, and may later spread to the vertebral bodies (compare with secondary tumours). The onset is usually acute, and in most cases due to a blood borne staphylococcal infection. Infection by other organisms, including the tubercle bacillus, may also occur but with a more gradual onset and sometimes also with retropharyngeal abscess formation. Spasm of the cervical muscles commonly results in marked limitation of neck movements, and cord compression may also occur.

Arthritis

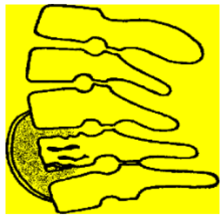
OA and cervical spondylosis*

Degeneration of the disc spaces, particularly C5/6 and C6/7, is common, and is often associated with narrowing of the inter vertebral foramen and osteophyte formation. This, in turn, may cause root pressure on the C5 and 6 roots on one or both sides. Neck movements are limited, particularly rotation to the side affected, lateral flexion to the opposite side and neck extension. The 'Huck step tender triad' (tenderness at : base of the neck, insertion of the deltoid muscle and over the extensor muscles of the forearm)is often seen. In the early stages of cervical spondylosis X-rays may appear normal

*UPDATE, 2022. MRIs have false +ve , where 25% of asymptomatic patients > 40yrs have a herniated nucleus pulposus/foraminal stenosis. In general surgery is not so good for discogenic neck pain. In RA cervical spine can have occipital headaches, progressive instability (atlantoaxial subluxation, most common/atlantoaxial invagination/ sub axial sub luxation. May need surgical fixation. AS patients with neck pain- exclude an occult Fx.

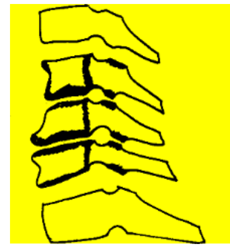
Cervical Spine Conditions

Infection



X-ray of TB with a 'cold' abscess

Arthritis



X-ray of cervical spondylosis

Miscellaneous conditions

RA: limited rotation with muscle spasm

Cervical spine injury seen with SPINAL SHOCK (is over when the bulbocavernosus reflex returns) AND/OR NEUROGENIC SHOCK (hypotension 2nd to loss sympathetic tone + bradycardia).

RA and other conditions

RA can cause considerable pain and stiffness of the cervical spine. It may lead to sub luxation and dislocation of the vertebrae due to softening of the ligaments. Nerve root and spinal cord compression may also occur. Other conditions of the neck include spasmodic torticollis, and a sternomastoid 'tumour'.

Thoracic and Lumbar Spine Examination

Look

1. **Genera inspection**

Note any obvious abnormality, looking at the back, sides and front of the patient.

2. **Skin**

Look for scars, sinuses or colour change. Note the presence of a hair tuft, discolouration or dimpling at the base of the spine indicating a spina bifida.

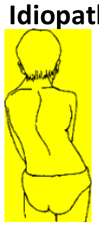
3. **Soft tissue**

Look for any swellings which may be due to infection, trauma, or tumours. Remember that an abscess in the vertebral column may point posteriorly or, if affecting the lower thoracic or lumbar vertebrae, may track down the psoas sheath and present in the groin. Look for spasm of the erector spinae muscles on either side of the spine. This is some time because of abnormal spinal curvature rather than the presence of a defect in the vertebral column itself. Scoliosis may be due to muscle spasm, paralysis or to a congenital or idiopathic scoliosis.

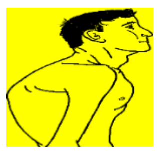
Thoracic and Lumbar Spine Examination

Kyphoscoliosis

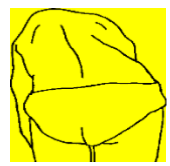
Idiopathic



kyphoscoliosis



Kyphosis



UPDATE, 2022, Adolescent Idiopathic Scoliosis when abnormal neuro findings, left thoracic curves, painful or progressive curves then do MR. Observe: skeletally immature patients with curves < 20-25 degrees and skeletally mature with curves<45- 50 degrees. Brace for curves > 25 degrees or of 20 degrees with documented progression in skeletally immature (Riser stages 0-2).Bracing is 90% effective when worn > 12-13 hrs/day. Surgery when curves > 50 degrees (need intra-op spinal cord monitoring). Infantile idiopathic scoliosis - Shows < 4yrs age. Most resolve. Rb-vertebra angle difference predicts risk of progression. Treat with Mehta de rotational cast. Congenital Spinal Deformities-high incidence associated problems (spinal, cardiac, GU). Neuromuscular scoliosis-Duchenne muscle dystrophy (surgery when curve progressive and > 25-30 degrees when FVC > 40% of normal. Progression is rapid, CVS conditions worsen, precluding surgery. CP- Fusion T2 to pelvis for non-walker, many complications.

Thoracic disc ruptures can occur, rarely operated on.

4. **Bone and Joint**

Look from the posterior and lateral aspects of the patient for any increase or decrease in spinal curvature i.e., scoliosis or kyphosis.

Kyphos and kyphosis

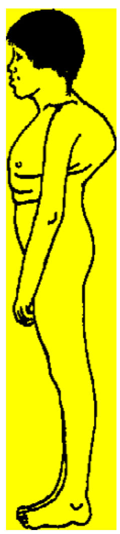
A kyphos is a sharp posterior convexity of the spinal column sometimes associated with a fracture. It may also follow collapse of vertebrae due to secondary deposits or infection. In the case of a chronic infection such as tuberculosis several vertebrae may be involved with shortening of the spine and possible neurological compression involving the nerve roots, spinal cord or corda equina. It is critical to carry out a neurological assessment of the lower limbs, including the bladder, in all these patients. A kyphosis is a gradual curve which may be due to paralysis, senile osteoporotic collapse of several vertebrae or Scheuermann's disease.

Lordosis

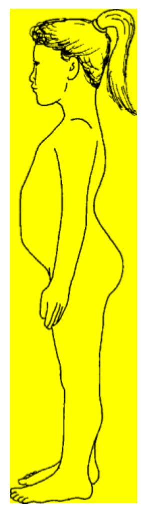
A lordosis is a posterior concavity of the spinal column, often in the lumbar region. It may be associated with low back pain, paralysis or spondylolisthesis. In pregnancy a compensatory lordosis may be necessary to maintain balance. This, combined with the lax spinal ligaments in later pregnancy, may potentiate low back strain sometimes associated with sciatica.

NB-Take ALL cases of back pain in children seriously and thoroughly investigate with blood tests, XRs and MRI.

Thoracic and Lumbar Spine



Thoracic kyphos

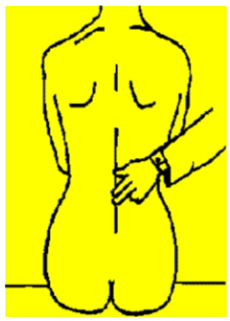


Excessive lumbar

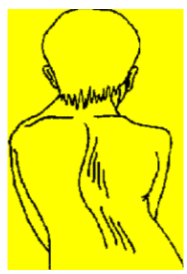
Feel

After inspection, the spine should be palpated gently. It is important to feel the spine for tender areas, both in the midline and laterally. The vertebral spinous processes and inter spinal ligaments should be carefully palpated for tenderness and gaps and also percussed gently. The muscles on each side of the spine should also be palpated for spasm. This may be worse on one side than on the other .Any swelling of the spine should be pal-pated. Bony or soft tissue swelling or an abscess may be present. Warmth and tenderness should be noted as well as deformity. If the patient has severe pain or muscle spasm no attempt should be made to sit the patient up. Instead, the patient should be rolled over to one or other side to carry out the examination. The patient is rolled in to a supine position for a full neurological assessment. A rectal examination should be carried out in all patients with low back pain and sciatica, where this is indicated other wise, pelvic causes of low back pain may be missed. These include carcinoma of the rectum, bladder, prostate and uterus.

Thoracic and Lumbar Spine Examination



Palpate **tenderness**



Feel for muscle spasm

Move

The three main movements of the thoracic and lumbar spine are:

1. Rotation

2. Lateral flexion

3. Flexion and extension

Rotation

Rotation of the spine occurs mainly in the thoracic region. It may be limited or pain full if there is an injury, infection, tumour or degenerative changes. The latter may include Scheuermann's disease in a young patient or OA in an older patient. Any pain on rotation should be noted. The exact spot where the pain is felt should be noted as well as any limitation of rotation to one side or the other.

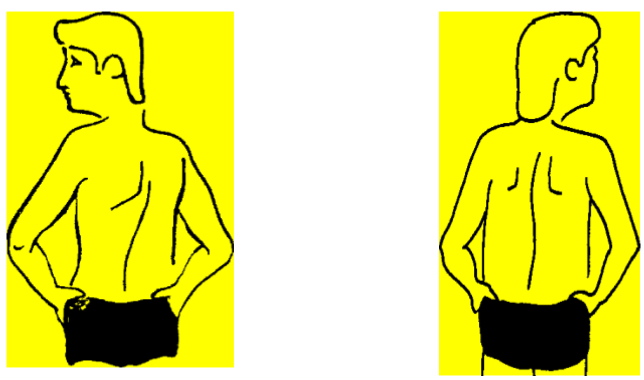
Lateral Flexion

Lateral flexion of the spine occurs mainly in the lumbar region. The patient should be asked to bend first to one side and then to the other. The arms must be kept close to the body and the patient should attempt to touch the lateral side of the knee with the out stretched fingers first on one side and then on the other. Bending should be lateral, not forward. Any difference in the degree of lateral flex-ion can then be noted with a fair degree of accuracy.

Lateral flexion is particularly limited in conditions such as low back strain and a prolapsed disc in the lumbar or lumbosacral region. In such cases, lateral flexion is often more limited to one side than the other. In conditions such as any losing spondylitis, infections and fractures, however, all movements may be restricted.

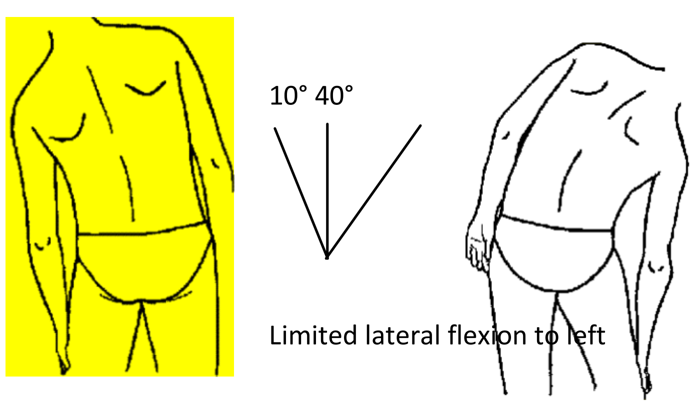
Thoracic and Lumbar Spine Examination

Rotation — thoracic spine



Limited rotation to right

Lateral flexion — lumbar spine



Limited lateral flexion to left

Flexion and extension

Flexion and extension occur both in the lumbar region and the hips, but more so in the hips.

Forward flexion and backward extension are both limited in prolapse of an inter vertebral disc, in severe degenerative arthritis of the spine, and in numerous other conditions. These include fractures, ‘lumbago’, severe bruising, any losing spondylitis and secondary tumours.

Movement is assessed by asking the patient to stand with the knees and the feet together. The patient should gently bend first for- wards, and then backwards.

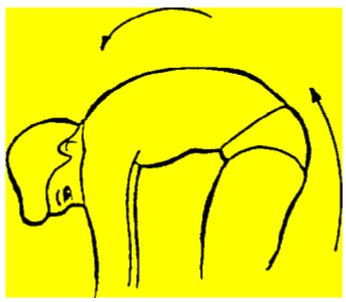
In some patients, limitation of forward flexion is due to tight hamstrings rather than to any intrinsic condition of the spine. In such cases the spine will be seen to flex more than normal while the actual ability to touch the toes is limited. In these patients extension is usually full.

Another method of assessing the degree of forward flexion is to mark two points in the upper and lower parts of the thoracic and lumbar spine respectively. The distance between the points is measured as the patient bends both backwards and forwards. This method is not usually used for ordinary assessment of spinal flexion and extension. It may, however, be useful if periodic assessment of the degree of movement is required (e.g., in a progressive condition such as ankylosing spondylitis).

DISH(diffuse skeletal hyperostosis, Forestier disease) is differentiated by the presence of non marginal syndesmophytes at three successive levels.

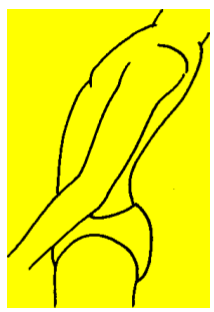
Thoracic and Lumbar Spine Examination

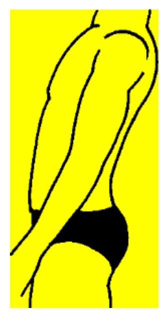
Flexion — lumbar spine and hips



Full Limited

Extension — lumbar spine and hips





Full Limited

Thoracic and Lumbar Spine Conditions

Congenital abnormalities

Congenital conditions of the thoracic and lumbar spine are uncommon. They include Sprengel shoulder, where one shoulder is higher than the other, and spina bifida in the lumbar region with or without associated meningomyelocele. Spondylolisthesis may be congenital or acquired. In this condition one vertebra is displaced, usually forward, on another usually in the lower lumbar region. Scoliosis may be due to various conditions. It may be due to incomplete development of one or more vertebrae. The latter may also produce a kyphos.

Neoplasia

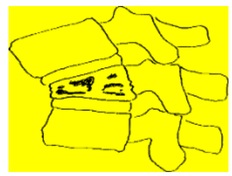
Primary spinal neoplasms are rare. Secondary deposits, on the other hand, are common and may cause collapse of one or more vertebrae*.They are most commonly due to secondary spread from breast, bronchus, thyroid, kidney, pro state or cervix, but almost any primary neoplasms can metastasise to the spine. Conditions such as multiple myeloma, lymphoma and the leukemias may also cause spinal collapse. In an elderly patient with back pain, the possibility of a secondary deposit from a

Thoracic and Lumbar Spine Conditions

Congenital abnormalities

Spina bifida with meningomyelocele

Neoplasia



X-ray spinal metastasis producing a kyphos

Trauma

X-ray of posterior disc prolapse at L4/5

Primary carcinoma, particularly of the breast and lung, must always be considered.

Trauma

Injuries of the spine associated with fractures usually result in a kyphos or sharp curve. In elderly people with osteoporotic spines, several vertebrae may be crushed at one time, particularly in the thoracic region, often resulting in a smooth kyphosis.

Infection

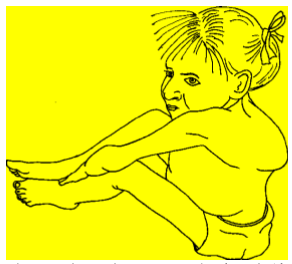
Infections of the spine are uncommon. They include blood borne infections which are often seen in patients who are in poor health such as drug addicts. Infections of the disc spaces may follow lumbar puncture or occasionally a spinal operation. Chronic infections of the spine include brucellosis and tuberculosis. A disc and two adjoining vertebrae are initially involved. In time several vertebrae may be affected, with or without evidence of an abscess. An abscess may point posteriorly or in the lumbar region. It may also track down the psoas sheath and present in the groin.

Paralysis

Paralysis of the spine sometimes leads to a scoliosis and, if it is severe, to a kyphoscoliosis with prominence of the ribs on one side due to rotation of the vertebrae. In the past the most common paralytic disorder causing scoliosis was poliomyelitis.

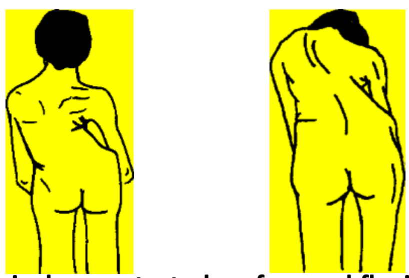
Thoracic and Lumbar Spine Conditions

Infection



Tuberculous kyphos with 'cold' abscess

Idiopathic conditions



Kyphoscoliosis demonstrated on forward flexion

This could lead to a scoliosis by producing a symmetrical spinal muscle paralysis. In a child this could be corrected by lifting the shoulders and upper body. In older patients it is more difficult to correct completely due to fibrosis of the muscles and fascia. Other paralytic conditions include as scoliosis associated with injury to the spinal cord, or associated with cerebral conditions including brain tumours, cerebral palsy, stroke and head injuries.

Idiopathic conditions

This is a scoliosis of unknown aetiology which usually arises in childhood. It is maintained and is exacerbated on forward flexion, unlike a scoliosis due to a short leg which usually disappears on forward flex-ion.

Degenerative conditions

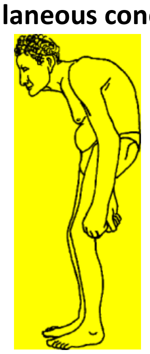
Degeneration of the inter vertebral discs, particularly in the older patient and particularly in the lumbar spine is common. TheL4/L5 and L5/S1 disc spaces are most likely to be narrowed by degeneration of the disc. The disc may protrude laterally or even posteriorly with pressure on the L5 and S1nerve roots respectively. Other nerve roots less commonly compressed and occasionally also the cauda equina. Patients may/may not have neurological signs associated. Signs of disc prolapse include limitation of straight leg

Thoracic and Lumbar Spine Conditions

Degenerative conditions

X-ray of disc degeneration and prolapse; usually L4/L5 or L5/S1

Miscellaneous conditions



Ankylosing spondylitis

Raising and diminished/absent reflexes and sensory disturbances in the lower limbs.

A central disc prolapse may press on the cauda equina and be associated with bladder symptoms, perineal sensory loss and a lax anal sphincter. This is a surgical emergency and requires immediate decompression or permanent bladder and sexual dysfunction will result.

Scheuermann's** disease a childhood condition involving the thoracic and lumbar spine. There is herniation of the disc into the adjacent vertebrae and this may be associated with narrowing of the disc space and back pain. Often a mild kyphosis.

Miscellaneous conditions

These include the rheumatoid group of diseases affecting mainly the spine initially, such as ankylosing spondylitis, AS, through to RA where the spine is often only affected late in the disease. The sacroiliac joints may be involved early in AS, and late in RA.

* A simple test to detect the big three of the spine-fracture, infection or metastases is to lightly thump along the spine. Pain indicates one of these, then X ray to detect fracture or metastases and blood tests/bone scan for infection.

** Scheuermann's disease-defined as thoracic kyphosis(>45 degrees) with > or more of 5 degrees anterior wedging at 3 sequential vertebrae, plus disc space narrowing, end plate changes, spondylolysis, scoliosis, Schmorl nodes. Not postural. Brace, rarely operate. Distinguish from Round Back (postural kyphosis) - No XR changes, corrects with extension, needs postural exercises.

Chapter 4

Examination of the Lower Limb

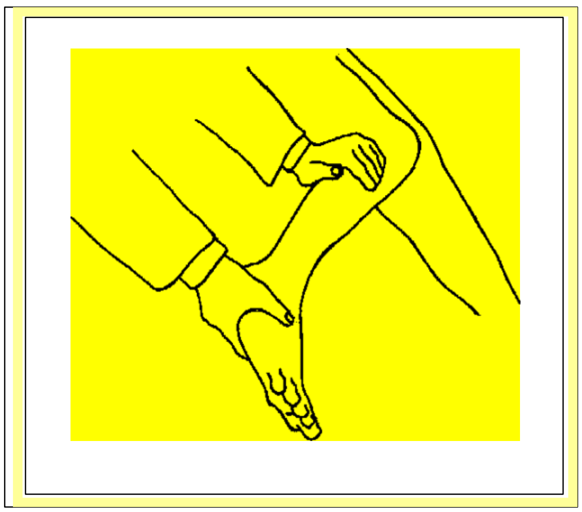
Gait and shortening

Hip and Femur

Knee and Tibia

Ankle and Foot

Neurological Examination



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Lower Limb Examination

The function of the lower limb is to allow us to walk, hopefully run.

Gait*

The patient should be examined walking, preferably with and without shoes. Abnormal gait includes:

1. Antalgic gait

2. Short leg gait

3. Paralytic gait

4. Trendelenburg gait

5. Stiff leg gait

6. Other

Antalgic gait

This is the gait associated with a painful leg or foot.

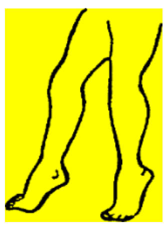
The patient walks with a minimum of weight on the painful side and will try to take the weight back to the normal side as quickly as possible. The patient may grimace as the weight is taken on the painful side.

Short leg gait

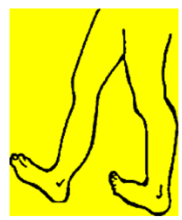
In the short leg gait the patient will dip down on the short leg during weight bearing on the affected side.

Lower Limb Examination

Examining gait

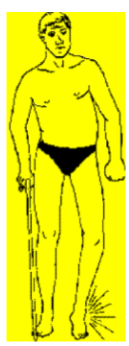


Walking on toes

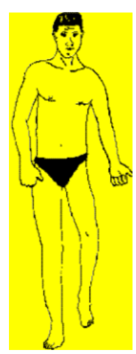


Walking on heels

Abnormal types of gait



Antalgic gait



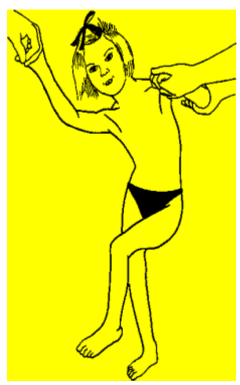
Short leg gait

Paralytic gait

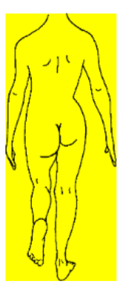
Paralytic gait occurs when one or both legs are paralysed. The paralysis may be spastic or flaccid. Spastic gait occurs in conditions such as cerebral palsy, following a stroke, cerebral tumour, skull Fracture or infection in the brain, cervical or thoracic spine. The common factor is an upper motor neurone injury. The patient will often also walk with a flexed hip, knee and ankle. The legs may be adducted and a scissor type of gait is typical of cerebral palsy. In upper motor neurone type paralyses, there is little or no wasting of the muscles and the legs are usually equal in length. The upper limb may also be affected, especially in cerebral palsy or stroke. All four limbs may also be affected. In a flaccid paralytic gait, there are different degrees of weakness between individual joints and muscles. This is unlike the spastic gait when the whole of one or both lower limbs tends to be equally paralysed. In the flaccid gait due to a foot drop, such as occurs with common peroneal and anterior tibial muscle paralysis, the patient will walk dragging the toe. Alter- natively, the step may be high to avoid catching the toe on the ground as the leg swings forward. In cases where the knee extensors are paralysed, as in poliomyelitis, the patient may brace the knee in order to compensate for a weak knee extensor and to prevent

Lower Limb Examination

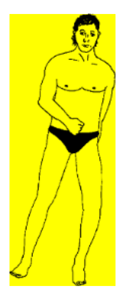
Abnormal types of gait



Paralytic gait; scissor gait secondary to cerebral palsy



Trendelenburg gait



Stiff leg gait

Trendelenburg gait

If the hip is painful, weak, dislocated or fractured, its stability is affected. As a result, the pelvis tilts down to the opposite side instead of tilting up when walking. This is because either the fulcrum of the joint is deficient or the muscles acting across the joint are not strong enough to stabilise the weight of the body through the hip joint.

Stiff leg gait

A stiff leg gait occurs when the hip or knee has been arthrodesed or cannot bend because of pain, limited movement or splinting. The whole leg is swung out-wards to clear the ground to compensate for a hip or knee which cannot bend. This motion is called circumduction.

Other types of gait

There are other types of gait associated with a deformity or stiffness. A combined type of gait is sometimes seen when a short leg combined with a paralytic leg and antalgic gait all occur in the same patient.

*It is difficult to accurately diagnose/describe the correct gait pattern. Practice as you observe people walking in the community. The gait cycle, walking, consists of stance, 60% (heel strike, foot flat, midstance, heel off) and swing, 40% (toe-off, early swing, mid swing, late swing).

Leg Shortening

Classification

Type

True (real) shortening

Apparent shortening

Combined true and apparent

Site

Above knee Below knee

Ankle and foot

True shortening*

Real shortening is present when the affected leg is actually shorter in overall length than the opposite limb. It is measured with the pelvis square or level if possible. The measurement is taken from the anterior superior iliac spine to the medial malleolus with the legs and the sole of the foot in the same position. This measurement should then be extended down to the bottom of the heel with the ankle in the neutral position. It is compared to the length of the opposite leg in the same position.

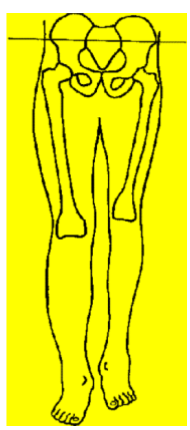
If there is a fixed abduction, adduction or flexion deformity of one hip which cannot be corrected, the opposite leg should be abducted, adducted or flexed to the same position before the measurement is taken. If the knee is in fixed flexion the opposite knee should be flexed to the same position before measurement. Similarly, if the ankle is in equinus or in a deformed position the opposite ankle or foot must be placed as near as possible in the same position before measurement.

True or real shortening is the real difference between the length of the legs. Apparent shortening is the shortening as it appears to the patient.

In assessing the amount of raise on the shoe required to compensate for the shortening, the apparent, rather than the real shortening must be taken into account. The patient with a fixed adduction deformity of hip or flexion contracture of knee, will still walk with these deformities until they have been corrected. The patient is only concerned with the distance of the sole of the foot from the floor when walking**.

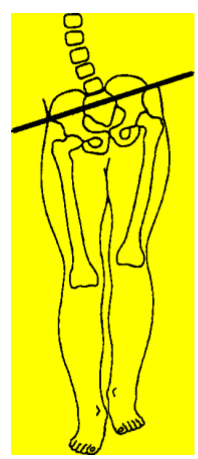
Leg Shortening

Real shortening



Pelvis squared Measure from ASIS to medial malleolus and sole of foot. Adduct opposite leg if fixed adduction

Apparent shortening



Pelvis tilted Measure from xiphisternum to medial malleolus and sole of foot

Unfortunately, most text books still describe measurement of the leg from the anterior superior iliac spine to the medial malleolus of the ankle instead of to the bottom of the sole of the foot. People do not walk on the medial malleolus but on the sole of the foot! Many patients with shortening have a flat or cavus foot or other heel and foot deformities which affect the distance from the medial malleolus to the sole of the foot on each side.

Apparent shortening

This is assessed by placing the two limbs as near as possible in the line of the trunk. Any tilt of the pelvis or flexion of the knee is ignored. The difference in height between the soles of both feet is then assessed. Alter-natively a measurement from the pubic symphysis, umbilicus or xiphisternum to the medial malleoli and the soles of the feet can be taken and compared. A more accurate, but more time consuming, method is for the patient to stand while wooden blocks are put under the shorter leg until the patient is standing in a nor-mal walking position.

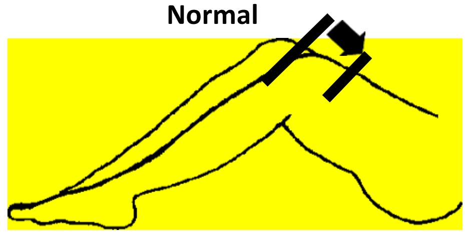
Site of the shortening

The exact site of shortening is important. Firstly, it is important to determine if it is above or below the knee and also if there is any shortening in the ankle and foot. This is best assessed by flexing both knees to 90°, as illustrated.

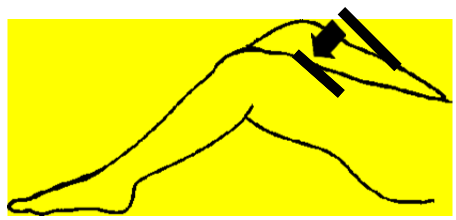
Leg Shortening

Site of shortening

Normal



Above the knee



Below the knee

Shortening above the knee

In assessing shortening above the knee, it is important to decide whether it occurs above the greater trochanter, or below the trochanter in the femoral shaft itself. The elevation of the trochanter on the shorter side can be quickly compared to that of the opposite side by placing one's thumbs on the anterior superior iliac spines with the middle fingers on the tip of the trochanters.

Nelaton's line is a more accurate method for determining this. The line drawn through the anterior superior iliac spine and the ischial tuberosity should normally pass through the top of the greater trochanter. If the shortening is above the greater trochanter itself, the tip of the trochanter will then be situated above Nelaton's line. Bryant's triangle is drawn as follows -

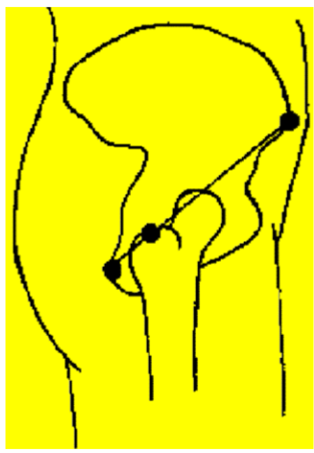
The patient lies supine and a line is drawn from the anterior superior iliac spine down towards the bed. A second line is then drawn from the anterior superior iliac spine to the tip of the greater trochanter. The third side of the triangle is a horizontal line, drawn proximally from the greater trochanter in the line of the femur to meet the first line drawn. This third line shows the amount of upward or downward displacement of the hip compared to the normal side.

It should be remembered that shortening in the femur may occasionally be both above and below the greater trochanter.

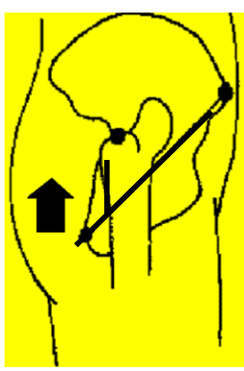
Telescoping of the hip, which indicates that the hip is dislocated, is assessed by pushing backwards on the lower femur with the hip and the knee flexed to a right angle and feeling the trochanter ride back on to the ilium. It is also reassessed with the leg adducted and the hip flexed. The test should then be repeated by pushing proximally

Leg Shortening

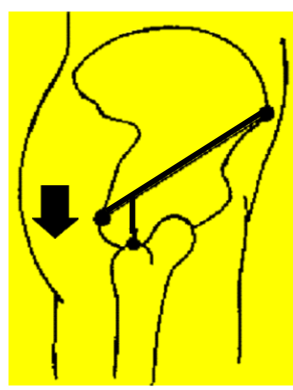
Nelaton's line



Normal



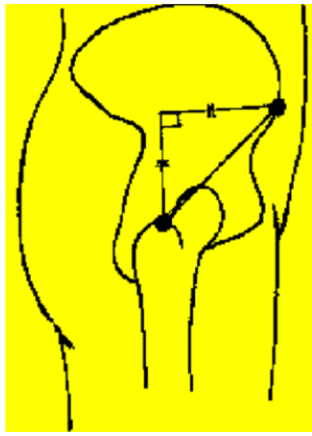
Superior displacement



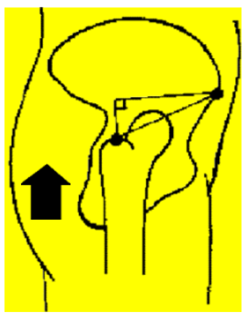
Inferior displacement

Leg Shortening

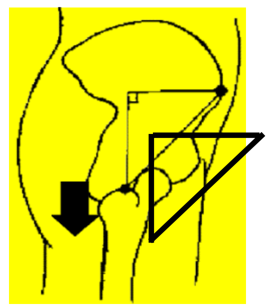
Bryant's triangle



Normal



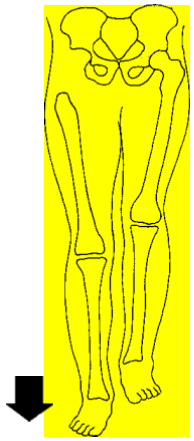
Superior displacement



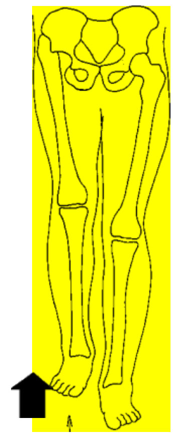
Inferior displacement

Leg Shortening

Telescoping in flexion



Distraction



Compression

on the foot with the hip and knee extended. The degree of telescoping is assessed by measuring the distance between the heels on both sides when the hip is pushed upwards as far as possible. This is compared with the normal position, and also with the degree of shortening when traction is exerted on the leg.

Shortening of the tibia

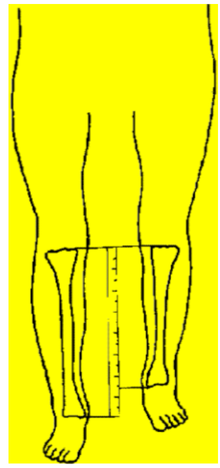
Shortening of the tibia can be assessed by flexing both knees to a right angle, and placing both medial malleoli exactly level. The distance at the knee between the anterior aspect of both thighs is then measured in the coronal plane. Alternatively, the distance between the top of the medial plateau of each tibia can be measured.

Shortening of the foot

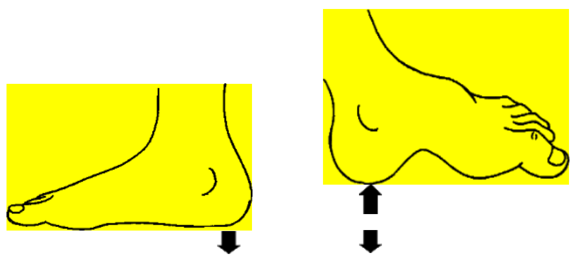
The whole foot may be wasted or smaller than the opposite side, with the heel pad smaller than normal. Shortening in both the length and width of the forefoot and toes may also be seen. In cases where the foot is flat or the heel pad is wasted, as may occur after fracture of the talus or calcaneus, there may be quite an obvious difference in heel height. Conversely, when the foot is clawed, as in polio myelitis or in other neurological dis-orders, the back of the calcaneus may be tilted down. The distance from the medial malleolus to the under surface of the heel is then increased, sometimes by as much as two or more centimetres. Despite this the foot is usually also shortened. In patients where shortening of the whole leg and foot is present the condition probably started during the growing period of childhood with a history of trauma, infection, paralysis or a congenital cause.

Leg Shortening

Shortening of the tibia



Shortening of the foot



Short right heel pes planus **Long left heel pes cavus**

Hip and Femoral Examination

Look

1. General inspection

Look for obvious asymmetry, abnormal posture or deformity.

2. Skin

The colour of the skin is noted and compared with the other side. Look for scars or suture marks indicating previous surgery or infection.

Note the characteristics of any wounds or sinuses. The direction of a sinus may be indicated by swelling above, below or to one side or by puckering of the skin. Look for granulation tissue in the edges of the sinus and at the amount and colour of any pus discharge. Yellow pus may indicate a staphylococcus aureus infection and green pus, infection with pseudomonas.

Examine the hip for pressure sores or redness over the greater trochanters. These may also occur over the lower sacrum and lumbar region.

3. Soft tissue

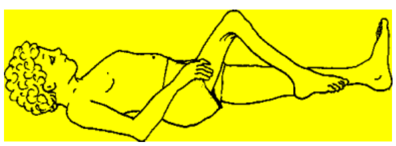
The size and circumference of the affected leg should be examined and compared with the opposite side. Note any muscle wasting, particularly of the quadriceps.

Look for any local swellings which may be due to tumours, trauma, infection, a psoas abscess or hernia.

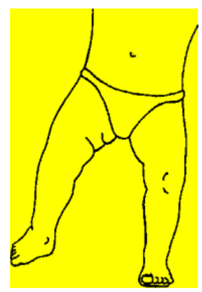
4. Bone and joint

Observe the contours of the thighs for any protuberance or evidence of deformity. The position and degree of rotation of the leg, may indicate the type of dislocation or the site of a fracture.

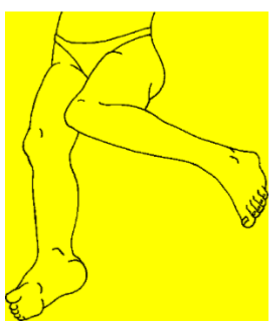
Hip and Femoral Examination



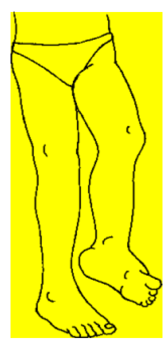
Muscle wasting



Asymmetrical skin folds



Posterior Dislocation: hip flexed, adducted, internally rotated and shortened



Anterior dislocation: hip slightly flexed, abducted and externally rotated

Feel

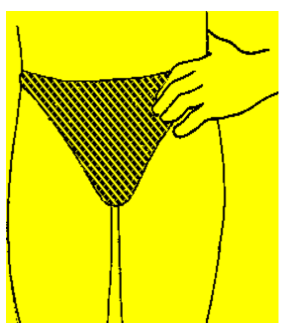
Palpation of the hip should include palpation of the greater trochanter on each side. Its position in relationship to the anterior superior iliac spine should be compared to the opposite side, as displacement up- wards may indicate dislocation or destruction of the femoral head. The centre of the hip joint is situated deep to a point half-way between the pubic tubercle and anterior superior iliac spine. It should be palpated for tenderness, warmth and swelling. Palpation in the hip area should also include the regional lymph glands and other swellings or tender areas including a psoas abscess.

Muscle tone of the affected thigh may be diminished, as well as the muscle bulk. With the patient in the prone position gluteal tone and tenderness should be assessed including tenderness in the line of the sciatic nerve. In addition, the lumbar spine should be palpated for tender areas. This is because degenerative hip conditions, especially if present for some time, often cause a low back strain and sometimes even a prolapsed disc with sciatic irritation.

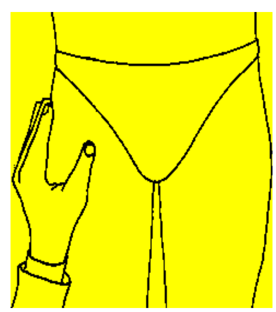
* A quicker but less formal way to measure shortening and to determine whether it is above/below the knee; is to get the patient to sit on the side of the bed. Then the extent and, location of shortening will be obvious.

**For determining heel raise for shoes ask the patient to stand up, see how much the short leg is off the ground when the pelvis is level.

Hip and Femoral Examination



Temperature and tenderness



Greater trochanter

Assessment of gluteal tone (maybe do this upright as adults do not like to lie face down. Important as you may find damage to inferior gluteal nerve, innervation to glut maximus).

Move

1. Flexion and extension

2. Internal and external rotation

3. Abduction and adduction

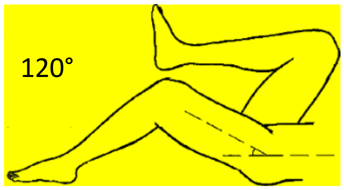
Flexion and extension

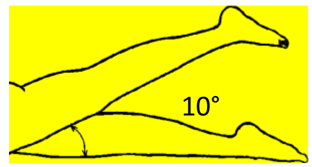
To assess the degree of flexion, both hips should be fully flexed and the degree of flexion noted. The patient is then asked to keep the opposite hip fully flexed on the abdomen, as shown. The hip to be examined is then gently extended in the line of the body. The patient will usually complain of pain or alter natively spasm of the muscles which can be felt when the limit of extension is reached. The degree of limitation of full extension is then noted (see illustration).

This is Thomas' test. It is by far the best test for assessing any limitation of extension in the adult. In addition adults with a fixed flexion deformity of one or both hips will find lying face downwards on a hard examination couch extremely uncomfortable and is usually quite unnecessary in assessing limitation of extension. In children, however, who often have very mobile hips and spine a prone position is often tolerated well and will enable the examiner to assess small differences in the degree of both hip extension and rotation in extension.

Hip and Femoral Examination

Flexion and extension



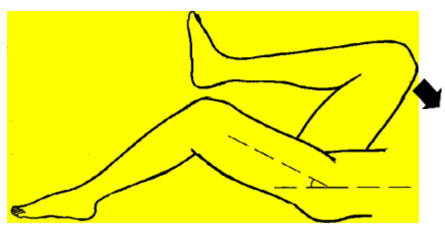


Flexion Extension

Thomas' test for fixed flexion deformity

(limitation of extension)

Fixed flexion deformity disguised by lumbar lordosis



Fixed flexion deformity of left leg revealed with right hip fully flexed to eliminate lordosis

Internal and external rotation*

Internal rotation in extension is assessed by feeling for the lateral and medial borders of each patella. The leg is then internally rotated and the coronal plane of the patella is assessed, rather than the rotation at the ankle and foot itself. External rotation is similarly measured. Internal and external rotation in extension can be evaluated more accurately when the patient is lying face down and both hips are rotated in and out. This is not normally necessary in adults and may be very uncomfortable for the patient.

Rotation in flexion can be measured by flexing both hips to 90° and assessing the internal and external rotation.

Any rotation deformity of the tibia or femur is evaluated by palpating the media land lateral malleoli and assessing them in relation to the patella. This will indicate any tibial torsion or rotation. The line joining the medial and lateral malleolus is approximately 20°– 30° externally palpated in rotation to the coronal plane. In tibial torsion this may be much greater.

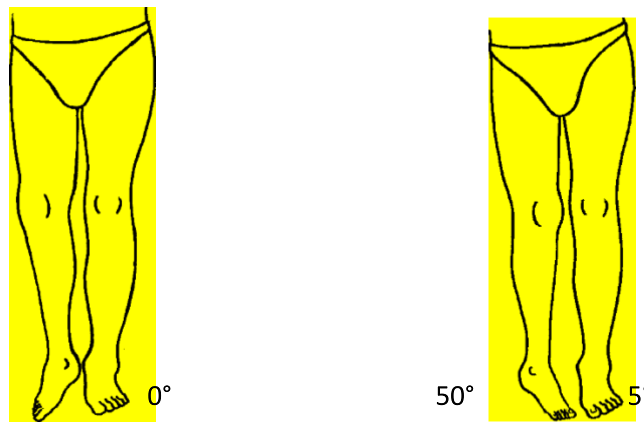
Rotation of the tibia in flexion is measured by flexing the knees to 90° and rotating the feet externally and internally and assessing the degree of rotation of the tibia from the neutral position. This is compare don both sides.

*UPDATE, 2022, The lateral patellar facet compression syndrome is where lateral structures are tight, causing a tilt, may need a surgical lateral release,.

Hip and Femoral Examination

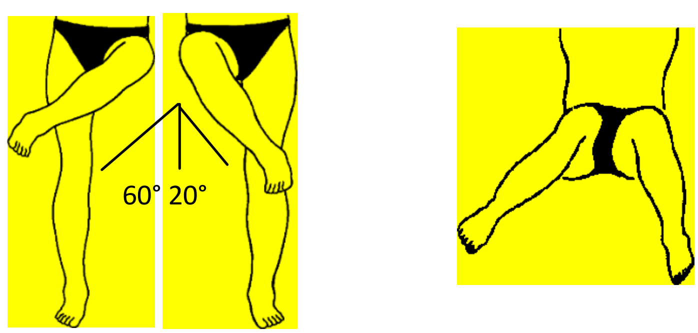
Rotation in extension

External Internal



Rotation in flexion

External Internal



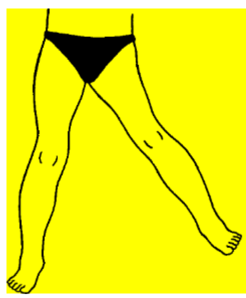
Normal Limited Normal Limited

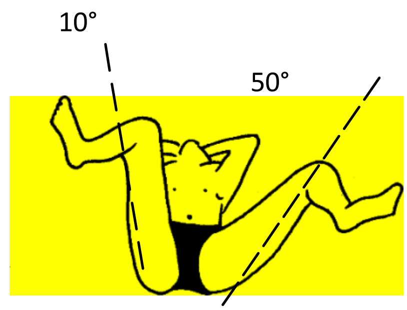
Abduction and adduction

Abduction and adduction of both the hips are assessed similarly. The amount of adduction from neutral is assessed in relation to the pelvis and the horizontal line joining both anterior iliac spines. This is then performed with the hips flexed to 90°. Abduction may be difficult to assess. The good leg should be abducted as far as it will go and allowed to hang out over the bed. This will lock the pelvis. The opposite leg is then abducted and the amount of abduction in relation to neutral is assessed. It is essential again to check on the line joining both anterior superior iliac spines in order to assess accurately the degree of abduction and adduction of the hips and children and in adults, when it is important to assess a small degree of limitation of abduction and adduction, the hips should be flexed to a right angle as shown and an assessment of abduction and adduction carried out as well.

Hip and Femoral Examination

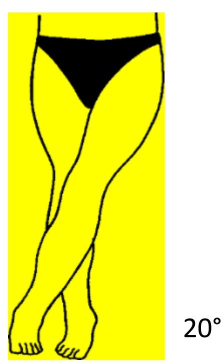
Abduction

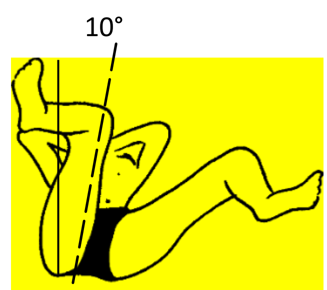




In extension Inflexion

Adduction





In extension Inflexion

Trendelenburg test

The Trendelenburg test is a test of hip stability. It is dependent on the fact that normally the pelvis tilts upwards away from the side of the weight-bearing leg on standing on one leg or walking. This is so that the centre of gravity of the body will be over the centre of the head of the weight-bearing hip joint. This is essential for hip stability and balance, as otherwise the patient would fall to the opposite side.

The Trendelenburg test is assessed by measuring the tilt of the pelvis. The top of the both iliac crests should be felt while the patient stands on each leg in turn without support.

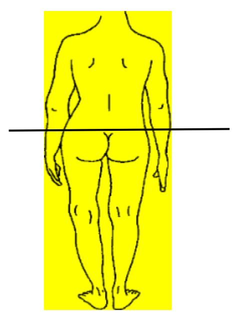
A negative Trendelenburg test occurs if the patient has good power and good hip stability. The iliac crest on the non weight-bearing side tilts up and the body tilts to the side of weight-bearing (see illustration).

A positive Trendelenburg test occurs if the pelvis sags downwards to the opposite side on weight-bearing. The patient will also then tend to fall to the opposite side. This may be prevented by either excessively tilting the body to the weight-bearing side or by holding a chair or other support to stop falling.

If the patient is unstable the examiner can stand in front of the patient holding both hands. The patient's hand on the side opposite to that of the weak hip will press downwards on the examiner's hand to prevent the patient falling.

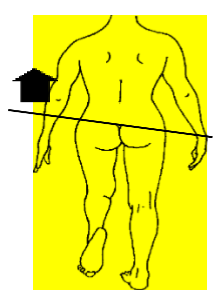
In cases where there is only slight weakness on the affected side there may be a delayed Trendelenburg test. In this case, after the patient has been standing on the weak leg for a few seconds, the pelvis will gradually sink downwards to the opposite side.

Trendelenburg Test

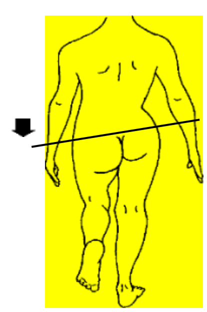


Negative Trendelenburg test — normal

Positive Trendelenburg test - abnormal



Pelvis tilts upwards



Pelvic sags downwards on unaffected side

The common causes of a positive Trendelenburg test are illustrated and include the following*:

1. Weak hip abductors

If the abductors are weak for any reason, the Trendelenburg test is positive. The abductors do not have enough power to support the pelvis and tilt it upwards when the patient stands on the weak leg. The cause of weak abductors may be paralysis (e.g., poliomyelitis), or wasting and pain due to OA or RA. The abductors may also be weak following an operation on the hip when the abductor muscles have been detached or damaged.

2.Damaged hip

Conditions which damage the hip between the greater trochanter and the acetabulum may cause instability. These include fractures of the neck or head of the femur or damage to the acetabulum. Instability also occurs if there is severe pain in the hip secondary to OOA o RA.

3. Dislocated or absent hip

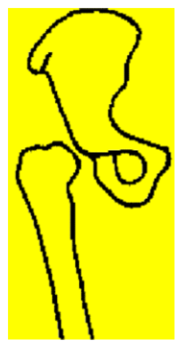
A dislocated or absent hip will mean that there is no fulcrum for the abductors to work across. Conditions which may lead to dislocation include congenital dis- location of the hip, absent head or neck of the femur due to previous infection in the first year of life (Tom Smiths disease), or excision of the hip (Girdles tone procedure). The Trendelenburg test will also be positive after a failed total hip replacement, THR, where infection has supervened and the prosthesis has been re- moved. *Common oral question.

Positive Trendelenburg Test

Common Causes

Weak hip abductors

Dislocated hip



Absent hip joint

Hip and Femoral Conditions*

Congenital abnormalities

In the older child and adult, examination of an un- treated congenital dislocation usually reveals a short leg with limitation of abduction in flexion. There may be telescoping but the movements will usually be pain- less. The patient will walk with an unstable and short leg gait, if only one side is affected, and will waddle with a swaying gait if both sides are affected. The pel-vis will look wider than normal as both hips and trochanters are riding high and laterally on the ilium. The Trendelenburg test will be positive. Other congenital conditions sometimes affecting the femur and hip include phocomelia due to drugs, such as thalidomide, used in the first trimester of pregnancy, as well as genetic causes. Coxa valga or vara, fibrous dysplasia, diaphyseal aclasis and other genetic anomalies may also occur and are discussed later.

Neoplasia

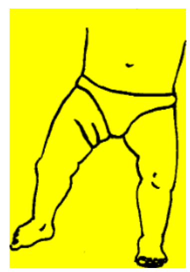
Primary neoplasms of the femur are uncommon and include benign bone cysts and chondroblastoma of the femoral head. Malignant neoplasms include giant cell tumours of the epiphysis, osteogenic sarcoma of the metaphysis and Ewing's sarcoma of the shaft. Soft tissue neo-plasms such as rhabdomyosarcoma and fibro sarcoma are rare. Multiple painful lipomata (Dercum's disease) may occur in obese people.

*UPDATE,2022,femoralacetabularimpingement,causesgroinpain and reduced ROM. External snapping of hip where iliotibial band catches on greater trochanter, internal snapping when iliopsoas catches on hip capsule.

Hip and Femoral Conditions

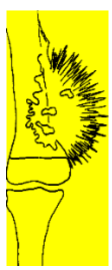
Congenital abnormalities

Phocomelia



Asymmetrical skin folds e.g. CDH*

Neoplasia



X-ray of osteogenic sarcoma of femoral metaphysis

X-ray of secondary

*Now called DDH, developmental dysplasia of the hip. Risk factors- breech,1st born, female, family history

tumour deposits with fractured neck of femur

Trauma

Fractures of the hip and femur are common and are usually easily differentiated from other hip conditions by a history and examination. Occasionally, however, a stress fracture of the femur, especially in children or in the osteoporotic bone of the elderly, may occur without obvious trauma and may cause difficulty in diagnosis.

In children, a stress fracture secondary to unaccustomed activity may mimic an osteogenic sarcoma radio logically with new bone formation. In the elderly, pathological fractures may also occur, not only in osteoporotic bone, but also in conditions such as Paget's disease where multiple stress fractures may lead to increased bowing before a complete fracture occurs. Dislocations of the hip due to acute trauma are usually easy to diagnose. Occasionally there may be difficulty if associated with previous paralysis or congenital anomalies.

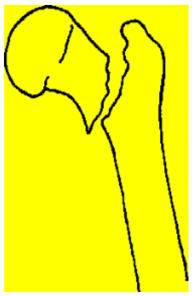
Infection

Pyogenic arthritis of the hip causes a very painful, flexed, externally rotated and adducted hip, with limitation of all movement sand generalised systemic symptoms and signs of toxaemia. Radiological examination may show no abnormality in the first 2–3 weeks.

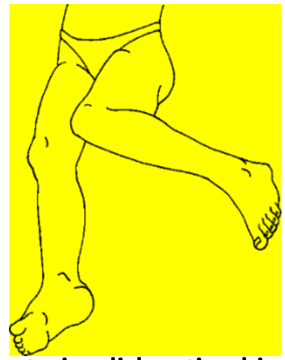
Osteomyelitis of the femur may be blood-borne, but is usually secondary to a compound fracture, an infected hip replacement or a pyogenic arthritis of the hip or knee. In primary osteomyelitis the X-ray may initially be normal, but there is usually severe toxaemia, especially in children.

Hip and Femoral Conditions

Trauma

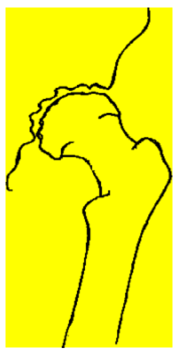


X-ray of a trochanteric fracture

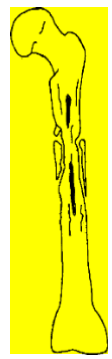


Posterior dislocation hip

Infection



X-ray of pyogenic arthritis



X-ray of osteomyelitis

Arthritis*

OA of the hip is common and may be primary (unknown cause) or secondary to previous fracture, dislocation or other hip abnormalities such as Perthes' disease or a slipped epiphysis. OA has a slow onset and is a chronic condition with in- creasing pain and deformity. There is limitation at the extremes of movement, finally resulting in a flexed, adducted and externally rotated hip with apparent shortening, due mainly to the adduction deformity. The opposite hip may also be involved, and in long- standing cases, secondary low back pain and degenerative arthritis of the lumbar spine is common. Knee pain may be due both to radiation from the hip as well as degenerative changes due to abnormalities of gait. X-rays show sclerosis and cyst formation, with diminution of the joint space and osteophyte formation of the femoral head and acetabulum.

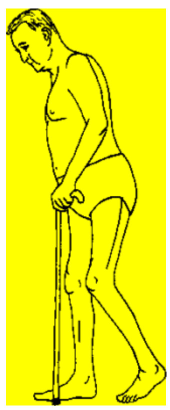
RA may also involve the hip. It is often bilateral and acute. There is usually other evidence of RA, particularly of the hands, wrists, knees and ankles and these are often involved before the hips. Secondary OA is common. Other arthritis affecting the hip are much less common than either OA or RA.

*Perthes, Coxaplana, Legg Calve Perthes,

UPDATE 2022- is non- inflammatory deformity of the femoral head from vascular insult, AVN, followed by re-vascularization/resorption/remodelling, usually boys aged 4-8 yrs, where low birth wgt /Family Hx, pain/effusion/limp, decr ROM, may be bilateral, see jnt space widening/ crescent sign, use Lateral Pillar class if., best outcome with maintaining sphericity of head. Treat with traction, anti-inflammatories, partial WB, sometimes surgery.

Hip and Femoral Conditions

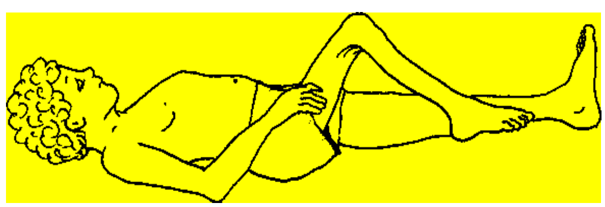
Arthritis



Patient with OA

X-ray of an OA hip with cysts and sclerosis

Miscellaneous conditions



Paralysis

Miscellaneous conditions

Other conditions involving the hip and femur include Paget's disease, where the femur is thickened and bowed, and this may occasionally cause a pathological fracture. Paralysis of the hip and thigh may be due to poliomyelitis or spina bifida (flaccid paralysis), or a head injury, stroke, cerebral palsy or cervical or thoracic spinal cord injury (spastic paraplegia).

The hip may show the surgical scars of previous hip replacements*. Occasionally, a hip replacement which has failed as are salt of infection may need to be excised (Girdlestone's excision arthroplasty), resulting in a telescoping hip joint which may be surprisingly functional. An arthrodesed or fused hip may be secondary to a previous pyogenic arthritis or a surgical arthrodesis.

*Total hip replacement is the MOST successful elective surgical procedure of ALL ; having the greatest impact on ADLs. This is a huge credit to the pioneering work of Sir John Charnley (1911-1989) and RLH.

Knee and Tibial Examination Look

1.General inspection

Compare both knees looking for obvious asymmetry or deformity.

2.Skin

Inspect the colour of the skin of the knee, thigh and leg and compare with the opposite side and also look for wounds, scars or sinuses on the front, sides and back.

3.Soft tissue

Look for swellings over all aspects of the knee. Swelling above the front of the knee may be an enlarged supra patellar bursa (an out pouching of the knee joint itself). Below the knee there may be an enlarged infra- patellar bursa (clergyman's knee), and on the front of the patella an enlarged prepatellar bursa (house maid's knee).

Swelling in the popliteal fossa may be a Baker's cyst or a popliteal aneurysm. Calf swelling may be due to a ruptured Baker's cyst or a deep vein thrombosis.

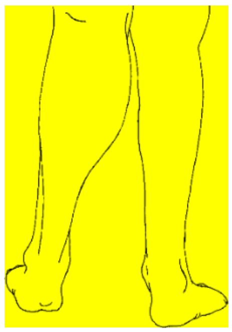
If the knee is not obviously swollen, look for filling out of the gutters on either side of the patella and this may be made more obvious by 'milking' down synovial fluid from just above the knee. It may indicate a joint effusion or synovial thickening.

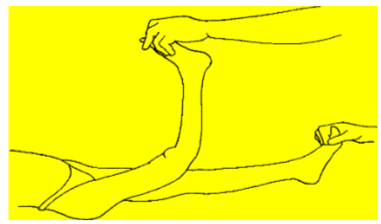
Check for wasting of the quadriceps and calf muscles.

4. Bone and joint

Look at the knee alignment, noting the presence of genu recurvatum, genu valgum or genu varum or flexion deformity. Look at the position of the patella. Look for bony swellings including tumours, possible fractures and infection.

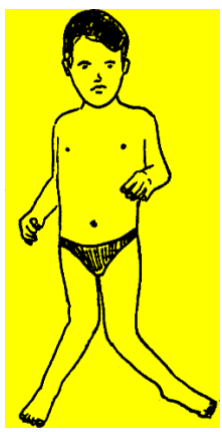
Knee and Tibial Examination

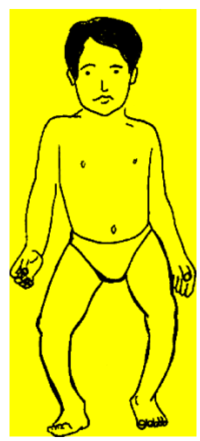




Genu recurvatum

Ruptured Baker's cyst





Genu valgum 'knock knees'

Genu varum 'bow legs'

Feel

1. Joint margin

2. Patella

3.Back of the knee

4. Other

Joint margin

The margin of the joint should be carefully palpated. This is best done with the knee flexed to a right angle. Any swelling or tenderness should be noted.

Tenderness in the joint line may indicate damage of the menisci or of the collateral ligaments. The exact location of the tenderness is important in making a diagnosis. Tenderness of the ligaments usually occurs on the medial or lateral side of the joint, quite distinct from injury of a meniscus in which the tenderness is usually located anterior or posterior to the ligaments themselves.

Occasionally, there may be a cyst of the lateral meniscus. This will usually present as a firm, smooth swelling in the lateral joint line which reduces into the joint on flexion of the knee.

Patella

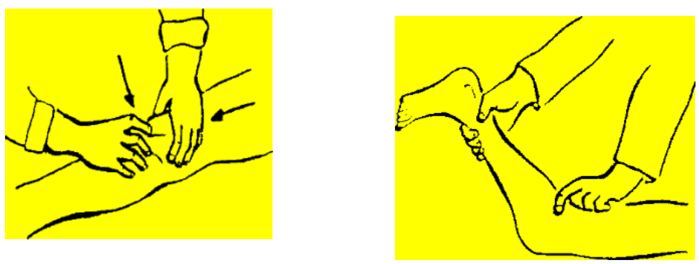
The margins of the patella should be carefully palpated. The patella is then gently moved sideways to determine any tethering. Grating of the patella with this movement, particularly with slight backward pressure, indicates roughness at the back of the patella as occurs in chondromalacia patellae.

If there is an effusion into the knee there may be a patellar tap. This test is elicited by squeezing any fluid from the supra patellar pouch into the knee joint. The patella is then pushed backwards against the

Knee and Tibial Examination

Temperature, tenderness, swellings

Joint margins



Patellar tap effusion in knee

femoral condyle. It is important to compare this to the other side. If there is too much or too little fluid a patellar tap cannot be elicited. A tap may sometimes be detected with a small amount of fluid by pushing the patella sideways.

The patella should also be gently pushed from side to side, particularly laterally. This may elicit pain in recurrent dislocation of the patella. The opposite side should be compared in all cases.

Back of the knee

Palpate the back of the knee for tenderness and swelling. This is best done with the knee flexed to about 60° and if possible with the patient lying prone. In OA an out pouching of the synovium may occur, called a Baker's cyst. A popliteal aneurysm may produce a pulsatile swelling in the back of the knee over which a bruit may be heard. If an aneurysm is suspected the peripheral vessels should be palpated, particularly the posterior tibial artery behind the medial malleolus, and the dorsalis pedis artery pulse between the first and second metatarsal bones. It is important to compare the pulsation in both limbs.

Popliteal lymph nodes may be felt at the back of the knee. Conditions below the knee such as pyogenic arthritis, a tumour, or an infected wound or ulcer may cause enlargement of these nodes.

Other areas to feel

Palpation of the front of the knee may show a tender area over the tibial tubercle. This may be due to Osgood Schlatter's type of osteochondritis — a traction apophysitis, often occurring in adolescent boys. Tenderness above the tibial tubercle may be due to partial or complete rupture of the ligamentum patellae. Tenderness over the patella itself may indicate a fracture or other injury, or a prepatellar bursa. Swelling above the patella sometimes signifies damage to the muscles above the patella or an effusion into the knee joint due to arthritis or infection.

Swelling of the knee itself is usually due to fluid, synovium, bone or a combination of these. Various types of fluid produce knee swellings. These include: synovial fluid which may follow cartilage injury, blood secondary to ligamentous damage or a fracture, and pus resulting from infection.

Synovial thickening may be due to acute or chronic synovitis or rarely a synoviosarcoma. RA and OA and many other arthritides may cause both synovial thickening and an effusion.

Move

1. Collateral ligaments and menisci
2. Cruciate ligaments
3. Flexion and extension

Collateral ligaments and menisci

The collateral ligaments should be examined carefully. This is best done with the knee in about 20° or 30° of flexion as the cruciates and the posterior capsule lock the knee when it is fully extended. It is important, as always, to compare both sides. Rupture of the collateral ligaments may often be associated with meniscal damage and tears.

Examination of the medial and lateral menisci involves rotating the knee into valgus and varus positions, and flexing and extending the joint. The finger tips placed on the medial or lateral joint lines respectively may feel a catching or clicking of a loose piece of meniscus. A loose piece of bone is sometimes detached, such as an osteochondral fragment from a fracture or from an osteochondritis dissecans. These may be felt in any part of the knee.

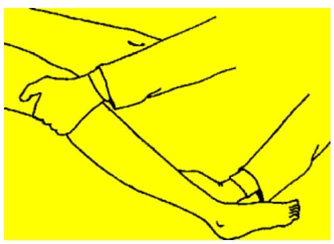
McMurray's test

This test is used to assist in the diagnosis of suspected meniscal tears, excluding bucket handle tears. The knee should be flexed to 90°, the examiner then externally or internally rotates the foot, and slowly extends the knee joint, with the leg held in rotation. External rotation is used to test for lesions of the medial meniscus, and internal rotation for lateral meniscal tears.

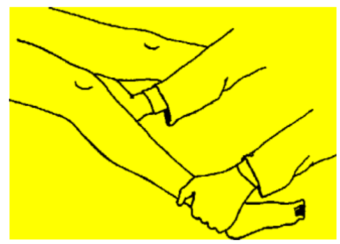
A normal knee will often 'click' when rotated in flexion. This can be differentiated from a positive McMurray's test, however, where the torn meniscus will produce a click that

Knee and Tibial Examination

Collateral ligaments

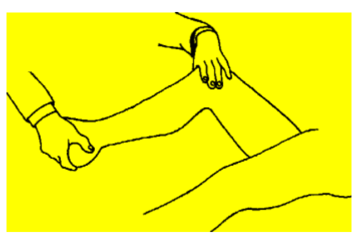


Testing medial collateral ligament—knee flexed at 20°



Testing lateral collateral ligament—knee flexed at 20°

Menisci



McMurray's test — internal and external rotation of the leg, both in abduction and adduction

is louder, and often palpable. In addition, a positive McMurray's test will often produce pain.

Cruciate ligaments

An anterior cruciate ligament, ACL* is tested for laxity by pulling the upper tibia forward on the femoral condyles with the knee flexed to a right angle. It can also be assessed by feeling for anterior laxity with the muscles relaxed, the heel on the bed and the knee flexed to about 20°. This is called Lachman's test. ACL injury is 2x to 8x in female (vs male) athletes.

The posterior cruciate ligament is tested by pushing the tibia backward on the femoral condyle.

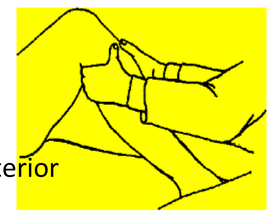
Pivot shift or jerk test

This is used to assist in the diagnosis of suspected ruptures of the ACL. The test mimics the sensation of collapsing with which the patients may present. The technique involves pushing the head of the tibia anteriorly, while the lower limb is internally rotated, and a valgus force is applied. While in this Position, the knee should be extended and flexed, which will alternately sublux, and reduce the lateral tibial plateau on the femoral condyle. Tibial reduction may occur with a sharp, visible, or palpable jerk at about 30° of flexion.

There may also be a combination of ACL and medial ligament rupture

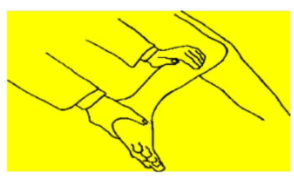
Knee and Tibial Examination

Cruciate ligaments



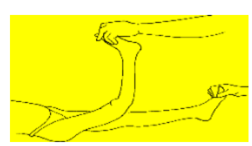
Draw sign

Lachman's test, most



Pivot shift test

Extension



Limited extension — fixed flexion deformity

Hyperextension — genu recurvatum

With anteromedial instability. This is often associated with a tear of the medial meniscus which is attached to the medial ligament. Rupture of the lateral ligament sometimes also occurs with posterior cruciate rupture, resulting in posterolateral instability. Combinations of these may also occur. More specialised tests are performed by orthopaedic surgeons to evaluate the exact degree of ligamentous damage in the knee joint, but the final diagnosis is usually made at arthroscopy.

One such test (consider the ACL as stalizing the tibia to allow extension by the quads. and the converse for the PCL to allow flexion by the hamstrings, so patient sits with foot on ground and tries to slide foot forward against your foot, see upper tibia sublux forward; and then slide backwards against your foot, see tibia sublux backwards) see Notes). Flexion and extension

The knee should be examined carefully for movement and the degree of flexion and extension noted. If there is any limitation, this should be compared with the opposite side because there are often slight variations in the normal patient. Some patients with normal knees have a slight degree of flexion or hyperextension deformity. Any tenderness on full extension or full flexion of the knee should be noted.

Knee and Tibial Conditions

Congenital abnormalities

Congenital conditions which may affect the knee and tibia include limb deficiencies such as phocomelia and overgrowth such as macrodactyly and congenital lymphangiectasis. Congenital contractures of the knee may occur with webbing and arthogryposis (generalised collagen replacement of muscles and associated with contractures). Genu recurvatum may be due to congenital shortening of the quadriceps or more commonly it is associated with maternal oestrogen excess prior to birth, together with an intrauterine mal position of the foetus in the last few weeks of pregnancy.

Genu valgum or varum are common and when severe are due to growth imbalance at the upper tibial or lower femoral growth epiphyses.

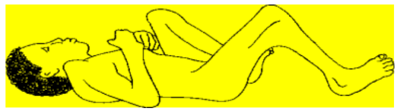
Neoplasia

Primary neoplasms of the tibia may be benign or malignant. Unlike the femur, however, secondary neoplasms are uncommon. Benign neoplasms include osteochondroma and non-ossifying fibroma. Malignant neoplasms include giant cell tumours in the epiphysis, osteogenic sarcoma of the metaphysis and Ewing’s sarcoma of the diaphysis.

UPDATE,2022. GCT-benign but locally aggressive, rarely metastasizes to lung. Seen in knee & sacrum, lytic lesion in metaphysis extends to epiphysis & to subchondral bone. Curettage, reconstruct(with bone/cement).

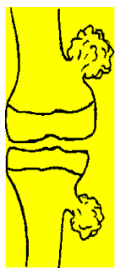
Knee and Tibial Conditions

Congenital abnormalities



Webbed knee

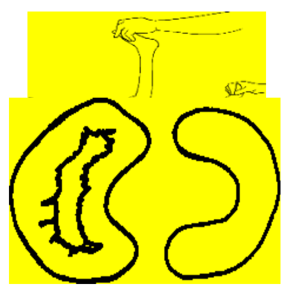
Neoplasia



Osteogenic sarcoma

Trauma

Meniscal injuries



Tear of anterior / posterior poles

With the knee flexed to a 90° angle there is usually localised tenderness just above the joint margin on the lateral side of the medial femoral condyle. Occasionally the detachment may be situated elsewhere. It is above the joint line rather than at the joint line. Numerous other injuries may occur, including tears of the menisci and ligaments, as well as fractures of the femoral condyles upper tibia or patella.

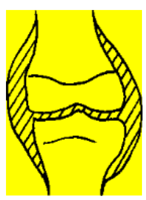
Infection

Infection may involve the knee joint. This is usually acute, and may be due to a blood- borne infection from a primary focus elsewhere, such as the throat or genitourinary tract and especially the go no coccus. It may also follow a penetrating wound or an operation on the knee. Osteomyelitis of the lower femur, or less commonly of the upper tibia, may also spread to the knee joint.

In infective arthritis of the knee, the joint is hot, tender and swollen, with

Knee and Tibial Conditions* Infection

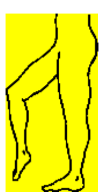
Arthritis



RA

X-ray of OA

Miscellaneous conditions



Paralytic leg

Paget’s disease of the tibia

Systemic upset and enlarged inguinal lymph nodes. This swelling extends above the knee into the supra-patellar bursa, which is continuous with the joint space of the knee. Occasionally the infection can below-grade and this may occur following early antibiotic therapy, or with an organism causing chronic infection such as the tubercle bacillus.

Infection of the prepatellar or infra- patellar bursae is usually due to direct local infection. The bursae are red, swollen and very tender over the front of the patella or upper tibia respectively, and the regional inguinal lymph glands are enlarged and tender. The underlying knee joint however, in the early stages, is unaffected.

Arthritis

Apart from an infective arthritis, the two common arthritides affecting the knee joint are RA and OA.

RA is often bilateral and usually involves other joints, particularly of the hands, wrists, ankles and feet. The onset is usually fairly acute, but the joint is much less warm, swollen and tender than in a pyogenic arthritis. There is often

*Patellofemoral pain syndrome, idiopathic anterior knee pain, due to muscular weakness, weak quadriceps/hip abductors and core muscles. Needs rehab.

considerable synovial swelling as well, and it is this, in the subacute and chronic stages, that is often more obvious than the actual effusion itself. Radiological examination in the earlier stages merely shows osteoporosis of the lower femur and upper tibia. In the later stages there is diminution of the joint space which progresses to secondary OA.

OA of the knee is much more common than RA and may be primary or alternatively secondary to trauma or other causes. Most cases are probably secondary to trauma. This will include not only ligamentous or meniscal damage, but also bony or cartilage damage. Asymmetrical joint surface stresses may occur in genu varum or valgum and also with irregular joint surfaces following a fracture of the upper tibia, lower femur or patella. X-rays in OA usually show diminution of joint space with osteophyte formation and sclerosis and there may also be evidence of an aetiological factor. Rarer causes of arthritis of the knee joint include other autoimmune diseases and psoriasis.

Miscellaneous conditions

Another condition affecting the knee and tibia is Paget's disease- causes thickening and bowing of the tibiae. Causes of paralysis of the muscles around and below the knee include spinal cord or sciatic nerve injury, spina bifida and poliomyelitis.

Ankle and Foot Examination*

Look

1. General inspection

Inspect the ankle and foot, comparing with the oppo- site foot. Note any obvious asymmetry or deformity.

2. Skin

Look for sores, scars or colour change. Sores or ulcers may be associated with poor circulation or with an in- jury or infection.

Callosities on the toes, on the sides or plantar sur- face of the foot may be due to an underlying structural abnormality or to badly fitting footwear.

Examine the nails for clubbing or deformity.

3. Soft tissues

Look for any swelling, noting possible causes such as gouty tophi over the first metatarsophalangeal joint, rheumatoid nodules over the tendoachillis, swellings resulting from trauma, infection or ganglia.

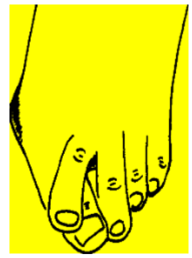
Look for muscle contractures as a cause of deformity such as in Dupuytren's contracture, Volkmann's ischaemic contracture or paralysis.

4. Bone and joint

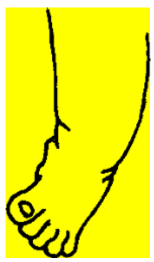
The deformities of the foot should be divided into those of the hind foot, forefoot and toes. Look posteriorly for valgus or varus deformity of the heels and then anteriorly for forefoot deformity. The forefoot may show clawing (pes cavus) or flattening (pes planus). Look at the toes for the presence of clawing or hallux valgus. Look for changes of RA or OA and note any bony swellings such as exostoses.

Ankle and Foot Examination

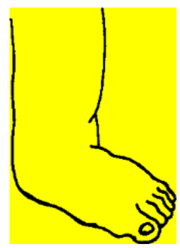
Callosities



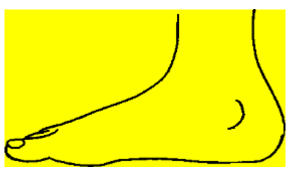
Hallux valgus



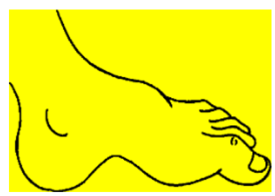
Varus deformity



Valgus deformity



Pes planus



Pes cavus

Feel

The examiner should feel the foot with the back of the proximal phalanx of the middle or ring fingers to assess the warmth of the toes, foot and ankle. This should be compared with the identical part of the opposite foot. The foot should then be palpated for tenderness and fluctuation. Palpation should be systematic, including feeling for tenderness over the lateral or me- dial malleolus of the ankle in injuries and over the dorsum of the foot and over the 5th metatarsal head. Sensation should then be tested and compared with the opposite side.

There may be tenderness and callosities over the proximal interphalangeal joints of the toes (corns), or over the 1st metatarsophalangeal joint (bunion), associated with a hallux valgus.

Examination of the sole of the foot may show localised tenderness under the heads of the 2nd or 3rd metatarsals or sometimes over the other metatarsals. This is called anterior metatarsalgia.

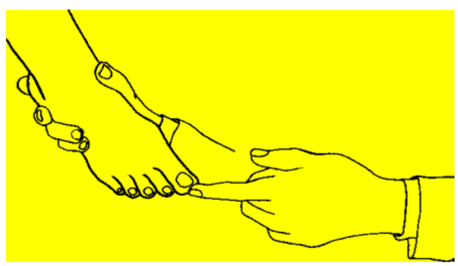
There may be tenderness between the heads of the 1st and 2nd, 2nd and 3rd, or 3rd and 4th metatarsals. This may indicate a neuroma of the digital nerve in this space which has developed secondary to chronic irritation. This pain is made worse by squeezing the forefoot between the 1st & 5th metatarsals which compresses the enlarged and inflamed nerve situated between the metatarsal heads. There may also be numbness between the toes affected by the neuroma.

Tenderness over the dorsum of the necks of the metatarsals may indicate a 'march' fracture. This is a stress fracture due to excessive or unaccustomed standing or walking.

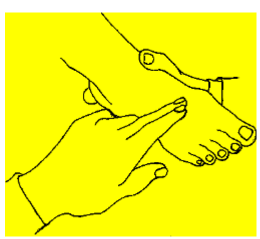
Ankle and Foot Examination

(foot and ankle problems are frequent and of great concern for many patients).

Temperature



Capillary return



Dorsalis pedis artery

Posterior tibial artery

There may be tenderness under the longitudinal arch. This is usually the result of foot strain, especially in heavy patients with poor muscles.

Tenderness under the heel usually indicates a plantar fasciitis or spur formation. This tenderness is just anterior to the most prominent part of the calcaneus. It may also be associated with a low grade infection elsewhere or with a rheumatoid diathesis.

If there is any difference in the temperature of the feet or any likelihood of vascular disturbance the pulses should be palpated. The dorsalis pedis artery is situated between the proximal part of the 1st and 2nd metatarsal shafts. The posterior tibial artery is situated half way between the medial malleolus and the point of the heel. The capillary return and the colour of the toes should be noted.

The left and right sides should be carefully com- pared and any difference noted. The actual distribution of tender areas on the underside of the foot is illustrated.

There may be sensory impairment and this is illustrated later and will help localise the level of neuro logical impairment.

*The great American Foot and Ankle Surgeon, Dr Roger Mann MD, examined his patients by sitting on a lowly set chair, patient on a raised couch. so, he could cradle the patient’s foot in his lap and hands. This way, he conducted a careful examination.

Ankle and Foot Tenderness*

*The sole of the foot mirrors what is happening with the bony structure. Examine it carefully for areas of thickening where abnormal loads are obviously being applied. Corrective osteotomies are difficult; maybe a simple compressible implant is all that is required.

**UPDATE, 2022.Interdigital neuromas (called Morton’s neuroma, seen in females, related to tight shoes, require padding or excision. Often with perineural fibrosis.

Anterior tarsal tunnel syndrome (compressive neuropathy deep peroneal nerve under inferior extensor retinaculum)-burning pain, paraesthesia medial 2nd toe/lateral hallux/1st web space and vague pain. May need surgical decompression. Tarsal tunnel syndrome is compression tibial nerve behind medial malleolus. May need surgery.

Move

Movements of the ankle and foot are divided into:

1. Movements of the ankle

2. Movements of the subtaloid and midtarsal joints

3. Movements of the forefoot and toes

Ankle*

The main movements of the ankle are plantar- flexion and dorsi flexion. The two sides must always be carefully compared. In the normal foot plantar flexion is 40°–50° and dorsiflexion 20°–30° from neutral. Neutral is when the foot is at 90° to the tibia.

A fixed equinus deformity should be assessed with the knee both fully flexed and fully extended. Where there is a tight Achilles tendon, the gastrocnemius muscle attached to the lower end of the femur is relaxed when the knee is flexed and allows for partial or full correction of the equinus. The Achilles tendon becomes tight again in extension and the foot goes into equinus. On the other hand, if equinus is due to local factors such as a posterior capsule contracture or a bony block in the ankle itself, no increase in dorsi flexion will occur when the knee is flexed.

Subtaloid joints

Inversion and eversion occur mainly at the subtaloid and midtarsal joints, although there is slight movement also in the plantar flexed ankle joint itself. The subtaloid joints are therefore, best examined with the ankle locked in dorsi flexion. This will ensure that any movement then occurring is at the subtaloid or midtarsal joints or even further forward

*The Silfverskiod test is useful to determine the cause of ankle contracture (Google it).

Ankle and Foot Examination

Plantarflexion and dorsiflexion

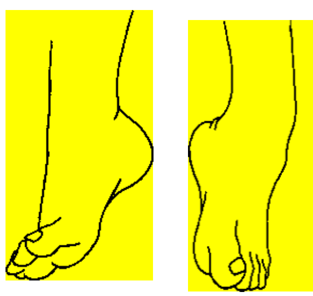
Fixed equinus deformity of right foot

Plantarflexion

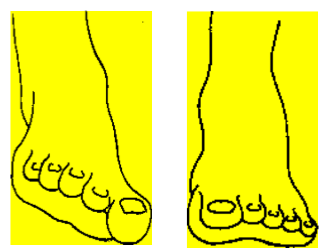
10°

Dorsiflexion

Inversion and eversion



Inversion



Eversion

in the fore foot itself, rather than in the ankle.

About 60° of inversion and 30°–40° of eversion of the foot is usually possible at the midtarsal joints. In conditions affecting the subtaloid or midtarsal joints, such as infection, this movement may be limited or

Forefoot and toes

The third set of movements involves the forefoot and toes. Further inversion and eversion may be present in the forefoot. In addition, a small degree of adduction or abduction is possible.

Deformities such as hallux valgus, with limitation of movement of clawing of the toes, may also be present. Injury to the 1st metatarsophalangeal joint can also result in stiffness of this joint (‘hallux rigid- us’). In some paralytic conditions there may also be clawing or ‘cocking up’ of the big toe.

The 2nd–5th toes can be 'clawed' at the proximal interphalangeal joints due to poor intrinsic muscles of the foot, FDL

Contracture ('hammer toe'). There is often a callosity or painful 'corn' over the dorsum of this joint due to pressure of shoes over this joint. In addition, the proximal phalanx is usually dorsally dislocated or subluxed at the metatarsophalangeal joint.

Occasionally the flexion deformity is mainly at the distal inter-phalangeal joint. This causes the pulp of the toe to press on the sole of the shoe and cause a callosity over the tip of the toe. This is called a mallet toe.

Ankle and Foot Conditions

Congenital abnormalities

Congenital conditions can be divided into limb deficiency, such as phocomelia, and limb overgrowth such as macrodactyly.

In congenital lymphangioma or similar conditions the whole limb may be enlarged, and sometimes the whole side of the body. The individual digits may be fused, and this is referred to as syndactyly, or individual joints may be stiff due to conditions such as arthrogryposis.

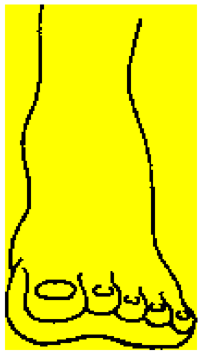
Talipes equino varus is usually due to a congenital deformity in which the foot is inverted (varus), and plantarflexed (equinus). The opposite to this is talipes calcaneo valgus where the foot is dorsi-flexed and everted. In true talipes equino varus or calcaneo valgus, deformities may occasionally be associated with spina bifida or myelomeningocele. In such cases there are usually also sensory disturbances, together with motor weakness. The feet may also be deformed. There may be clawing of the toes, overriding of the little toe or a hallux valgus.

Neoplasia

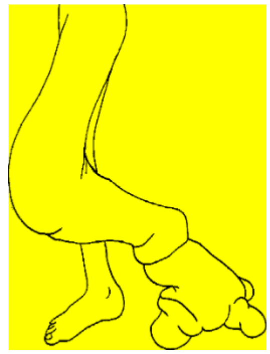
Neoplasms of the ankle and foot are rare. The neoplasms may be malignant, such as a melanoma, or benign soft tissue swellings such as a ganglion. Other neoplasms include enchondroma, ecchondroma and chondrosarcoma. Exostoses may occur, usually due to rubbing of a shoe over a bony prominence such as the 1stmetatarsal head, the 5th metatarsal base or the calcaneus.

Ankle and Foot Conditions

Congenital abnormalities

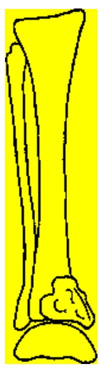


Talipes equino varus

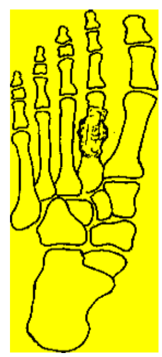


Macrodactyly

Neoplasia



X-ray of a giant cell tumour of the distal tibia



X-ray of a chondrosarcoma of 2nd metatarsal

Trauma

The different varieties of ankle and foot injuries are too numerous to be discussed here. In general, however, injuries may be class if ideas either acute or chronic, and then as fractures or ligament us injuries.

Old fractures may produce deformity, and vascular damage to muscle may cause a fibrous contracture.

Infection

There may be evidence of infection of the ankle and foot. Infection may be acute or chronic and may involve the skin, the underlying bone or joint, or the soft tissue in between. Infection is particularly common in hallux valgus, or bunions, where the rubbing of a shoe over the prominent head of the first metatarsal results in the formation of a bursa which may break through the skin and become secondarily infected.

Arthritis

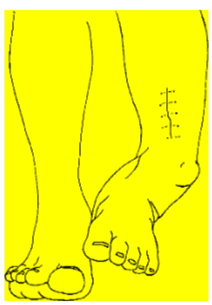
OA

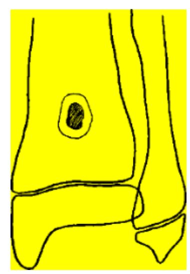
Degenerative conditions are common in the elderly patient. They may involve the ankle or the joints of the foot. They are particularly common following in- juries such as a fracture of the calcaneus involving the subtaloid joint, the ankle or the 1st metatarsophalangeal joint of the big toe (which may lead to hallux rigidus).

They may lead to degenerative OA with pain, swelling and deformity.

Ankle and Foot Conditions

Trauma **Infection**





Old trauma **X-ray of a Brodie's abscess**

OA

Hallux valgus: OA of 1st MTP joint

Metabolic arthritis

In gout, the metatarsophalangeal joint of the big toe is often involved. Involvement may be unilateral or bilateral. After a time, the skin may break down with extrusion of a white chalky material which contains uric acid crystals. There may be other evidence of gout including gouty tophi of the fingers, hands, ears and over the olecranon. Other joints may also be affected.

Autoimmune arthritis

RA is usually symmetrical and affects mainly the small joints of both the hands and the feet, particularly the proximal inter phalangeal joints and the metacarpophalangeal joints. Initially there is synovial thickening and effusion with inflammation. Gradually, over a period of months or years, the cartilage and the bones of the small joints are destroyed leading to secondary OA. In addition, the overlying tendons may be attenuated and destroyed leading to joint subluxation, especially of the metacarpophalangeal and proximal inter phalangeal joints RA in children is called Still's disease*. It may leave the child with multiple deformities of the hands, feet and other joints with growth retardation and secondary OA.

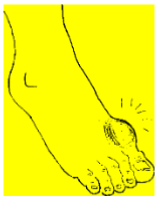
Foot is commonly involved (hallux valgus, subluxed, dislocated MTP jnts, claw toes, hammer toes, bursae; mid foot arthrosis; hind foot subluxed; also, ankle jnt).Forefoot reconstruction, mid-foot fusion and ankle/subtalar fusions may be required.

Paralytic conditions

Poliomyelitis commonly affects the lower limbs more than the upper limbs. It is an asymmetrical, flaccid, lower motor neurone type of paralysis with normal sensation. The limb is often shortened. Common deformities are an equinus ankle with occasional valgus or varus deformities, together with clawing of the foot and toes.

Ankle and Foot Conditions

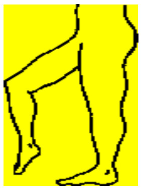
Metabolic arthritis Autoimmune arthritis



Gout

Rheumatoid feet

Paralysis



*UPDATE,2022, Juvenile idiopathic arthritis. Is a persistent noninfectious arthritis, lasting longer than 6 wks. Presents before 4yrs age. Involves the knees, wrists(flexed/ulnar deviated),hand9fingers extended, swollen, radially deviated).May develop progressive iridocyclitis, cervical spine(kyphosis, facet ankylosis, atlantoaxial instability).Can be polyarticular, pauciarticular, systemic(Still's Disease).

Damage to the thoracic spine usually results in spasticity with an upper motor neurone type paralysis affecting both lower limbs. Fractures of the lumbar spine, on the other hand, may lead to a lower motor neurone flaccid paralysis.

Spastic paralysis may also be due to birth trauma, stroke, or congenital anomalies. In these conditions both feet are usually held in equinus and the muscles are not wasted. The reflexes are usually increased asymmetrically. Sensation is often virtually normal.

Damage to peripheral nerves may occur in injuries such as open wounds or in dislocation of joints such as the hip and knee. Both sensory loss and flaccid paralysis may result.

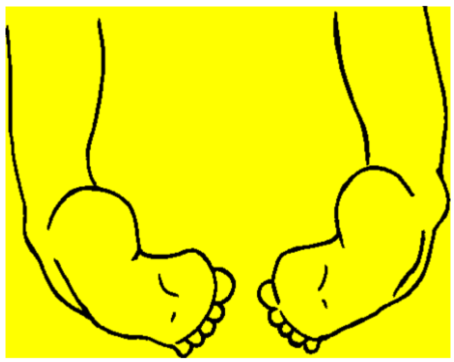
Ulceration and bed sores, also known as decubitus ulcers, may occur in paralysis if there is an associated sensory loss, as the patient is unable to feel areas where there is excessive or prolonged pressure. This ulceration usually involves the point of the heels as well as the greater trochanters and the sacrum. Such sores generally do not occur in poliomyelitis patients where sensation is normal.

Miscellaneous conditions

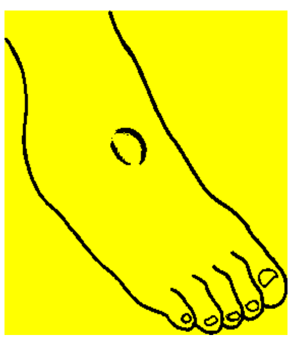
Other conditions include tenderness over the Tendo Achillis and its sheath due to excessive use, thickening of the fascia under the longitudinal arch, associated with clawing of the toes, and Dupuytren's fascial contracture, often associated with a similar condition in the hands. Curved overgrowth and thickening of the toe nails, particularly of the big toe, is called onychogryphosis.

Ankle and Foot Conditions

Miscellaneous conditions



Bilateral spastic talipes equinovarus



Ganglion

Plantar fibromatosis

Neurological Examination of the Lower Limb

Neurological assessment

1. Look

2. Feel - sensation

3.Move - tone power reflexes co-ordination

Peripheral nerve lesions

1.Lateral cutaneous nerve of the thigh

2.Femoral

3.Sciatic

4.Commonperoneal

5.Tibial

Neurological Assessment

Lower limb neurological deficits may be the result of cerebral, spinal or peripheral nerve lesions. These causes are discussed in more detail in Chapter 11:"Neurological and Spinal Conditions".

The neurological examination of the lower limbs should include an assessment of tone, power, reflexes, sensation and co-ordination.

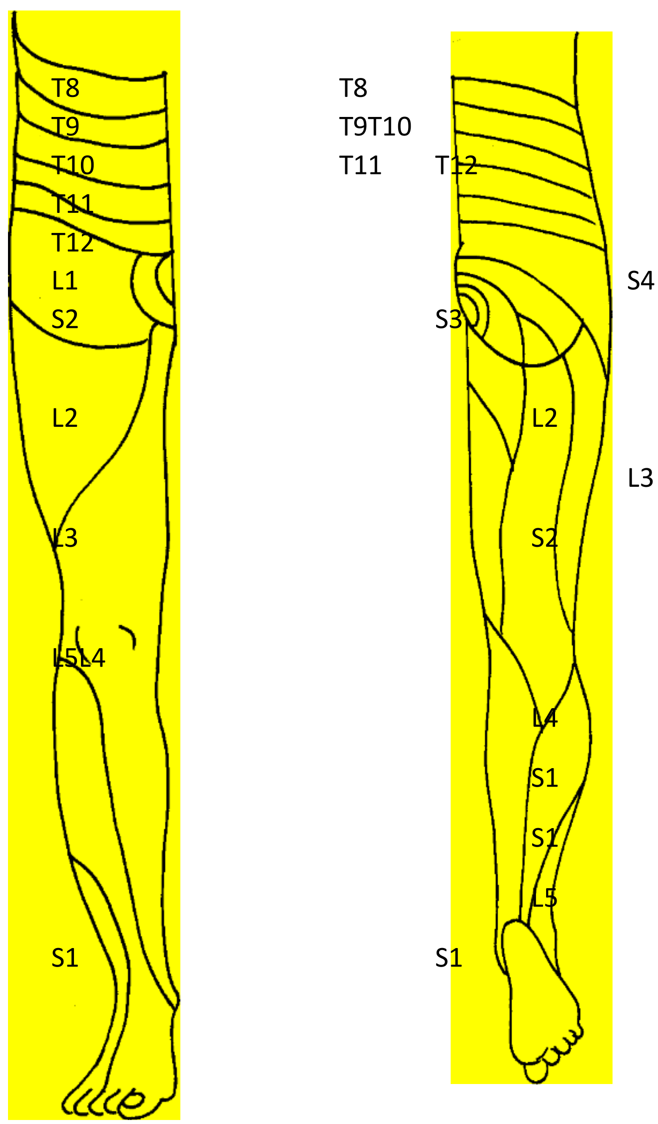
Look

The limbs should be inspected initially for wasting, deformity, contractures, and shortening. Skin changes such as discolouration, ulceration, or hair loss may also be noted and are usually due to either vascular or neurological pathology. Posture of the limbs may give a clue as to the possible aetiology of paralysis. This may include an adduction deformity of the lower limbs ('scissoring') in a patient with a spastic diplegia, and occasionally athetoid movements or fasciculation. Shortening of any part of the limb may indicate that a neurological condition has been present since birth or childhood, for example spina bifida or poliomyelitis. The contralateral 'normal' lower limb should always be inspect-ed for comparison.

Feel

Muscle bulk and temperature changes should be com- pared by palpation of both lower limbs. The bladder should be palpated for enlargement if there is any his- tory of urinary retention or difficulty in micturating.

Dermatomes Lower Limb



Anterior Posterior

Sensation

The dermatomes of the lower limb are illustrated. It should be noted, however, that there is often considerable sensory overlap. Sensory testing should include light touch, pinprick (pain), and proprioception, as a minimum for every patient with a possible neurological lesion.

Proprioception, or joint position sense is examined by holding the sides of the digit and passively dorsi- and plantar flexing it, while the patient with eyes closed, nominates whether the digit has been moved up or down. More specialised tests of sensory function include examination of temperature perception and vibration sense.

Sensory examination should always include comparison with the opposite, 'normal' limb.

Move Tone

The limb should be moved passively through its full range of motion, at varying speeds. Tone may be normal, increased, or decreased. Hypertonia is seen with upper motor neurone lesions, and may be pyramidal or extra- pyramidal, the former typically producing 'clasp knife' rigidity, and the latter producing 'lead pipe' rigidity.

Muscle power

The power of individual muscles is graded from 0 to 5:

0 —complete paralysis

1 —a flicker of movement only

2 —able to move when gravity is eliminated

3 —just able to move against gravity

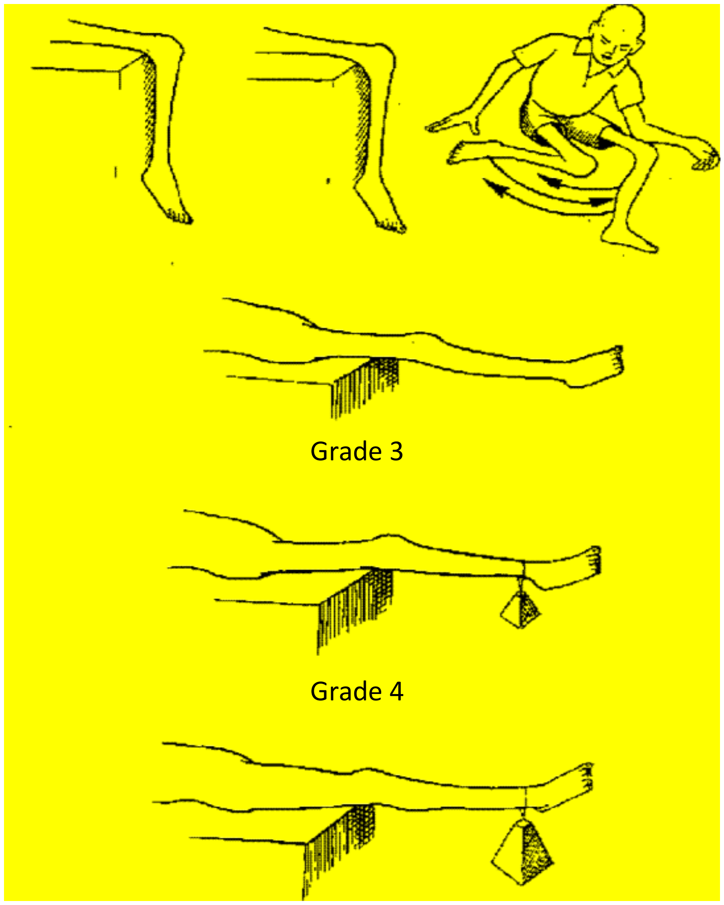
4 —able to move against gravity with some resistance

5 —normal

Adding '1/2' or ''+' signifies a power in between two grades. The importance of

Muscle Power

Grade 0 Grade 1 Grade 2



Grade 5

assessing muscle power is based on the fact that a power of more than 3 in the knee extensors, or in the foot dorsiflexors, will mean that a caliper will not be necessary. A powerless than three, however, means that a caliper maybe necessary. A detailed assessment of sensory deficit should always be considered with motor power to assess the probable neurological deficit and its site.

Reflexes

Deep tendon reflexes to be assessed in the lower limb are the knee jerk (L2,3,4) and ankle jerk (S1,2).

Clinically reflex activity may be graded as:

+ — hyporeflexia

++ — normal

+++— hyperreflexia

Clonus, which may be sustained or unsustained should be noted separately.

Hyperreflexia and clonus are indicative of an upper motor neurone spastic paralysis. The Babinski sign (a superficial reflex), which is elicited by stroking the lateral, volar aspect of the foot, is considered indicative of an upper motor neurone lesion if the great toe extends (with or without fanning of the other toes). Flexion of the great toe (and other toes) may be regarded as normal, but it must be considered in the clinical context.

It is also important to assess whether movement is voluntary, or involuntary as in an upper motor neurone spastic paralysis.

Co-ordination

Tests of co-ordination in the lower limb include the heel to the opposite shin test. This may be associated with upper limb co-ordination such as intention tremor and past pointing, as well as the ability to perform

Rapidly alternating movements of the feet (such as tapping the sole of the foot against the examiner's hand), the incoordination of which is known as dysdiadochokynesia.

Peripheral Nerve Lesions

Lateral cutaneous nerve of the thigh

Damage to this nerve (L1 spinal nerve root),usually occurs as the nerve passes medial to the anterior superior iliac spine. This will cause numbness and often hyperaesthesia of the outer side of the thigh, known as meralgia paresthetica. There is usually localized tenderness over the nerve as it passes just medial and deep to the iliac spine.

Femoral nerve

Damage to the femoral nerve in the upper thigh may lead to paralysis of the quadriceps muscles. Irritation of the femoral nerve can be assessed by flexing the knee with the patient face down and the hip extended. This is called the femoral nerve stretch test.

Sciatic nerve*

Sciatic nerve irritation is usually due to a prolapsed disc at the L4,5 or L5, S1 levels. This will press on the L5 or S1 nerve roots respectively. There will be weak- ness of foot dorsiflexion in the case of an L5 lesion and diminution or absence of the ankle jerk, together with weakness of plantarflexion in the case of S1 nerve root compression.

The straight leg raising test on the affected side may be markedly limited in sciatic nerve irritation. In addition, with the knee extended and the hip flexed as far as possible, passive dorsiflexion of the foot (Laseques' test) will stretch the sciatic nerve further producing pain and muscle spasm. This effect can also be obtained by flexing the neck on to the chest when the leg is raised with the knee fully extended. Sensory loss may involve a part or the whole leg below the knee. Complete sciatic nerve division, usually in the buttocks or upper thigh, will lead to total paralysis of the muscles below the knee, as well as complete sensory loss.

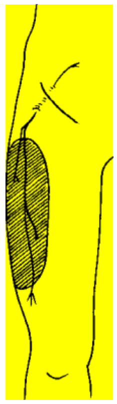
Common peroneal nerve

This is often damaged during dislocation of the knee, with rupture of the lateral collateral ligament of the knee or fractures of the upper fibula as the common peroneal nerve wraps around the neck of the fibula. Damage to the entire nerve will lead to complete paralysis of dorsiflexion of the foot and ankle, while paralysis of the deep branch innervating the peroneal muscles will only produce an inversion deformity of the foot. In addition, there will often be sensory loss over the medial two-thirds of the dorsum of the foot and lateral side of the leg.

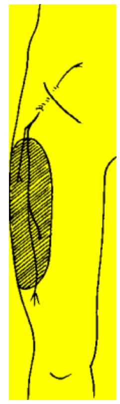
Tibial nerve

Damage to the medial popliteal nerve is usually due to a dislocation of the knee and leads to variable paralysis of plantar flexion of the foot and toes. There will also be numbness of the heel and part of the sole, the lateral side of the foot and posterior aspect of the leg. The nerve may also be compressed in the fascial tunnel behind the medial malleolus and this can lead to weak-ness of the intrinsic muscles of the foot.

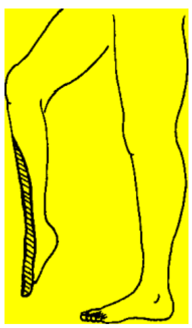
Peripheral Nerve Lesions

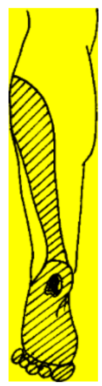


Meralgia paresthetica



Complete sciatic nerve lesion - sensory deficit





Common peroneal nerve lesion –

sensory deficit and foot drop

Chapter 5

Investigations

Haematology

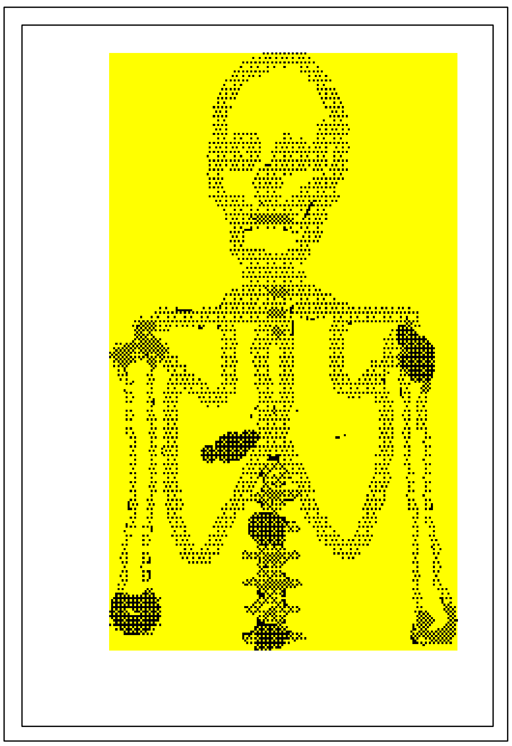
Clinical chemistry

Microbiology

Imaging techniques

History and cytology

Miscellaneous



Classification

Haematology

- Full blood count and blood film
- Erythrocyte sedimentation rate (ESR) Serology
- Bone marrow biopsy

Clinical chemistry

- Electrolytes —sodium and potassium
- calcium and phosphate Alkaline and acid phosphatase
- Urinalysis
- Uric acid and cholesterol
- Oxygen and carbon dioxide levels

Microbiology

- Micro-urine and urine culture
- Culture of bone and joint Sputum and stool samples Wound swab
- Blood culture
- Joint aspiration

Imaging techniques

- Ultrasound
- X-rays
- Computerised tomography (CT)
- Magnetic resonance imaging (MRI)
- Nuclear scanning
- Real-time imaging techniques
- Positron emission tomography (PET) imaging*

Histology and cytology

- Needle aspiration
- Trephine biopsy

Open biopsy

*UPDATE, 2022. PET is a functional imaging technique which shows how an organ/system is working. Used to assess cancers, neurological disorders and cardiac. Uses radiotracers. Looks at metabolic and physiological processes. Now being used more commonly but remain expensive.

Haematology

Full blood count and blood film

A full blood count (FBC) usually includes haemoglobin levels, red cell, white cell, and platelet numbers, as well as several other investigations.

In all cases of suspected infection and inflammation a white cell count (WBC) should be carried out. In pyogenic infections a neutrophilia will usually be present. The white blood cell count (WBC) is usually normal in inflammatory conditions such as RA. It is only slightly elevated or normal in trauma which may otherwise mimic infection. Occasionally abnormal cells maybe present, such as in the leukemias and HIV infection.

The haemoglobin (Hb) should be assessed before any major surgery and should be a routine investigation in all major conditions.

ESR

The erythrocyte sedimentation rate (ESR) is raised in infections, in acute RA and in many other acute conditions. It is usually normal in chronic conditions such as OA and in minor fractures.

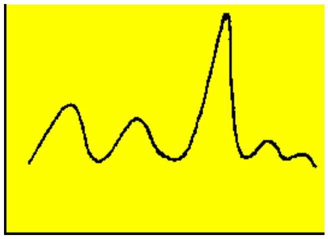
Serology

Plasma proteins and electrophoresis The albumin/globulin ratio is reversed in multiple myeloma, and the electrophoretic pattern is altered.

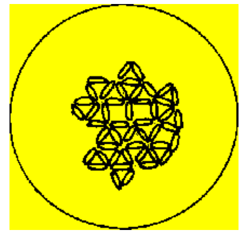
Agglutinins

The Widal test is used for typhoid fever and other salmonella infections. Brucella agglutinins may remain raised years after

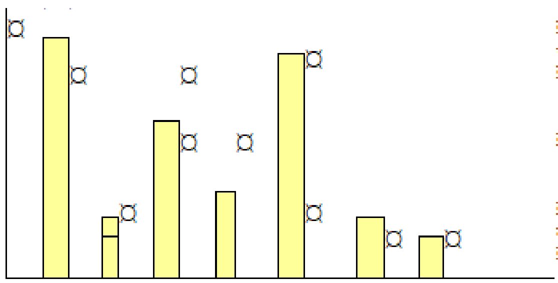
Haematology



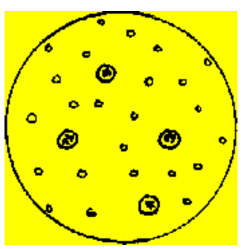
Electrophoresis



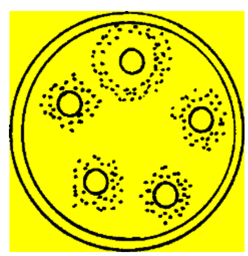
Haemagglutination



Biochemistry



High power field
of blood film



Agar plate with antibiotic sensitivity discs

the patient has recovered from the original infection. Rheumatoid and latex agglutination is often raised in RA as C-reactive protein.

HLA-B27 is usually present in 95% of patients with ankylosing spondylitis and Reiter’s syndrome. This test alone is not di- agnostic, however, as this genetic marker may be present in other conditions as well as in normal individuals.

HIV* infection should be tested for as should agglutination tests for hepatitis B and C before surgery is carried out in all patients whose lifestyle may have exposed them to infection. (Intravenous drug users, homosexuals and haemophiliacs.

*The author was the first to notice HIV/AIDS in NYC,1981.

Bone marrow biopsy

A biopsy of the marrow of the iliac crest or sternum is carried out in blood disorders such as multiple myeloma and lymphatic or myeloid leukaemias

Clinical Chemistry

Electrolytes: sodium and potassium

A low potassium level may lead to a profound fall in blood pressure and retention of sodium may lead to hypernatraemia. Cardiac dysrhythmia is common in disturbances of the sodium and potassium ion levels in the serum.

Calcium and phosphate

Calcium and phosphorus levels may be altered in rickets. This helps differentiate the various types of rickets (see Chapter 12).

Hypercalcaemia is a complication of excessive bone destruction or metabolism in conditions such as secondary deposits in bone and Paget's disease. It can be lethal if not corrected prior to surgery.

Alkaline and acid phosphatase

The alkaline phosphatase is raised in conditions where there is excessive bone destruction such as in multiple secondary deposits. It is also raised in other conditions such as multiple myelomatosis and Paget's disease.

The acid phosphatase is raised in carcinoma of the prostate, which commonly metastasizes to bone.

Urinalysis

Albumin may be present in the urine in renal failure and in urinary infections. The specific protein, Bence-Jones protein, is positive in about 40% of cases of multiple myeloma. Bence Jones proteose appears as a cloudiness in the urine on heating which disappears on boiling, unlike albumin which remains coagulated on boiling.

A test for glucose in the urine should also be routine before all orthopaedic operations. Diabetes may lead to peripheral neuritis and also to poor healing of wounds and occasionally gangrene, particularly in the lower limb, if the glucose level is not rectified.

Assessment of the pH of the urine may be useful in assessing the likely causative organism in urinary tract infection. Part of the treatment of urinary infection may be to change the pH of the urine.

Increased excretion of calcium and phosphorus may occur in rickets and other conditions where bone destruction is increased or renal absorption decreased.

Specific tests in rare congenital conditions include urinary alpha-fetoprotein in pregnant women with a foetus with spina bifida (also in the amniotic fluid) and

urinary creatine phosphokinase in pseudo-hypertrophic muscular dystrophy.

Uric acid and cholesterol

The serum uric acid level is raised in gout. It is an essential investigation if there is any doubt that the arthritis may be gout.

The serum cholesterol is raised (hypercholesterolaemia) in many patients with ischaemic heart disease.

Oxygen and carbon-dioxide levels

Oxygen and carbon dioxide saturation levels are essential in assessment of the severely injured patient.

Microbiology Investigations

Micro-urine

The urine should always be inspected for cloudiness and for blood. The odour should also be noted.

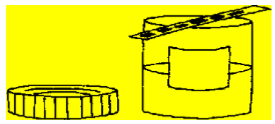
The urine should be examined microscopically for blood and pus cells and then centrifuged and the sediment examined for bacteria.

If urinary infection is suspected, the urine should be cultured and the sensitivity to antibiotics of any bacteria grown should be determined. This will take two to three days.

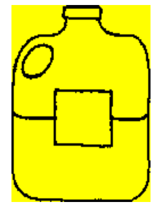
Culture of bone and joint

In conditions where an unusual infection of bone or joint is suspected, such as tuberculosis, a culture for the tubercle bacillus should be performed. This may take three to six weeks. If an anaerobic organism such as Clostridia welchii (which causes gas gangrene)

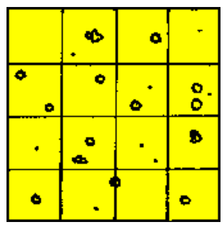
Microbiology Investigations



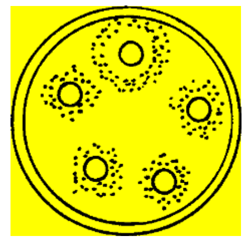
Urine analysis



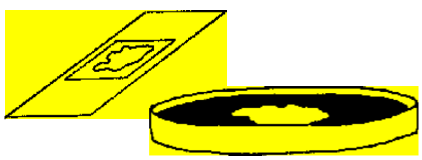
24hr urine collection for Bence-Jones protein



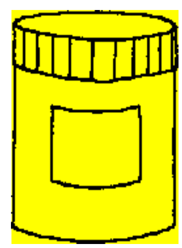
Cell counts using counting chamber



Agar plate with antibiotic sensitivity discs



Tuberculosis: Zeil–Nielsen stain and culture



Stool sample for microscopy and culture

is suspected, anaerobic culture will be necessary.

Sputum and stool samples

In suspected tuberculosis of bones and joints the sputum should be cultured for the tubercle bacillus and examined under the microscope for acid fast bacilli.

If secondary deposits in bone are suspected to have arisen from a lung carcinoma, sputum cytology for malignant cells will be required. Salmonella may cause bone infections in sickle cell anaemia, and a specific medium is required to culture this organism. Stool culture may also be positive for salmonella.

Wound swab

Pus should be taken and examined

microscopically for cells and bacteria. It should also be cultured and the sensitivity of any bacteria determined. Pus for microscopy and culture should be taken before the wound is cleaned with an antiseptic and before anti- biotics are given.

Blood culture

Blood culture must be taken before antibiotics are given if acute osteomyelitis, pyogenic arthritis or other infection is suspected. Sensitivity of the bacteria to antibiotics should be assessed but intravenous treatment is usually started using the most appropriate antibiotic(s) while awaiting results, which may take at least 2 days.

Joint aspiration

In suspected joint infections such as pyogenic arthritis of the knee, the joint should be aspirated with a fairly fine needle.

Microscopy, with a gram stain for organisms, culture and sensitivity should be carried out on the fluid obtained.

Microscopy will show uric acid crystals in gout and calcium pyrophosphate dihydrate crystals in pseudogout.

Other cavities which may be aspirated include the chest and abdomen. Abscesses may also be aspirated to obtain pus for gram stain, culture and sensitivity.

Where gas gangrene is suspected, microscopy, as well as culture for anaerobic organisms, should be carried out. In revision operations routine culture, sensitivity and microscopy should be performed at the time of re operation.

Imaging Techniques

Imaging techniques include X-rays, nuclear scanning, computerised tomography (CT) and magnetic resonance imaging (MRI) as well as ultrasound for soft tissue visualisation. This specialty has expanded considerably in recent years and has improved the investigation of orthopaedic conditions. Three dimensional and subtraction C T and MRI scanning are amongst the latest techniques for visualisation particularly in tumours, surgery and trauma where indicated.

A standard chest X-ray with posterior/ anterior and lateral views is sufficient for diagnosing most chest conditions. In the case of tumours with possible secondary deposits, CT scanning of the chest may be necessary in addition to a plain x-ray.

Standard bone and joint X-rays are sufficient in most cases.

Ultrasound

Ultrasound is a simple diagnostic method which does not irradiate or harm the patient. It will delineate different density tissues by the use of very high frequency sound-waves. Its use is relatively limited but it has a place in the diagnosis of soft tissue tumours, particularly in the abdomen, and also for conditions such as congenital dis-location of the hip.

X-rays

X-rays of affected bone and joints will often be sufficient for diagnosis. In most cases at least two views at right angles to each other, an antero-posterior (AP) and a lateral, will be required. It is important that the bone and joint above and below the lesion be X-rayed as well as the affected bone and joint or joints.

A tomogram is helpful for diagnosing a bone sequestrum in the centre of a cavity which might otherwise be obscured by the overlying bone or to confirm a non-union of a fracture. In this technique the X-ray tube is rotated so that only one part of the bone is in focus at a time.

Chest X-rays

A chest X-ray is essential in all patients in whom a tumour is suspected, and also in all patients, particularly over the age of fifty, who may require a major operation. This is also important in all patients who have a history of chest problems, and particularly in suspected tuberculosis of bones and joints where a primary focus in the lung may be responsible. A chest X-ray is also important in suspected malignant tumours with possible pulmonary secondaries.

Contrast media

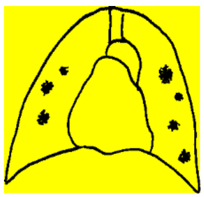
Injection of contrast media into joints and cavities may help outline difficult areas. This includes air contrast arthrograms in knees and other joints. Injections of dye(radiopaque contrast medium) into sinuses may help delineate the extent of the sinus cavity or abscesses.

Organ Imaging

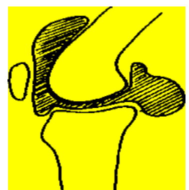
X-ray of a pathological fracture

X-ray of OA hip

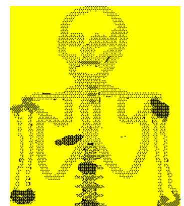
Tomogram



Chest X-ray



Arthrogram



Nuclear medicine

MRI

A radiopaque contrast medium injected into the spinal cavity is called a myelogram. This will show not only a tumour blocking the spinal canal but also protrusion of discs causing pressure on nerve roots in conditions such as sciatica and low back pain. Myelograms are now being superseded in many cases by computerised tomography (CT) scanning and magnetic resonance imaging (MRI). Computerised tomography (CT) scanning Computerised tomography is proving invaluable in orthopaedic surgery. The bone is X-rayed with a low dose of radiation and a computer analyses the information received to form a of an intervertebral disc or to show the exact site for tumour surgery. New techniques allow for 3-dimensional visualisation of bones and joints.

Magnetic resonance imaging

This is a relatively new technique which measures the radiation emitted from hydrogen ions as they realign after being oriented in a strong magnetic field. There is no ionizing radiation used. This is particularly useful in the diagnosis of soft tissue lesions, such as ruptures of knee ligaments, since it gives a greater range of contrast than CT scanning, but at present is far more expensive. It is particularly valuable for visualizing soft tissues and also in tumour.

surgery. It should not be used in patients with ferrous metal implants or cardiac pacemakers.

Nuclear scanning

Nuclear scanning in orthopaedics involves the intra- venous injection of a radio- isotope, technetium-99m methylene diphosphonate, which selectively binds to bone tissue. The concentration of the isotope is partially determined by the vascularity of the tissue involved. Hence in the presence of a normally growing epiphysis, bony infection or neoplasia, there will be great- er uptake. The suspected are of pathology, and often the whole patient, will be scanned by a gamma-camera, which detects the level of emission. Regions of high concentration are commonly referred to as 'hot' areas.

In most patients the kidney and bladder will also show pooling of this isotope which is excreted through the renal tract, it will make these viscera appear hot.

Another isotope commonly used is gallium. Gallium scanning is used to detect foci of inflammation, and some neoplastic tissues as a result of its affinity for chronic inflammatory cells.

Other imaging techniques

Other imaging techniques include cineradiography, fluroscopy, or videotaping. Cineradiography, unlike fluroscopy provides a permanent record of active movement, and with higher resolution than is possible with videotape. Pathology, that is not immediately obvious on standard plain X-rays, may become apparent when movement is displayed. It may also be retained for future reference and comparison.

infection.

Trephine biopsy

Trephine biopsy of bones is indicated in suspected primary tumours and particularly in secondary deposits. The trephine is a wide-bored needle of about 2–3 mm diameter with a cutting edge. The core of tumour is approximately 10–30 mm in length and 2 mm in diameter. The core is rubbed across one or two glass slides and the remainder is sent for pathology.

If there is any possibility of infection the specimen should also be sent for gram staining and culture. The trephine biopsy is particularly valuable for biopsy of inaccessible sites such as the lumbar spine.

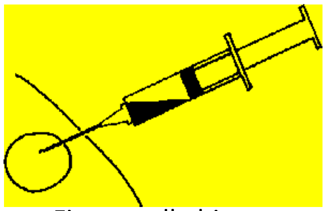
Open biopsy*

If a larger biopsy is needed an open biopsy is carried out. A wedge of tumour, including the bone and if possible the edge of the tumour, is removed. In certain tumours, such as osteochondroma, the whole tumour should be excised as it may not be obvious which part of the tumour may be undergoing malignant change. A provisional diagnosis can sometimes be made on examination of the smear on the slide. A definitive diagnosis will

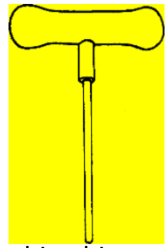
*UPDATE, 2022. Principles of Biopsy. Use longitudinal incisions so it can be excised with future resection approach lesions through muscle if possible; avoid functionally important and neurovascular structures meticulous haemostasis; biopsy soft tissue component of bone tumour; culture biopsy and biopsy of what cultured.

Immunohistochemistry (IHC) and molecular testing can help in the diagnosis of some bone & soft issue tumours.

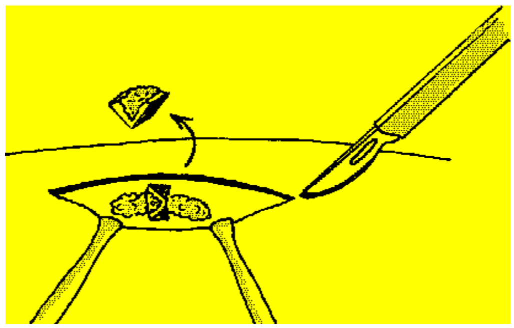
Biopsy and Aspiration



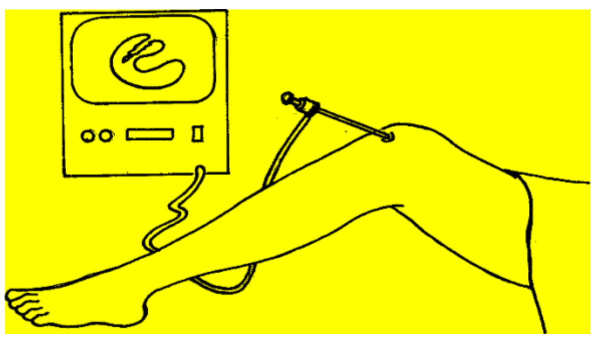
Fine needle biopsy



Trephine biopsy



Open biopsy



Arthroscopy of the knee joint

Usually mean a wait of several days while bone and cartilage is decalcified.

No major operation should be carried out, particularly for primary tumours, until a biopsy result is available, as occasionally an infection or other condition may mimic a tumour, and vice versa. Examples are Ewing's sarcoma of bone which may mimic osteomyelitis, and a parathyroid tumour with associated hypercalcaemia causing cystic areas in bones. These may mimic a primary malignant tumour or a secondary deposit from carcinoma elsewhere.

Miscellaneous Investigations

Arthroscopy

One of the most significant advances in both diagnosis and treatment in recent years has been the use of the arthroscope. This is a tube with a telescope and light by which the interior of the knee, shoulder and other joints can be viewed through a monitor and, if necessary, operated upon.

It is invaluable for taking biopsies of suspicious areas under direct vision. It also enables procedures, such as removal of loose bodies and torn menisci, as well as division of adhesions and repair of ligaments, to be carried out.

Electrical tests

Electrocardiograph (ECG)

This should be a routine test on all patients with suspected heart abnormalities and on all elderly patients who will be undergoing general anaesthesia. It assesses abnormalities of rhythm and conduction.

Electroencephalograph (EEG)

A test to detect abnormal patterns of electrical activity in the brain. It is used for detecting and assessing abnormal foci causing epileptic seizures, and in assessing the extent of brain damage in head injuries and tumours.

Electromyogram (EMG)

In this test a needle electrode is placed in a muscle to assess electrical activity and this is displayed on an oscilloscope. Axon-al degeneration in a muscle with denervation will be represented by 'fibrilation potentials' instead of being 'silent' as occurs in the normal resting muscle with an intact nerve supply. This indicates disruption of muscle innervation but may not appear until three weeks after the interruption of neural conduction. Peripheral neuropathies and anterior horn involvement in the spinal cord have a different appearance from denervated

Nerve conduction studies

Conduction velocity is measured using surface electrodes. It varies with the age of the patient and room temperature. Normal conduction velocity is approximately about 45 metres per second in the lower limb and 50 metres per second in the arm. Damage to a nerve and its myelin sheath will slow or completely block conduction through an injured segment of the nerve. A generalised abnormality is indicative of a peripheral neuropathy while a localised lesion is indicative of a single nerve injury. Nerve conduction studies on sensory nerves are easier to perform than those on motor nerves. Lesions of the central nervous system do not produce abnormalities in peripheral nerve conduction studies. Spirometry

The vital capacity/ other measures of lung function can be of value to the anaesthetist, especially in assessing elderly patients with poor resp. function. with poor respiratory function.

Exercise tolerance

In elderly patients' assessment of exercise tolerance and its effects on the ECG, pulse and blood pressure, may be of value in assessing the likely effects of increased mobility following hip or knee replacement. Graded increasing work load on an exercise bicycle (eg, Bruceorde Brusk protocol) or treadmill will allow accurate assessment of an exercising 'stationary' patient.

Triple histamine response

This is a test used mainly in brachial plexus injuries to assess the level of division. In a very high lesion at the cord level proximal to the posterior root axon, injection of a drop of histamine into the forearm will cause a reflex vasodilatation with a wheal and hyperaemia. If the division is distal to the axon no reflex can take place and there will be no 'triple response'.

Doppler ultrasound

This is particularly useful in the lower limb to assess blood flow over an artery by means of an ultrasound probe. This can accurately show the site of a block/narrowing in an artery, and as a result, often avoid the need for an angiogram.

Angiogram, venogram and lymphangiogram

This is an X-ray of the arterial tree after injection of a radiopaque dye into a major vessel. The arterial tree, together with any occlusion or narrowing, can be demonstrated. More sophisticated techniques include digital subtraction angiography where a computer is able to eliminate soft issue and bone from the image.

A venogram is the injection of a radiopaque dye into a major vein to demonstrate venous occlusion in patients suspected of having a deep vein thrombosis. The injection of a contrast medium into lymphatics, or lymphangiogram, may be indicated in lymphatic obstruction.

Chapter 6

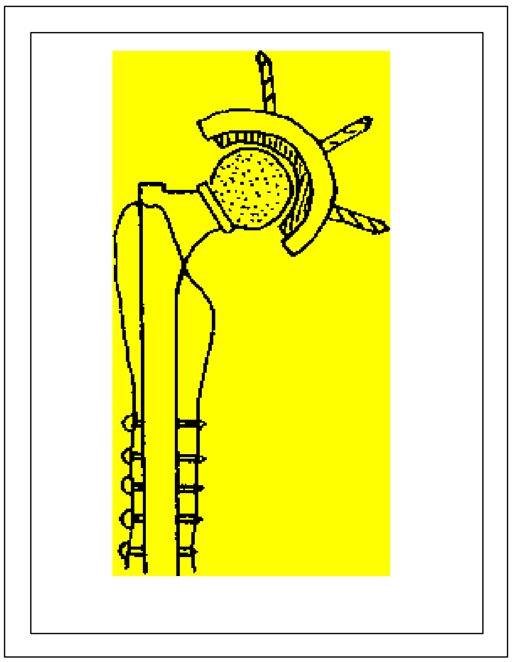
Treatment

Conservative

Medical

Operative

Rehabilitation



Classification

Conservative treatment

Physiotherapy

Supports

Medical treatment

Analgesia

Anti-inflammatory medication

Antibiotics

Injections into joints and cysts

Chemotherapy

Hormone therapy

Radiotherapy

Operative treatment

Soft tissue correction

Osteotomy

Arthroplasty

Arthrodesis*

Rehabilitation

*Patients are a lot less happy to accept arthrodesis now(now an historic procedure). Some feel that a hip arthrodesis makes them look like a cripple or that having a knee arthrodesis makes mobility almost impossible. They are more prepared to accept arthroplasty with revision procedures. Many remain optimistic that stem cell therapy will provide an answer.

Conservative Treatment

Physiotherapy

Physiotherapy can be divided into three main categories:

Thermal and cryotherapy

Radiant or superficial heat are suitable for patients who are unfit to travel to a physiotherapy department or who have an implanted prosthesis. Sometimes ice packs are used if there is considerable bruising immediately after injury.

Deep heat, such as short wave diathermy or ultrasound can be used in cases where there is no implanted prosthesis or plates, nails or screws.

Massage

Massage in its various forms is soothing to the patient but has a limited place.

Exercise

Exercise may be active or passive. Active exercises, where the patient exercises the joint, are by far the most valuable. They increase the power of muscles and actively move the joints, often increasing both the range of joint movement and joint lubrication. Passive exercises, where the physiotherapist moves the joints, may be necessary where the joint is paralysed or where the patient is reluctant to move the limb. They have a place, but are of much less value than active exercise. Useful in preventing contractures across joints, in the shoulder, hand and knee.

In addition to passive exercises performed by the physiotherapist, a machine called a continuous passive motion machine (CPM) is now in use. This machine is powered by an electric motor and is used mainly on the lower limb and occasionally on the upper limb. It moves the limb through a variable range of movements at a predetermined speed. It is invaluable for patients recovering from severe knee or hip operations (and occasion-ally the upper limb) to prevent the joints from becoming stiff postoperatively.

It has also been shown that constant movement by these machines markedly improves the nutrition of the joint cartilage and often accelerates the recovery of joint mobility.

Transcutaneous electrical nerve stimulation (TENS)

In chronic pain, particularly low back pain and sciatica, transcutaneous nerve stimulation with a battery powered machine worn by the patient may relieve pain. A small pad placed over the site of maximum tenderness on the skin can electrically stimulate the underlying cutaneous nerves in differing amplitude and duration.

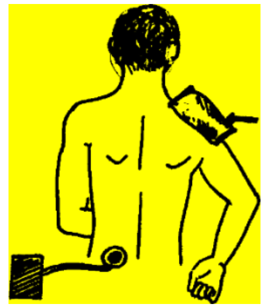
Supports Boots and innersoles

In the case of a short leg, a contracted knee or an equinus ankle, a raise on a boot, either on the heel alone or on both the sole and the heel, may be necessary.

Many other supports are in common use, including innersoles in shoes to support ‘fallen arches’ and soft plastic inserts to relieve pressure areas on the sole of the

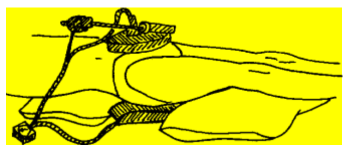
Physiotherapy

Radiant heat

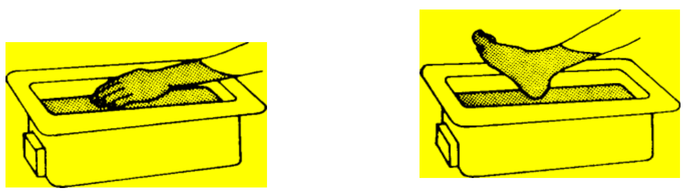


Icepacks

Transcutaneous electrical nerve stimulation (TENS)



Short wave ultrasound diathermy



Wax baths

to special finger supports to extend the fingers.

There are many other supports for both the upper and lower limb, including those for a weak elbow or shoulder, and corsets to support a weak spine or neck.

TemporarysupportscanbemadeoutofplasterofParisorvariousplasticsandincludesupportsfortheknee,ankle and upper limb.

Bed supports

These include special cushions to support a patient’s back, supports and cushions under the sacrum and under the heels to prevent pressure sores in bed, and pillows under the legs to elevate the feet or to keep the knee flexed after a hip operation.

*Plantar fasciitis can oft be successfully treated with comfortable shoes (flexible, with soft inner soles with no ridging and soft hind support). Lula, The Pres. Brasil, 2003- 10,worethewell-designed Ferracini shoes. One small city in South Brasil, New Hamburg, called the National Capital of Shoes, has 5 million shoe manufacturers.

Exercises

Upper limb

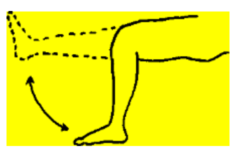
Shoulder

Elbow

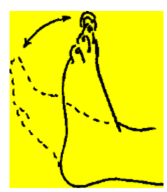
Wrist

Lower limb

Hip



Knee



Ankle

Continuous passive movement machine

Walking aids

A variety of crutches is available. Some allow the patient to bear weight mainly on the shoulders and hands. In addition, there are short elbow crutches and walking frames.

Walking sticks vary from those with a broad base and four prongs, called quadrapods, to single walking sticks which are used in the opposite hand to the affected leg.

Wheelchairs and motorized vehicles

A variety of wheelchairs is available, from ordinary wheelchairs where the patient is self-propelled, to electric or petrol driven wheelchairs allowing patients on the road. Special adaptations to cars with hand controls will allow disabled patients to drive cars, even if both legs are completely paralysed.

Spinal supports

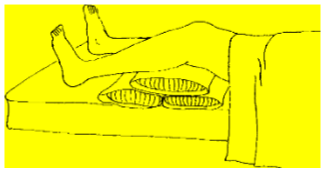
These include supports for the cervical, thoracic and lumbar regions and are used not only for fractures and dislocations, but also for a variety of other neck and back conditions.

Cervical supports vary from soft collars and supports which extend up to the back of the neck and under the jaw to 'Minerva' supports which extend from the top of the skull to the pelvis.

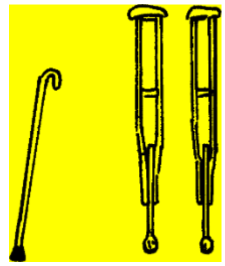
Other less commonly used forms of spinal support include halo-thoracic and halo-pelvic traction. A metal 'halo' is secured by pins to the outer table of the skull. The halo is then attached by distraction rods to a plaster jacket or to pins inserted in the iliac crest to achieve both traction and stability.

Thoracic supports often also support the lumbar region. Various types of braces are available to support the lumbar and lower thoracic regions.

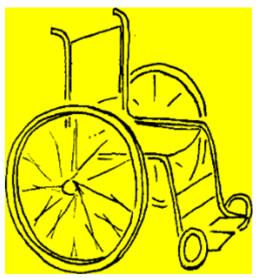
Supports



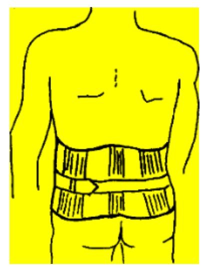
Three pillows



Canes and crutches

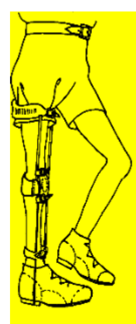


Wheelchair



Spinal support

Inner sole and raised boot



Above knee caliper

Medical Treatment

Analgesics

Analgesics are available in varying strengths. It is important that drugs of addiction be avoided where possible, particularly in chronic conditions. The exception is in oncology where a lesion is in operable and an-algesia a priority.

Anti-inflammatory drugs

Non-steroidal anti-inflammatory drugs, such as ibrufen and diclofenac, are used commonly for arthritis. They have some effect in diminishing inflammation and oedema. All these drugs have side effects, especially on the gastro intestinal system, and should be used with caution and for a limited period in most cases.

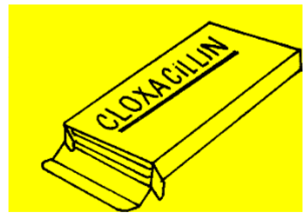
Aspirin has been shown to be effective both as an analgesic and as an anti-inflammatory drug but also has side effects. Steroids such as hydrocortisone and prednisone are sometimes used in advanced RA as are gold salts and other drugs. These all have potentially severe side effects.

Antibiotics

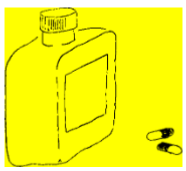
Antibiotics are used for specific infections such as osteomyelitis and tuberculosis. They are occasionally injected into joints such as in pyogenic arthritis of a knee joint. In many cases they are used prophylactically before and after major surgery, for example in hip and knee replacements where infection would be a serious complication. Anti-biotics such as gentamicin in saline may also be used to wash out wounds during major operations such as a total hip or knee re-placement. In addition, systemic antibiotics are usually given in large doses at the time of operation and then continued for at

Medical Treatment

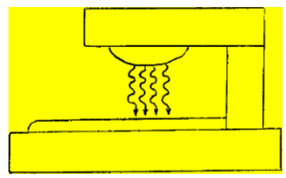
Analgesics and anti-inflammatory drugs



Antibiotics



Chemotherapy and hormones



Radiotherapy

223 **Treatment**

Least three days post operatively. In the case of suspected infection, treatment may be continued for one to three weeks and even up to three months or longer. It is important, however, that the appropriate antibiotic be given for the infection being treated. In all infections it is important that the sensitivity of the organism be determined if possible before treatment is started.

Injections into joints and cysts

Injection of cortisone into benign cysts may cause the lining of the cyst to be absorbed and the cyst may subsequently resolve.

Antibiotics may be injected into joints for acute joint infections. Drainage with a suction drain, plus large doses of I V antibiotics, is the usual treatment.

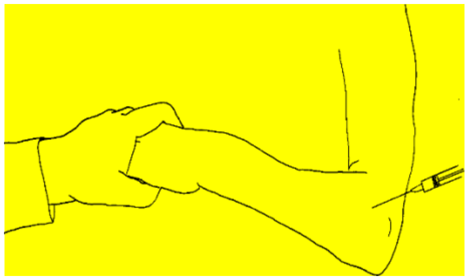
Occasionally there is a place for the injection of hydrocortisone into joints such as the knee in OA or RA. This carries, however, the potential danger of steroid arthropathy. Injection of steroids into chronic tender partial tears of muscles, such as in tennis elbow or in de Quervain's tenovaginitis, may be indicated.

Chemotherapy and hormones

Chemotherapy is relatively new and is used mainly in the treatment of tumours. It consists of a variety of new drugs which specifically affect proliferating cells. These drugs are extremely toxic and the patient may require other drugs after the chemotherapy to undo their harmful effects on healthy tissues.

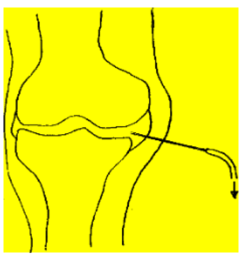
Drugs currently in use include methotrexate, vincristine, cisplatin and doxorubicin hydrochloride. These drugs are given intravenously in various combinations, usually for a period of up to two years, and usually about every three weeks for approximately three days.

Medical Treatment

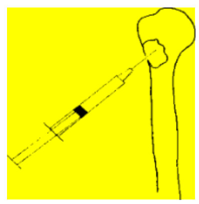


Cortisone injection for tennis elbow

(Platelet-rich plasma injections may help healing damaged soft tissues)



Drainage of septic arthritis



Cortisone injection into benign bone cyst

The effects of these drugs on tumours such as Ewing's sarcoma and occasionally osteogenic sarcoma can be dramatic, although only lifesaving in specific cases.

In addition to adjuvant chemotherapy, alteration of the hormonal balance may have a dramatic effect in hormone dependent tumours such as carcinoma of the breast or prostate. In carcinoma of the breast, drugs such as tamoxifen may be used, depending on the age of the patient. Provided the tumour is hormone sensitive, a patient with secondary deposits from carcinoma of the breast may survive for many years, even following pathological fractures.

In carcinoma of the prostate there is occasionally a place for orchidectomy.

The administration of stilboestrol may also have a beneficial effect.

Radiotherapy

Used for fast-growing tumours such as Ewing's sarcoma and, to a lesser extent, tumours such as osteogenic sarcoma. Its main place is in the treatment of secondary tumours, particularly after internal fixation of a pathological fracture.

Radiotherapy is occasionally indicated for benign tumours in inaccessible sites, such as an aneurysmal bone cyst or giant cell tumour of the spine which cannot be removed. Low dose radiotherapy is also given to prevent recurrence of myositis ossificans in those patients predisposed to this complication, e.g. following major hip surgery in patients with previous ossification.

Operative treatment

Soft tissue correction

There is a place for soft tissue correction in contractures of joints in poliomyelitis or spastic paralysis, including flexion contractures of the hip, knee or ankle. This procedure performed by either open or closed methods, can often correct a deformity, allow realignment of the joint and permit the patient to be weight-bearing. Soft tissue correction may be combined with bony correction.

In constriction of tendon sheaths such as the flexor sheath of the fingers (trigger finger) or over the radial styloid process (de Quervain's syndrome), division of the tendon sheaths alone will often free the constricted area.

Similarly, neurolysis of nerves such as the median nerve under the carpal tunnel in the wrist will allow for recovery of a sensory and motor deficit.

In RA proliferation of synovium may cause erosion of the cartilage if left untreated. Excision of synovium, particularly of the metacarpophalangeal joints of the fingers, and in the knee, may delay the erosion and degeneration.

In partial paralysis with muscle imbalance, transfer of working tendons may partially compensate for paralysis. An example is the transfer of the tibialis posterior tendon from being an inverter and plantar-flexor of the foot to being a dorsiflexor of the ankle and foot. Tendon transfers around the wrist and hands can compensate for im- balanced weakness in nerve injuries and paralysis, provided there is adequate power of at least grade 4 in the tendon to be transferred and provided any deformities are first corrected.

Osteotomy

An osteotomy is realignment by removing or opening out a wedge of bone in order to correct a deformity. This will not only correct a deformity such as a flexed, valgus or varus knee, but also allows a different and healthier area of cartilage to accept weight- bearing. Osteotomy can also diminish the excessive blood supply to an inflamed or arthritic area of the joint and allow oedema to subside. Osteotomy is, however, usually palliative rather than curative as the original area of OA or degeneration is not replaced. Osteotomy of bone will also correct malalignment in malunited fractures and so prevent the onset of OA due to asymmetrical pressure on a joint.

Osteotomy of the trochanteric region of the hip corrects an adduction or abduction deformity and allows a different area of the cartilage on the head of the femur to be weight bearing. It also decreases excessive hyperaemia and oedema of the joint capsule. A varus deformity of the knee may be associated with narrowing and OA of the medial joint compartment with sparing of the lateral compartment. A lateral wedge of 20°–30° in the upper tibia will change the weight-bearing of the tibia from varus to valgus. The good lateral compartment will then take most of the body weight and regeneration of part of the medial articular cartilage may then occur.

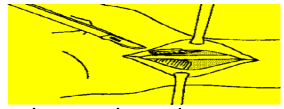
Osteotomies of bone are usually held by nails, plates or staples.

Arthroplasties

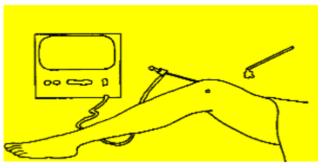
An Arthroplasty is the formation of a movable, mobile joint from a stiff joint, usually by joint replacement. It can be divided into three main types.

Operative Treatment

De Quervains syndrome — division of Tendon sheath



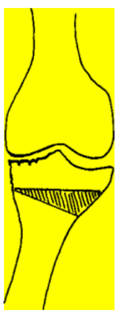
Carpal tunnel syndrome — division of flexor retinaculum



Arthroscopic

synovectomy

Tendon transfer



X-ray of genu varum deformity

X-ray of corrective osteotomy

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Excision arthroplasty

An excision arthroplasty is the excision of a destroyed or painful joint without replacing it with a prosthesis. Stability is variable and dependent upon any remaining ligaments, scar tissue and muscles. In the hip it is called the Girdlestone arthroplasty. It is used in an infected hip after a failed hip replacement, in severe fractures where the patient is not fit for hip replacement, or in the very elderly.

Excision arthroplasty of part of the proximal phalanx of the big toe in hallux valgus in elderly patients (Keller's operation) or excision of the head of the radius in a severe fracture are other examples.

Hemiarthroplasty

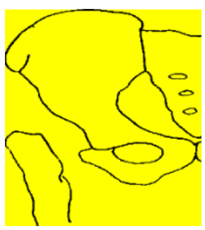
Hemiarthroplasty is the replacement of half of a joint. This is most commonly performed in the hip for subcapital fractures in elderly patients.

Other types of arthroplasty include replacement of the scaphoid, the trapezium, the head of the radius or the proximal half of the proximal phalanx of the big toe.

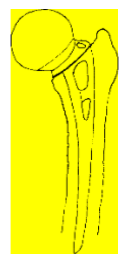
Total joint replacement

The most successful total arthroplasty to date has been hip replacement-both the femoral head and the acetabulum are replaced. In the past this has entailed using a metal head articulating on a high density polyethylene socket, both cemented into place with methyl methacrylate bone cement. Unfortunately, in the past, up to one third or more of these have shown evidence of failure or loosening within ten years, particularly in young and active patients and particularly the acetabular com- ponent. This is partly due to the difference between the modulus of elasticity of the cement and that of bone as well as the

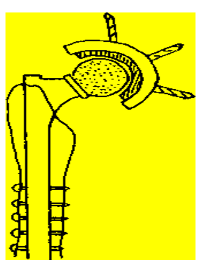
Arthroplasty

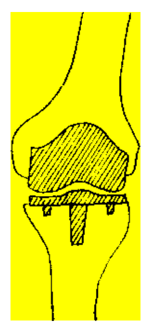


Girdlestone's excision Arthroplasty



Austin–Moore hemiarthroplasty





X-ray of a cementless hip replacement

UPDATE, 2022. Before TKR, restore knee strength/balance/agility/weight loss, NSAIDs, tramadol, and valgus osteotomy for med. cpt disease.

relatively high friction of metal on high density polyethylene. Other factors are metal sensitivity to chrome cobalt or stainless steel, reactions from wear particles from the high density polyethylene and fragmentation or infection of the bone cement.

Most new types of THRs are cementless. The Huckstep hip has an inert titanium stem which is locked into place with screws to allow full postoperative weight-bearing. A partially stabilised zirconium (PSZ) ceramic or chrome cobolt femoral head articulates with a high density poly- ethylene socket held in place with screws.

Other types of total joint replacement, which are extensively used, include total knee replacements with a metal femoral component articulating with a high density polyethylene tibial component. These are usually held in place by cement or without cement by a friction fit.

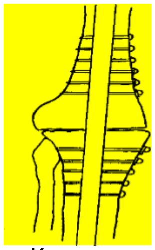
Most other arthroplasties have not proved very successful except for plastic arthroplasty of the fingers in RA but even the plastic in these may produce problems. Ankle arthroplasties, except in RA, often fail while arthroplasties of both elbow and shoulder have a limited place and need further improvement.

Arthrodesis

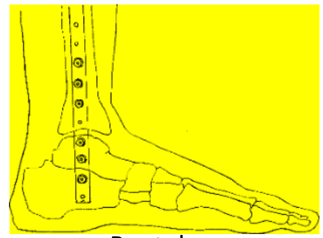
An arthrodesis is a fusion of a joint so that it does not move at all. This is usually achieved by excising the joint and obtaining a bony fusion. If bony fusion fails the result will be a fibrous union which will usually move slightly and cause pain if stressed. Fusion of the knee joint is best achieved with an intramedullary locking nail.

A Huckstep titanium nail with locking screws is probably the most satisfactory for this

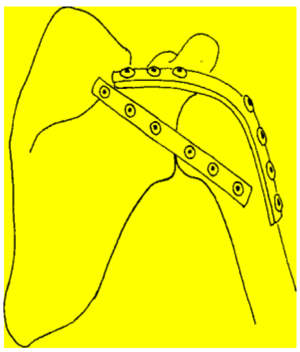
Arthrodesis



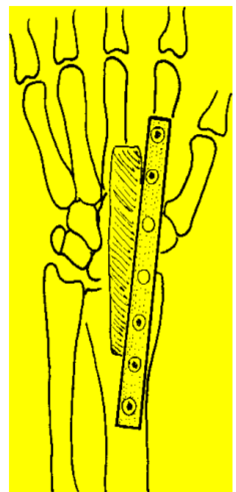
Knee



Pantalar



Shoulder



Wrist

purpose and allows for immediate full weight- bearing.

Also, the use of a similar locking nail for a pantalar arthrodesis (combined ankle and subtaloid joints). In the hip and shoulder, extraarticular fixation can be combined with internal fixation. Bone graft from the patient's own iliac crest is often used as an additional stabiliser.

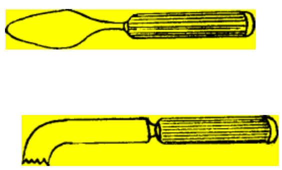
The advantage of a successful arthrodesis is that the joint is quite painless and strong. It is therefore particularly valuable for the knee, ankle, subtalar joints and toes, as well as the wrist or smaller joints such as the interphalangeal joints of the fingers.

The disadvantages include both lack of movement and strain on the neighbouring joints. This is particularly seen in arthrodesis of the hip where additional strain is placed on the lumbar and thoracic regions of the spine, often resulting in low back pain. Arthrodesis of the hip is therefore an operation for some young patients and is seldom indicated in middle aged or elderly patients, particularly those with pre- existing back problems.

Rehabilitation

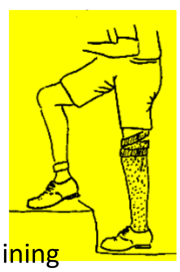
Rehabilitation, both at home and at work, for severe chronic orthopaedic conditions is important, particularly if the patient has residual stiffness, pain or deformity of a major joint. Physiotherapy is essential for most patients with stiff and painful joints (already discussed). It may include heat and massage, but more importantly, active and occasionally passive exercises. Walking on soft sand in bare feet is good for the patient following ankle and foot operations, while cycling on an exercise bike may be indicated following hip, knee and back operations. Swimming in a heated

Rehabilitation

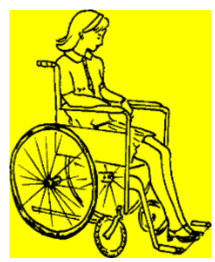


Modified food utensils

Artificial limb

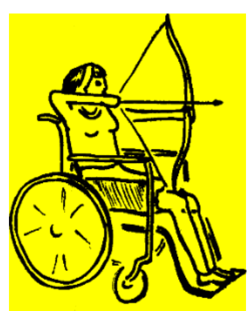


Gait retraining



Wheelchair

Early re-employment



Recreation

benches together with adjustments and attachments to machines.

Adaptations to assist in the activities of daily living, especially in patients with amputations, paralysis and severe RA, may include combs and sponges with handles, towels with loops, baths with seats, and supports in the lavatory. Special attachments to eating utensils such as rubber handles on spoons and forks, are also available.

The social rehabilitation of patients with severe deformities is also important as these patients may otherwise become housebound, introspective and depressed.

Mobility for the severely disabled is particularly important. In addition to wheelchairs, cars with special hands controls and automatic gears are available, thus enabling these patients to leave their homes. The severely disabled, if given assistance in improving their home/work environment, are particularly reliable workers. In many countries the law requires large companies to employ disabled people as up to 3% of their staff. It is essential that this is actually enforced.

Section II

Specific Orthopaedic Conditions

Chapter 7

Congenital and Paediatric

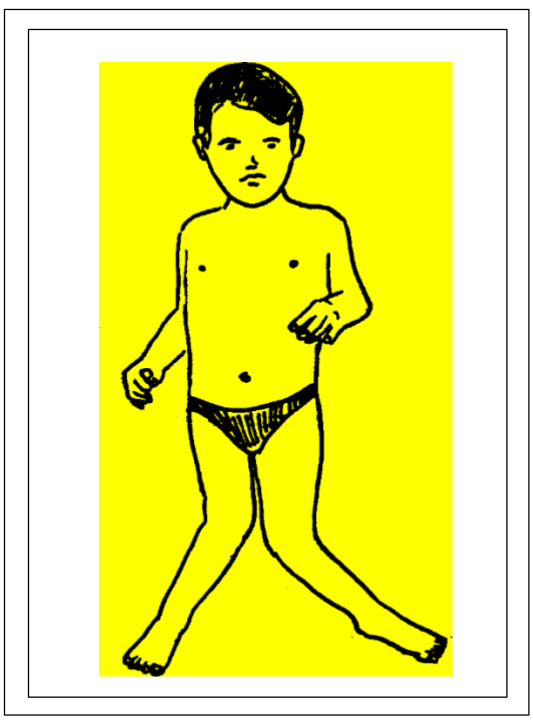
Conditions

Generalised abnormalities

Upper limb

Spine

Lower limb



Classification

Generalised abnormalities

Achondroplasia

Osteogenesis

Imperfecta, OI*

Arthrogryposis

Still's disease

Hurler's syndrome

Diaphyseal aclasis

Hypothyroidism

Upper limb

Limb deficiencies

Macromelia and macrodactyly

Trigger fingers

Syndactyly

Lobster claw hand

Absent

Extra digits

Trunk

Spina bifida and meningomyelocele

Scoliosis

Kyphos and kyphosis

Lower limb

Whole Limb

Phocomelia

Macrodactyly

Hip

Congenital dislocation

*Slipped epiphysis

Perthes' disease

Transient synovitis

Septic arthritis

Coxa vara and valga

Protrusio acetabuli

Knee

Genu varum and valgum

Genu recurvatum

Osteochondritis

Congenital webbing

Ankle and foot

Talipes equino varus

Talipes calcaneo valgus

Pes cavus

Pes planus

Metatarsus adductus

Osteochondritis or avascular necrosis Exostoses

Accessory bones

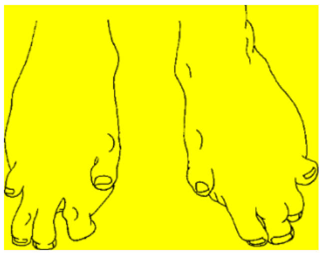
Syndactyly

opposite limb must always be examined. It may show a similar deformity, which is usually painless, with no evidence that the abnormality is acquired such as operation scars. All gradations of spina bifida including a meningomyelocele must also be looked for. Besides skeletal abnormalities, there may be other congenital abnormalities and thus a full examination should always be carried out. Other family members may show similar abnormalities or give a classic history which in most cases simplifies the diagnosis. Relatively common non-orthopaedic abnormalities include: cleft lip and palate, Down's syndrome, cardiac abnormalities such as tetralogy of Fallot (which produces a boot shaped heart) and abdominal visceral abnormalities such as pyloric stenosis.

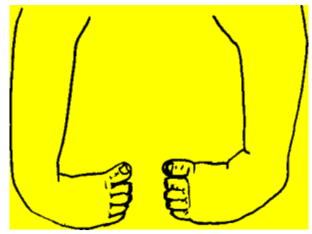
UPDATE, 2022.Congenital hand conditions include-radial clubhand (associated with TAR syndrome, Holt-Oram syndrome, VACTERL syndrome, Fanconi anaemia,) ulnar clubhand, cleft hand, radioulnar synostosis, Clinodactyly, camptodactyly, Flexed thumb, Arthrogryposis, Duplication (preaxial and postaxial), Syndactyly, Macrodactyly, Thumb hypoplasia, Madelung deformity.

Diagnosis

Orthopaedic anomalies

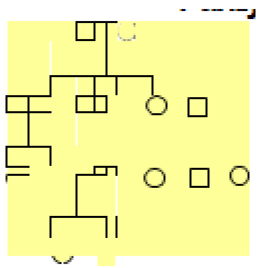


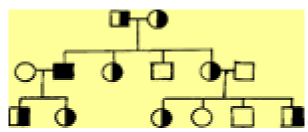
Microdactyly



Talipes equino varus

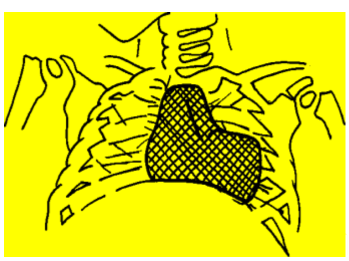
Family history



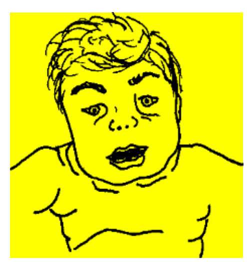


Autosomal recessive disorder

Non-orthopaedic anomalies



X-ray of a 'boot heart'



Facial features — Hurler's syndrome

Generalised Abnormalities

Achondroplasia

Achondroplasia is a congenital condition with an autosomal dominant pattern of inheritance, but approximately 80% of cases arise from anew gene mutation. The main disability is due to a failure of normal ossification of the long bones which are consequently much shorter than normal. The trunk, however, is little affected although spinal stenosis, thoracic kyphosis and an excessive lumbar lordosis are commonly found. This may produce severe neurological sequelae such as spinal cord compression and even quadriplegia.

The hands are broad, quite divergent, and the middle three fingers of equal length.

The head is slightly larger than normal with a depressed nasal bridge and bulging forehead. There is, however, no mental impairment and many achondroplastic dwarfs find gainful employment. Achondroplastic dwarfs are seldom taller than 125 cm.

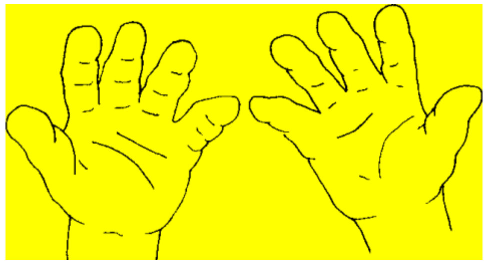
Treatment

The complications of achondroplasia include degenerative joint disease, especially OA of the hips, which may require joint replacement. Nerve compression and

Generalised Abnormalities

Achondroplasia

Achondroplastic dwarf - may occasionally require crutches as paresis or paralysis may result from spinal stenosis



Hands of an achrondroplastic dwarf

paralysis due to the spinal stenosis may require laminectomy and decompression occasionally extending for the entire length of the spine.

Osteogenesis imperfecta (Fragilitas ossium)

(Humpty Dumpty, the nursery rhyme, read the words, it is a good description of the condition).

Osteogenesis imperfecta is usually inherited as an autosomal dominant trait. As a result of defective collagen synthesis, the bones are abnormally brittle and multiple fractures are common.

Other collagen-containing tissues such as the tendons, ligaments, skin, teeth and sclerae of the eyes may also be affected.

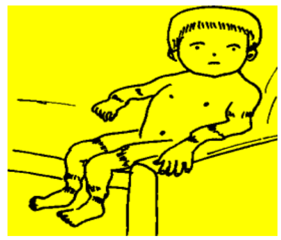
All gradations occur, from multiple fractures at birth to less severe forms where the child does not develop fractures until later in life. The sclerae, especially in the late-manifesting or 'tarda' cases, maybe blue due to lack of opaque collagen with resulting translucency to the choroid. There may also be deafness due to otosclerosis and ligamentous laxity in the chain of ossicles.

As a result of these often multiple fractures, the limbs and trunk may be deformed and shortened. Fractures should be treated by the standard methods and usually heal satisfactorily. The remaining multiple deformities, however, especially of the femur, may require internal fixation including intra-medullary nailing, to straighten them.

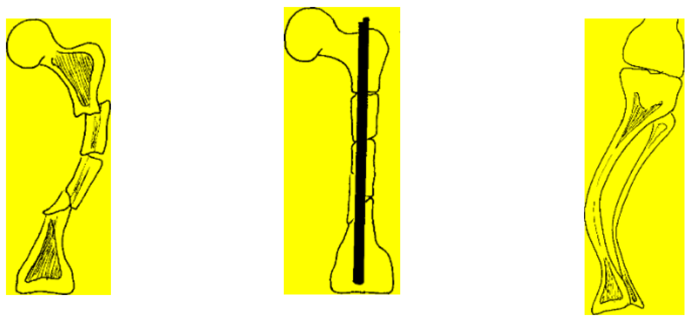
In severe cases calipers, spinal braces, and other supports required.

Generalised Abnormalities

Osteogenesis Imperfecta*



Child with osteogenous imperfect showing limbs with multiple deformities



X-ray of a deformed tibia

Blue sclerae in types I and II. Basilar invagination in severe cases. Bisphonates reduce incidence of fractures.

Arthrogryposis

This is due to collagen replacement of muscles surrounding joints and there are often multiple flexion contractures with thickened joint capsules and severe deformities which may lead to dislocation of the joints and very severe deformities.

Still's disease

This is RA occurring in childhood and mainly affecting the peripheral joints. There are often systemic manifestations with an enlarged spleen and liver together with growth disturbances due to epiphyseal damage. The condition is discussed in Chapter 10.

Hurler's syndrome

This is a congenital condition with multiple deformities, mental disturbance and symmetrical dwarfism with limbs and trunk equally affected. It is due to a rare muco-polysaccharide disorder.

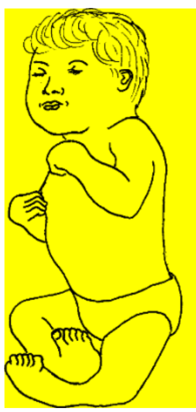
Diaphyseal aclasis

Multiple osteochondromata occur and these may occasionally develop into chondrosarcomata. This is discussed further in Chapter 8.

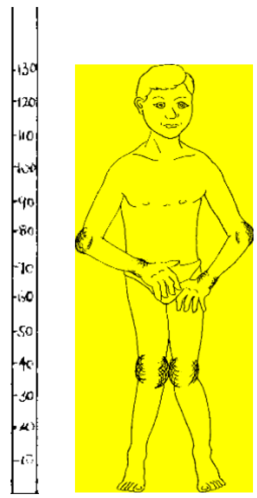
Other tumours

These are discussed in Chapter 8.

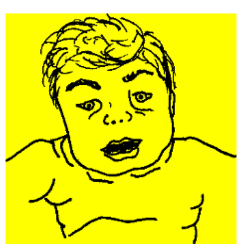
Generalised Abnormalities



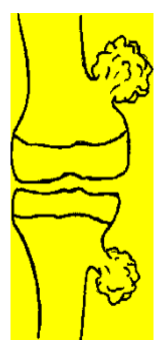
Arthrogryposis multiplex congenital



Still's disease



Hurler's syndrome



X-ray of diaphyseal aclasis

Upper Limb Conditions

Limb deficiencies

Deficiencies of the limbs may vary from complete absence (amelia) to partial absence (phocomelia). Every gradation may occur and only one limb or all four limbs may be affected, or even absent.

There may be absence of one or more bones on the medial and lateral aspects of the arm or leg and this may lead to deformities such as a Madelung's deformity (radial deviation of both hands) due to a short or absent radius or varus of both feet due to absent tibia. Often the digits on the side of the absent long bone are also deficient or absent.

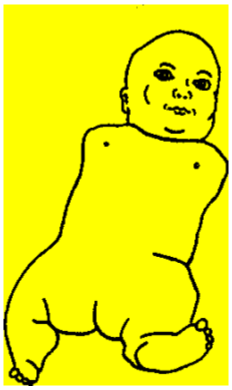
The cause of limb differences is usually drugs such as thalidomide in the first trimester of pregnancy. Other causes include irradiation, rubella, true genetic abnormalities or unknown aetiological factors.

Macromelia and macrodactyly

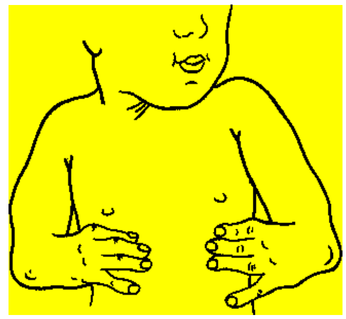
Overgrowth of the limb may also occur. It may be due to a true genetic abnormality when individual digits may have overgrown (usually three digits), or may involve the whole limb. In the latter case, congenital lymphangiectasis may be responsible.

Upper Limb Conditions

Drugs and irradiation



Amelia



Madelung's deformity

Idiopathic conditions

Macrodactyly

Macromelia

Trigger thumb and little finger

A contracture of the fibrous flexor sheath of the thumb or little finger may occur. This is usually symmetrical and affects either both thumbs or both little fingers. The digit is may be held in fixed flexion or they may permit 'triggering' or 'snapping' into ex-tension due to a secondary nodule on the tendon suddenly being released from the constricted flexor sheath like a tight cork in a bottle

Syndactyly

Syndactyly is fusion of one or more digits. It may affect all the digits together, or, more commonly, pairs of digits such as index and middle finger together or with the ring and little finger fused. The limbs are usually, but not always, symmetrically affected.

Lobster claw hand

This is different in that there is lack of fusion with usually only two digits creating a claw-like deformity as illustrated.

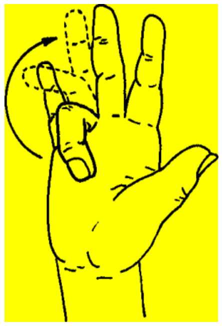
Absent or extra digits

Digits may be absent or an extra digit may be present as a small appendage. In the latter case amputation is usually indicated.

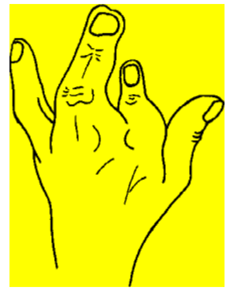
UPDATE,2022. It is as important to perform as amputation (consider to be a reconstructive procedure as an alternative to salvage) as carefully as any other operation. The metabolic cost of walking is increased, esp for proximal amputations. Common complications of lower limb amputations are-phantom limb sensation, pain (somatic and neuropathic), oedema, jnt contractures, skin problems. Such problems can be quite disabling. , rigid post-op dressings are important. Technical considerations are important-secure transected muscles to each other or to bone, bury transected nerves, rigid post-op dressings are important.

Orthoses are used to control body motion of body parts (e.g. Knee or wrist brace) for unstable joints, substitute for deficits.

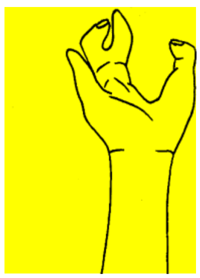
Upper Limb Conditions



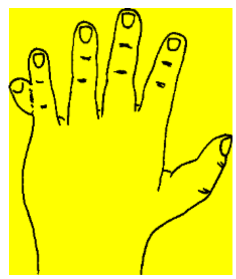
Trigger finger



Syndactyly



Lobster claw hand



Extra digit

Other developmental upper limb deformities

These are discussed elsewhere and may be part of a generalised developmental abnormality. They include the short upper limbs and spade-like 'chubby' fingers in achondroplasia, the long spider-like fingers with loose joints in Marfan's syndrome*, as well as craniocleidodysostosis, a condition where there is absence of membrane bones of the skull and clavicles. Also included are multiple osteochondromata of diaphyseal aclasis, and various types of bony fusion such as a synostosis between radius and ulna, or between the ulna and the humerus.

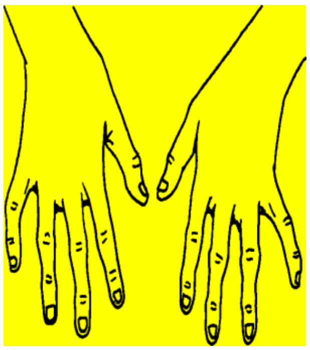
General treatment

The aim, in treating these deformities, should be to maintain function rather than achieve a cosmetic result. Many patients, despite the deformities, have surprisingly good function and this must not be destroyed just to improve the appearance.

Artificial limbs specially tailored to the individual deformity have a real place, but many patients do not use these prostheses unless they are fitted in early childhood.

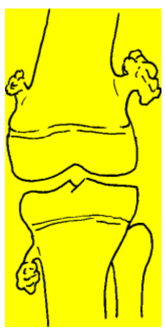
*Marfans, defect in fibrillin-1 (FBN1). Autosomal dominant, pectus deformities, scoliosis, acetabular protrusion.

Treatment



Arachnodactyly

Craniocleidodysostosis



X-ray of multiple osteochondromata

X-ray of radio-ulnar synostosis

Spinal Conditions

These are discussed in more detail in Chapter11. The four most significant deformities are:

Spina bifida (myelodysplasia) and meningomyelocele*

This is a defect usually in the lower lumbar spine which may vary from being a small asymptomatic mal fusion of the posterior parts of the vertebrae to a complete protrusion of the cord and the nerve roots, as in a meningomyelocele. In the latter case paralysis of the bladder and lower limbs and an associated hydrocephalus is common.

Scoliosis

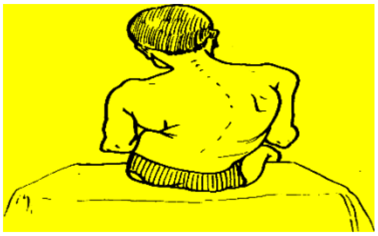
A lateral curvature of the spine and its causes vary from a congenital hemivertebra to paralysis, as occurs in conditions such as polio, but in many cases it is of unknown aetiology.

Unequal limb lengths will produce a scoliosis which is compensated for when the patient sits down or bends forward.

Kyphosis and kyphos

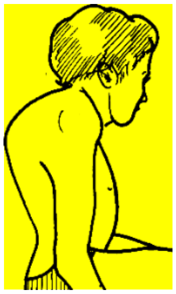
A kyphosis- a smooth forward curve of the spine, while a kyphos is an abrupt curve. A kyphosis may be due to Scheuermann's disease (an osteochondritis of the intervertebral disc spaces which mainly affects the thoracic vertebrae) or to paralysis. Kyphos usually due to a fracture, infection or a secondary tumour of the spine.

Spinal Conditions



Spina bifida

Scoliosis



*UPDATE, 2022, Spina bifida-lowest function level is L4 (quadricep function with some ambulation, L5has good prognosis for independent walking with bracing.

Myelomeningocoele seen with folate deficiency in utero and ahigh prevalence of IgE-mediated latex allergy. Can have hip flexion and adduction contractures, hip dislocations; knee quadriceps weakness; foot and ankle-calcaneal deformity, valgus, rigid clubfoot and spine problems-kyphosis, scoliosis, pelvic obliquity.

probably mainly genetically determined.

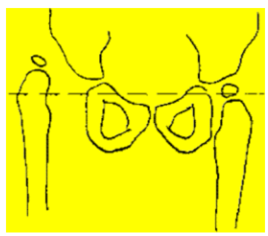
The main defects which appear in untreated cases are an upwardly dislocated hip, a poorly formed, sloping acetabulum (instead of the normal 600 shelf) and an ante-verted and poorly formed neck and head of femur (greater than the usual 350 anteversion).

Every infant must be examined for dislocation or subluxation at birth. If CDH is present there will be limitation of abduction in flexion, usually with the ability to reduce the hip with a click (Ortolani's test- elevation & abduction of femur relocates a dislocated hip; Barlow's test - adduction & depression of femur dislocates a dislocatable hip). Telescoping of the hip, shortening of the

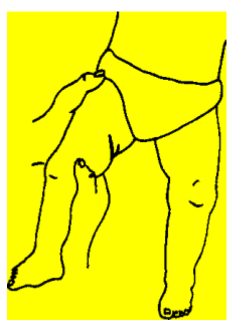
Lower Limb Conditions

Congenital dislocation of the hip

(Easily missed; and will prove disaster for child with waddling gait and early OA).



Asymmetrical skin folds X-ray of CDH



Hip telescoping

Congenital and Paediatric Conditions

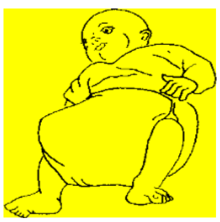
In many cases, however, an infolding 'limbus' of capsule prevents concentric reduction, necessitating open reduction if splinting fails. A persistent anteversion of the head and neck of the femur may require external rotation osteotomy of the upper femur with plate fixation. Open reduction of the hip and excision of the limbus is sometimes necessary.

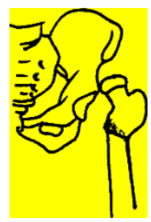
Between the ages of six months and six years, if these methods fail and the head is incompletely covered by an adequate acetabulum, various methods may be used to improve joint function and stability. These include innominate (Salter) osteotomy, or various other methods to increase the stability of the acetabulum including fashioning a shelf of bone or displacement of the ilium above the acetabulum. Up to the age of twelve years open reduction should also be considered but above this age the alternatives are no treatment, an osteotomy of the upper femur to give stability (Schantz) or in adult life a cementless THR.

Slipped capital femoral epiphysis Slipping of the femoral epiphysis is usually seen between the ages of 10 and 15. This is caused by an imbalance between sex and growth

Lower Limb Conditions

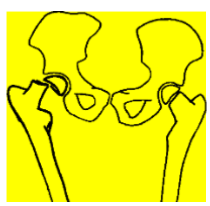
Congenital dislocation of the hip(DDH)





Abduction pillow (Pavlik harness new born). Goal is to achieve and maintain

Slipped epiphysis



XR of SUFE

Pain, referred will be in knee with normal knee

XR BUT look at hip xray as hip externally rotates with flexion.

Perthes'disease (Legg-Calve-Perthes)

Perthes' disease (Legg-Calve-Perthes) Perthes' disease is an osteochondritis of the femoral capital epiphysis and is due to disturbance of the blood supply to the femoral head. Children usually present between the ages of 5 and 10. The onset tends to be gradual and the patient complains of mild pain in the hip and walks with a limp. There is no constitutional upset, blood investigations are normal and examination of the hip shows slight limitation of all movements.

The cause is unknown but may be due to trauma at a critical stage of growth. A similar condition occurs in sickle cell anaemia.

Diagnosis is confirmed on X-ray which may not show any abnormalities in the earliest stages. Initially there is flattening and decrease in the depth of the epiphysis which becomes denser and fragmented. Nuclear scanning will show deficient uptake in the ossific nucleus of the head.

The head gradually revascularises over a period of two years but the head and neck usually remain permanently flattened and deformed in severe cases.

Treatment should aim to contain the softened femoral head in the acetabulum and prevent full weight-bearing in the early stages. Initially the child should be ad-mitted to hospital and treated with skin traction in abduction. As soon as the pain has settled this is replaced by an abduction walking frame with gradually increasing weight-bearing.

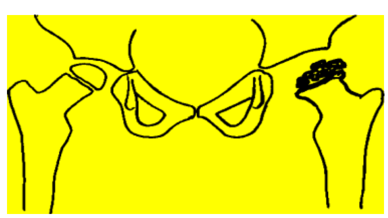
Severe cases are later complicated by OA and may require THR.

Transient synovitis

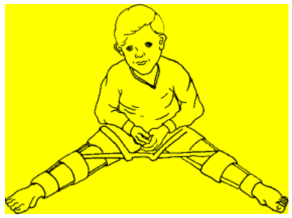
Not uncommon in the first 10 years of life. Acute or insidious onset. Complaints of severe hip pain with the hip flexed, initially abducted then

Lower Limb Conditions

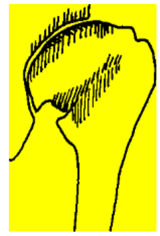
Perthes' Disease (Legg-Calve Perthes)



X-ray of unilateral Perthes' disease



Abduction splint



X-ray of old Perthes

Adducted/externally rotated. X-rays and white cell count are initially normal with a normal or <20mm/hr. Try bed rest, NSAIDs, shoulder improve 24- 48 hrs. ?Viral, allergy or trauma cause.

MUST EXCLUDE INFECTION. Other DD is a low grade infection (TB or Perthes').

Septic arthritis

An infective arthritis in childhood is a surgical emergency as it can lead to destruction of the head of the femur and osteomyelitis of the upper femoral shaft. (Old name- Tom Smith's disease). Usually staph.

The ESR,CRP and WBC up, child usually pyrexic, ill and in severe pain. X-rays are normal in the early stages. Joint aspiration with culture and surgical drainage are urgently required, together with intravenous antibiotics after blood for culture has been taken. See Kocher criteria below.

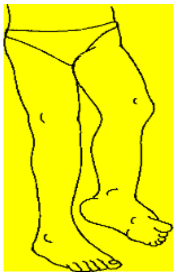
Coxa vara and valga and protrusio acetabuli

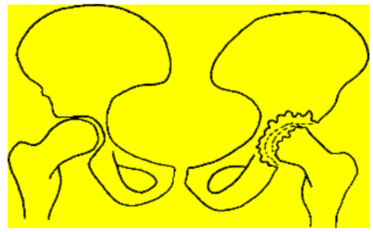
Coxa vara and valga refer to a decrease and increase respectively in the angle between the head and neck of the femur and its shaft. Protrusio acetabuli is an extension of the acetabular fossa into the true pelvis, which limits movement at the hip joint. A mild degree of coxa vara and valga is common. A severe degree may be genetically determined and is usually bilateral. Asymmetrical coxa valga is often associated with a paralysed hip such as in polio and spina bifida. Other causes include fractures of the neck of the femur.

A protrusio acetabuli, when the hip is deep in the acetabulum, may lead to later OA, as may a very shallow acetabulum.

Hip Conditions

Transient synovitis*Infective arthritis



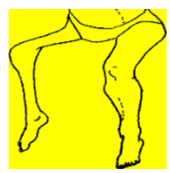


Flexed externally rotated and abducted

X-ray of the destruction of acetabulum and femoral head

Coxa vara

Coxa valga



X-ray of OA*Transient synovitis, 2022, apply Kocher criteria to exclude septic arthritis where 3 of 4 of the following apply- WBC > 12,000 cells/microL, ESR > 40mm/hr, cannot WB, temp.> 38.6 C.

NB-Joints prone to spread from local osteomyelitis-intra- articular metaphyses such as the hip, elbow, shoulder and ankle

Knee conditions

Genu varum and genu valgum

Knock knees and bow legs are common in child-hood and are often familial if unassociated with poliomyelitis, injury or bone disease, they usually improve without treatment after the age of 3. Occasionally corrective osteotomy is required at the age of 12–14 or stapling epiphysiodesis of the tibial and femoral epiphyses at about 10 years to stop epiphyseal growth on the contralateral side.

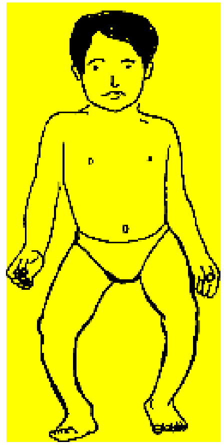
Congenital genu recurvatum

This is usually due to increased intra- amniotic pressure and excessive oestrogens at the time of birth. Immobilisation in a padded plaster, in as much flexion as possible for three weeks will usually effect a cure. Occasionally this condition is associated with arthrogryposis or with fibrotic and tight quadriceps and these conditions are difficult to treat and will usually require operation.

Osteochondritis

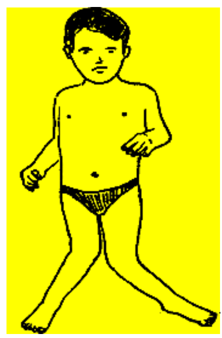
A painful knee, particularly between the ages of 10 – 15 years may be due to an osteochondritis of the femoral condyles and is classically seen on the lateral side of the medial femoral condyle. There is often a softened circular segment of cartilage which may become detached, together with its underlying bone, to form a loose body in the knee joint. If rest and support fail to secure its attachment and revascularisation at an early stage of the condition, operation with drilling or pinning may be required and occasionally excision of a loose fragment.

Knee Conditions



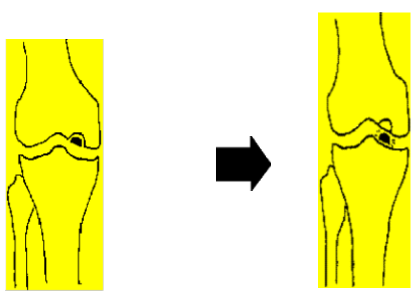
Genu varum ('bow legs')

Abnormal genuvarum called Blount disease seen aged 0-4 yrs and in adolescence (metaphyseal-diaphyseal angle >16 degrees) mild - brace; severe - need surgery.

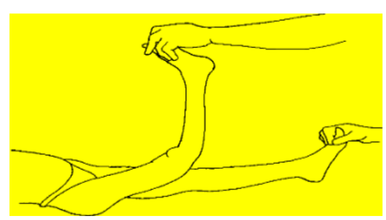


Genu valgum ('knock knees')

Surgery when >10 cm between medial malleoli or >15 degrees valgus at age >10yrs.



X-ray of osteochondritis



Genu recurvatum

Ankle and foot conditions*

Talipes equino varus, Clubfoot

This is usually a congenital deformity present at birth, sometimes with a family history and may be unilateral or bilateral. The foot is pointed downwards and inwards, and has normal sensation and initially normal power.

Occasionally it is associated with spina bifida when both sensation and power may be diminished, and the spine must be inspected in all cases, the neurological conditions, such as poliomyelitis and arthrogryposis. And genetic (PITX1-TBX4 transcriptional pathway).

Treatment should be started ASAP with weekly passive stretching and strap- ping, followed by plaster of Paris or splints after manipulation (Ponsetti casting). Subsequent treatment may necessitate soft tissue correction and later a bony operation.

Talipes calcaneo valgus, TCV

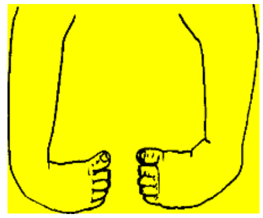
This is the opposite deformity to equino varus and the foot is dorsiflexed and evert-ed. It is usually caused by intrauterine pressure on the foetus and most cases are easily corrected by passive stretching, strapping and plaster. Occasionally there is a true genetic abnormality due to a congenital vertical talus or spina bifida and this is more difficult to treat. Poliomyelitis may cause a calcaneo valgus deformity due to muscle imbalance.

Pes cavus

A clawing of the longitudinal arch of the foot often associated with clawing of the toes. Mild cases are sometimes idiopathic and familial. Other cases(67%)-neuro- logical conditions such as spina bifida, peroneal muscular atrophy, Friedreich's ataxia, polio, vascular insufficiency, CP.

Do MRI of spine. Use block test to evaluate.

Ankle and Foot Conditions



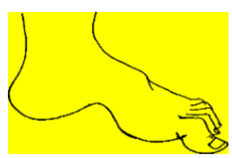
Talipes equino varus

CAVE-cavus, adduction of forefoot, varus of hind foot, equinus. Also, this is sequence of correction with Ponsetti casting +/- Achilles tenotomy.

Associated with absence/diminution anterior tibial artery.

Talipes calcaneo valgus

Associated with posteromedial bowing of tibia and leg length deficiency (latter may require surgery).



Pes cavus ('clawfoot')

UPDATE, 2022, Tibial bowing, Posteromedial-is physiologic, often with LLD, corrects spontaneously, with TCV,

Pes planus ('flat foot')

may need lengthening; Anteromedial-with fibular hemimelia and ankle problems and severe LLD, skin dimpling, linked to sonic hedgehog gene; Anterolateral-with congenital tibial pseudoarthrosis of tibia.

In severe cases callosities develop under the forefoot and toes and necessitate special footwear and occasionally soft tissue or bony correction.

Pes Planus, flatfeet

A common condition with the medial border of the foot in contact with the ground and foot everted. Often a family history. It may also be associated with a short tendocalcaneus with the valgus flat foot compensating for limitation of dorsiflexion. Also ligamentous laxity.

The foot is usually mobile and the arch is restored when the patient stands on the toes. It may occasionally be rigid, and the cause may be a congenital calcaneo-navicular or other subtaloid bony bar leading to peroneal spasm and a spastic flat foot.

Mobile flat feet seldom require treatment except for an occasional small raise on the inner side of the heel or an arch support. Spastic flat feet sometimes require a subtaloid arthrodesis.

Metatarsus Adductus

A congenital deformity with the forefoot adducted and the child walking with an intoeing gait. It may be limited to the first metatarsal (metatarsus primus varus) in which case the big toe may be pivoted laterally (hallux valgus). Most cases do not require treatment apart from appropriate footwear, passive stretching, and sometimes a small raise on the outer side of the shoe.

Osteochrondritis, AVN

Affects the navicular (Köhlers disease) or head of the second metatarsal (Freiberg’s disease),both are probably due to trauma, with interruption of the blood supply resulting in AVN. Gradual revascularisation, with residual deformity and little disability usually.

UPDATE, 2022. Do a dorsal closed wedge osteotomy of MT head; swings articular surface up in MTP jnt.

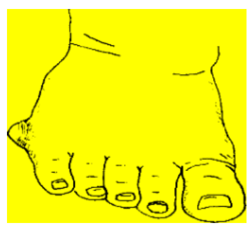
Ankle and Foot Conditions

In-toeing: due to incr. femoral anteversion, internal tibial torsion and metatarsus adductus.

Out-toeing: due to hip external rotation contracture and external tibial torsion.

Metatarsus adductus

X- ray of Freiberg's disease — osteochondritis of 2nd metatarsal head



Exostosis 5th metatarsal head

*UPDATE, 2022.Tarsalcoalition, is a disorder mesenchymal segmentation, Talo calcaneal, TC, and calcaneonavicular ,CN most common. Can be autosomal dominant, pain,

Syndactyly/ overriding 5thtoe.

peroneal spasticity, flatfoot, do CT, may need surgery.

occurs with conservative treatment with rest and perhaps supports.

Exostoses

These are often associated with an overlying bursa and may be due to irritation by footwear. They include the back of the calcaneus, the base or head of the 5th metatarsal (bunionette, Taylor's bunion, causing shoe problems), and dorsum of the metatarsals in cavus feet. The most common site is the medial side of the 1st metatarsal head associated with a hallux valgus.

Accessory bones

These are due to a congenital deformity and are usually asymptomatic. They include the os trigonum (behind the talus; posterior ankle impingement in ballet dancers) and os tibialis externus (the medial side of the navicular). They do not require treatment but are some- times confused with an old fracture.

Syndactyly

This may be variable in extent and implies partial fusion of the web of one or more toes. It is often familial and seldom re- quires treatment.

Other toe deformities

The 5th toe may override/underride the 4th toe. Occasionally the other toes are clawed in the proximal or distal interphalangeal joint. In the latter case there may be an associated neurological abnormality (see above). Severe deformities occasionally require operative correction, but most cases can be treated by padding and shoes.

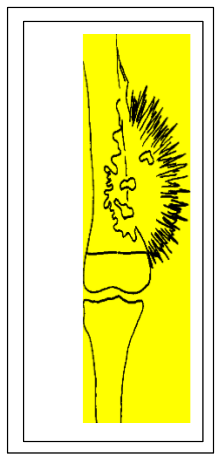
UPDATE, 2022, Sesamoids, foot, tibial and fibular, in the FHB tendon, under 1st MTP jnt. Can fracture/dislocate or be sprained (Turf toe, where forced dorsiflexion of 1st MTP jnt with foot in equinus, plantar plate injury). Don't excise BOTH sesamoids, only partial sesamoidectomy.

Chapter 8

Musculoskeletal Neoplasms*

Benign neoplasms

Malignant neoplasms



*RLH was world famous for his surgical oncology/tumour work, that is why there is a large section in this boo BUT remember you may only come across one malignant primary neoplasm in your career but many metastases.

273 **Musculoskeletal Neoplasms**

Introduction

Musculoskeletal tumours can be divided into:

1.Primary bone tumours

2.Secondary deposits in bone

3.Soft tissue tumours

Primary tumours in bone can be divided, in turn, into benign or those which are localised and will not spread to other parts of the body, and malignant or those which may metastasise or spread elsewhere and cause death. The benign tumours can be subdivided into those which were present at birth and have a genetic link such as multiple osteochondromata and those apparently occurring for the first time after birth.

Primary tumours also have been subdivided into those arising from bone, those from cartilage and those from the bone marrow. There is sometimes an overlap between these origins.

Bone tumours can also be classified according to whether they arise from the medulla (Ewing's sarcoma or multiple myeloma), from the bone itself (osteogenic sarcoma, chondrosarcoma) or from the overlying periosteum (non-ossifying fibroma, periosteal osteogenic sarcoma).

Secondary tumours spread by the blood stream are commonly from breast (nearly half of all secondaries), thyroid, bronchus, kidney, prostate, cervix, ovary, colon or bone but other primary tumours may spread to bone.

Soft tissue tumours may arise from muscle, fibrous tissue, synovia, lymph nodes, nerves, blood vessels, fat and skin.

Diagnosis

The diagnosis of bone tumours is made on clinical and radiological grounds, with other investigations including bone scanning and blood analysis. A benign tumour is usually painless, static in size, with a well-defined edge on X-ray, and 'cold' on bone scanning in the adult. Blood investigations are usually negative. A malignant tumour may be in a classical site, growing rapidly and be hot and painful. It may have classical X-ray appearance such as 'Codman's triangles' and 'sunray spicules' with indistinct margins. It may also infiltrate the soft tissues and be 'hot' on bone scans.

Blood investigations may show a raised alkaline phosphatase, abnormal electrophoretic curve for plasma proteins and possibly other abnormalities.

In secondary bone tumours a known primary site, and the typical appearance of multiple secondaries often helps to make the diagnosis. Trephine or fine needle biopsy may still be necessary for confirmation.

In tumours such as multiple myeloma and other haematological malignancies, additional investigations including a bone marrow biopsy, and sometimes urine analysis for Bence–Jones proteose may be needed.

A final diagnosis may have to rely on a biopsy which is essential in all suspected primary malignant bone tumours.

UPDATE, 2022. Malignant bone tumours - present with pain, metastasize via lung and often to the lungs, osteosarcoma and Ewing commonly metastasize to bone.

Benign Neoplasms Classification

Cartilage

Enchondroma

Ecchondroma

Chondroblastoma

Osteochondroma

Bone

Bone cysts — unilocullated

multiloculated

Osteoma

Osteoid osteoma

Osteoblastoma

Soft tissue

Fibrous tissue

Fibrous dysplasia

Non ossifying fibroma

Fibrous cortical defect

Neurofibroma

Vascular

Eosinophilic granuloma

Aneurysmal bone cyst,

ABC*

Giant cell tumour 'benign'

Haemangioma

UPDATE, 2022.Common tumour-associated genetic associations (Miller et al, 8th Ed., page 702).

-Osteosarcoma-tumour suppressor genes Rb(retinoblastoma) + p53(Li-Fraumeni syndrome).

-Ewings sarcoma-t(11;22),gene product is EWS-FLI1.

-Synovial sarcoma-t(X,18),gene products are SYT-SSX1 + SYT-SSX2.

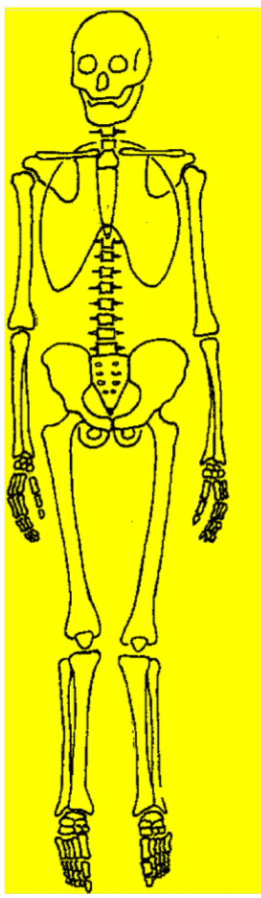
-Myxoid liposarcoma-t(12;16), gene product is FUS-CHOP.

-Alveolar rhabdomyosarcoma-t(2;13),gene product is PAX3- FKHR

-Fibrous dysplasia GNAS

Benign Neoplasms

Common sites of occurrence



1. Enchondroma and ecchondroma
2. Chondroblastoma
3. Osteochondroma
4. Bone cysts
5. Osteoma
6. Osteoid osteoma
7. Osteoblastoma
8. Fibrous dysplasia
9. Non ossifying fibroma and fibrocortical defect
10. Neurofibroma
11. Eosinophilic granuloma
12. Aneurysmal bone cysts*
13. Giant cell tumours
14. Haemangioma

*ABC, UPDATE, 2022. Non-neoplastic, locally aggressive. XR- eccentric, lytic, expansile in metaphysis. Fluid levels on MRI T2images.Curettage,bone grafting. Local recurrence in children.

Benign Cartilaginous Neoplasms

Enchondroma and ecchondroma*

An enchondroma is a benign, congenital cartilaginous tumour which may be present in any bone but is particularly common in the hands and feet. It may expand the bone and have flecks of calcification.

An ecchondroma/periosteal chondroma is similar but expands outside the bone and is mainly confined to the hands and feet.

Enchondromata in the more proximal bones, and especially in the pelvis, may undergo malignant change and develop into chondrosarcomata.

If these tumours are growing or painful they should be excised. If there is any suggestion of neoplastic change, biopsy is essential.

Chondroblastoma

A chondroblastoma is a benign, congenital lesion which is usually present in an epiphysis and classically in the femoral head. It is a small circumscribed area which may have flecks of calcification.

The treatment is curettage and bone grafting if symptomatic, often performed under image intensifier control.

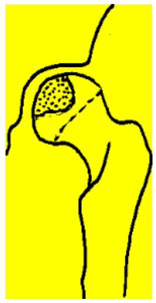
Osteochondroma

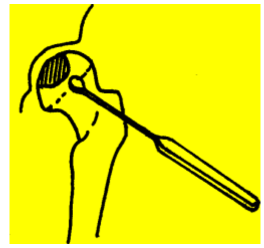
Diaphyseal aclasis is an autosomal dominant, congenital lesion which produces multiple osteochondromata. They arise from the epiphyseal plate and diaphysis and often have a stalk protruding away from the epiphyseal plate with a cauliflower-shaped cartilaginous cap on the end which may have an overlying bursa. In children the unossified radiotranslucent cartilage cap may cause the

Benign Neoplasms

X-ray of an Enchondroma and ecchondroma

Treatment: excision if malignant Or symptomatic – otherwise conservative





X-ray of a chondroblastoma **Treatment: curettage and bone graft**

tumour to look smaller on X-ray than it actually is. Growth disturbances are common at the epiphysis which may be broadened and the limb shortened.

The osteochondroma has a classical appearance on X-ray and, as it is often multiple, other lesions should be looked for. The tumours may press on tendons and ligaments, or may be prominent and therefore liable to be knocked. In 1- 3% of patients the cartilaginous cap may undergo malignant change to a chondrosarcoma(The thickness of the cartilage cap(>2cm) may increase risk of malignancy.

If the lesion is symptomatic or malignant change is suspected it should be excised in its entirety rather than taking an isolated biopsy which may not include the part of the tumour undergoing malignant change.

UPDATE, 2022. Multiple hereditary exostoses is an autosomal dominant disorder, seen in childhood,

with multiple osteochondromas. Mutations found in EXT1, EXT2 & EXT3 gene loci. EXT1 -greater risk

malignancy. In 5-10% a 2nd chondrosarcoma develops(low grade).

Benign Bony Neoplasms

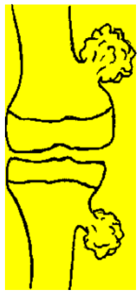
Simple Bone cysts(unicameral)

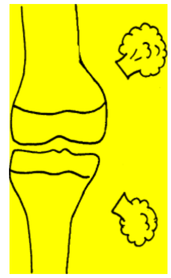
Bone cysts are congenital, benign, unilocular or multilocular defects in the bone and are commonly seen in children. Symmetric cystic expansion. They usually have a lining of fibrous tissue. They commonly occur in long bones such as the femur and tibia and, if large, may fracture. The fracture usually heals satisfactorily and usually results in obliteration of the cyst. This process may take many months or years.

Small bone cysts not in danger of fracturing can usually be kept under observation and may gradually obliterate. Large bone cysts are best treated with injections of hydrocortisone acetate resulting in over 80% resolving. Bone cysts will occasionally require curettage of the lining and bone grafting with

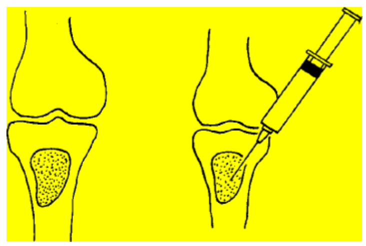
bone, usually from the ipsilateral iliac crest. Compared to ABC-ABC have pain/swelling/eccentric. Bone cysts can first show with Fx and pain. Central and not wider than growth plate.

Benign Neoplasms





X-ray of an osteochondroma **Treatment: excision if symptomatic**



X-ray of a bone cyst Treatment: hydrocortisone injection or excise and bone graft

Osteoid osteoma

A cystic area in a bone which may have a small nidus (similar to that of a chronically infected Brodie's abscess) on X-ray and a hot area on isotope scan. The area is lined by fibrous tissue and classically is most painful at night, with the pain being relieved dramatically by aspirin. May have scoliosis. If the area is larger than 2cm in diameter it is usually called an osteoblastoma. Treatment-NSAIDS, curettage of the lesion, or radiofrequency ablation which usually results in a dramatic cure.

Osteoblastoma

An osteoblastoma is a benign, congenital lesion which is usually present in the metaphysis of a long bone and is often confused with an osteoid osteoma. One differentiation is size and the osteoblastoma is usually larger than 2cm in diameter, and has a punched-out appearance with a clearly demarcated margin. The treatment is curettage and bone grafting if large.

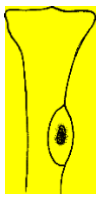
Benign Soft Tissue Neoplasms Fibrous tissue

Fibrous dysplasia

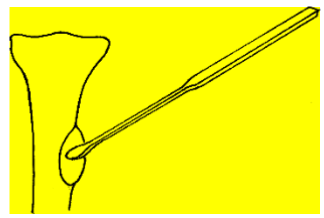
Fibrous dysplasia is a congenital defect and may affect one bone (monostotic fibrous dysplasia) or more than one (polyostotic fibrous dysplasia). X-rays show an expansion of the bone, cystic spaces and increased trabeculae. The areas are usually ‘hot’ on isotope bone scanning and occasionally pathological fractures may occur.

If the areas are large, or pathological fractures occur, they may require curettage, bone grafting and occasionally ORIF.

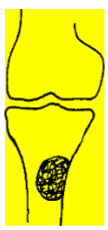
Benign Neoplasms



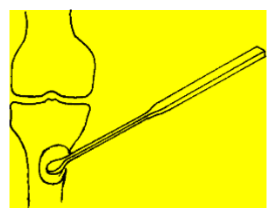
X-ray of an osteoid*



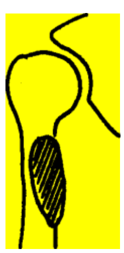
Treatment: curettage and biopsy



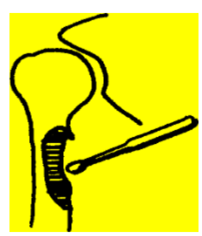
X-ray of an osteoblastoma



Treatment: curettage and bone graft



X-ray of fibrous dysplasia



Treatment: curettage and bone graft if in danger of fracture

*Osteoid osteoma-Central nidus <2mc with ring of lucency +/- scoliosis

Non ossifying fibroma (metaphyseal fibrous cortical defect)

A fibrous cortical defect and a non ossifying fibroma are related defects of the cortex, usually of a long bone such as the femur or tibia occurring in children (30-40%). They usually resolve spontaneously, but if large, may require curettage and bone grafting. Large defects may occasionally cause pathological fracture.

Neurofibromatosis*(often in exams)

A congenital condition, generalised or localised. There may be multiple neurofibromata affecting the spinal, cranial or peripheral nerves. If large may lead to paralysis, chiefly through pressure on the cord in the spinal canal.

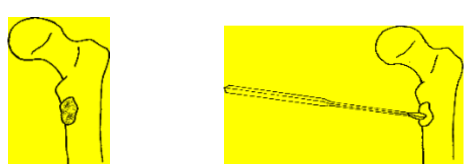
There may be cutaneous neurofibromata and characteristic brown discolouration of the skin known as 'cafe au lait' spots. Other features include scoliosis, limb weakness, overgrowth of a limb or fractures due to infiltration of the mid tibia causing a pseudoarthrosis. In the rare instance of malignant change the neurofibroma starts growing and becomes a fibrosarcoma. Occasionally the sarcomatous change may also occur in the cutaneous fibromata. Investigation- when a complication arises, such as pressure on the spinal cord. In these cases, plain X- ray, CT scanning and MRI may be required before surgical excision of the neurofibroma.*Autosomal dominant, of neurofibromin 1 gene chromosome 17.

UPDATE, 2022. Regarding soft tissue sarcoma: suspect with- enlargement(painless or painful),large >5cm deep to fascia, have low intensity on MRI T1 + high intensity MRI T2,do CT chest to exclude mets., in hand see epitheliod, in foot see synovial sarcoma, lymphatic mets in 5% cases;

Fibrous tissue: extra-abdominal desmoid tumours are "rock- hard"; nodular fasciitis-painful, rapidly growing, excise; undifferentiated pleomorphic sarcoma (malignant fibrous histiocytoma) most common malignant sarcoma in adults, low signal on T1 + high on T2,wide marginal excision + radiotherapy; fibrosarcoma, similar presentation and treatment.

Benign Neoplasms

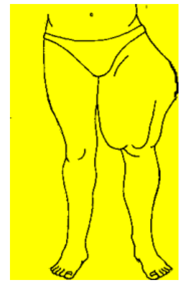
Non-ossifying fibroma



Treatment: curettage, bone graft if complications likely

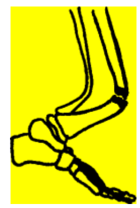
Neurofibromatosis

Multiple neurofibromata



Limb overgrowth

Scoliosis



X-ray of a mid-tibial pseudoarthosis

Eosinophilic granuloma

A congenital, benign lesion of a long bone or the spine; is one of the mucopolysaccharoidoses. May cause a complete collapse of a spine (vertebra plana) or a fracture. May require curettage, bone grafting and ORIF.

Aneurysmal bone cyst

An aneurysmal bone cyst is a benign bone tumour of young adults, usually involving the shaft of a long bone but may affect a vertebra. There is often expansion of the bone which is filled with blood. The bone is weakened and may fracture.

The cyst should be curetted, if accessible, and filled with bone graft if necessary. The bone graft is taken from the ipsilateral iliac crest. Fractures may need stabilisation with plates or nails. Inaccessible tumours such as those involving the spine, or recurrences after surgery, may need low dosage radiotherapy.

'Benign' giant cell tumour

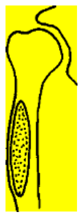
This may present in every gradation from a circumscribed tumour at the epiphysis of a long bone extending to the articular margin, to a highly malignant tumour (described below) extending into the soft tissues.

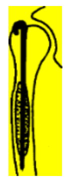
Benign tumours are best treated with excision of non-essential bones or curettage and grafting in essential bones. Liquid nitrogen into the cavity before grafting will diminish the likelihood of recurrence.

UPDATE,2022. Angiosarcoma, associated with Stuart-Treves syndrome as well as cutaneous & lymph node mets (ESARC). Synovial Disorders: PVNS (favourite in exams), usually in the knee, XRs shows cystic changes both sides of the joint, highly vascular villi, hyper plastic synovial cells, haemosiderin-stained, multinucleated giant cells, chr. inflamm cells. Needs synovectomy. Further see page 287.

Benign Neoplasms

Eosinophilic granuloma





Treatment: ORIF after curettage

Benign giant cell tumour

X- ray of a circumscribed giant cell tumour

Synovial sarcoma, knee and foot, spotty mineralization

Treatment: curettage and bone graft on XR, biphasic cells (epithelial + spindle), NB-Sarcomas may spontaneously haemorrhage, BEWARE. -Myositis ossificans, has peripheral mineralization with central lucent area.

Malignant Neoplasms Classification

Primary Neoplasms

Cartilage

Chondrosarcoma

Bone

Cortex

Osteogenic sarcoma

Periosteal and parosteal osteogenic sarcoma

Paget's osteogenic sarcoma

Medulla

"Malignant giant cell tumour"

Ewings sarcoma

Multiple myeloma

Soft tissue

Fibrosarcoma and malignant fibro histiocytoma

Rhabdomyosarcoma

Synoviosarcoma

Basal squamous cell carcinoma and malignant melonoma

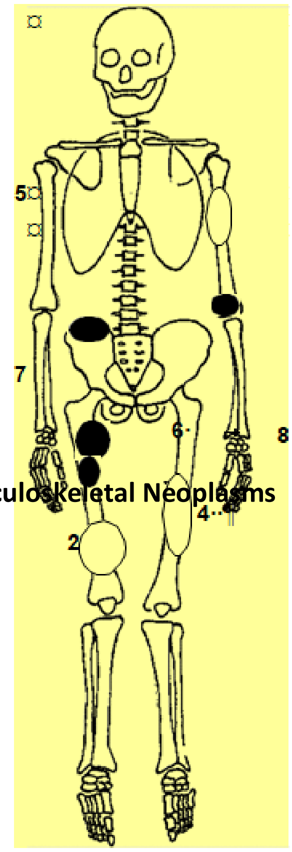
Lipoma

Angiosarcoma

Secondary Neoplasms

Malignant Neoplasms

Common sites of occurrence



1. Chondrosarcoma
2. Osteogenic sarcoma
3. Giant cell tumour4. Ewing’s sarcoma
5. Multiple myeloma
6. Malignant fibrohistiocytoma
7. Rhabdomyosarcoma
8. Synoviosarcoma

Malignant Cartilaginous Neoplasms

Chondrosarcoma

Chondrosarcoma can be primary or secondary to an osteochondroma, enchondroma or ecchondroma. They usually occur in the shafts of long bones, the pelvis (most common site) or the scapula, but may occasionally occur in the hands and feet where they are usually secondary to an enchondroma.

Diagnosis (difficult, cannot base on histology alone) and must include the clinical history, a previous benign tumour plus a gradually increasing bony mass which is usually tender and warm. X-rays show a tumour, usually with expansion of the bone, indefinite edges with or without specks of

calcification. Bone scanning will show an area of increased uptake. Confirmation of the diagnosis requires biopsy. Histology will show cartilage cells with mitotic figures. In slow growing tumours the clinical history of increased growth may be necessary to confirm the histological diagnosis.

A chondrosarcoma is usually much slower growing than an osteogenic sarcoma and the prognosis is better.

The treatment of a tumour secondary to an osteochondroma is complete local excision. At least 3 cm of normal bone should be excised on each side of the lesion if possible (wide-margin surgical resection). In other tumours resection of bone at least 6 cm clear of the tumour should be aimed for, including the joint itself if necessary. If complete excision is not possible then amputation should be carried out.

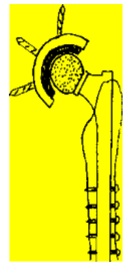
Most tumours are radioresistant. Local palliative resection of isolated pulmonary secondary deposits is often indicated.

Chemotherapy as adjunct for dedifferentiated (the most malignant) and mesenchymal chondrosarcomas. The dedifferentiated type has a biomorphic histological and radiographic appearance.

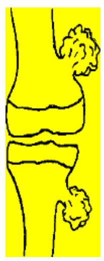
Malignant Neoplasms

Chondrosarcoma

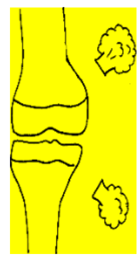
Primary chondrosarcoma of upper femur



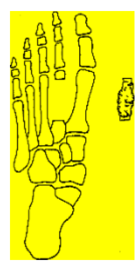
Treatment: excision, ceramic and titanium hip and femur



Chondrosarcoma; secondary to diaphyseal aclasis



Treatment: complete excision



Chondrosarcoma; secondary to enchondroma

Malignant Bone Neoplasms

Cortex

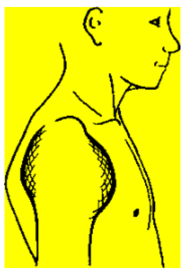
Osteogenic sarcoma

An osteogenic sarcoma is a highly malignant tumour occurring most commonly in the 15-25 year old age group. It may also occur in Paget's disease in old age and as a parosteal osteogenic sarcoma in middle age.

The metaphysis of the upper tibia, lower femur and upper humerus are the most common sites but it may occur at other sites. There is a variable degree of bone, cartilage and fibrous tissue found on pathological examination, and the tumour metastasises via the blood stream to the lungs and other organs. Diagnosis is made by the history of the pain, swelling and warmth, usually in the metaphyseal region of a long bone in a young adult. X-rays show variable degrees of bone destruction and regeneration with elevation of the periosteum (Codman's triangles) and perforation of the tumour through the periosteum (sunray spicules). There is often

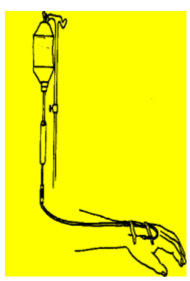
Malignant Neoplasms

Osteogenic Sarcoma



Osteogenic sarcoma

X-ray of an osteogenic sarcoma showing sun-ray spicules and Codman's triangle



Treatment: chemotherapy, followed by amputation, occasionally local excision and bone replacement may be required

X-ray and CT scan of the lungs may show evidence of secondary involvement. Biopsy is essential to confirm the diagnosis.

The present recommended treatment for osteogenic sarcoma is three courses of chemotherapy given at about 3-weekly intervals, followed by amputation at least 6 cm above the highest level of tumour. The chemotherapy is then continued for 1–2 more years. At the time of amputation, the response of the tumour to the preoperative chemotherapy is assessed and this is changed if necessary.

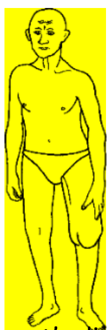
In the case of low-grade osteogenic sarcoma and parosteal osteogenic sarcoma without significant overlying soft tissue involvement, there is a place for resection of the tumour and prosthetic replacement or arthrodesis of the neighbouring joint followed by chemotherapy.

In Paget's disease the prognosis is very poor, but palliative amputation and sometimes radiotherapy is indicated. Palliative chemotherapy and radiotherapy and local re- section of isolated lung secondaries is also sometimes indicated.

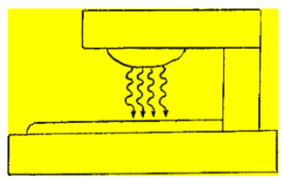
The prognosis in osteogenic sarcoma has been improved with chemotherapy but still has only a 30-50% survival rate compared with 520% before chemotherapy.

Malignant Neoplasms

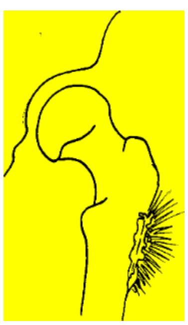
Osteogenic Sarcoma



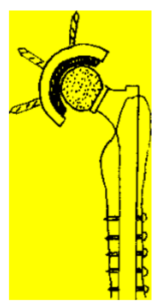
Secondary to Paget's disease



Treatment: deep X-ray therapy & palliative amputation



X-ray of a parosteal sarcoma of upper femur



Treatment: total hip and upper femoral replacement

Medulla

Giant cell tumour, GCT*

A giant cell tumour may present as any grade from benign to malignant. It usually involves the epiphysis of a long bone but occasionally other bones such as the pelvis may be affected. The lower femur and upper tibia are the most common sites, and most tumours extend to the joint margin but not beyond.

The tumour usually has clear-cut margins and often expands the bone. In the malignant varieties the margins may become indistinct and there may be fractures and considerable expansion into the surrounding soft tissues.

The histopathology shows giant cells and a variable amount of fibrous stroma.

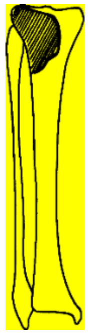
The diagnosis is made on the clinical picture as well as the X-ray appearance which shows an expanded cortex with no new trabeculae. Bone scans usually show a 'cold' tumour with surrounding hyperaemia.

Treatment should be excision if possible. Alternatively extensive curettage, together with the use of liquid nitrogen to destroy any cells remaining in the cavity, will be required. The residual cavity should then be filled with cancellous bone graft. In the case of a 'malignant' giant cell tumour with considerable soft tissue involvement, or with an inaccessible surgical site or following a recurrence, there is a place for deep X-ray

UPDATE, 2022.Notochordal soft tissue tumours-chordoma, malignant, arises from primitive notochordal tissue, in sacrococcygeal region or sphenooccipital regions, CT shows midline bony mass.

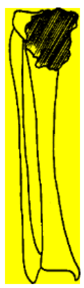
Malignant Neoplasms

Giant Cell Tumour

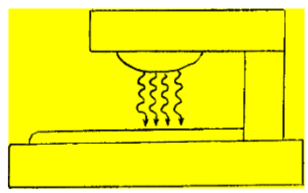


X-ray of a 'benign' giant cell tumour: extends to articular surface with well defined margin

Treatment: curettage, liquid nitrogen and bone graft; complete excision if possible



X-ray of a malignant giant cell tumour: Poorly defined margins



Treatment: deep X-ray therapy or amputation

Ewing's sarcoma**

Ewing's sarcoma occurs commonly in children and occasionally in older age groups. It classically involves the shaft of a long bone, especially the femur, tibia and humerus, but may occur elsewhere. It is a tumour arising from lymphocytes in the bone marrow and may resemble secondaries from a neuro-blastoma. Round cell sarcoma. It often metastasizes early and may grow rapidly.

The diagnosis is made by a history of a hot swelling which is tender and may mimic osteomyelitis. There may be rapid growth with a raised ESR and white cell count. Classically the X-ray appearance is elevation of the periosteum, 'onion peeling'.

There may be 'sun-ray spicules' similar to an osteogenic sarcoma but the lesion usually extends more into the diaphysis than the metaphysis. Bone scanning will show 'hot' areas. Biopsy is essential and often shows

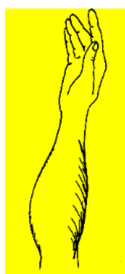
The treatment should be excision, if possible, as well as chemotherapy and radiotherapy if necessary. Amputation may occasionally be required. Metastases go to the lung(50%), bone(25%) and bone marrow (20%).

The prognosis has been markedly improved with chemotherapy such that the 5 year survival rate is now 70–80%. **Classic 11:22 chromosomal translocation produces the EWS-FLII fusion gene. Biopsy shows round blue cells with minimal cytoplasm

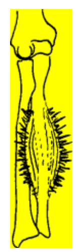
UPDATE, 2022. Adamantinoma-is a rare tumour seen in anterior cortex tibial diaphysis, needs wide -margin surgical excision.

Malignant Neoplasms

Ewing's Sarcoma

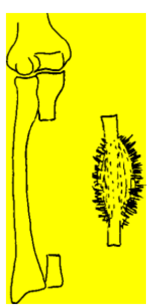


Ewing's sarcoma

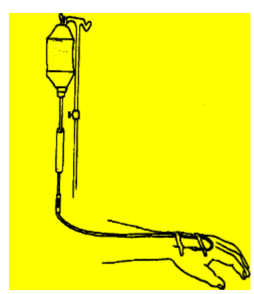


X-ray of an Ewing's sarcoma showing onion peeling and spicules

Treatment



Excision



Chemotherapy or radiotherapy

Myeloma**

(Solitary (better prognosis), multiple myeloma, osteosclerotic (rare)

This is a tumour of the bone marrow in adults with considerable numbers of plasma cells present on biopsy. It may be solitary but most cases are multiple with deposits in the skull, vertebrae and other bones.

The diagnosis is made on a general systemic upset accompanied by multiple tender areas and Sometimes pathological fractures. There may also be severe backpain due to spinal secondaries and sometimes paraplegia.

Radiological diagnosis depends on the presence of classic 'punched-out' areas in bone plus a bone marrow biopsy or tumour showing the characteristic plasma cells. The serum proteins usually show a reversed albumin/globulin ratio on electrophoresis.

The urine in 40% of cases shows Bence Jones protein (proteins which cause cloudiness on heating that disappear on boiling).

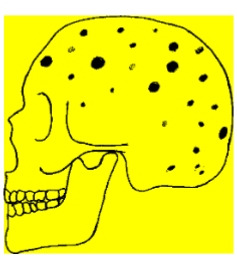
The treatment is chemotherapy and radiotherapy if necessary. Pathological fractures will usually require internal stabilisation but the bone may be extremely vascular and bleed profusely.

UPDATE,2022.*GCT basic histo. Is round/ oval spindle-shaped nucleus and the multinucleated giant cells. The stromal malignant cells produce RANKL (receptor activator for nuclear factor kappa B ligand). The giant cells express RANK and are responsible for the osteolytic aspect of GCT. Also new drug, Prolia, a human monoclonal antibody that binds RANKL, thereby inhibiting the maturation of osteoclasts.

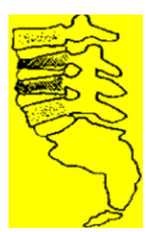
**Multiple myeloma. Always in exams-History of bone pain, hypercalcaemia, typical x ray changes(punched-out lytic lesions), elevated globulin levels and in urine (light- chains of IGs G and A. Histology shows sheets plasma cells, monoclonal. Well-differentiated cells have eccentric nuclei with peripherally clumped. chromatic "clock faces".

Malignant Neoplasms Multiple Myeloma

X-ray appearance

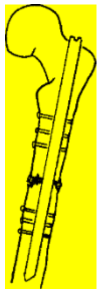
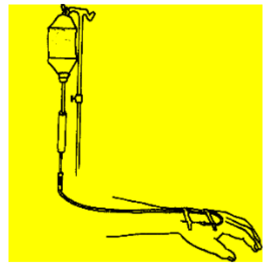


Skull showing 'punched-out' areas



Spine: collapsed vertebrae with normal discs

Treatment

ORIF pathological fractures Chemotherapy and radiotherapy

Neoplasms

Soft tissue tumours may involve only the soft tissues themselves or may be adherent to or even erode into the underlying bone or joint.

Fibroma, fibrous dysplasia and malignant fibrohistiocytoma

A benign fibroma radiologically appears as a cleanly punched-out bone defect (fibrous cortical defect or non-ossifying fibroma). Fibrous dysplasia may show extensive involvement of one or more long bones with expansion and cyst formation and possible fractures. Caused by genetic activating mutation of GS alpha surface protein causing incr. production cAMP. This is present at birth and is called monostotic (one bone) or polyostotic (more than one bone, less common but more symptoms) fibrous dysplasia. “Ground glass” appearance on X-ray. Histology-“alphabet soup” and “Chinese letters”. McCune-Albright syndrome (polyostotic with endocrinopathy, café au lait spots/precocious puberty). Osteofibrous dysplasia is similar but in children < 10 yrs. in the tibia.

Malignant fibrohistiocytoma may involve any bone or the fibrous tissue overlying bone. Radical excision, including the in- volved bone, is usually possible with re- placement, otherwise amputation may be necessary. Occasionally the tumours will respond to radiotherapy or chemotherapy.

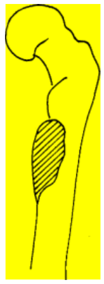
Rhabdomyosarcoma

Most common sarcoma in children. Is translocation of chromosome 2&13,the gene product is PAX3-FKHR. This is a malignant tumour of skeletal muscles which requires radical excision. It responds to radiotherapy and chemotherapy, but the prognosis is usually poor.

Synoviosarcoma

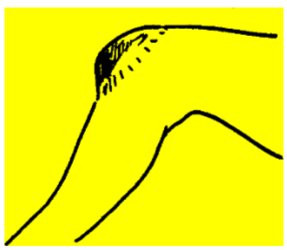
A benign tumour of synovial tissue is known as a synovioma. Malignant change is known as a synoviosarcoma coma which often metastasises early. It requires radical excision and often deep X-ray and chemotherapy.

Malignant Neoplasms



X-ray of a fibrohistiocytoma of proximal Femur

Treatment: excision followed by hip and femoral replacement



Synoviosarcoma

Rhabdomyosarcoma of biceps brachii (Leiomyosarcoma - same imaging & treatment)

Basal and squamous cell carcinomata

Basal cell carcinoma (BCC) of the skin seldom metastasises but may erode locally, eventually infiltrating and destroying the underlying bone. Squamous cell carcinoma (SCC) and melanoma may not only infiltrate the under-lying structures but may metastasise.

Liposarcoma

These are common and seldom become malignant. Occasionally malignant change occurs producing a liposarcoma which shows rapid growth and requires radical excision. Occasionally these may occur in the medulla of along bone and expand the cortex.

Angiosarcoma

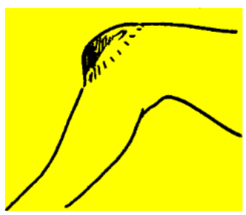
These are usually benign capillary or arteriolar malformations. They may involve a vertebra and produce the classical radiological appearance of trabeculae.

An angiosarcoma is a malignant tumour which on X-ray may show areas of calcification. It requires radical excision and sometimes amputation.

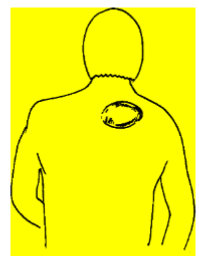
Neurofibrosarcoma

These can be single or multiple, as in neurofibromatosis. Neurological deficit may result from pressure on the spinal cord or peripheral nerves. Malignant change is rare and results in a fibro sarcoma. Treatment varies from decompression to radical excision and even amputation.

Malignant Neoplasms



Squamous cell carcinoma



Liposarcoma

Angiosarcoma

Neurofibrosarcoma

Secondary Neoplasms*

Secondary tumours usually arise following blood borne spread from a carcinoma, or occasionally sarcoma elsewhere in the body. Secondaries from carcinoma of the breast ac- count for nearly 50% of metastases. Other common tumours to metastasise to bone include: lung, thyroid, kidney, prostate, cervix and ovary. These may produce multiple deposits, as do multiple myeloma and the leukaemias.

These tumours metastasise mainly to the red marrow areas such as the spine, ribs, pelvis, femur and humerus. Secondaries distal to the elbow and knee are relatively uncommon. Metastases are usually multiple but may be solitary, especially secondaries from the thyroid and kidney, both of which are highly vascular, as are myeloma deposits.

Most secondaries are osteolytic and usually cause punched-out areas, but those from prostate and about 10% of breast secondaries are osteosclerotic. Pathological fractures are common and collapse of vertebrae may occur with paraplegia and quadriplegia.

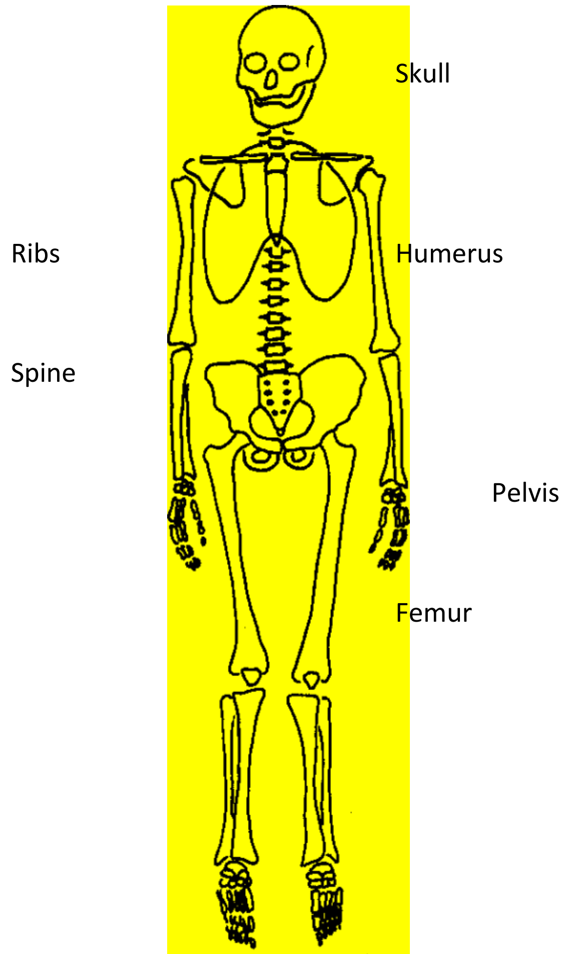
The diagnosis is made on a history of a primary tumour plus an area of tenderness, pain and perhaps fracture at the site of the metastatic deposit. Many cases, however, first present with a painful area or pathological fracture, and it is only then that a primary tumour is suspected and looked for.

Radiology will usually confirm the diagnosis, especially if the existence of a primary tumour is already known. If there is any doubt, a trephine biopsy is carried out but before an anaesthetic or operation is considered a skeletal survey and isotope bone scan should be carried out. The minimum requirements are PA and lateral views of the chest, lateral

*UPDATE, 2022.Esp > 50 yrs age with a destructive bone lesion, identify the primary, 85% cases, do biopsy, usually from prostate/thyroid/breast/lung/kidney typically epithelial cells in fibrous stroma, bone destruction from osteoclasts (tumour secretes PTHrP, stimulates RANKL release with activation of osteoclasts.

Secondary Neoplasms

Common sites for metastases



views of the cervical and lumbar spines, and AP views of pelvis and both humeri and femora. This is important as bones with a potential for pathological fractures may be discovered and prophylactic pinning considered. Knowledge of cervical spine involvement will also help an anaesthetist avoid damage to the cord during intubation if an operative procedure is required. Lateral as well as AP views must be taken of all bones known to be involved.

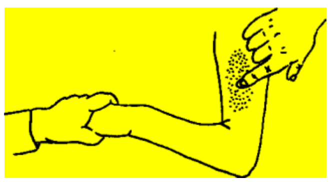
A bone scan is useful and may show multiple 'hot' areas which do not show up on X-ray. Occasionally a CT or MRI scan or tomogram may be helpful to assess the extent of the lesion.

Additional useful investigations include an alkaline phosphatase level which is often raised in the presence of secondary deposits, and an acid phosphatase level, which may be elevated in carcinoma of the prostate. The measurement of serum calcium and phosphorus is important, as hypercalcaemia is common in multiple secondary deposits and is a potentially lethal complication following surgery. Itis therefore essential that all patients should have a normal serum calcium before an anaesthetic is given.

A reversed albumin/globulin ratio is seen in multiple myeloma and bone marrow biopsy may be helpful in the diagnosis of myeloma and leukaemia. A full blood count and blood film are important.

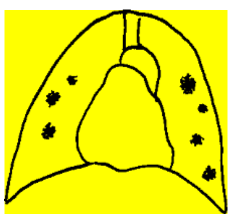
Secondary Neoplasms

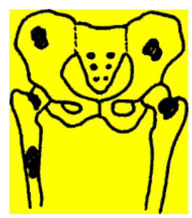
Diagnosis



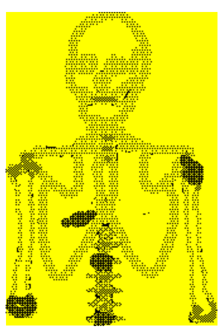
Area of tenderness

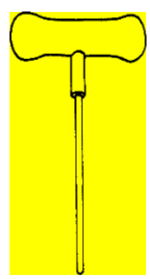
X-ray of a pathological fracture





X-ray of secondary deposits





Bones scan

A trephine biopsy can usually be carried out with a needle, but is better done with a 2 or 3 mm bone trephine under image intensifier control. Occasionally an open biopsy is indicated.

Treatment should aim at stabilisation before a fracture has occurred, with early mobilisation of the patient. The appropriate general treatment is usually local radio- therapy, plus hormones, such as tamoxifen for breast secondaries and chemotherapy for multiple myeloma , renal and other secondaries. Stabilisation of the spine, lower humerus, radius, ulna, lower femur and tibia before a fracture has occurred, is usually by the use of a brace or skelecast. Metastases to the pelvis require radiotherapy and those to the acetabulum require skin traction and non- weight bearing mobilisation on crutches. Potential and actual fractures of the shaft of the humerus and femur are best treated with prophylactic and therapeutic internal fixation, together with methyl methacrylate cement to give extra stability if necessary. This must always be followed by radiotherapy to the area as well as hormones and chemo-therapy if indicated.

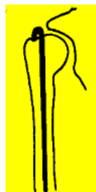
Secondary deposits with vertebral collapse should normally be treated with a brace and radiotherapy. If there is associated paraplegia this should be treated as a surgical emergency with decompression and stabilization.

In summary, the management of potential and actual pathological fractures aims to stabilise the fracture by the simplest method, enabling the patient to be mobile and return home or to a nursing home as soon as possible after the appropriate radiotherapy and chemotherapy.

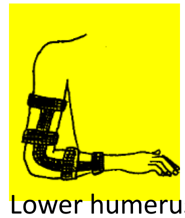
Secondary Neoplasms

Treatment

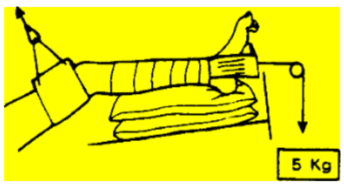
Upper limb and spine



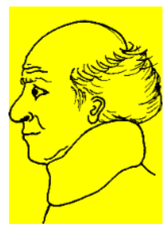
X-ray of Rush nail(great implant)



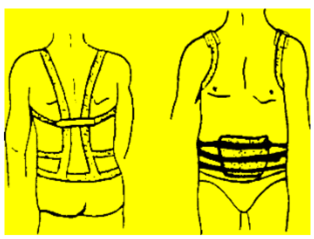
Lower humerus skelecast



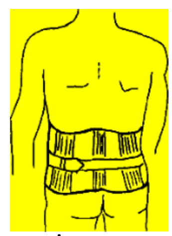
Acetabulum: Russell traction



Cervical spine —neck collar



Thoracic spine: Taylor brace



Lumbar spine support

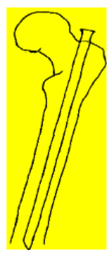
Secondary Neoplasms

Treatment

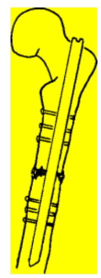
Lower limb

Hip blade plate and cement

Total cemented hip replacement



Küntscher nail Huckstep



Titanium locking nail

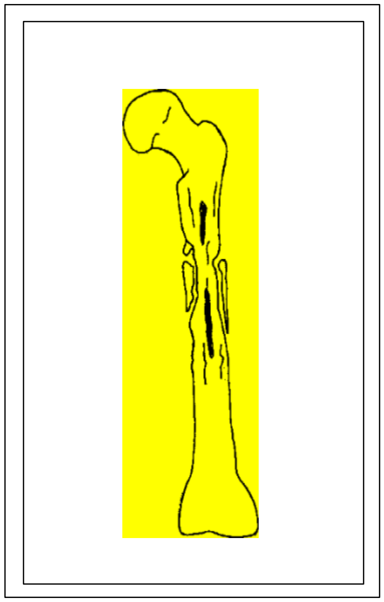
Chapter 9

Infection

Osteomyelitis

Pyogenic arthritis

Tuberculosis (TB)



Classification

Osteomyelitis

Acute

Diagnosis

Treatment

Conservative

Medical

Operative

Subacute or chronic

Diagnosis

Treatment

Medical

Operative

Treatment for non-essential bones

Treatment for essential bones

Pyogenic arthritis

Diagnosis

Treatment

Tuberculosis

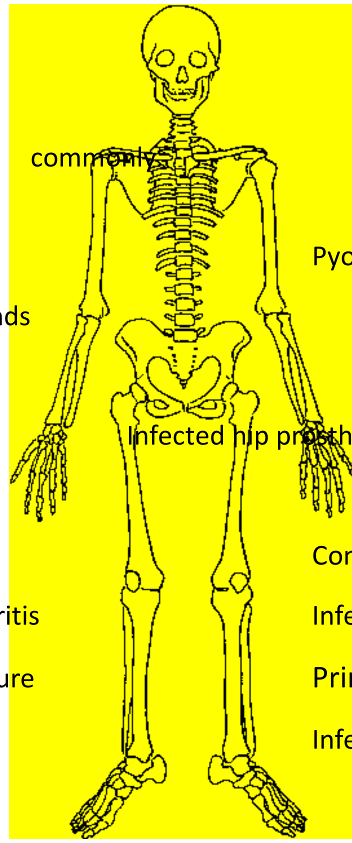
Clinical features Investigations

Treatment

Complications

Musculoskeletal Infection

Common sites of occurrence



315 **Infection**

Osteomyelitis*

Primary osteomyelitis, or infection of the bone, is usually caused by a pyogenic organism. It is commonly due to blood-borne spread in a patient with a lowered resistance and an associated bacteraemia or pyaemia.

Damage to the bone by a closed injury, resulting in an overlying local haematoma, may sometimes be a precipitating cause, but many patients do not give a history of previous trauma.

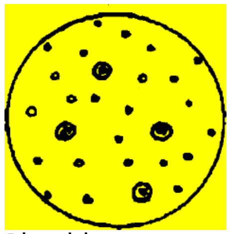
In certain tropical and sub-tropical countries sickle cell anaemia may cause massive thrombosis of the arterioles supplying the whole diaphysis of a bone with subsequent blood borne infection. This may cause extensive osteomyelitis involving several bones at the same time.

Secondary osteomyelitis, which is more common than primary osteomyelitis may be due to an open wound down to the overlying bone, a compound fracture or postoperative infection.

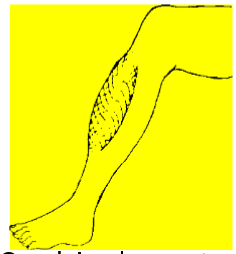
Acute and chronic osteomyelitis is still common in most developing countries of the world. In Europe, North America, Australia and other affluent societies acute primary osteomyelitis is seen less frequently and more often starts as a subacute or chronic disease.

The clinical picture of osteomyelitis varies in different age groups, and this is partly due to the differing vascular patterns of bone in infants, children and adults. In infants the epiphyses are primarily damaged, in children the shafts of long bones, while in adults the joints are usually involved as well.

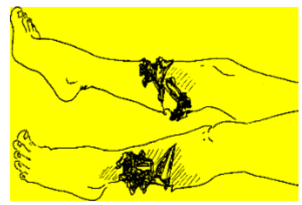
Osteomyelitis — Causes



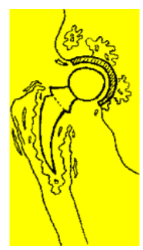
Blood-borne spread



Overlying haematoma



Sickle cell anaemia



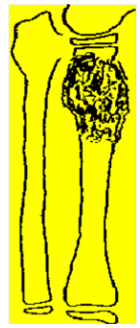
Compound fracture

X-ray of an infected prosthesis

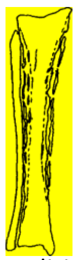
in the non sickler. Classically, evidence of acute osteomyelitis does not show radio logically until two to three weeks after the onset of symptoms, but X-ray changes may be seen much earlier. Blood cultures should always be performed and pus cultured following needle aspiration. Percutaneous aspiration should be carried out if open operation is delayed and there is a large collection of pus under tension. Stool culture for salmonellae may also be useful when sickle cell anaemia is a possibility. The white count may sometimes not be raised in salmonella osteomyelitis and low grade pyogenic osteomyelitis. The ESR is raised in acute osteomyelitis and this may be useful in differentiating acute trauma in a young child where the history may not be accurate.

Osteomyelitis

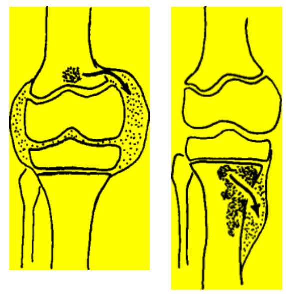
Symptoms and signs: swelling, pain, pyrexia, erythema and lymphadenopathy



X- ray of primary osteomyelitis

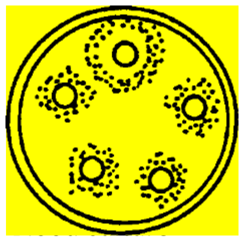


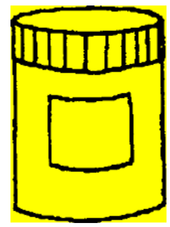
X- ray of osteomyelitis o of the tibia



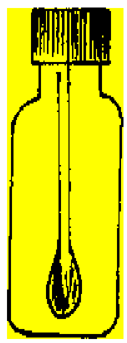
Local spread

Osteomyelitis — Investigations



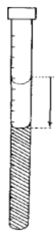


Stool culture if salmonella suspected

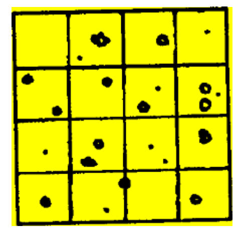


Pus swab in culture media

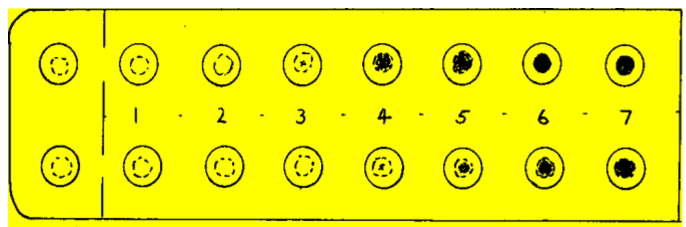
Osteomyelitis —Investigations



ESR



WBC: total and differential counts



Widal and brucella agglutination tests

General treatment

It is essential that treatment be immediate, adequate and uninterrupted for at least one month and usually longer. There are still too many patients who develop chronic osteomyelitis, and its complications, due to a failure to observe this simple principle. There is no justification for deferring treatment until the results of pus or blood cultures become known and if there is doubt as to the diagnosis, prophylactic chemotherapy should be given intravenously in any case. Blood or pus for culture should be taken before chemotherapy is started, but if this is delayed for any reason, treatment must be started.

Conservative treatment

Immobilisation

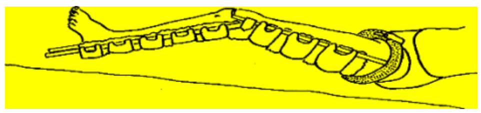
The splinting of an infected bone is essential as pathological fractures are common and the limb must be rested. A well-padded plaster backslab (not complete plaster) or a Thomas splint should be used initially and completed as the swelling subsides. An infected upper limb should be elevated in a sling or abduction splint and the lower limb kept elevated in bed. Infections of the spine will necessitate rest in either a Taylor brace for the upper thoracic region or a lumbar brace for the lower thoracic and lumbar regions. An ordinary plaster jacket is useless for immobilising any part of the spine in a young child. A Minerva, or similar support which prevents flexion and rotation of the cervical spine, and a spica support for the lower spine, may be required.

Medical treatment

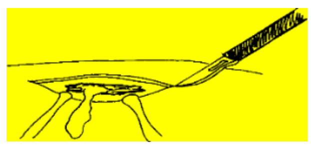
Antibiotic therapy

High dose, intravenous penicillin or cloxacillin given with proben acid is the best empirical therapy until culture results are

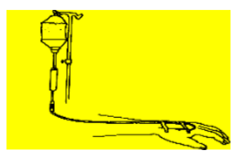
Osteomyelitis — Treatment



Rest and elevation



incision and drainage



IV antibiotics

*UPDATE, 2022,Osteomyelitis in children, because of their rich metaphyseal blood supply and thick periosteum, usually boys, usually s. aureus, less so H. influenzae, MRSA with a PVL gene mutation associated with DVT and septic emboli, associated with trauma, blood-borne seeding of metaphysis, tender painful and inflamed metaphysis, usually febrile, when chronic forms a Brodie abscess, Diagnosis from WBC/ESR/CRP/aspiration/blood cultures/MRI (if available). Use broad-spectrum antibiotics then specific antibiotics, monitor response with clinical picture and falling CRP, if not responding then surgery.

Neisseria gonorrhoeae septic joints, migratory polyarthritis, seen in sexually active young adults.

known, provided there is no history of penicillin allergy.

This combination of drugs should be changed if necessary once the sensitivity of the infecting organisms is known. Cephalothin, and ampicillin after cloxacillin are the most useful drugs at the present time, but other anti-microbial agents may replace these in the future. Chemotherapy should be continued in large doses for at least three weeks followed by smaller doses.

General treatment of the patient is important, and blood transfusion may be required for anaemia, particularly in postoperative osteomyelitis.

Operative treatment

Indications for the aspiration of pus

A large collection of pus will require drain- age, and this is usually best done by incision rather than by aspiration.

Indications for surgery

1. A patient with a definite collection of pus.

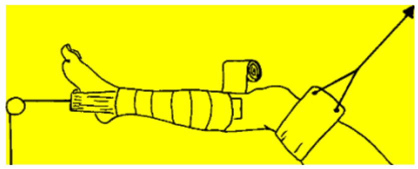
2. A patient in whom intensive conservative treatment and large doses of drugs has not produced either a local or systemic improvement within two days.

3. All patients who are dangerously ill or toxic due to the accumulation of pus under tension.

4. All patients with infection of the upper and lower ends of the femoral or humeral shafts in whom the infection is not rapidly controlled by conservative measures. This is a prophylactic measure against damage to the epiphysis. The metaphyses of these bones are intra-capsular and spread to the epiphysis of the bone tends to be early with epiphyseal destruction.

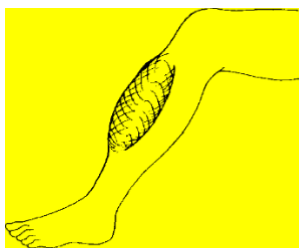
Osteomyelitis —

Indications for Surgery

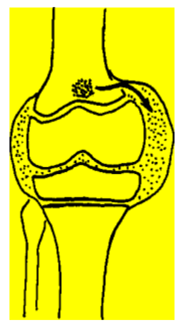


3-5 kg

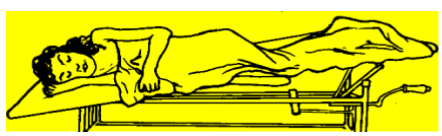
Failed conservative treatment



Collection of pus



X-ray of infection of intra capsular sites



Very ill or toxic patient

Subacute and chronic osteomyelitis

There are many thousands of cases of sub-acute or chronic osteomyelitis due to incomplete treatment of the acute disease or secondary infection of fractures and bone operations. Osteomyelitis may also start as a sub-acute or chronic infection without apparent cause.

Diagnosis

The diagnosis is straightforward, except in certain cases of low grade osteomyelitis, chronic infections of the spine and certain atypical cases. Specific tests which may be helpful are staphylococcal antibody investigations for both the anti-haemolysin and anti leucocidin titres. Sinograms and tomograms may show sequestra and cavities which are not obvious on ordinary X-ray. It should be noted that the white blood count may be normal, the pus collected may be sterile or the organism may be resistant to the usual antibiotics, especially if previous chemotherapy has been given.

General treatment

Rest and splintage is important and has been discussed under acute osteomyelitis. Immobilisation in plaster and treatment as an outpatient with chemotherapy is sometimes a matter of necessity. The patient with long standing osteomyelitis may be anaemic and will often benefit from a blood transfusion.

Medical treatment

Antibiotic therapy

Antibiotics are used as an adjunct to adequate operative treatment. This treatment must be prolonged, never shorter than one month and often of several months' duration. In cases where the organism is resistant to all anti- biotics or the pus proves to be sterile on culture, cloxacillin may be of value after an adequate sequestrectomy or debridement.

Repeated cultures and sensitivities are important and the appropriate antibiotics should be used. The laboratory should be used merely as a guide to the appropriate chemotherapy. Clinical response, side effects, ease of ad- ministration and cost are the main guide- lines as to the appropriate choice of drugs. Antibiotic therapy must be prolonged but most antibiotics have side effects if given for long periods. They also have the disadvantage of having to be given 2–4 times per day. In chronic osteomyelitis avascular bone receives relatively little, or none, of the circulating antibiotic.

Cloxacillin is probably the best antibiotic at the present time, but will probably be superseded in the future.

Operative treatment

This is essential in many cases, but the correct timing and type of operation is important. The surgical management of the various types of subacute and chronic osteomyelitis will be discussed. This treatment is, of course, in addition to adequate chemotherapy, splinting and rest.

Chronic osteomyelitis in a non essential bone

This includes the upper three-quarters of the fibula, the small bones of the hands and feet, the clavicle, some tarsal bones and, in adults, the lower end of the ulna.

In all these bones excision of the focus should be carried out for established infection. Care must be taken, however, in excising part of the fibula in growing children, as a later valgus deformity of the ankle may occur. Implantation of the lower resected end of the fibula into the tibia may prevent this.

Chronic osteomyelitis in essential bones

Sequestra and adequate skin cover.

The following regimen is usually indicated:

1. Sequestrectomy, but only when there is adequate involucrum to stabilise the bone.

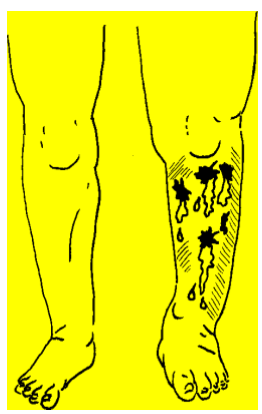
2. Removal of as much involucrum and avascular bone as possible in order to effect a primary skin closure. Dense scar tissue may also harbour infection.

3. Saucerisation, which involves the surgical excision of tissue, in this case bone, thereby forming a shallow depression with the aim of facilitating drainage of the affected area.

4. Secondary or loose closure of the wound.

5.Adequate splinting and postoperative suction drainage.

Chronic Osteomyelitis



Multiple sinuses

X-ray appearance of sequestra, involucrum and cloacae

Pyogenic Arthritis

May be primary or due to blood stream spread from another focus. It is sometimes, but not always, associated with an injury of the joint.

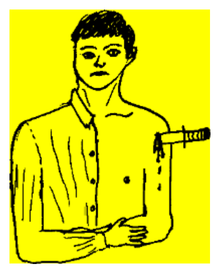
It is commonly secondary either to an osteomyelitis involving bone with an intra capsular metaphysis (upper and lower ends of humerus or femur), or from an over- lying wound which may or may not communicate with the joint.

Diagnosis and treatment

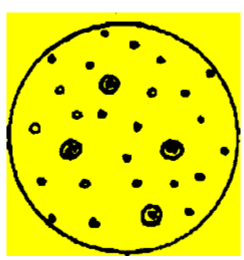
Early diagnosis and pus culture is essential and acute arthritis will necessitate immediate aspiration of pus and an injection of crystalline penicillin or appropriate antibiotics into the joint space. Washing out the joint through an arthroscope may also have a place in treatment. A pressure bandage over cottonwool may also be required. In the case of knees and ankles, Russell traction will be necessary in order to distract and rest the joint for the hip and knee. Other joints will need splinting and rest. Repeated early aspiration, or occasionally operation, may also be indicated. The incision, however, should always be closed after drainage of pus, but there is a place in severe joint involvement for closed joint irrigation and drainage with the appropriate antibiotics, as in osteomyelitis. There is little place for incision and open drainage in most cases as there is with osteomyelitis of the shaft of the bone.

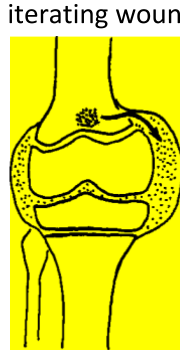
In joint destruction, arthrodesis may be necessary later and occasionally an arthroplasty. In a child this may interfere with growth and should be delayed if possible. Deformities can often be corrected by skin traction alone followed by immobilisation

Pyogenic Arthritis —Causes



X-ray of an infected knee prosthesis iterating wound





Haematogenous spread Secondary osteomyelitis

in POP or plastic splint. The joint may subsequently progress to ankylosis without operation and its position should therefore be as functional as possible when this happens. In the case of severe deformity of the hip, in adults, arthrodesis may be indicated. In children, however, shortening of the limb and recurrence of deformity may occur after operation and this may necessitate a later corrective osteotomy.

This is preferable, to a gross untreated contracture which may cause a strain on other joints, together with a scoliosis or other deformities.

Complications of osteomyelitis and pyogenic arthritis

The treatment-below:

Squamous cell carcinoma

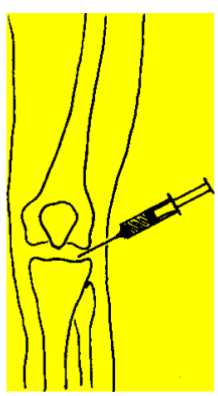
This is uncommon and may only occur after several years of discharge from a chronic sinus. Increased pain, a foul discharge and haemorrhage suggest the onset of malignant change and metastases may spread to the draining lymph nodes. Block dissection of glands, however, should be deferred until all the effects of inflammation have disappeared.

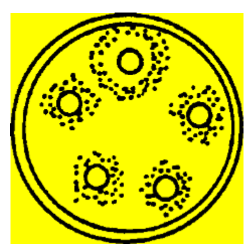
Destruction of upper femoral epiphysis

Thomas Smith, 1874, discussed the first 21 cases of 'septic necrosis' of the epiphysis of the hip joint in infancy. This is a common complication of late untreated and incompletely treated osteomyelitis and arthritis of the hip in babies under the age of one year. In cases treated early the head of the femur may reform. Diagnosis is by aspiration of pus and definitive operative drainage may be urgently required.

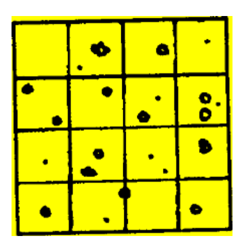
Pyogenic Arthritis

Diagnosis



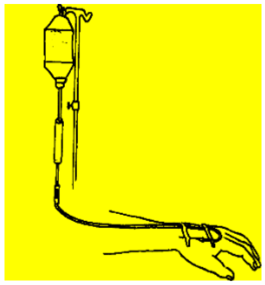


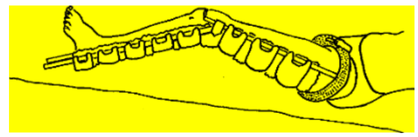
Blood culture



WCC: total and differential counts

Treatment





IV antibiotics — Rest and elevation

In late cases, with disappearance of the femoral head, an arthroplasty may be necessary in adults. In young children implantation of the upper end of the fibula to replace the upper end of the femur may be performed. In an older child an arthrodesis, shelf operation or sub- trochanteric osteotomy may be the best procedure. Many patients, however, do remarkably well with merely a raised boot. Surgery should, therefore, be deferred until growth has ceased, unless there is extensive deformity or an implantation operation is considered. THR may be a good option in the quiescent adult case.

Dislocation of hips

This may occasionally occur instead of destruction of the heads of the femur. Manipulative replacement and sometimes operation, followed by a bilateral hip spica in abduction, is indicated.

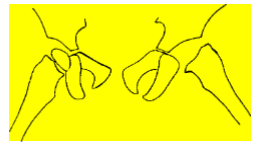
Destruction of the lower femoral epiphysis

This may lead to marked valgus or other deformities of growth and requires corrective osteotomy. Recurrence is likely and later stapling to prevent excessive growth on the growing side of the epiphyseal plate can be performed, although osteotomy is probably the best procedure once growth has ceased.

Conclusions

Early diagnosis and immediate intravenous chemotherapy in large doses for prolonged periods, as well as drainage if indicated, are essential if complications are to be minimised, in both osteomyelitis and pyogenic arthritis

Osteomyelitis and Pyogenic Arthritis Complications



Development of squamous cell

carcinoma in chronic sinus tract

X-ray of a dislocated hip

X-ray of epiphyseal destruction; may produce bone growth abnormalities

Tuberculosis, TB

TB of the bones and joints is usually due to infection by the human strain of TB. It usually spreads from a focus in the lungs, and occasionally from other sites to a joint or the spine, and establishes a chronic infection.

Initially there is a chronic synovitis with considerable synovial thickening. The hip or knee is commonly involved, but any joint can be infected and occasionally the bone itself. Patients who are left untreated progress to erosion of the underlying cartilage with frank caseous (cheese-like) pus, and eventually to destruction of the adjacent bone. Tuberculosis of a joint finally results in fibrous rather than bony ankylosis, unless secondary pyogenic infection is superimposed.

The infection in the spine usually starts at the anterior margins of the vertebrae, adjacent to the disc, with involvement and narrowing of at least one disc and its adjacent vertebrae. Pus can also spread to the adjacent vertebrae along the anterior longitudinal ligament which leads to the collapse of vertebrae and pressure on the spinal cord by necrotic bone or disc tissue.

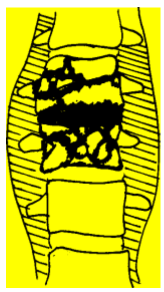
Clinical features

Tuberculosis usually only affects one joint and there is often a long history of swelling with fairly minimal pain. Muscle wasting and synovial thickening are marked and a joint effusion may be present. The joint is usually warm rather than hot and the regional lymph nodes are often involved. The patient often complains of a progressive deformity, sometimes over a period of months or years, with marked limitation of movement, finally resulting in a fibrous union of the joint.

Tuberculosis*

X-ray of hip jointed destruction

X- ray of knee joint destruction



X- ray of knee joint destruction

X- ray of destruction of vertebral bodies and intervertebral discs

*It remains the scourge of the world after 17,000 yrs; in 2020 10M got TB and 1.5M died. The 2nd leading cause of death after covid. Resistant strains are growing. Inhalational phytochemicals may help. Few new drugs on the horizon. Poverty is the disease, TB the symptom (Nature. 16/5/22, Book review, The Phantom Plague: How TB Shaped History, V Krishman).

Investigations

An X-ray may show soft tissue swelling, bone rarefaction and gradual narrowing and destruction of the joint space as the cartilage and bone are involved. The spine will show narrowing of one or more disc spaces with involvement of the adjacent vertebra, an abscess on AP view, and later collapse with production of a kyphos.

The white cell count is usually normal, but the ESR is often raised. The Mantoux test is usually positive and chest X-ray often shows a primary focus in the lungs. Aspiration of joint fluid may show acid fast bacilli and later frank caseous pus. Culture will take three to six weeks and a synovial biopsy may also be necessary.

Treatment

Early treatment includes rest of the joint with a splint, or skin traction if the hip and knee are involved. This should progress to non-weight bearing with crutches. Treatment with anti-tuberculous drugs may be prolonged. At present various combinations of rifampicin, isoniazid, pyrazinamide, pyridoxine, ethambutol and streptomycin are the principle anti-tuberculous drugs in use. If a major joint is destroyed, long term treatment options include arthrodesis, or occasionally an arthroplasty if the disease has been quiescent for at least 1–2 years.

Complications

The major complications are secondary infection following skin breakdown, and joint destruction leading to fibrous ankylosis. Spinal TB may cause paralysis due to vertebral collapse or pressure by pus, bone or disc tissue. This may lead to thrombosis of the vessels supplying the spinal cord. Lumbar vertebral infection may track down the psoas sheath producing a psoas abscess in the groin.

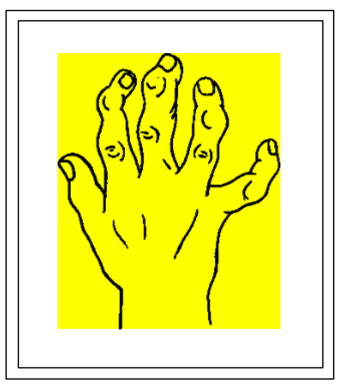
OA

RA

Crystalline arthropathies

Seronegative spondyloarthropathies

Miscellaneous



Classification

OA*

RA**

Still's disease

Crystalline arthropathy

Gout

Pseudogout

Seronegative spondyloarthropathies

Reiter's syndrome

Psoriatic arthropathy

Enteropathic arthritis

Post-infective arthritis

Ankylosing spondylitis

Miscellaneous

Haemophilic arthropathy

Neuropathic arthropathy

Hypertrophic osteoarthropathy

*Is simply a loss of articular cartilage.

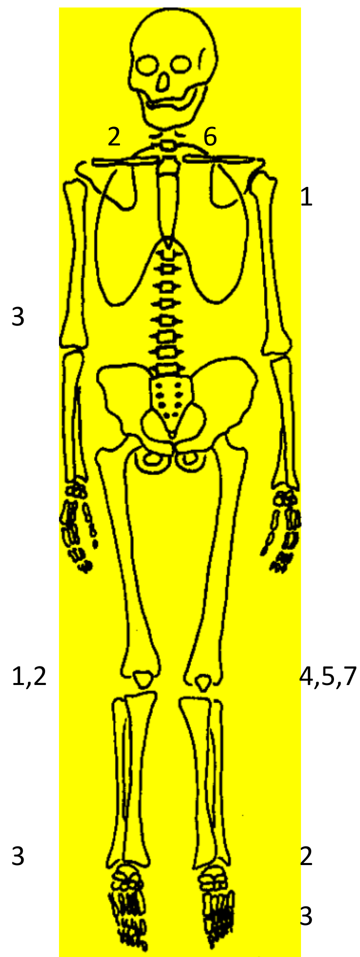
**Is widespread joint synovitis where the joint/capsule and ligaments are destroyed.

UPDATE, 2022. Hand OA, features are: affect joints in this order, DIP/thumb CMC/PIP/MCP .May need arthrodesis or arthroplasty. OA of thumb CMC is common-may need arthrodesis or trapeziectomy with lig. reconstruction.

Hand RA, features are: tendon rupture, ulnar drift at MCPs, swan neck/boutonniere deformities. Vaughan-Jackson syndrome (rupture ext tendons), Mannerfelt syndrome (rupture FPL, index FDP), Caputulnae syndrome (DRUK instability), Rheumatoid wrist (subluxes volarly/ulnarly), Z-deformity. May need synovectomy, tenosynovectomy, arthrodesis, arthroplasty.

Arthritis

Common sites of occurrence



341 **Arthritis**

OA

OA is a degenerative or 'wear and tear' arthritis which is by far the most common of all the arthritides. It may be primary, usually occurring in the elderly and where the cause is unknown, or secondary, where there is a precipitating cause such as injury to the joint, previous infection, RA or a factor dating from childhood such as Perthes' disease, slipped epiphysis or incompletely treated congenital dislocation of the hip.

In secondary OA there is usually irregularity of the congruous joint surfaces leading to rapid degenerative changes.

OA may be classified into an atrophic type, where there is diminution of the joint space with cystic spaces and not much new bone formation, and a sclerotic and hypertrophic type where there is considerable osteophyte and new bone formation. This classification is, however, empiric and there is considerable overlap. Primary OA is much more common in the main weight-bearing joints such as the hip and knee while secondary OA may affect only one joint.

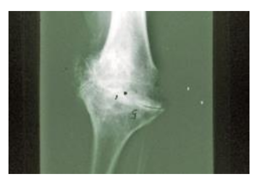
Pathology

The first change in OA is narrowing of the joint space, usually at the site of weight-bearing, as well as irregularity and gradually increasing sclerosis.

This is often followed by eburnation and sclerosis of the underlying bone. There may be cystic spaces under this area due to abnormal pressure transmission. As degeneration continues the rest of the joint will narrow and reactive bone formation results in osteophyte outgrowth at the edges of the joint. The congruous margins of the joint often flatten and become deformed and this

OA — Aetiology

X-ray of OA: increased incidence with age



X-ray OA hip from old Perthes' from childhood. X-ray of OA knee 2nd to an old knee fracture.

is particularly common in the head of the femur and the lower femoral condyles.

Synovial irritation and thickening occurs in OA with excess synovial fluid formed as a result of this synovitis. In advanced cases considerable synovial thickening is common.

Clinical picture

There may be a history of a precipitating condition in childhood such as Perthes' disease or dislocation of the hip. In adult life underlying conditions such as haemophilia, RA meniscal damage or fracture of the patella may all lead to secondary arthritic changes, especially if there has been underlying cartilage damage with incongruity of the joint surface. In many cases no precipitating cause can be found.

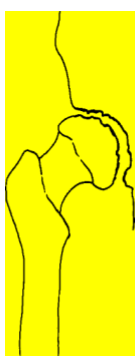
Unlike rheumatoid or infective arthritis, primary OA is usually slow to progress, with increasing pain, and limitation of joint movement often over a period of years. There is no constitutional upset, pyrexia, or acute inflammation with only mild pain at the extremes of movement.

In OA of the knee there is usually a synovial effusion as well as synovial thickening. In the later stage osteo-phytic broadening of the joint margins may occur.

OA commonly only affects a single joint. More than one joint may eventually be affected especially if other joints have been damaged in the case of secondary OA. In primary OA, other joints may also have been subjected to abnormal strain, such as back and knee strain accompanying a deformed, stiff, osteoarthritic hip.

Other joints commonly affected in primary osteo- arthritis, in addition to the hip and knee, include the spine, the metatarso-

OA - Pathology



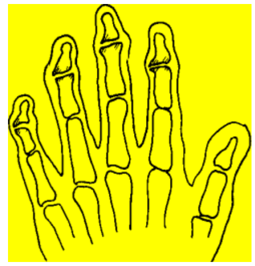
X-ray of degeneration of articular surface

X-ray of loss of joint space and periarticular sclerosis

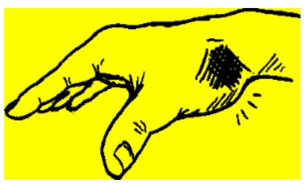
X-ray of severe OA: osteophytes, synovial cysts and cartilage denudation

OA – Upper Limb

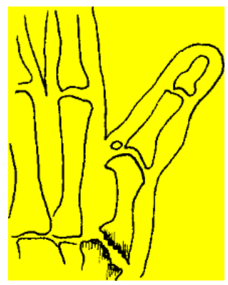
nodes



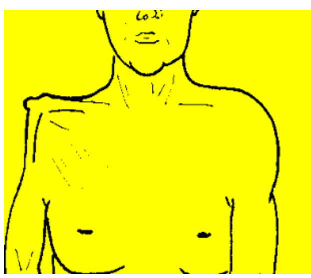
X-ray of Heberden's nodes



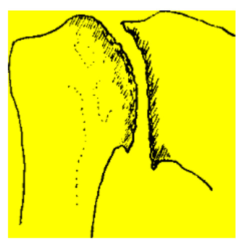
Painful first MCP joint



X-ray of first MCP joint

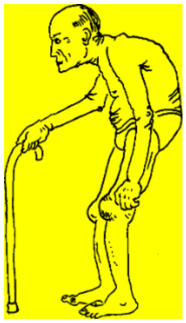


Wasted shoulder



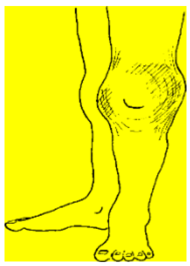
X-ray of OA shoulder

OA – Lower Limb



Arthritic gait

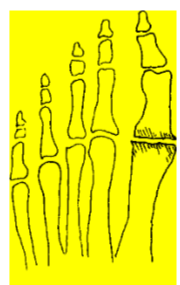
X-ray of OA hip



Swollen knee

X-ray of knee showing osteophytes

First MTP joint



X-ray of 1st MTP joint

phalangeal joints of the big toes, and the metacarpophalangeal and carpometacarpal joints of the thumb. There is often osteophyte formation with hard, slightly tender swellings of the distal interphalangeal joints of the fingers (Heberden's nodes) and much less often hard swellings of the proximal interphalangeal joints (Bouchard's nodes). The small bones, especially the tarsometatarsal joints, may also show osteoarthritic changes.

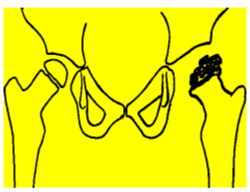
Investigations

Unlike most of the other arthritides, OA does not cause any constitutional disturbance. In addition, all blood tests and other investigations are normal except where the arthritis is secondary to RA, haemophilia or another precipitating cause.

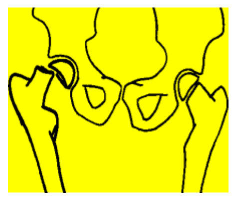
Apart from the classical clinical findings the diagnosis may be confirmed radiologically. Although in the early stages of OA X-rays show only slight narrowing of the joint space, in the later stages severe narrowing of the whole joint space may occur, with sclerosis, cystic spaces and osteophyte formation. The destruction of the bone, particularly of the acetabulum and head of the femur, may be severe, with upward subluxation of the head of the femur. In the hip this is usually associated with a deformity in flexion, adduction and external rotation. Involvement of one side of the joint space more than the other is common in the knee, with a secondary varus or valgus deformity of the tibia or the femur.

X-rays may show that the OA is secondary to an underlying condition such as Perthes' disease, a slipped epiphysis, an avascular femoral head following steroid therapy, a fractured neck of the femur or a dislocated hip.

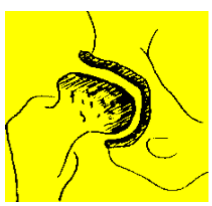
OA — Underlying Conditions



X-ray of Perthes' s disease



X-ray of a slipped femoral capital epiphysis



X-ray of AVN of the femoral head.

Staged using the modified Ficat system (includes symptoms, XRs, bone scan and MRI)

Conservative treatment

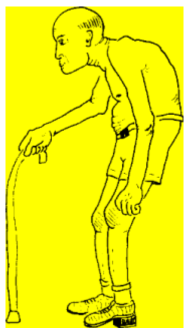
The initial treatment in early OA is conservative with analgesics and non- steroidal anti-inflammatory drugs, as well as heat and active exercises. In addition,

a heel raise will compensate for shortening as well as a flexion deformity of the hip, knee or ankle by preventing excessive stress on the contracted joint when walking.

In severe cases knee or back supports may be necessary. Intensive physiotherapy should include shortwave diathermy and ultrasound before operation is considered. Although local injection of hydrocortisone, especially into the knee, sometimes gives temporary relief, this is not usually recommended in most patients, as secondary avascular changes in the joint may follow and make subsequent surgery more difficult and dangerous.

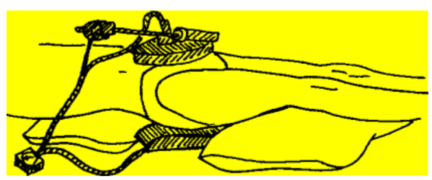
If there is an underlying cause such as RA or gout, this of course should also be treated.

OA-Conservative Treatment

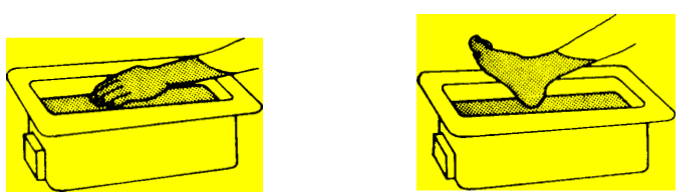


Raised heel and stick

Analgesics and anti-inflammatory medication



Short wave diathermy



Wax baths and exercises

Operative treatment

The operative treatment of OA can be divided into osteotomy or correction of deformity, arthrodesis or arthroplasty.

Osteotomy

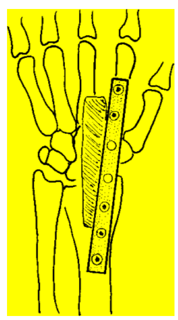
Osteotomy is particularly indicated to correct a varus, and to a lesser extent a valgus, deformity of the knee where narrowing of the joint is mainly confined to the inner or outer side, with a fairly normal contralateral joint space. This correction redistributes weight-bearing to the relatively normal side and usually results in marked symptomatic improvement. This is particularly indica-ted in the patient who has at least 90° of flexion in the affected knee.

Osteotomy in the subtrochanteric region of the hip may also help correct an adduction deformity if there is otherwise a fairly reasonable range of joint movement. It is indicated in patients under the age of forty, but does make subsequent total hip replacement more difficult.

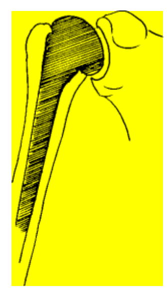
Arthrodesis

Arthrodesis is mainly reserved for a severely osteoarthritic joint with marked destruction, especially in a younger patient when joint replacement is not likely to last, due both to the activity of the patient and the expectation of a relatively long life span. It has the disadvantage of causing strain on other joints, particularly the spine and knees. In some joints, however, such as a severely osteoarthritic wrist, ankle or first metatarsophalangeal joint, an arthrodesis is useful, especially if the arthritis is associated with a neurological deficit or tendon damage. Arthrodesis is also used at the knee when a previous TKR has failed.

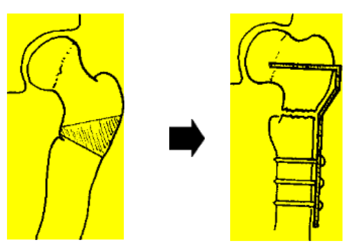
OA- Operative Treatment



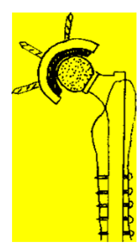
X-ray of a wrist arthrodesis



X-ray of a shoulder replacement*



X-ray of a femoral osteotomy



*UPDATE, 2022. OA shoulder from trauma, end stage rotator cuff dis., RA affects shoulder.

Arthroplasty

In very unfit patients an excision arthroplasty of the hip, by removing the head and neck of the femur alone (Girdle- stone procedure), may result in a painless mobile hip which will usually allow the patient to be fully weight-bearing, usually with the aid of sticks.

Excision of the proximal half to two- thirds of the proximal phalanx of the big toe (Keller’s operation) and excision of the trapezium in severe carpometacarpal arthritis of the thumb in the elderly may be indicated.

In most cases, however, replacement of the joint itself by a prosthesis result in a stable and painless joint with a relatively good range of movement, particularly in the hip and knee.

In the past these joints were cemented in place with methyl methacrylate bone cement. This caused loosening, particularly in young patients and as a result, many joint re- placements, especially in patients under 55, are now cementless.

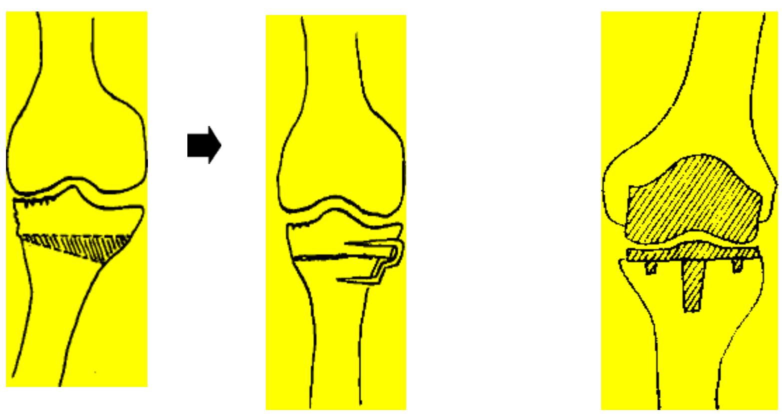
Other operations for OA

Arthroscopy may be used therapeutically as well as diagnostically, particularly in the knee joint. For example, it is often possible to shave the posterior aspect of a rough patella or remove loose foreign bodies from a joint.

Postoperative rehabilitation

After operation, adequate physiotherapy is advocated and this includes strengthening exercises for weakened muscles and walking re-education. It will also include rehabilitation of the patient back into the workforce and home if relevant (chap 6).

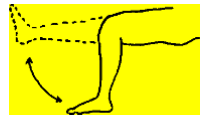
OA – Operative Treatment



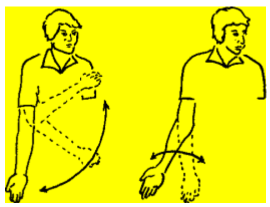
X-ray of a total knee replacement

Postoperative physiotherapy

Shoulder joint



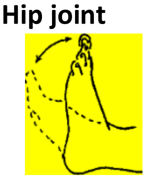
Knee joint



Elbow joint

Hip joint

Wrist joint



Ankle joint

355 **Arthritis**

RA

A chronic inflammatory polyarthritis of unknown aetiology which is often bilateral and symmetrical. It is probably an autoimmune condition, but other aetiological factors may precipitate it, including an inflammatory process elsewhere.

It is most prevalent in young adults and is three times more common in females than males. Symptoms sometimes first appear in childhood but usually appear at a later age.

Pathologically, there is a chronic proliferative synovitis with villous hypertrophy. The synovium is infiltrated with lymphocytes and plasma cells. A pannus of granulation tissue extends into the joint, gradually eroding the articular cartilage and later, the underlying bone. Cystic spaces may be evident on X-ray. In addition, the overlying tendons and joint capsule may be damaged resulting in tendon rupture or joint ankylosis.

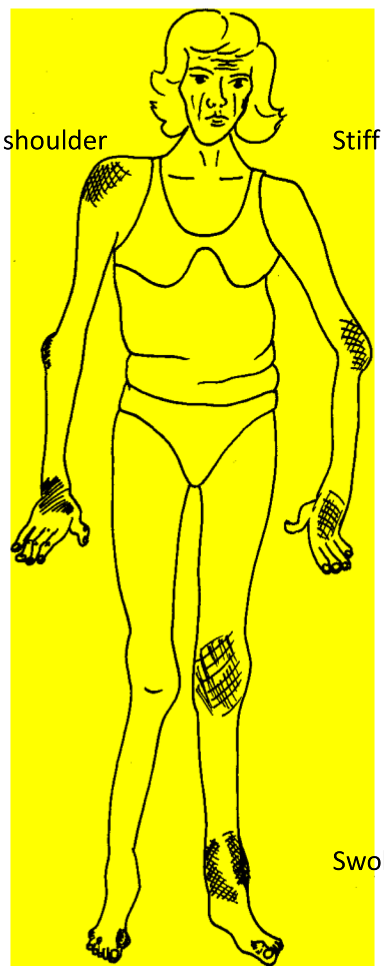
The disease may also be complicated by many extra-articular manifestations, the most characteristic of which are rheumatoid nodules. These commonly occur over the ulnar border of the forearm but they may also occur over the Tendo Achillis, sacrum, occiput and sclera. Nodules may also occur in the viscera, particularly the heart and lungs. Other systemic manifestations of the disease include vasculitis, lung disease, Sjögren's syndrome, neurological complications and anaemia.

Clinical course

The disease classically starts in the hands and feet and is usually symmetrical. The metacarpophalangeal and proximal interphalangeal joints are initially affected and often the wrists as well. The swellings are warm, fairly soft and slightly tender,

RA

Common sites of occurrence



quite different to the chronic bony hard nodules of the distal interphalangeal joints in OA (Heberden's nodes). More proximal joints such as the elbow and knee are often affected as well as the cervical spine, shoulders and hips. Sometimes only a single joint is involved. The disease may have many exacerbations and remissions.

The destruction of the joint cartilage and underlying bone will lead to secondary osteoarthritic changes in the affected joints. The destruction of the joint capsule may lead to subluxation or dislocation of joints, particularly the metacarpophalangeal and proximal interphalangeal joints of the hand. Rupture of tendons is common in the hands and leads to classic deformities.

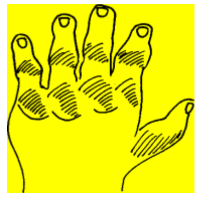
In chronic RA there is ulnar deviation or ‘drift’ of the fingers relative to the metacarpals due to metacarpophalangeal joint destruction and imbalance between the actions of opposing intrinsic hand muscles. The heads of the proximal phalanges are displaced palmar wards and ulna wards and the overlying extensor tendons are often ruptured.

The Z deformity of the thumb is due to rupture of the extensor tendon which inserts into the base of the proximal phalanx of the thumb.

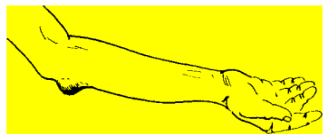
A ‘buttonhole’ (boutonnière) deformity of the proximal phalanges of the fingers is similarly due to rupture of the insertion of the middle slip of the extensor tendon into the base of the middle phalanx with palmar displacement of the two lateral slips on each side of the proximal phalanx.

A ‘swan neck’ deformity is due to rupture of the insertion of the extensor tendon into the distal phalanx with overaction of the slip into the middle phalanx. This causes a

RA: Upper Limb – Early Changes



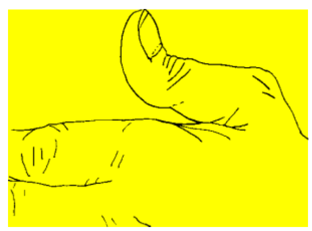
Soft tissue swelling of metacarpophalangeal and proximal interphalangeal joints



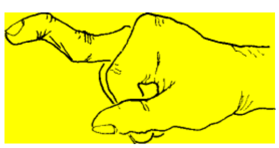
Swollen wrist and elbow

RA: Upper Limb – Late Changes

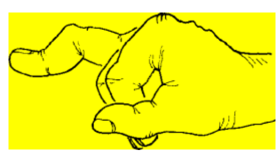
Ulnar deviation



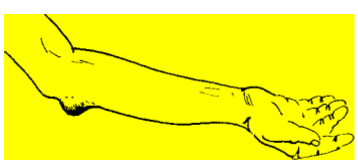
Z thumb deformity



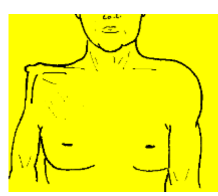
Swan neck deformity



Buttonhole deformity

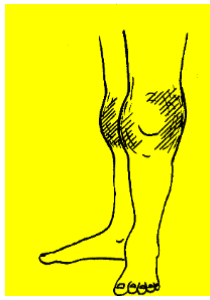


Rheumatoid nodule



Wasted shoulder

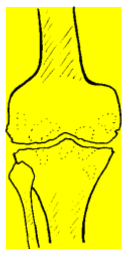
RA: Lower Limb – Early Changes

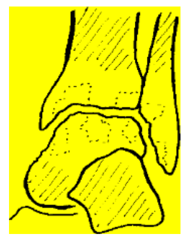


Swollen knees

Swollen ankle

Late changes





X-ray of destruction of articular surface

flexed distal phalanx and a hyperextended middle interphalangeal joint.

In severe cases of RA marked involvement of the ligaments in the cervical spine may cause subluxation or even dislocation of the vertebrae with neurological changes or even quadriplegia.

In the wrist, synovial thickening may cause compression of the median nerve, and the same may occur to the ulnar nerve at both the elbow and the wrist.

Investigations

Diagnosis relies mainly on the clinical findings discussed. The ESR is raised but the white count is normal and the patient may be anaemic. Tests for rheumatoid factor are positive in about 70–80% of cases but it is not specific to RA. Other investigations which may be helpful include complement levels, C-reactive protein, joint aspiration and synovial biopsy.

Conservative treatment

In the acute stages treatment consists of rest of the affected joints by appropriate splints in the 'position of function' plus bed rest for a limited period followed by gradual mobilisation of both the patient and the affected joints. Analgesics and non- steroidal anti-inflammatory drugs will be required, but these should not be continued once the disease is quiescent. Attention to the general medical condition of the patient is important.

Knee and foot supports, walking frames, crutches and sticks may be required to mobilise the patient and protect the skin.

Operative treatment

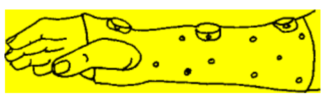
If synovial proliferation continues, despite conservative management, synovectomy may be required before gross damage to the articular

RA - Treatment

Conservative

Analgesia and non steroidal

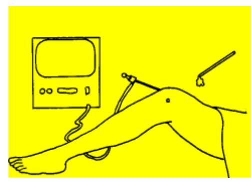
anti-inflammatory drugs (NSAID's)



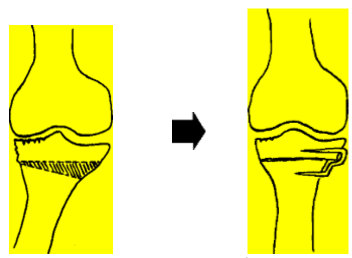
Splint or crepe bandage

Physiotherapy

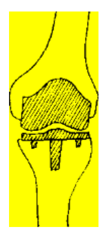
Operative



Arthroscopic synovectomy



X-ray appearance of an osteotomy



X-ray of a

cartilage has occurred. This may be especially effective in the knees.

Tendon ruptures may require repair or tendon transposition but this should not be carried out in the presence of active disease. Decompression of the median nerve at the wrist, or transposition of the ulnar nerve at the elbow may give very satisfactory relief when these are being irritated or compressed. In the chronic disease, joint replacement should be considered. Total hip and knee replacement may be very satisfactory, as may joint replacement of the fingers or arthrodesis of the wrist, but only when their overall benefit to the patient has been considered.

Still's disease

(Juvenile rheumatoid arthritis, JRA)

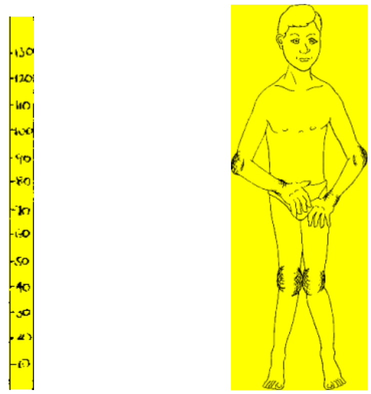
This is a mixed group of RA and ankylosing spondylitis. It occurs in childhood and is usually associated with erythema in about 50% of cases and with splenomegaly, fever, lymphadenopathy, iritis and pericarditis as well as other systemic effects in a lesser number of patients.

There is often stunted growth and in severe cases multiple joint involvement, including the cervical spine with deformities, dislocations and contractures.

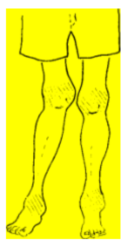
A common complication is micrognathia which is also known as mandibular hypoplasia or shrew face. This results from involvement of the temporomandibular joints.

The treatment is similar to that of RA in adults, with the accent on conservative management and prevention of deformities.

Still's Disease



Affected child with stunted growth and involvement of multiple joints



Swollen knees and ankles

Cervical involvement

Crystalline Arthropathies

Gout

Gout is caused by deposition of uric acid crystals in the joints of patients with hyperuricaemia. The metatarsophalangeal joint of the big toe is affected in about 75% of patients, which is known as podagra. It may be due to either overproduction (inborn error of metabolism), or under excretion of uric acid and occurs mainly in men. Other joints can be involved including the ankle, knee and hands. Classically an attack is brought on by conditions such as stress, operations, trauma or intercurrent infections.

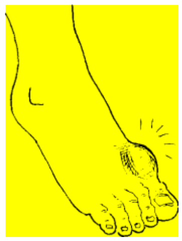
Clinically the patient has a very tender, hot and swollen joint and is pyrexic. There is usually a history of a previous episode of swelling and in over 90% of cases only one joint is affected.

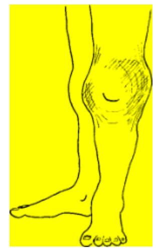
There may be signs of gouty tophi else- where especially over the helix of the ear, over the prepatellar and olecranon bursae and over tendons. These tophi which form in chronic gout may ulcerate and exude white chalky urate crystals. These areas may become infected. Patients are often hypertensive and obese and may have associated kidney and vascular disease.

Laboratory investigations show a serum uric acid above 6 mg% and there is often a leucocytosis and raised ESR in an acute attack.

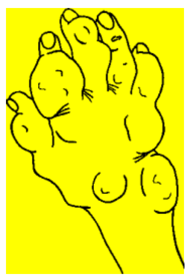
X-rays will show well demarcated, ’punched- out’ areas adjacent to the affected joints in chronic cases. Tophi and joint aspirations show classic needle-like uric acid crystals which are negatively birefringent under polarised light.

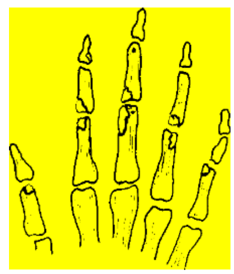
Gout





Hot, red, tender swelling1st MTP joint – podagra Swollen knee





Severe gouty tophi

Treatment

In the acute stage a non-steroidal anti-inflammatory drug will usually be sufficient, plus bed rest and avoidance of alcohol and rich food.

In chronic cases drugs to lower the urate level, such as allopurinol, may be necessary, especially if there are renal stones or auric acid level over 8 mg%.

Pseudogout

In this condition, which appears to have a familial basis, there are depositions of calcium pyrophosphate crystals classically in the knee but also in other joints including the hip.

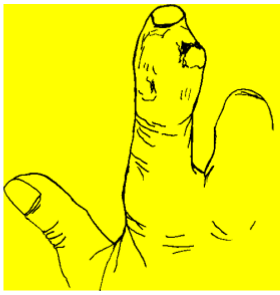
As with gout there may be acute attacks, but in most cases it is a chronic condition like OA.

Diagnosis is made by finding calcium pyrophosphate crystals in the joint aspirate, plus calcification, usually in the menisci of the knee on radiological examination.

Treatment in the acute stage is with joint aspiration, analgesics and non steroidal anti-inflammatory drugs. In the chronic stage the treatment is similar to that for osteo-arthritis.

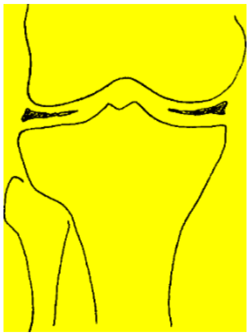
Gout

Gouty tophus in helix of the ear

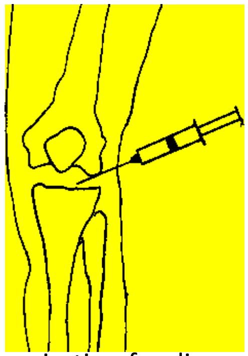


Gouty tophi with secondary infection

Pseudogout



X-ray of pseudogout: meniscal calcification



Joint aspiration for diagnosis

Seronegative Spondyloarthropathies

Reiter's syndrome

This is classically a triad of arthritis, conjunctivitis and urethritis. It usually affects the small joints of the hands and feet but the hip, knee and other joints may also be affected. The treatment is appropriate antibiotic therapy for the chronic urethritis together with standard therapy for arthritis.

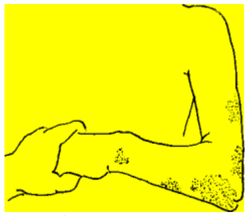
Reactive arthritis

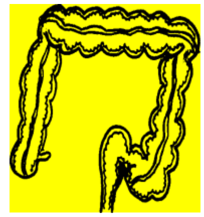
Chronic infections such as chronic osteomyelitis, salmonella, brucella, yersinia enterocolitica and viral infections may cause a non-infective arthritis elsewhere in the body similar to RA. This can be treated by addressing the cause, together with conservative management of the arthritis with aspiration and culture, anti-inflammatory drugs and splinting, as required.

Psoriasis, ulcerative colitis and Crohn's disease

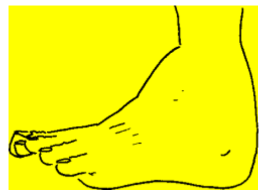
An arthropathy similar to RA is often seen in various skin, gut and inflammatory conditions elsewhere such as in urogenital and upper respiratory infections. This usually involves the peripheral joints. The systemic condition should be treated and the arthritis managed in a similar fashion to RA.

Seronegative Arthritides

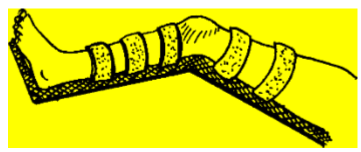

Psoriatic rash on extensor surfaces


Enteropathic arthritis


Reiter's disease: conjunctivitis


Reiter's disease: swollen ankle


X-ray of chronic osteomyelitis


Splinting for septic arthritis

Ankylosing spondylitis, AS

This is a chronic inflammatory condition affecting mainly the spine, sacroiliac joints, shoulders and hips and sometimes the knees. Males are affected five times more commonly than females, with peak incidence occurring between the ages of 15 and 30 years. There is probably a combined genetic and infective aetiology and many of these patients have a history of chronic infection such as urethritis and iritis.

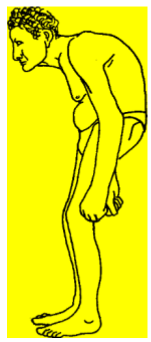
Clinically there is a history of gradually increasing back pain and stiffness, worse at night and in the early morning. Other major joints may gradually stiffen and the patient has an increasing kyphosis with limitation of all back movements. Limitation of chest expansion is due to involvement of the costovertebral joints.

Diagnosis is made on the clinical history and examination together with the X-ray findings of bony bridging across the discs, mainly in the lower thoracic and lumbar spine, as well as narrowing or obliteration of the sacroiliac joints. In the acute stages the ESR is usually raised, but tests for the rheumatoid factor are negative. In over 95% the HLA B27 genetic marker is present.

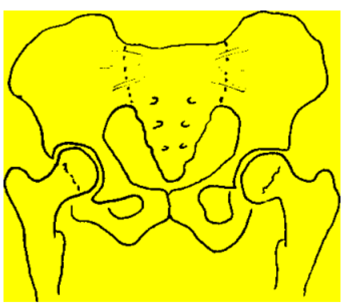
Treatment is initially conservative, with analgesia and non-steroidal anti-inflammatory drugs. Local heat and back extension exercises are important to prevent a kyphosis. Sleeping on a firm mattress with fracture boards, together with a lightweight back support to maintain extension whilst standing, may be helpful.

Occasionally a hip replacement will be required in the chronic stage as may spinal osteotomy for a severe kyphosis. Low dose radiotherapy has an occasional place for severe unresolved pain.

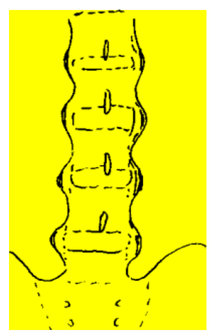
Ankylosing Spondylitis



Patient in characteristic posture



X-ray of reduced sacroiliac joint space



X-ray of a ‘Bamboo spine’

Miscellaneous

Haemophilic arthropathy

Haemophiliacs often develop a degenerative arthritis and stiffness in joints, particularly the knee, due to recurrent bleeding and synovitis. In the acute stage it is essential to administer cryoprecipitate before any attempt is made to aspirate the joint. Following aspiration of the joint a pressure dressing should be applied. Care must be taken, as some of these patients are HIV positive as a result of an infected transfusion in the past. In the case of chronic synovitis an arthroscopic synovectomy may be indicated.

Neuropathic arthropathy

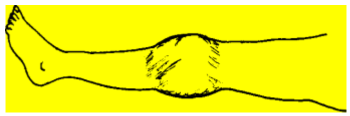
Joints with deficient sensation may progress to marked joint destruction and OA. In the upper limb this is usually secondary to syringomyelia and the patient may have an abnormally increased range of virtually painless movement of the shoulder despite gross destruction. Similar changes in the lower limb may be due to tertiary syphilis. Occasionally neuropathic joints occur in limbs with denervation such as in spina bifida or in diabetes.

Hypertrophic osteoarthropathy

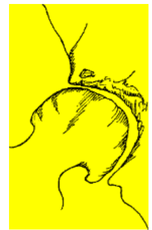
This is a syndrome of painful clubbing of digits and swelling of the wrists and ankles due to a periostitis. It may occur in pulmonary neoplasms or infection, cyanotic heart conditions or gastrointestinal disorders such as ulcerative colitis, Crohn's disease and hepatic cirrhosis.

Radiologically there may be evidence of periostitis, and dramatic improvement is obtained by removal of the cause i.e., pneumonectomy or even vagotomy.

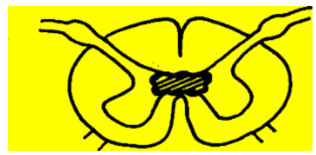
Miscellaneous Arthritides



Haemophilic arthropathy



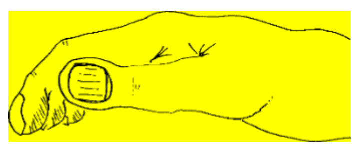
X-ray of secondary OA



Neuropathic arthropathy: MRI scan showing syringomyelia

Hypertrophic osteoarthropathy

May be secondary to a pulmonary neoplasm



Clubbing of fingers with wrist swelling

Chapter 11

Neurological and Spinal Conditions

Cerebral conditions

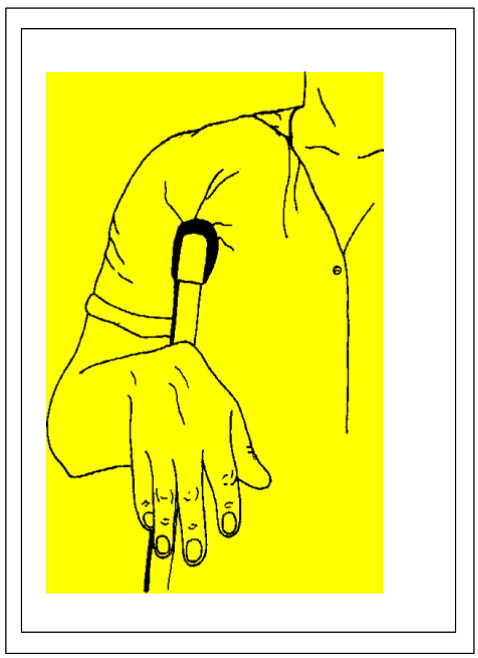
Spinal conditions

Cervical spine

Thoracic and lumbar spine

Pelvic and sacral conditions

Peripheral nerve lesions



Classification

Cerebral Conditions

Cerebral palsy

Head injuries

Haemorrhage

Thrombosis and embolus

Neoplasms

Spinal Conditions

Cervical spine

Congenital abnormalities

Klippel Feil syndrome

Sprengel's shoulder

Cervical rib

Torticollis

Spina bifida

Congenital webbing

Neoplasia

Benign -soft tissue

cartilaginous

bony

Malignant - primary - soft tissue

cartilagenous

bony

secondary

Trauma

Soft tissue injuries -tendons/ligaments

Subluxation and dislocation Fractures

Infection

Discitis

Osteomyelitis

Tuberculosis

Arthritis

Autoimmune -RA

ankylosing spondylitis Degenerative cervical spondylosis

Paralysis

Poliomyelitis

Syringomyelia

Thoracic and lumbar spine

Congenital abnormalities

Spina bifida and meningomyelocele

Lumbarisation and sacralisation of vertebrae Spondylolysis and spondylolisthesis

Spinal stenosis

Diastema to myelia

Hemivertebrae

Neoplasia

Benign -meningioma

neurofibroma

haemangioma

eosinophilic granuloma

Malignant -primary

secondary

Trauma

Soft tissue injuries- tendons /ligaments

Subluxation Dislocation Fractures

Infection

- Discitis
- Osteomyelitis
- Tuberculosis

Arthritis

- RA
- Ankylosing spondylitis

Spinal paralysis

- Trauma
- Thrombosis and embolus of the cord
- Neurofibromatosis*
- Transverse myelitis
- Syringomyelia

Scoliosis

- Congenital abnormalities
- Idiopathic causes
- Paralysis
- Compensatory

Kyphosis and lordosis

- Congenital abnormalities
- Neoplasia
- Trauma
- Infection
- Osteoporosis
- Paget's disease
- Scheuermann's disease

Back pain

- Congenital abnormalities
- Neoplasia

Trauma

*John Merrick, the Elephant Man, had multiple neurofibromatosis, portrayed in 1980 film.

Infection

Prolapsed intervertebral disc

Miscellaneous conditions

Pelvic and Sacral Conditions

Congenital abnormalities

Neoplasia

Benign -soft tissue

Cartilaginous

Bony

Malignant - primary - soft tissue

Cartilaginous bony

Secondary

Trauma

Soft tissue injuries

Subluxation and dislocation

Fractures

Infection

Soft tissue

Bone (osteomyelitis)

Joint (pyogenic arthritis)

Arthritis

Degenerative (OA)

Autoimmune (ankylosing spondylitis)

Miscellaneous conditions

- Paralysis
- Coccydynia

Peripheral Nerve Lesions

Aetiological classification

- Peripheral neuritis
- Peroneal muscular atrophy
- Duchenne muscular dystrophy
- Friedreich's ataxia
- Poliomyelitis

Anatomical classification

Upper limb nerve lesions

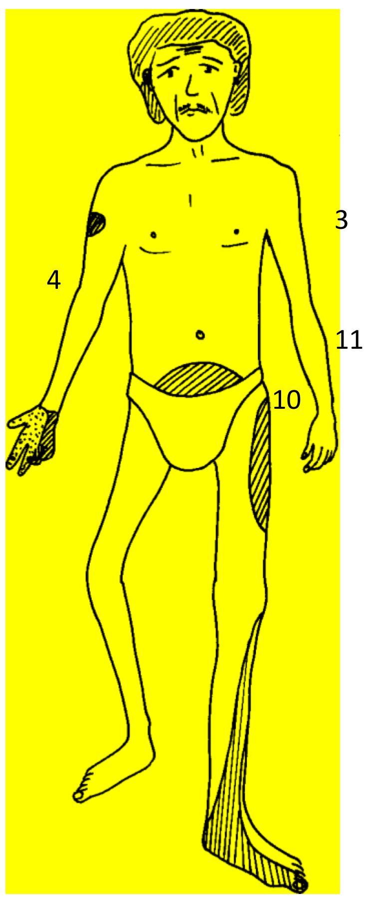
- Brachial plexus
- Axillary nerve
- Radial nerve
- Ulnar nerve
- Median nerve
- Digital nerves
- Sudek’s atrophy
- Nerve entrapment

Lower limb nerve lesions

- Cauda equina
- Lumbosacral plexus
- Sciatic nerve
- Common peroneal nerve
- Tibial nerve

Peripheral Nerve Lesions

Common sites of occurrence



1. Peripheral neuritis
2. Poliomyelitis
3. Brachial plexus
4. Axillary nerve
5. Radial nerve
6. Ulnar nerve
7. Median nerve
8. Digital nerve
9. Sudek's atrophy
10. Nerve entrapment
11. Cauda equina
12. Sciatic nerve
13. Common peroneal nerve
14. Tibial nerve

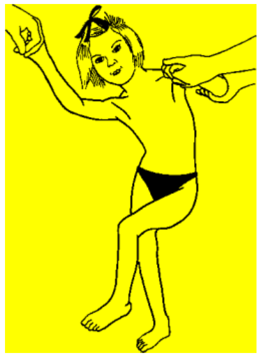
Introduction

Paralysis may be due to cerebral, spinal or peripheral causes, or to a combination of these. If it is cerebral or spinal above the lumbar region, paralysis is usually spas- tic in nature. Lesions at the lumbar region affecting the cauda equina and peripheral nerves usually cause a flaccid paralysis. In the thoraco-lumbar region there may be a mixture of flaccid and spastic paralysis due to damage to both the lower cord and the cauda equina.

Neurological dysfunction may affect pow- er, sensation and autonomic functions, particularly the bladder. In polio, in which the anterior horn cells in the spinal cord are selectively destroyed, only motor power is affected. In peripheral neuritis due to diabetes or certain toxins only sensation may be altered. Common causes of paralysis vary from conditions present at birth, such as spina bifida, to paralysis from tumours, trauma, infections and degenerative conditions.

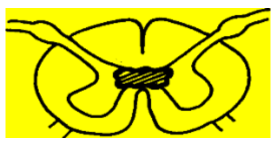
A detailed examination of the patient should include a thorough evaluation of the peripheral nervous system, including: tone, power, reflexes, sensation, co-ordination and autonomic function. Higher centres and the cranial nerves should also be assessed and the spine itself examined for tenderness, muscle spasm, deformities and cutaneous abnormalities. The examination of a patient with lower back pain or sciatica should include a rectal examination to exclude an intrapelvic lesion where carcinoma of the bladder, prostate, uterus or rectum, or an intrapelvic abscess could be responsible. Abdominal examination should exclude cholecystitis, as well as gastrointestinal, genitourinary, gynaecological, retroperitoneal and vascular causes such as an aortic aneurysm.

Neurological Conditions

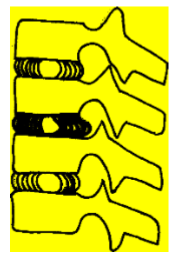


Cerebral palsy

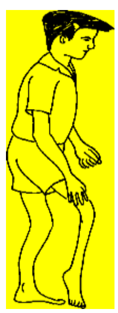
CT of a cerebral neoplasm



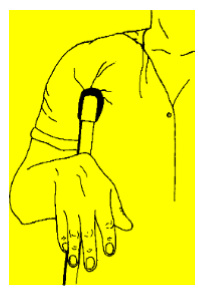
CT of syringomyelia



X-ray of a prolapsed



Poliomyelitis



Radial nerve palsy

Cerebral Conditions

Cerebral palsy

Cerebral palsy is a non-progressive cerebral disorder which usually occurs before or at birth. It may occasionally be due to meningitis or other postnatal conditions.

The majority of cases are caused by hypoxia which commonly produces an extra pyramidal lesion. Causes of cerebral palsy include hypoxia during labour, antepartum haemorrhage, preeclamptic toxaemia, pre-maturity or post-maturity of the infant, and cardiopulmonary or other diseases of the mother such as diabetes or renal impairment, meningitis or perinatal infections.

Maternal rubella and rhesus incompatibility with kernicterus may also affect the brain as may birth trauma and cerebral infections such as meningitis.

Developmental abnormalities of the brain and occasionally of the spinal cord such as meningomyelocele may also be associated with cerebral damage.

Clinically the neurological dysfunction in cerebral palsy is a lack of motor control. This may be due to defects in the basal ganglia with extrapyramidal signs such as increased tone in muscles. There may be cerebellar signs with ataxia and in coordination, or pyramidal signs with spasticity. A combination of these signs may be present. In addition, there may be some sensory loss and varying degrees of mental retardation. There may also be fits and impairment of sight, hearing and speech. Although spastic hemiplegia is the most common manifestation, monoplegia, diplegia and quadriplegia may be present with any of the signs mentioned

Cerebral Palsy

UPDATE, 2022: Classifications, Physiologic-Spastic, Athetosis, Ataxia, Mixed; Anatomic Hemiplegia, Diplegia, Quadriplegia; Functional- a gross motor and functional system (GMFCS). NB-the ability to sit independently by age 2 is best prognostic sign of ability to walk.

MRI of brains shows periventricular leukomalacia. Botulinum toxin (pre-synaptic blocker of cholinergic receptors at neuromuscular junction) can temporarily reduce spasticity.

Ora baclofen can control tone. Botulinum toxin A helps for 3-6 mths for severe spasticity.

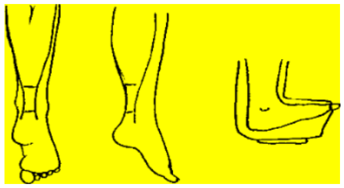
CP hips at risk are those with abduction of <45 degrees and also where uncovering of the femoral heads on X-Rays.

Clinically the patient may present with a flexed elbow and palmar flexed, pronated wrist with a swan-neck deformity of the fingers. The lower limb or limbs usually show a flexed hip and knee with an equinus ankle and the patient may walk with a scissor type gait due to spasm of the hip adductors. Most of these deformities result from upper motor neurone lesions, and spasticity is common. The muscles are hypertonic and of normal bulk, and there is often only minimal sensory loss. This is unlike poliomyelitis where there is an asymmetrical flaccid paralysis with wasted muscles and normal sensation and in peripheral nerve injuries where there is both motor and sensory loss.

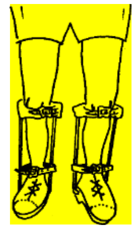
The treatment of cerebral palsy is mainly conservative with extensive physiotherapy and rehabilitation for both the child and the adult. Intensive reeducation may often improve the child, and mobilisation should be encouraged if cerebral involvement is not too extensive. This will include elongation of the ten- do Achillis plus a below knee caliper if necessary, adductor tenotomy to correct the hip adductors and elongation of the biceps tendon to correct the elbow flexion contracture. Contractures can also often be passively corrected. Simple methods such as this are usually sufficient in most cases. Tendon transfers and osteotomy of bones may sometimes be necessary, although these more extensive procedures should only be undertaken by those skilled in this type of surgery.

In summary, the treatment of spastic children should involve not only surgery and splints but also education, mobilisation and rehabilitation. In severe cases this may entail institutional care.

Cerebral Palsy - Treatment



Correction of equinus deformity: elongation of Achilles tendon



Below knee calipers

Tendon transfer

Other: Toe- walking: tight heel cords, AFO, maybe TA lengthening. Crouched gait: hamstring

389 **Neurological and Spinal Conditions**

Stroke and head injuries

A stroke is defined as an upper-motor neurone lesion which is often acquired in later life. Stroke is usually caused by a cerebrovascular incident which includes haemorrhage, thrombosis or embolus. It may also follow a head injury, and less commonly various neuro logical disorders such as disseminated sclerosis and cerebral tumours. A stroke usually affects the arm and leg on the side opposite to the cerebral lesion. As with cerebral palsy, however, it may affect only one limb, or all four limbs and the trunk.

The clinical picture is very similar to that of CP with all gradations of physical and mental impairment. Left sided cerebral lesions in right-handed people and in a majority of left-handed people, cause dysphasia due to involvement of the speech centres. The treatment is very similar to cerebral palsy with the emphasis being on mobilisation and rehabilitation. Simple subcutaneous elongation of the Tendo Achillis alone to correct an equinus deformity will often also reflexly improve a spastic flexion deformity of the hip and knee on the side affected. Similarly, open elongation of the biceps tendon alone will often reflexly improve a palmar flexion and pronation deformity of the wrist and forearm.

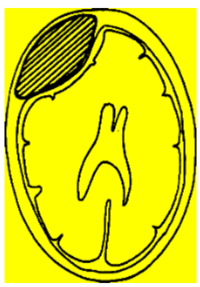
Cerebral neoplasms

The possibility of a secondary tumour, a meningioma, a glioma or other cerebral neoplasm must always be considered in all patients with a history of increasing weakness, sensory loss, ataxia or mental impairment. Referral to a neurologist plus EEG, CT or MRI scans may be indicated as well as other investigations.

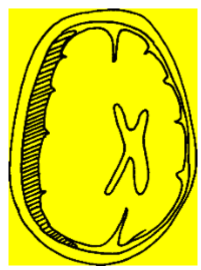
Stroke and Head Injuries

Fall on to head

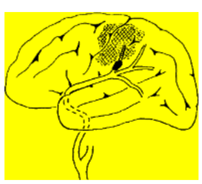
X-ray of skull fracture



CT of an extradural haemorrhage



CT of a subdural haemorrhage



CT of an embolus or thrombus

CT of a cerebral neoplasm: primary lesion or secondary deposit

Cervical Spine Conditions

Congenital neck deformities*

Klippel-Feil syndrome

This is due to congenital fusion of one or more vertebrae in the cervical region. The neck is short as a result and there may be an abnormally low hairline.

Sprengel's shoulder

This is due to a high-riding scapula on one or both sides. There is winging, hypoplasia and an omovertebral bar.

Cervical rib

This may be present on one or both sides and is an extension of the transverse processes of the vertebrae. It may be a fibrous band, a complete rib, or any gradation in between. Its clinical importance is that it may impinge upon the lower cords of the brachial plexus or on the subclavian artery. Very occasion- ally the rib or band requires excision due to vascular or neurological compression which is usually made worse by downward traction on the arm.

Torticollis

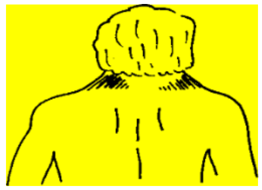
This is probably due to damage of the sternomastoid muscle at birth with swelling and contracture of the muscle. This pulls the head to the opposite side and if it is not divided early leads to facial asymmetry. Late division of the muscle may cause diplopia as the eyes have gradually compensated for the abnormal posture.

Late onset torticollis may be due to cerebral or spinal conditions including injuries of the cervical spine. Spasmodic torticollis sometimes has a psychological cause.

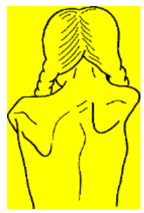
*Down Syndrome, Trisomy 21 (encodes for type IV collagen (COL6A1 and COL642),joint laxity, metatarsus primus varus, pes planus, Atlanto-Axial instability, scoliosis, sp- listhesis, hip instability, patellar dislocation, lig. laxity, mental retardation, heart disease.

Cervical Spine —

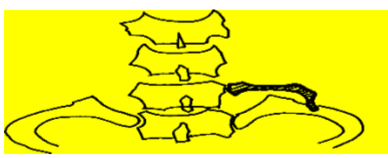
Congenital Abnormalities



Klippel- Feil syndrome, associated with renal and congenital heart disease, auditory problems, and Sprengel deformity. After fusion avoid contact sports



Sprengel's shoulder, Associated with Klippel-Feil, kidney problems, scoliosis diastematomyelia. Surgery for cosmesis and decreased abduction.



X-ray of a cervical rib Torticollis

Neoplasia

2nd deposits in the vertebrae are the most common cause of neurological compression. These affect one or more vertebral bodies and less commonly the laminae and pedicles with possible subluxation or dis-location leading to quadriplegia. The disc spaces are usually intact, with secondary deposits, providing a useful radiological means of distinguishing them from infections which almost always involve the disc.

Neurofibromata and meningiomata are rare causes of paralysis.

Trauma

A dislocation or fracture dislocation is a common cause of nerve root or even spinal cord compression. A flexion rotation force is the usual mechanism.

Infection

Pyogenic infection usually involves one disc space alone initially with the adjacent vertebrae. There may also be an abscess which can cause cord compression.

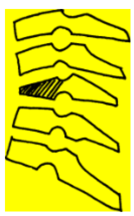
Tuberculous infection is much more insidious and often causes destruction of more than one vertebra and the disc between.

Arthritis

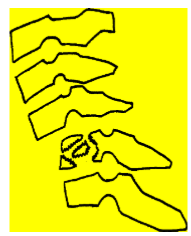
Autoimmune (RA)

RA causes softening of the ligaments, particularly in the upper cervical region with subluxation or dislocation of the odontoid peg and possible quadriplegia due to cord compression.

Cervical Spine Conditions

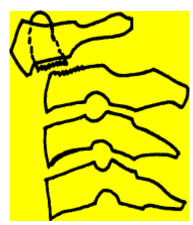


X-ray of a secondary neoplasm



X-ray of a vertebral fracture and dislocation

X-ray of discitis



X-ray of the atlas subluxed on the axis

Degenerative (cervical spondylosis)

This condition commonly affects the C4/5 and C5/6 disc spaces with narrowing and secondary degenerative changes in the posterior facet joints. Osteophytes in this region may press on the C5 and C6 nerve roots, occasionally producing neurological signs which may radiate down one or both arms into the hands. Pressure on the cord itself is rare, but involvement of other nerve roots may occur.

The patient usually complains of neck pain with radiation down one or both arms and occasionally sensory loss in the relevant fingers. There may be occipital headaches and sometimes a history of trauma, particularly of a hyperextension or whiplash injuries.

On examination there is often a tender triad of pain over the base of the neck, the insertion of the deltoid and over the extensor muscles of the forearm (not the extensor origin which is referred to as tennis elbow). The biceps jerk may be diminished in a C5 or 6 lesion and the triceps in a C7 or C8 lesion and there may be associated motor and sensory loss in the distribution of these nerves.

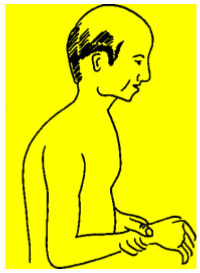
Examination of the neck will usually show limitation of rotation towards the side of the lesion, limitation of lateral flexion away from the affected side, and reduced neck extension. External rotation and abduction of the shoulder on the affected side may be limited.

X-rays, including oblique X-rays, may show narrowing of the C4/5 or C5/6 or other disc spaces with osteophytes and narrowing of the intervertebral foramina.

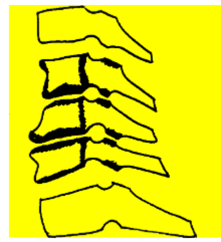
Treatment should include neck exercises, local heat, traction with rotation and flexion to the side of the lesion, anti-inflammatory drugs, analgesia, and a supportive collar.

Cervical Spine Conditions

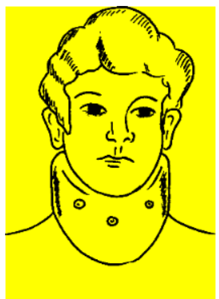
- Cervical Spondylosis



'Huck step tender triad'



X-ray of cervical spondylosis



Supportive collar

Neck traction with rotation and flexion to side of lesion

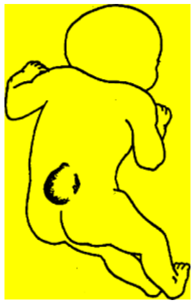
posterior elements in the vertebral arch which have failed to fuse, usually of the lumbar region and associated with involvement of the spinal nerves and cord. Nerve involvement may vary from tethering to protrusion an associated hydro cephalus in severe cases. There is a genetic predisposition, with a 5-10% risk of an off- spring being born with spina bifida if a parent or sibling has a similar defect.

Diagnosis in utero may be made by analysis of amniotic fluid for alpha-fetoprotein and ultrasound imaging of the foetus.

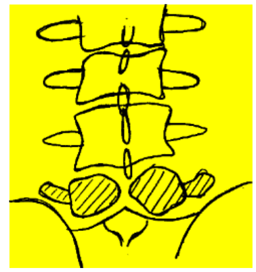
Clinical examination may reveal all gradations of defects. These vary from a mild defect which is only evident on X-ray and apparent clinically as a small dimple, or hairy naevus in the midline and not accompanied by neurological signs, to more extensive defects with herniation of the dural sack (meningocele) or herniation of both the cord and dura (meningomyelocele). In severe herniations the hernial sack may be open and the contents exposed, or alternatively any coverings may rapidly break down. Surgical correction should be undertaken as soon as possible.

All gradations of motor, sensory and autonomic impairment may occur, from talipes

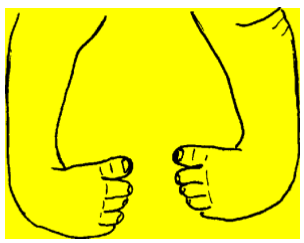
Spina Bifida and Meningomyelocele



Meningomyelocele



X-ray of spina bifida



Talipes equinovarus

Hydrocephalus

equinovarus to complete paralysis and dis- location of the hips. Bladder paralysis may lead to infection and ascending pyelonephritis.

Motor paralysis varies and is sometimes progressive. It should be treated initially as simply as possible with soft tissue surgery and splinting. Sensory loss in the distribution of the motor paralysis may lead to pressure sores which must be prevented by adequate padding under the splints.

Urinary incontinence may lead to urinary infection and again adequate prophylaxis is essential. Treatment depends on the severity of the malformation. Closure of the meningomyelocele must be done as a matter of urgency before ulceration and meningitis supervenes. Hydrocephalus should be treated with a ventriculoperitoneal shunt.

Calipers and orthopaedic surgery for muscle imbalance and lower limb contractures, and urological surgery for disturbances of bladder function may be required.

Prolonged follow up is essential, including physiotherapy and rehabilitation.

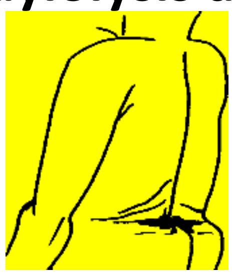
Lumbarisation and sacralisation of vertebrae

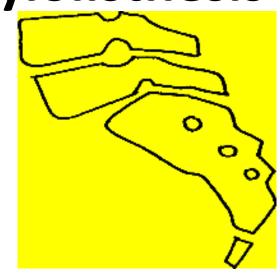
The upper sacrum may form a 6th lumber vertebra and conversely the 5th lumbar vertebra may be fused with the sacrum. This may lead to an increased propensity for low back pain and sciatica.

Spondylolysis and spondylolisthesis

Spondylolysis is a defect in the pars interarticularis, (the neck of bone between the laminae and pedicles of the lumbar spine) usually between the 4th and 5th lumbar vertebrae or between the 5th lumbar vertebra and the sacrum. It can be congenital or acquired and is best seen on oblique X-rays. Spondylolisthesis is a forward slip of one vertebra on another, most commonly in the lower lumbar region, which may result in

Spondylolysis and Spondylolisthesis*





Spondylolisthesis — step in lumbar sacral region X-ray of a forward slip

Oblique X-ray spondylolisthesis with forward displacement

*UPDATE, 2022-seen in athletes who hyper-extend, where high-grade listhesis (>50%) may have flexed hip and knee with equinus, sacral prominence, proximal hyperlordosis. Slip angle determines nonunion and pain (when > 45-50 degrees there is greater risk of slip progression, instability, post op pseudo-arthrosis. Pelvic incidence (PI)= pelvic tilt + sacral slope. When minor may lead to sp- listhesis. Acute spondylolysis - treat with antilordotic brace (TLSO with thigh extension).

cauda equina compression. Back pain is common, but neurological signs are uncommon.

The most common cause of a mild spondylolisthesis occurring in any part of the lumbar spine is degeneration of the facet joints and the intervertebral disc secondary to OA. Again, neurological signs are uncommon, but back pain may be severe. Clinically, apart from muscle spasm and tenderness of the lower lumbar spine, a step may be felt at the site of a slip as one vertebra and its spinous process subluxes forward on the vertebra below. A defect in the pars interarticularis seen on oblique X-rays has been compared to the head, eyes and ears of a Scottish terrier dog. A collar at its neck signifies a spondylolysis.

A forward slip of its head (represented by the transverse process and upper pedicle) on the body and front legs (represented by the lower pedicle and spinous processes) signifies a spondylolisthesis. Investigations should include not only X-ray views of the area, but also CT scans of the individual vertebrae and occasionally an MRI scan in addition. The treatment of back pain in spondylolisthesis is usually back exercises, rest and a supporting corset. In severe cases, decompression of the nerves or posterolateral arthrodesis of the affected part of the lumbar spine alone may be necessary.

Spinal stenosis

Spinal stenosis may be due to congenital narrowing of the spinal canal in conditions such as achondroplasia or it may develop following encroachment of osteophytes upon the vertebral canal as occurs in OA of the facet joints. Alternatively spinal stenosis may be secondary to a previous fracture of the vertebral bodies. As a result the vertebral canal is narrowed and the patient may develop symptoms of claudication with pain in the calves and yet have normal peripheral circulation(DO vascular assessment). Do Xray, CT (not myelopathy now). Treatment is

laminectomy + decompression of the spinal cord. So lumbar spinal stenosis can be central/ lateral/foraminal.

Diastematomyelia

A congenital defect in which the lower spinal cord is divided by a fibrous band or bony spicule. It is often associated with spina bifida and may produce a neuro- logical deficit. It is often progressive during growth of the child. Do MR. Must resect before corrective surgery of deformity.

Hemivertebrae

A congenital defect of part of a vertebra may cause a scoliosis. The spine will obviously be weak and although paraplegia is uncommon a protective corset or an arthrodesis of the spine may be required.

Neoplasia Meningioma

A meningioma arising from the meninges is a slow growing benign tumour which may cause paraplegia, particularly in the thoracic spine.

Neurofibroma

Neurofibromata are discussed in Chapter 8. A neurofibroma arising from a spinal root in the spinal canal can cause partial or complete paralysis due to pressure on the cord.

Haemangioma

Haemangioma of the vertebra is usually a congenital lesion diagnosed on X-ray by coarse striae. It seldom requires treatment except low dose radiotherapy if symptomatic.

Eosinophilic granuloma

Eosinophilic granuloma usually causes complete collapse of the vertebral body and is known as a Calve's disease. It is not uncommon in children and young adults and usually does not require operative treatment. Occasionally a more extensive eosinophilic granuloma of the spine will require treatment with low dose radiotherapy.

Trauma

Soft tissue injuries

Soft tissue injuries of the spine are common and are due usually to sudden twisting and flexion strains or to direct trauma. Closed injuries seldom require more than heat, exercise and sometimes a back support.

Subluxation and dislocation

Subluxations and dislocations without a fracture may occur in the cervical spine causing nerve compression and occasionally quadriplegia. The diagnosis and management of these conditions are discussed in 'A Simple Guide to Trauma'.

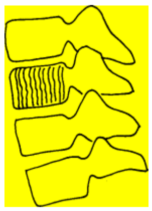
Fractures

Fractures of the spine can be divided into two categories: stable without displacement with intact posterior ligaments, or those that are unstable. Stable fractures usually present without neurological signs and only require rest, back exercises and support.

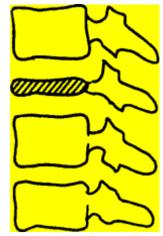
Unstable fractures usually show displacement of one vertebra on another, often associated with rupture of the interspinous and supraspinous ligaments and most have some neurological deficit. In the thoracolumbar

Thoracic and Lumbar Spine Conditions

Neoplasia

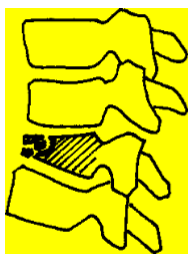


X-ray of a haemangioma

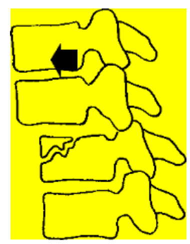


X-ray of an eosinophilic granuloma

Trauma



X-ray of a stable fracture of vertebral body



X-ray of an unstable vertebral fracture

and cervical regions incomplete unstable lesions may require operative stabilisation.

Infection*

Discitis (infectious spondylitis, vertebral OM)

This is usually an infection of a disc space in the lumbar spine. It may follow lumbar puncture or may be blood borne, especially from pelvic infections. Drug addicts are also prone to this condition.

Diagnosis-clinical history and examination, X- ray shows disc narrowing and, sometimes, involvement of the adjacent vertebral bodies, loss of lordosis. ESR is usually raised up, the WBC may be elevated, and blood culture taken before the initiation of antibiotic therapy may isolate may show a pyogenic organism.

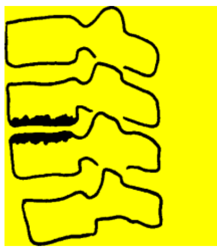
Treatment- bed rest and intravenous antibiotics followed by mobilisation and oral antibiotics for at least three months. Any causative factors should also be treated.

Tuberculosis of thoracic and lumbar spine

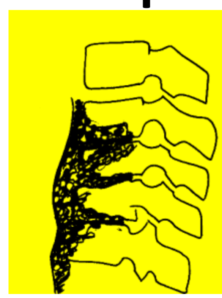
Tuberculosis is still common in many developing countries and may cause paraplegia with an increasing motor and sensory deficit as well as bladder paralysis. The onset is usually insidious with an increasing kyphosis and possible abscess formation which may track down the psoas sheath into the groin, if the abscess is in the lower thoracic or lumbar region. There is involvement of at least one disc space and its adjacent vertebrae but several vertebrae and discs may be involved (Chapter 9). Metastatic deposits, on the other hand, usually spare the intervertebral discs.

*Pyogenic vertebral OM from haematogenous staph.a.

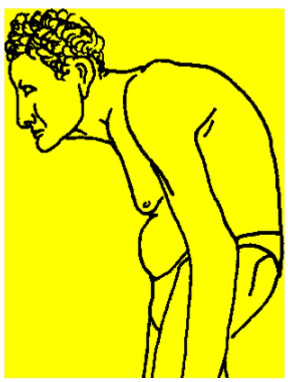
Thoracic and Lumbar Spine Conditions



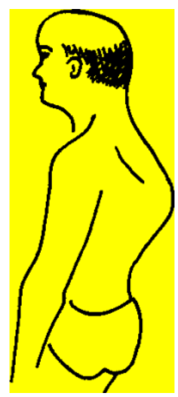
X-ray of discitis



X-ray of spinal tuberculosis



Kyphosis



Kyphos

Arthritis

RA

RA is discussed in more detail in the relevant chapter on arthritis (Chapter 10).

It mainly affects the cervical spine in the later stages of disease. There is usually considerable osteoporosis and stiffness in severe cases and this may progress to a virtual arthrodesis. The thoracic and lumbar spine can also be involved in severe cases and be osteoporotic with some stiffness. In the early stages of RA, ligamentous laxity may allow forward subluxation or even dislocation of the atlas on the axis with possible neurological pressure and even quadriplegia.

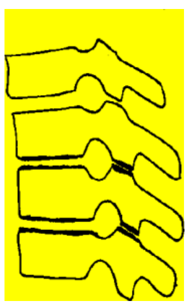
This can be particularly hazardous if a general anaesthetic is necessary, as intubation may cause subluxation or dislocation with paralysis.

Ankylosing spondylitis

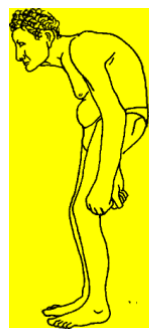
Ankylosing spondylitis is discussed in more detail in Chapter 10. It causes marked stiffness of the spine and sacroiliac joints with obliteration of the sacroiliac joints and bony bridging, particularly in the lumbar region. Increasing kyphosis in the thoracic region is common with and may lead to a very severe deformity.

Treatment is aimed at preventing increasing deformity by adequate physiotherapy, a firm mattress and non- steroidal anti-inflammatory drugs. Occasionally even steroids may be necessary as well as low doses of radiotherapy. Occasionally spinal osteotomy to correct a very severe kyphosis may be indicated.

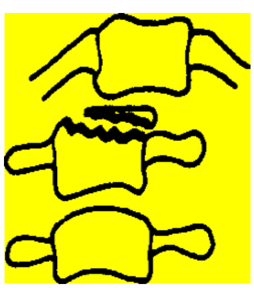
Thoracic and Lumbar Spine Conditions - Paralysis



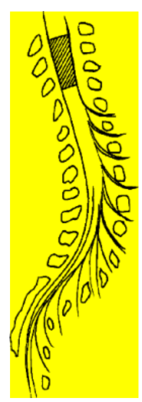
X-ray of RA



Ankylosing spondylitis



Paralysis may be secondary to spinal trauma



Thrombosis of vessels supplying the spinal cord

Spinal Paralysis

Trauma

Fractures and fracture dislocations may cause all gradations of paralysis (see above). In addition, penetrating injuries often cause paralysis.

Thrombosis and embolus of the spinal cord

This usually follows trauma and occasionally infection or tumour. The treatment is of the cause together with the management of the associated paraplegia.

Neurofibromatosis

Neurofibromata of the spinal nerve roots may cause cord compression with partial or complete paraplegia or quadriplegia. Transverse myelitis

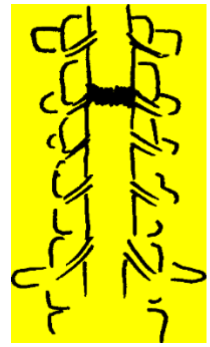
This is probably due to a viral infection and usually results in complete division of the spinal cord with paraplegia and sometimes quadriplegia. Treatment of musculoskeletal paralysis, sensory loss and bladder involvement is symptomatic.

Syringomyelia

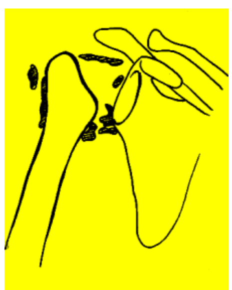
This is a central degeneration of the spinal cord, most commonly seen in the cervical region. The sensory components are usually involved more than the motor. Charcot type neuropathic joints may occur, especially in the upper limb, with little or no pain and often an appreciable or even increased range of movement which belies the severe X-ray changes. Diagnosis is confirmed on CT or MRI scanning of the affected spinal cord. Treatment is symptomatic.

Thoracic and Lumbar Spine Conditions — Paralysis

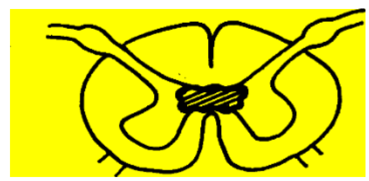
Neurofibromatosis maybe complicated by spinal paralysis



Transverse myelitis



X-ray of a Charcot joint, a possible complication of spinal paralysis



CT of syringomyelia

Scoliosis

Scoliosis of the thoracic and lumbar spine may be fixed or mobile. It may also be compensatory to a short leg or tilted pelvis.

Congenital scoliosis

This is due to a spinal anomaly such as a hemivertebra or other defect and will usually result in a fixed scoliosis which may also be associated with a kyphosis. It may require a spinal support or arthrodesis.

Paralytic scoliosis

This is due to spinal paralysis such as in poliomyelitis, neurofibromatosis or spastic hemiplegia. After a time, the scoliosis becomes fixed by ligamentous and bony shortening and rotation of the vertebrae. It is treated by a supporting brace and occasionally by arthrodesis of the spine.

Idiopathic scoliosis

This is usually fixed, is often progressive in childhood until skeletal maturity is attained. The cause is unknown and rotation of vertebrae usually results in prominence of the ribs on one side and a deformity which is called a kyphoscoliosis. Bony changes and wedging of the vertebrae take place and the kyphoscoliosis remains despite forward flexion. This sometimes requires correction by operation plus a supporting brace.

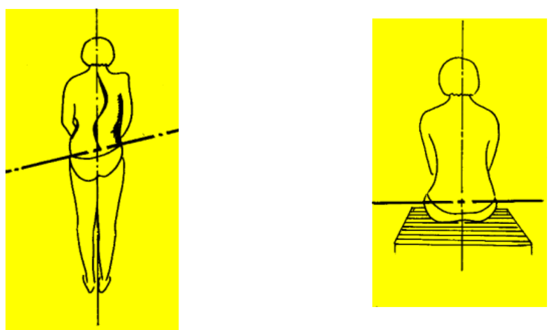
Compensatory scoliosis

Due to a short leg and is usually obliterated by viewing the back with the patient seated, or with the shortening compensated for by wooden blocks. It is also obliterated by the patient bending forward.

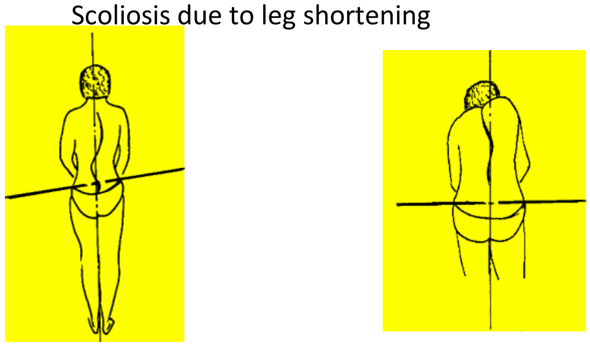
Kyphosis and Lordosis

A kyphos is a sharp forward flexion deformity of the spine and is usually due to anterior

Thoracic and Lumbar Spine Conditions - Scoliosis



Scoliosis due to leg shortening



Kyphoscoliosis

wedging of one or more vertebrae. This may be the result of a fracture or fracture dislocation following acute trauma or it may be the result of metastatic deposits. It may also be secondary to pyogenic or tuberculous infection or infective discitis. In an un- stable acute fracture, there is usually a gap between the supraspinous and interspinous ligaments. This is not present when the kyphosis due to other causes.

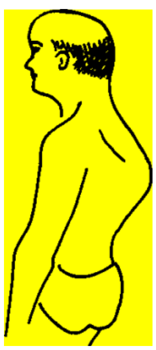
A kyphosis is merely a gradation of a kyphos, and is a more gradual forward flexion, usually more pronounced in the thoracic region. It may be due to spinal muscle weakness as occurs with paralysis or old age, or secondary to senile osteoporosis, with anterior wedging of several vertebrae and narrowing of the disc space anteriorly.

In Scheuermann's disease or osteochondri and occasionally sciatica. A lordosis may also compensate for weak spinal muscles or for spinal stenosis.

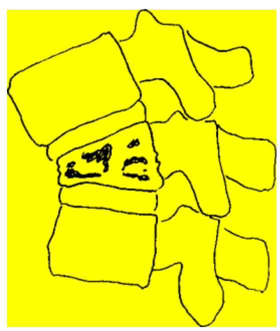
The diagnosis is made on clinical history, physical and radiological examination. This should include appropriate investigations for a psoas abscess or other abscess if infection, such as tuberculosis, is suspected.

Wedging of vertebrae in both senile kyphosis and Scheuermann’s disease can usually be

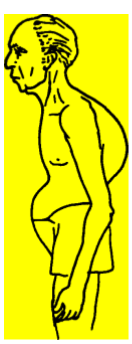
Thoracic and Lumbar Spine Conditions - Kyphosis



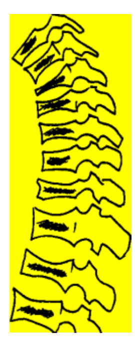
Kyphos



X-ray of a kyphos secondary to metastatic deposit



Kyphosis



X-ray of senile osteoporotic kyphosis

confirmed by X-ray, as can a fracture due to trauma. A fracture due to an eosinophilic granuloma (Calvé's disease) usually causes almost complete flattening of a vertebra. Collapse resulting from a secondary deposit may be more difficult to diagnose. This necessitates clinical examination for a primary tumour and also X-rays and nuclear bone scanning. If in doubt a trephine or needle biopsy of the vertebra may be necessary.

Treatment depends on the causative factor, but will often include back extension exercises and a suitable brace. Specific treatment may include deep X-ray therapy or occasionally spinal decompression for secondary deposits plus antibiotics for infection.

Congenital abnormalities

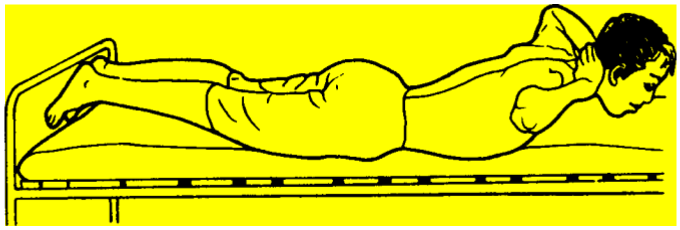
True congenital causes of a kyphosis are due to a defective development of the vertebrae and are uncommon. If symptomatic they may require back exercises, spinal support and occasionally an arthrodesis of the spine.

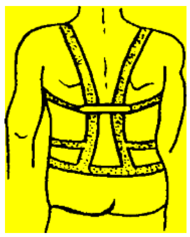
Neoplasia

Neoplastic causes of a kyphosis or a kyphos are almost always due to a secondary rather than a primary tumour. Treatment usually necessitates deep X-ray therapy plus a back support. Hormones or chemotherapy where indicated may be necessary, and occasionally anterior decompression and stabilisation for neurological compression.

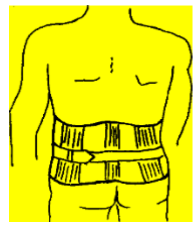
Kyphosis - Treatment

Back exercises

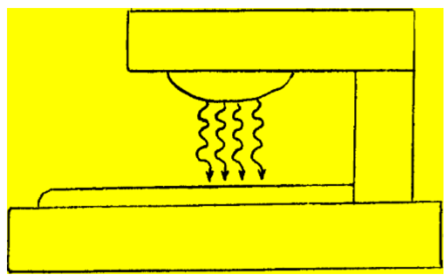




Taylor brace



Lumbar support



Deep X-ray therapy for secondary deposits

Trauma

Fractures of the thoracic and lumbar vertebrae can be either stable or unstable. The stable fractures are not usually associated with paralysis, and both the infraspinous and the supraspinous ligaments are intact.

Treatment is bed rest with back extension braces for about 1–2 weeks. This is followed by support in a lumbar corset which may occasionally extend up to the chest, such as a Taylor brace. The patient will be required to continue with back exercises such as swimming.

Unstable fractures are usually associated with some neurological damage together with rupture of the supraspinous and interspinous ligaments. Unstable fractures in the thoracolumbar region may require external stabilisation with rods or cables. Most cases associated with complete transection of the cord are treated conservatively with two hourly turning on a water- bed. Attention to paralysed limbs to prevent contractures and bed sores is essential, as well as sterile catheterisation of the bladder to minimise infections and facilitate an automatic or autonomous bladder (see Part 2).

A burst fracture of the lumbar vertebrae may cause pressure on the cauda equina requiring urgent decompression.

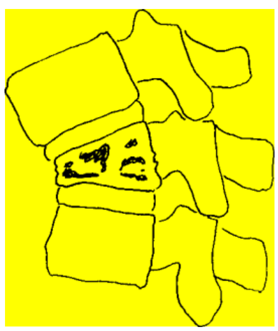
Infection

Infective causes of a kyphosis include a discitis (infection of a disc) due to a pyogenic organism introduced by lumbar puncture or by blood stream spread. Tuberculosis may also cause severe destruction of more than one vertebra with paraplegia or occasionally quadriplegia. These conditions are discussed in more detail in Chapter 9.

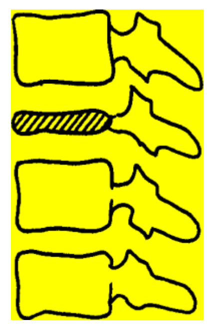
Kyphosis and Lordosis

Summary of Causes

Neoplasia



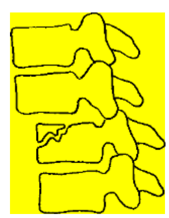
X-ray of a metastatic deposit



X-ray of an eosinophilic granuloma

Trauma

X-ray of a stable vertebral fracture



X-ray of an unstable vertebral fracture

Osteoporotic collapse

This commonly involves several vertebrae, more commonly in the thoracic than the lumbar spine. Back pain and a kyphosis is common, but neurological involvement is rare.

Treatment includes rest plus heat and a spinal support. An adequate diet, with sufficient calcium and vitamins, swimming, and back extension exercises, are essential.

Paget's disease

Paget's disease (Chapter 12) may lead to a gradual increasing kyphosis due to the anterior wedging of the thoracic vertebrae. There will usually also be other evidence of Paget's disease. The management is conservative with analgesics plus calcitonin in severe cases together with back exercises and sometimes a back support.

Scheuermann's disease

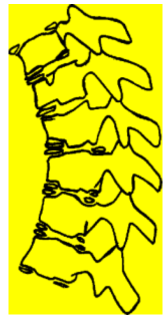
This condition usually develops in adolescence and affects the bodies of the thoracic and, to a lesser extent, the lumbar vertebrae. It may be due to trauma to the ring epiphyses of the vertebrae with resulting protrusion into the adjoining vertebral bodies.

There is usually back pain with limitation of spinal movements, particularly rotation, with the development of a smooth kyphosis, mainly in the mid thoracic region. X-ray shows mild wedging of several vertebrae with slight irregularity and herniation into the vertebral bodies, particular-

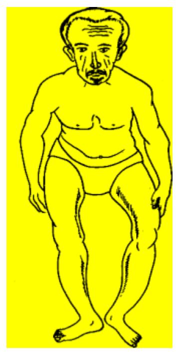
Kyphosis and Lordosis

Summary of Causes

Scheuermann's disease



X-ray of Scheuermann's disease



Paget's disease

421 **Neurological and Spinal Conditions**

Back Pain

Congenital abnormalities

Any defect in the integrity of the lumbar spine may progress to chronic low back strain especially if precipitated by heavy lifting and trauma. This includes spina bifida, spondylolisis and spondylolisthesis, spinal stenosis and congenital vertebral defects. These are all discussed in more detail under individual headings.

Neoplasia

Primary neoplasms of the lower spine are uncommon but include soft tissue neoplasms such as neurofibromata and bony neoplasms such as aneurysmal bone cysts and eosinophilic granulomas.

Secondary neoplasms are much more common, particularly from breast, lung, thyroid, kidney, prostate and uterus and these are discussed in Chapter 8. They may involve the sacrum, femora and other bones as well as the lumbar spine.

Pelvic neoplasms may cause referred back pain. These include prostate, bladder, uterine and rectal malignancies. A rectal examination is therefore important where this is indicated, as is examination of the abdomen to exclude gastrointestinal and genitourinary neoplasms.

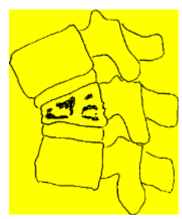
Trauma

This includes spinal fractures and ligamentous injuries. In many cases recurrent minor trauma, particularly twisting strains and heavy lifting may precipitate an acute episode of 'lumbago' with muscle spasm and referred pain into the buttocks and backs of the thighs. Degenerative changes in the facet joints due to repeated injuries may lead to osteophyte

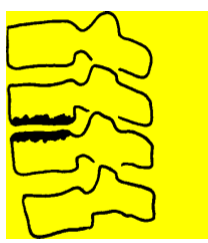
Back Pain

Summary of Causes

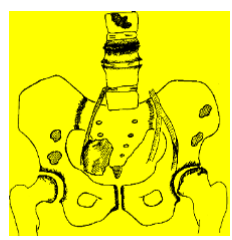
X-ray of spondylolisthesis



X-ray of vertebral metastases



X-ray of spinal infection



Pelvic causes

formation and limitation of back movements. Recurrent episodes result in increased stiff- ness and wasting of muscles.

X-ray may show disc degeneration and osteophyte formation, and treatment is usually conservative with back exercises, short wave diathermy, and sometimes a lumbosacral corset. Occasionally arthrodesis of the lumbar spine may be necessary. Associated sciatic nerve irritation may need specific management (see below).

Coccydynia results from trauma to the coccyx, most often following a fall. Occasionally the coccyx may be fractured. Sitting on a soft cushion is usually all that is necessary, but injection of long acting local anaesthetic may be required for persistent pain.

Infection

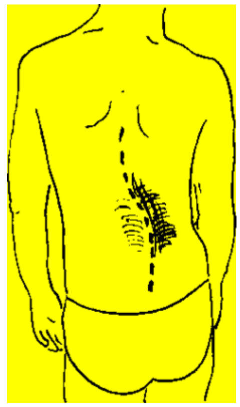
Infection of the lumbar spine usually involves a disc space initially. It may occasionally also affect the sacroiliac joint. Infection is discussed further in Chapter 9. Pelvic infections are common, especially of the bladder, prostate and female genital tract, and may cause referred low back pain. Retroperitoneal infection may also lead to low back pain.

Prolapsed intervertebral disc

Prolapse of an intervertebral disc usually occurs in the L4/5 or L5/S1 intervertebral disc regions and is most often seen on only one side but may be bilateral. It may occur in other regions, especially at the L3/4 level, and occasionally disc protrusion may occur at more than one level simultaneously. It is often due to degeneration of the disc and therefore occurs most commonly in middle or old age.

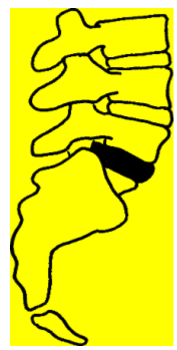
Degeneration of the annulus fibrosus allows the nucleus pulposus to herniate through

Prolapsed Intervertebral Disc



Muscle spasm and compensatory scoliosis

X-ray of L4 disc prolapse



X-ray of L5 disc prolapse

a rent in the annulus. Protrusions at the L4/5 level will thus compress the L5 root, while protrusions at the L5/S1 level will compress the first sacral root. Occasionally the protrusion is central, pressing on the cauda equina-affecting autonomic control of the bowel/bladder leading to bowel/urinary retention, saddle anaesthesia, foot drop. Urgent MRI, then surgical decompression of the cauda equina is required as an emergency.

So, most disc ruptures protrusions/herniations are poster-lateral, where post. long. lig is weakest, and so affect the transversing nerve root (L4/5 affects L5).Far lateral/foraminal stenosis, affect the exiting nerve root(L4/5 affects L4)

Symptoms and signs of prolapsed intervertebral disc

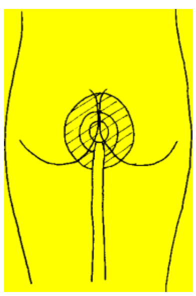
The classic symptom is low back pain with radiation of severe pain down the back of the leg to the ankle and foot. It may be associated with neurological signs such as motor and sensory loss and occasionally bladder involvement. There may be a history of previous episodes of back pain and sciatica or of a previous injury.

Protrusion of the L4/5 disc may cause L5 root pressure with pain radiating down the leg to the dorsum of the foot. There may be numbness on the outer side of the calf and medial two- thirds of the dorsum of the foot with weakness of dorsiflexion, particularly of the foot and toes. There is often associated spasm of the spinal muscles with tenderness over the lower lumbar spine on the side of the lesion. The muscular spasm may produce a scoliosis. Limitation of lateral flexion of the lumbar spine to the same side will be most marked with a protrusion lateral to the nerve root, while limitation of lateral flexion to the opposite side will be most marked with a protrusion medial to the nerve root.

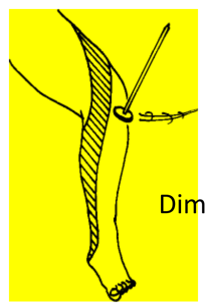
Protrusion of the L5/S1 disc will press on the S1 nerve root and may lead to pain and numbness on the outer side of the foot and under side of the heel. There may be weakness of both eversion and plantarflexion of the foot with a diminished or absent knee jerk.

Prolapsed Intervertebral Disc

Sensory and Motor Deficit



Central disc protrusion

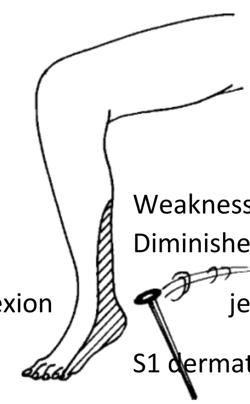


Diminished knee jerk

L4 dermatome (L3/4disc)

Weakness in dorsi-flexion

L5 dermatome (L4/5disc)



Weakness of plantarflexion Diminished ankle jerk

S1 dermatome(L5/S1 disc)

Protrusion of the L3/4 disc may cause pressure on the L4 nerve root and may lead to numbness over the front of the knee and leg with diminution of the knee jerk and weakness of the knee extensors.

Central protrusion of a lower lumbar disc can press on the cauda equina and lead to urinary retention. On examination there is usually perianal numbness and a patulous anus. Emergency decompression is essential to avoid permanent damage to sphincter innervation.

Disc protrusions at other levels are less common. Occasionally pressure on the cord itself at a higher level may cause paraplegia, or quadriplegia.

The differential diagnosis of lumbar neurological compression includes the various causes of low back pain (see above) as well as the causes of localised nerve root pressure. These include secondary tumours and multiple myeloma of the lumbar spine which usually cause vertebral destruction with sparing of the discs. Fractures and infections of the spine may also cause nerve root and spinal cord compression.

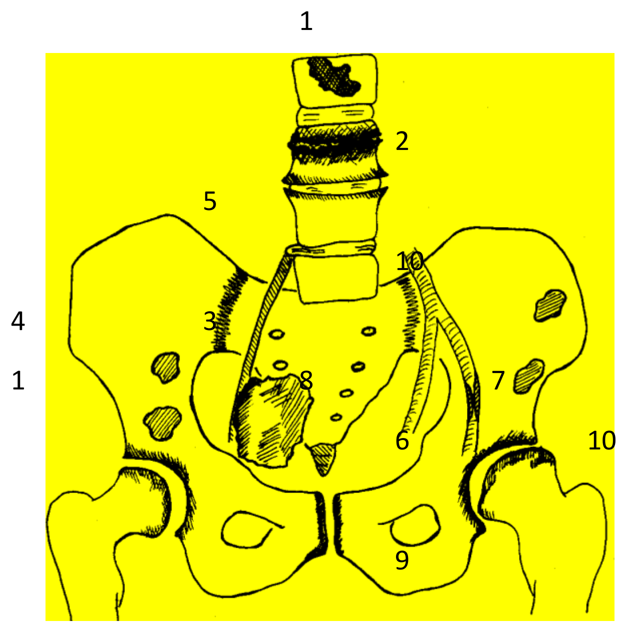
Miscellaneous conditions

Pathology involving thoracic abdominal or pelvic viscera may produce referred spinal pain, which at times may be the first, or even only, sign of disease. Thoracic and upper abdominal pathology tends to produce pain in the thoracolumbar legion, lower abdominal diseases in the lumbar region, and pelvic diseases tend to refer pain to the sacral region. On examination there are often no signs of actual spinal pathology i.e., there is little stiffness and there is a full range of movement. Peptic ulceration, gastroduodenal tumours, pancreatitis and cholecystitis may all produce back pain, as may retroperitoneal pathology such as lymphomas or an abdominal aortic aneurysm.

UPDATE, 2022. Lumbar spine disc rupture, >90% with back + leg pain recover in 1-3 mths. If symptoms persist at 6 wks. do MRI. Surgery asap where cauda equina. Otherwise surgery, partial discectomy/ laminectomy where symptoms progressive at 12 wks.

Back Pain

Summary of Causes in the lumbar spine and pelvis



1. Secondary deposits

2. Low back strain

3. Prolapsed disc

4. Ankylosing spondylitis5. Trauma

6. Coccydynia

7. Vascular

8. Pelvic tumour

9. Gynaecological

10. OA

pain may result from colonic conditions such as colitis, diverticulitis or colorectal neoplasms. Sacral pain is usually a result of urologic or gynaecological diseases. Uterine malposition (e.g., retroversion) and dysmenorrhoea may produce sacral pain, but the latter is usually poorly localised and has a wide radiation. Endometriosis and endometrial carcinoma are other possible causes of sacral pain, particularly where there is local invasion.

Senile osteoporosis* or poor muscle tone due to obesity or lack of exercise may also lead to chronic low back pain.

Unequal leg lengths due to a tilted pelvis, deformed hip, knee or ankle or true shortening of a leg will also, if left uncorrected, cause low back strain and chronic back pain. High heeled shoes may also cause low back strain, particularly in those unaccustomed to wearing them.

Treatment of chronic low back pain

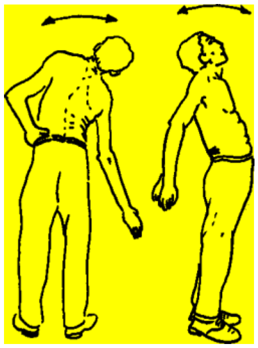
The management of low back pain includes treating both the causes and the effects.

Apart from analgesics and non-steroidal anti- inflammatory medication, the optimum treatment consists of bed rest on fracture boards to ease the initial pain. The mattress should be supported by fracture boards with the knees slightly flexed over one or two pillows. This

is followed by an exercise program to strengthen the back muscles together with heat. Education regarding sitting, lying and lifting is essential and swimming is the most effective long term exercise. Occasionally a lumbosacral corset, worn while the patient is working or travelling, will help relieve the pain. Pain relief is best achieved by mobilising the spine and strengthening the back muscles. Manipulation under anaesthesia may also be indicated in chronic cases without sciatic compression.

*Note transient osteoporosis of the hip, pregnant women or 50 yr. olds, see on XR, MRI, spontaneously recovers.

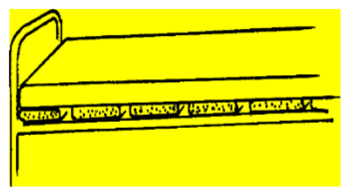
Back Pain - Treatment



Physiotherapy

Heat

Local anaesthetic spray and extension exercises



Fracture boards

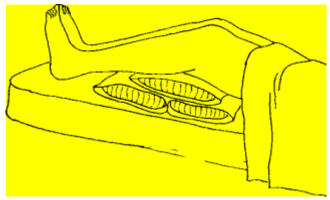
In the case of sciatic irritation due to a prolapsed disc, skin traction of about three to four kilograms on each leg, or alternatively, pelvic traction, will help to distract the lumbar vertebrae and increase the size of the intervertebral foramina, thus relieving the pressure on the nerve. It may be necessary to continue this for two or three weeks, and the patient should be gradually mobilised with a lumbosacral brace. Occasionally an epidural injection of local anaesthetic and steroids will alleviate the symptoms.

In over 90% of cases, conservative management is successful and operation can be avoided. It is essential, however, that patients build up weak extensor muscles of the spine and regularly exercise the spine. Swimming in a warm pool is probably the best form of exercise. Education regarding lifting, sitting and the benefit of a regular exercise program is also essential (Chapter 6).

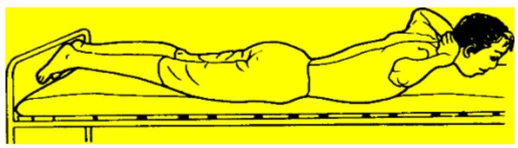
Although most cases will respond to conservative measures, the indications for operation include cauda equina lesions (emergency decompression), and progressive or unresponsive lesions with appreciable neurological signs despite conservative management.

In acute lesions, injections of chymopapain is sometimes used in attempts to dissolve the disc. This may fail and sensitivity re- actions sometimes occur. Excision of the disc can be performed by open laminectomy or by a nucleotome. The latter is removal of the disc through a scope like an arthroscope. In some cases, an arthrodesis of the spine may be indicated for severe back pain, or for the potential instability due to an extensive laminectomy.

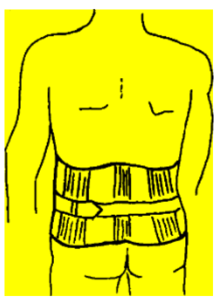
Back Pain – Treatment*



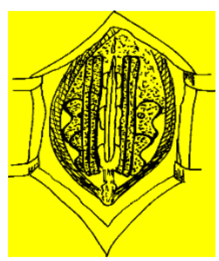
Bed rest and supports



Spinal exercises



Lumbar corset



Laminectomy or arthrodesis

*Epidural
abscess. Rare. Un
well. In IV drug
uses, immune suppressed
Do
MRI. Drain asap.

*Spinal TB-in
vert. body, discs
preserved.
TB drugs, correct
deformity.

Pelvic and Sacral Conditions

Congenital abnormalities

Congenital abnormalities of the pelvis itself are uncommon but an ectropion may occur in which there is a defect in the front of the pubis so that the bladder opens on to the front of the lower abdomen.

Defects of the acetabulum may occur with congenital dislocation of the hip or conversely with protrusio acetabuli where the hip is inserted more deeply than normal into the pelvis.

Neoplasia

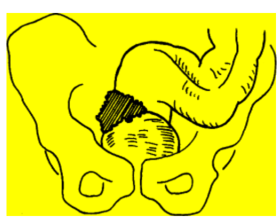
Primary tumours which occur are mainly osteochondromas or enchondromas and these may occasionally undergo malignant change to a chondrosarcoma. Giant cell tumours and other primary tumours are even less common.

Secondary tumours are relatively common, and have often arisen from primary tumours in the breast, lung, thyroid, kidney, prostate or uterus. Such tumours are usually treated conservatively with deep X-ray therapy, together with hormones or chemotherapy if appropriate. Almost all other primary tumours can result in secondary spread to the pelvis.

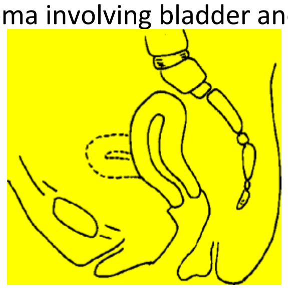
Trauma

Fractures of pelvis are common. Shear (vertical force) fractures may be associated with sciatic nerve palsy. Fractures of the pubic ramus may cause rupture of the bladder or membranous urethra.

Pelvic and Sacral Conditions



Carcinoma involving bladder and rectum



Retroflexed uterus

Infection

Pyogenic arthritis of the hip occurs mainly following internal fixation of hip fractures or hip replacements. Infections of the sacroiliac joint by pyogenic organisms or Mycobacterium tuberculosis are very uncommon.

Arthritis

Degenerative (OA)

There may be secondary degenerative OA in joints previously affected by ankylosing spondylitis.

Miscellaneous conditions

Paralysis

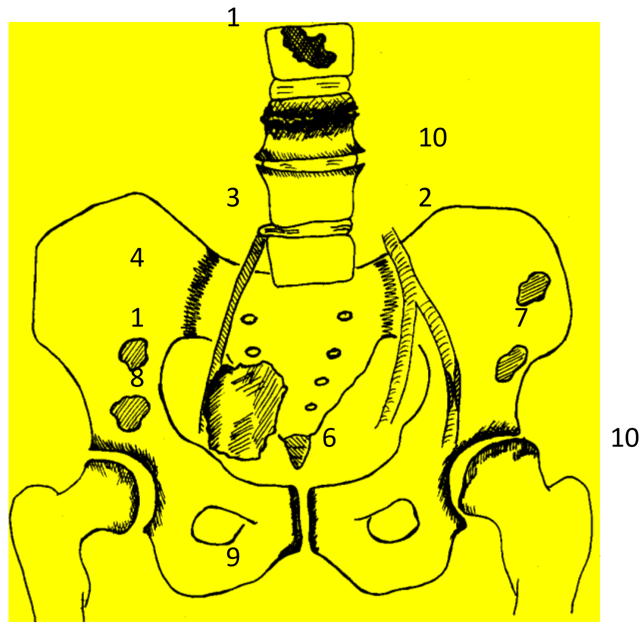
In poliomyelitis and some other paralytic conditions in childhood, such as meningomyelocele, the pelvis on one or both sides may be small or poorly developed.

Coccydynia

Coccydynia is a very painful condition usually resulting from trauma to the coccyx. There is severe tenderness over the coccyx and this is occasionally associated with a fracture.

Treatment is conservative with the patient using a soft foam cushion to sit on. Occasionally an injection of a long- acting local anaesthetic may be required.

Pelvic and Sacral Conditions



1. Secondary deposits
2. Low back strain
3. Prolapsed disc
4. Ankylosing spondylitis
5. Trauma
6. Coccydynia
7. Vascular
8. Pelvic tumour
9. Gynaecological
10. OA

Peripheral Nerve Lesions

Aetiological Classification

Peripheral neuritis

The many causes include diabetes, alcoholism and toxicity. There is usually sensory loss and burning sensation of the fingers and toes with normal muscle power.

Peroneal muscular atrophy (Charcot–Marie–Tooth disease, CMT)*

Autosomal dominant condition often first presenting in early childhood, clawing and wasting of the intrinsic muscles of the hands and feet and awkward gait. Pes cavus, weakness of the peroneal muscles, loss of proprioceptive sensation below the knees and claw toes. Foot supports, calipers and occasionally operative correction of deformities may be required. Also, lateral ankle instability and later lateral foot pain.

Duchenne muscular dystrophy**

A sex linked recessive pattern of inheritance, in males. Seen when the child begins to walk. Pseudohypertrophy of the calf muscles (fat deposition). Not able to walk by age 10 and will commonly die by the age of 20. Splinting and tendon transfers may help. CPK levels high. Gower's sign +ve.

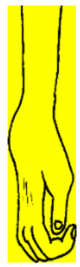
Friedreich's ataxia

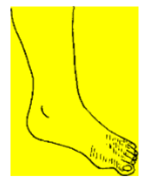
This is an autosomal recessive disorder (the Frataxin gene, GAA repeat at 9q13) with progressive degeneration of the posterolateral columns of the spinal cord and part of the cerebellum. The child has an ataxic gait as well as clawing and varus deformity of the feet.

** walk-up their thighs to get up from the floor indicating quads weakness (Gower's sign).

Peripheral Nerve Lesions

Tooth disease Peripheral

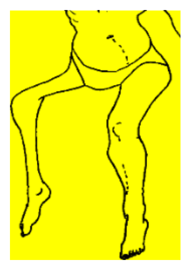




neuritis

*CMT, autosomal dominant and variable inheritance. Defect in gene responsible for peripheral myelin protein22,(PMP 22).

For oral exams, relative will be placed behind patient as hint for you.



Poliomyelitis

Poliomyelitis

Poliomyelitis is a paralytic condition caused by one of three types of viruses leading to the disruption of the anterior horn motor cells of the spinal cord and basal ganglia. It usually occurs under the age of 5 years.

A febrile illness may be followed by a flaccid, asymmetrical paralysis with normal sensation. Occasionally respiratory and bulbar palsy may result in death.

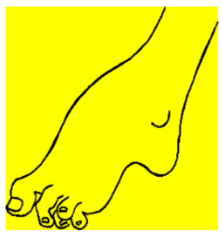
Prophylaxis is with the Sabin oral live, attenuated vaccine given at 2, 4, and 6 months of age with a booster at school age. A booster dose should also be taken by those under 40 visiting countries in the tropics and subtropics where large epidemics are still occurring in the 1990s. In these countries there are still many millions of untreated paralytic patients. In economically developed countries most polio patients were paralysed 30–40 years ago in infancy and most will require renewal of calipers and other splints for the rest of their lives. Occasionally increasing weakness in middle and old age will require further treatment.

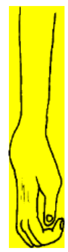
Bulbar palsy usually resolves, but the asymmetrical flaccid paralysis in severe cases may lead not only to a flail limb, but also to contractures due to the unbalanced muscle action. The lower limbs are often more severely affected than the upper limbs with the extensors of the hip, knee and ankle being more often affected than the flexors resulting in a flexion contracture of the hip, knee and ankle. The lack of muscle bulk in a growing child will also lead to hypoplasia and shortening of the affected limb.

In the upper limb the deltoid, triceps and thenar muscles are commonly affected. In the trunk, scoliosis is common as well as respiratory paralysis.

Poliomyelitis*

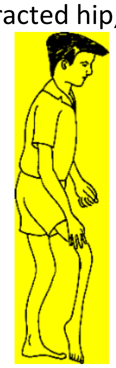
*RLH was a world authority on the surgical management of polio **victims from his work in Uganda**.





Pes cavus and toe clawing   Clawing of hands

Wasted, contracted hip, knee and ankle.



Recovery will only occur in the first few months of paralysis and residual paralysis of the lower limbs may necessitate calipers to enable the patient to walk.

Soft tissue fasciotomies and tendon transfers may be required to allow a caliper to be fitted or dispensed with. An osteotomy or arthrodesis may be necessary to correct a deformity. Appropriate tendon transferoperationsmayenableapatienttowalkwithoutasupport.Insevereparalysisofboth lower limbs the patient must have adequate power in the arms to use crutches before lower limb operations are performed. Shortening is common. Leg equalisation operations may be required.

In the upper limb arthrodesis of a flail shoulder, where the patient has a functional hand, may be indicated, as will tendon transfers in selected patients.

A very weak trunk with scoliosis may require a supporting corset to enable a patient to sit unsupported. Extensive arthrodesis of the spine may prevent a patient with severe lower limb paralysis walking with calipers and should be avoided in most cases.

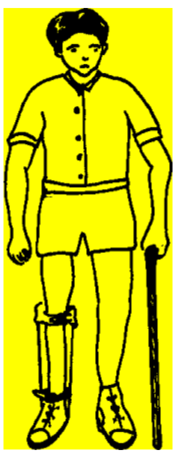
Intensive physiotherapy is usually needed to prevent muscle contractures, to build up partially paralysed muscles and to re-educate a patient in walking.

Complications include dislocations of a hip due to weak abductors and fractures of the thin osteoporotic bones.

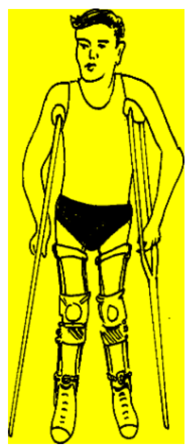
The social rehabilitation of the patient is important, with wheelchairs and other aids for the severely paralysed.

The principles of treatment of polio patients will often apply to other patients with paralysis due to spina bifida, fractures, strokes.

Poliomyelitis -- Treatment



Polio patient with caliper and stick



Polio patient with calipers and crutches

Polio patient in a wheelchair

UPDATE, 2022. Postpolio Syndrome. is a new wave of progressive weakness, a "burnout" of the alpha motor unit which has expanded. Occurs after middle age. Progressive muscle/joint weakness with fatigue. Slowly progresses. Risk factors are severe first disease/slower recover/was adolescent/adult.

Anatomical classification — upper limb

Individual nerve lesions will be discussed in this chapter whilst the diagnosis and assessment of peripheral nerve lesions in general is discussed in Chapter 2.

Brachial plexus

The brachial plexus extends from spinal cord segments C5 to T1 and may be damaged by trauma. Damage to roots C5 and C6 will lead to paralysis of the deltoid and external rotators of the shoulders. The arm is held in internal rotation and extension (waiter's tip position, or Erb's palsy).

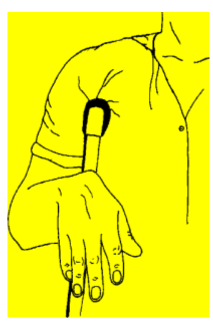
Damage to the lower roots (C7, 8, and T1)leads to a flexed elbow due to paralysis of the triceps and a weak hand due to paralysis of the small muscles of the hand (T1 innervation).

A complete brachial plexus lesion will lead to a flail, wasted arm held in extension and internally rotated with complete sensory loss.

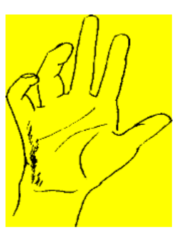
The extent of sensory loss in partial lesions of the brachial plexus is also illustrated in Chapter 2.

In adult life the most common causes of brachial plexus injuries are motorcycle accidents with falls on the point of the shoulder. In most cases the prognosis is very poor, especially with high complete lesions.

Upper Limb Nerve Lesions



Radial nerve palsy



Ulnar nerve palsy

Median nerve palsy

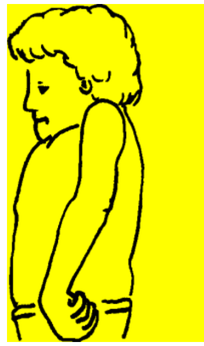
Investigations include X-rays and CT scans of the cervical spine and sometimes a myelogram or MRI scan to show tears of the nerve roots from the cervical cord. Electrical conduction studies should be delayed until at least three weeks after injury to allow for settling of the spinal shock. Treatment initially consists of relaxing the brachial plexus with a splint in about 60½ of abduction. Steroids may also be given to reduce oedema of the nerve roots. There may also be an indication for operative exploration and repair of a post-axonal (low) lesion, but this is often very difficult and the prognosis poor.

Late management of partial lesions which do not recover with conservative treatment, such as physiotherapy, may require operative treatment. This usually entails tendon trans- fer and occasionally arthrodesis of the wrist or the use of supports. In complete lesions with a flail arm and absent sensation, an above elbow amputation with arthrodesis of the shoulder is usually the treatment of choice, followed by the fitting of an artificial arm, provided the trapezius, rhomboids and other muscles have adequate power to move the scapula.

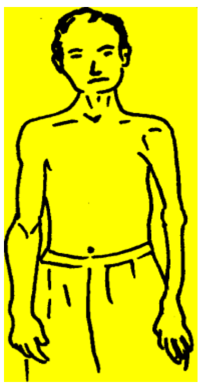
Axillary (circumflex) nerve palsy

The axillary nerve may be damaged in fractures and dislocations of the shoulder and upper humerus. There is numbness over the deltoid insertion as well as paralysis of the deltoid. The inability of the patient to abduct the arm may be due to paralysis of the deltoid or merely due to pain or the dislocation. Most cases of closed injuries recover, but an abduction splint and physiotherapy may be required.

Brachial Plexus Lesions



Erb's palsy showing 'waiter's tip' position



Diagnosis

1. Altered nerve response to electrical stimulation

2. Absent or diminished sensation and sweating

3. Flail or weak arm

Radial nerve lesion

A high radial nerve palsy may be due to pressure on the nerve in the axilla by pressure from crutches that are too long.

The usual site of a radial nerve palsy, is however, in the mid humerus and is due to a fracture with pressure on the nerve in the spiral groove.

Occasionally a fracture or dislocation at the elbow may cause a low lesion of the radial nerve, affecting mainly its distal branch, the posterior interosseous nerve.

High lesions usually result in a complete wrist drop together with inability to extend the metacarpophalangeal joints. The interphalangeal joints can, however, be ex- tended by the interossei and lumbricals (sup- plied by the ulnar and median nerves). There is also associated numbness over the base of the thumb and the back of the hand.

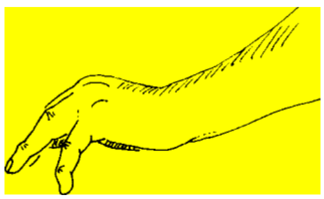
Low lesions of the posterior interosseus nerve below the long extensors of the wrist may result in paralysis of extensors of the metacarpophalangeal joints with extension of the wrist intact.

Most closed lesions of the radial nerve are incomplete and over 80% will recover without operation.

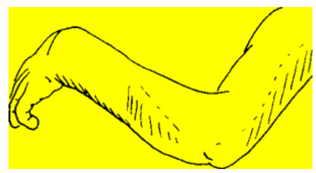
Investigations include electromyographic and nerve conduction studies, but these are of little value until at least 3 weeks after the injury.

Initial treatment consists of a cock-up splint for the wrist combined with springs to maintain extension of the metacarpophalangeal joints (lively splint).If a complete division of the nerve is suspected early exploration and microsurgical repair should be carried out. Occasionally nerve grafting may be required. If recovery does not occur tendon transfers, combined with an arthrodesis of the wrist, may be indicated.

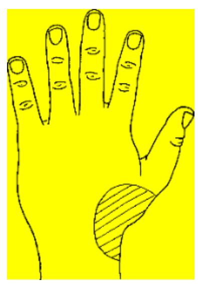
Radial Nerve Lesion



Low level nerve injury

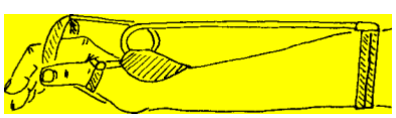


High level nerve injury

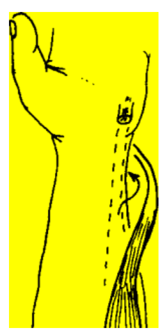


Sensory deficit

Treatment



Splint



Arthrodesis and

Ulnar nerve lesion

The ulnar nerve is injured commonly at the elbow. It may, however, sustain an open injury elsewhere in its course. Examination of the ulnar nerve is described in Chapter 2.

The nerve supplies all the small muscles of the hand except for the muscles of the thenar eminence and the lateral two lumbricals. In addition, it supplies the long flexors of the fingers, except for those to the thumb and forefinger which are supplied by the median nerve but there is often an overlap. The ulnar nerve also supplies the sensation to the ulnar one and one half fingers and to the ulnar side of the hand.

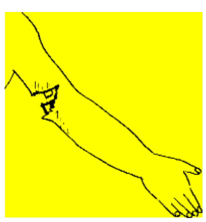
The ulnar nerve at the elbow may be damaged by blunt trauma to the elbow causing a neuropraxia (concussion) or an axonotmesis (damage to the axon continuity). Fractures round the elbow, operations and open injuries may completely sever the nerve

(neurotmesis). In addition, an old fracture of the lower humerus, particularly a supracondylar fracture in a child, may cause epiphyseal damage with an increasing valgus deformity of the elbow. This can lead to a late (tardy) nerve palsy due to gradual stretching of the nerve over the medial condyle.

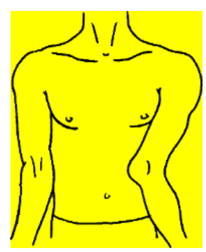
At the wrist a fracture on the ulnar side of the lower ulna, pisiform or hamate may cause nerve damage or compression, as may a synovitis in conditions such as RA.

In open injuries microvascular repair is indicated. The nerve should be transferred anterior to the medial condyle and usually deep to the flexor muscle origin. Neurolysis or freeing of the nerve alone may also be required in late palsy.

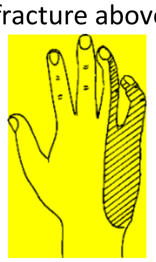
Ulnar Nerve Lesion



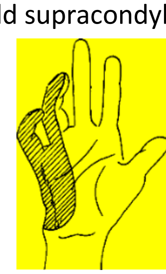
Compound fracture above the elbow



Old supracondylar fracture



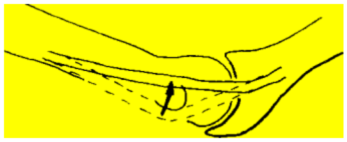
Dorsum

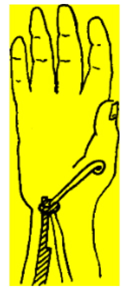


Palm

Sensory deficit

Treatment





Anterior transfer of nerve   Tendon transfer at the elbow

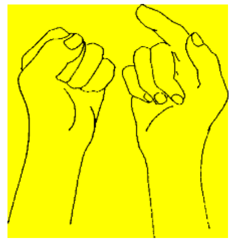
Median nerve lesion

The median nerve may be divided at the elbow, in the forearm or at the wrist. High lesions will affect the nerve supply to the long flexors of the thumb, index finger, and to a lesser extent the middle fingers. The thenar muscles, except adductor pollicis, together with the lumbrical muscles to the forefinger and ring finger, are also paralysed. This will result in a loss of flexion and the pointing index finger. There will also be associated numbness over the thumb, index and middle fingers, and half the ring finger together with two-thirds of the palm.

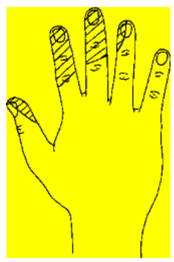
Median nerve compression at the wrist may occur due to compression in the carpal tunnel when it is narrowed in the front of the wrist. This narrowing may occur not only in fractures and arthritis of the wrist, but also following soft tissue oedema in RA and in pregnancy. Decompression by division of the flexor retinaculum will often lead to a dramatic and complete recovery.

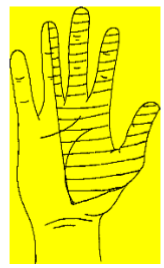
Repair of a divided median nerve is best carried out by microsurgical techniques except where there is a dirty wound, in which case wound healing should first be achieved. There is occasionally a place for replacing a nerve defect by cable grafting from a cutaneous nerve. In cases where recovery does not occur, tendon transfers may be indicated to restore flexion of the forefinger and opposition to the thumb. In assessing recovery, the time of regeneration to the nearest muscle endplate is 1mm per day. Electromyographic and nerve conduction studies can also assess recovery.

Median Nerve Lesion



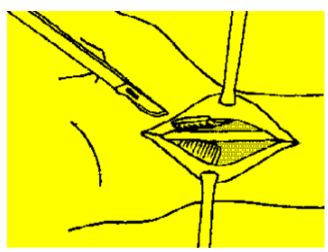
Testing for motor weakness





Dorsum Palm Sensory deficit

Treatment



Exploration and microsurgical repair

Digital nerve division

Digital nerve division is usually caused by direct injury. Suture by microsurgery is indicated where a significant disability will result, such as nerve division on the radial side of the index finger or both sides of the thumb.

Sudek's atrophy (Reflex sympathetic dystrophy)

This is probably due to an autonomic nerve dysfunction, and is usually associated with severe fractures of the upper limb. It may also occur following a stroke or myocardial infarction.

The patient will often have trophic skin changes and severe hyperaesthesia (hypersensitivity) of the skin. Discolouration, sweating, joint deformities and stiffness are common. Radiological investigation may show marked osteoporosis and a bone scan increased vascularity.

Treatment is difficult and includes sup- ports to prevent contractures, ice packs and physiotherapy. Sympathectomy by injections of chemicals or by operative division have a limited place and may also cause complications.

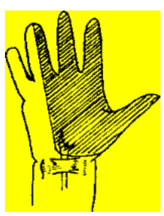
Nerve entrapment

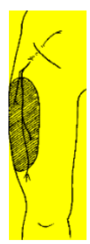
Bone or soft tissue may press on nerves where they traverse fibro-osseous sheaths. This may be due to overuse, to previous fractures, or synovial swelling as occurs in RA and pregnancy. The most common sites are the carpal tunnel of the wrist (median nerve), and medial epicondyle of the elbow (ulnar nerve). The lateral cutaneous nerve of the thigh under the lateral end of the inguinal ligament, the common peroneal nerve at the neck of fibula and the posterior tibial nerve behind the medial malleolus may also be compressed. Decompression may lead to rapid relief of symptoms.

Other Nerve Injuries Digital nerve

Laceration causing digital nerve damage

Nerve entrapment





Wallerian degeneration for axonotmesis and neurotmesis. Do peripheral n. repair within 14 days. Brachial plexus injury-observe for 3 mths.

Preganglionic (Horner's syndrome, scapular winging (long thoracic n., rhomboids) motor deficits with intact sensory, Do EMG (check paraspinals) and CXR (elevated hemidiaphragm). Nerve transfers and tendon transfers (several mths) best done in specialized units.

Anatomical classification — lower limb

Cauda equina

Damage to the cauda equina is often a surgical emergency as it usually causes bladder paralysis with retention or incontinence as well as weakness of the lower limbs.

The most common cause of paralysis is damage from a fracture of the lumbar spine or from central prolapse of an intervertebral disc. Damage, however, may also occur in spondylolisthesis, spina bifida, or as a complication of secondary deposits in the lumbar vertebrae. Neuro- fibromatosis and spinal infections may also cause paralysis.

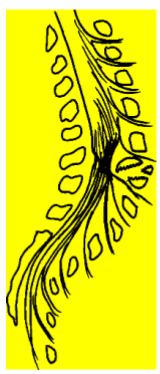
The diagnosis is on clinical grounds and one or more of the following may be present: perianal numbness, a patulous anus, variable degrees of paralysis and urinary retention. Investigations should include a CT or MRI scan as well as X-rays.

Treatment may involve a laminectomy and decompression as a matter of urgency in most cases.

Lumbosacral plexus

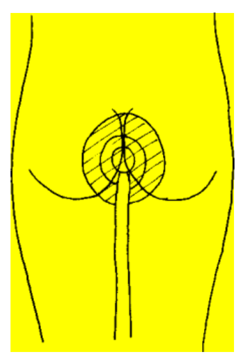
Fractures and dislocation of the lower lumbar vertebrae and sacrum, or the posterior part of the pelvis, may cause damage to the lower lumbar and upper sacral nerve roots. These may occasionally require operative decom- pression, but most cases are treated with bed rest followed by a lumbosacral support.

Cauda Equina Lesions



Cauda equine trauma

Bladder paralysis



Sensory loss

knee and upper fibula.

The posterior tibial nerve may also be damaged in knee injuries and can be trapped under the retinaculum posterior to the medial malleolus, especially in ankle fractures.

Treatment of sciatic, posterior tibial and common peroneal nerve injuries varies from neurolysis at the greater sciatic foramen, over the neck of the fibula, or behind the medial malleolus, to microsurgical repair.

In posterior tibial and complete sciatic nerve injuries, sensory loss may necessitate special footwear to prevent sores under the heel. Foot drop may require a caliper or splint to support the foot with the addition of a toe raising spring.

In certain cases of incomplete paralysis, tendon transfers may be indicated to balance the foot. Tibialis posterior and anterior, the peroneal muscles and extensor hallucis longus are all suitable for tendon transfers provided their power is at least 4.

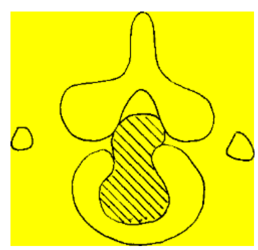
In complete foot drop a triple arthrodesis of the subtaloid joints may enable the patient to walk without a caliper.

Investigation of sciatic nerve lesions

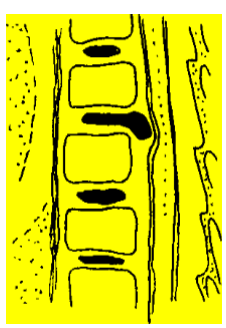
A full history and clinical examination is essential. This includes examination of the spine and a full neurological assessment, together with a full examination of the rest

Investigation of Sciatica

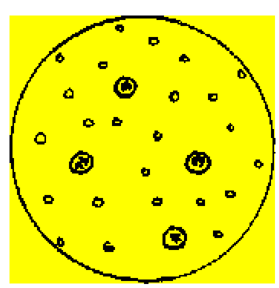
X-ray of spondylolisthesis



CT scan of a prolapsed disc



MRI scan of a prolapsed disc



Haematological investigations

of the patient, including an abdominal and a rectal examination. Carcinoma of the prostate, bladder, uterus or rectum are relatively common causes of low back pain and sciatica. Radiological examination of the lumbar spine should include a localised lateral X-ray of the lumbosacral disc spaces and also an oblique view of the lumbar spine if a spondylolisthesis is suspected. In the past, myelograms and discograms were performed, but these have now been superseded in many cases by computerised tomograms (CT) and, where necessary, by magnetic resonance im- aging (MRI).

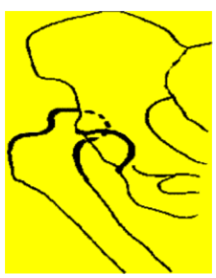
Occasionally a nuclear bone scan is indicated to assist in the diagnosis of neoplasms and infections.

Investigations should include a full blood count, as well as serum proteins (multiple myeloma), and acid and alkaline phosphatase (carcinoma of the prostate or multiple secondaries respectively), where indicated.

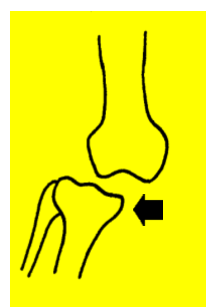
Serum agglutinins for salmonella and brucella may occasionally be indicated.

Other investigations may include urine analysis and X-rays of chest or pelvis if tuberculosis is suspected, or if there is a possibility of secondary deposits. Very occasionally electrical studies such as EMG and nerve conduction studies may be indicated to assess the level and degree of nerve compressions. These investigations are described in more detail in Chapter 4.

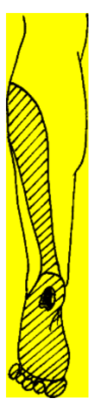
Lower Limb Nerve Lesions



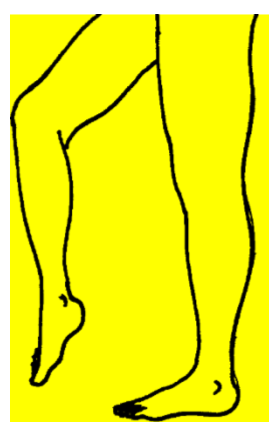
X-ray of a posterior dislocation of the hip



X-ray of a dislocated knee



Tibial nerve palsy



Common peroneal nerve palsy

Common peroneal nerve

As the peroneal nerve winds around the upper part of the fibula, it is usually injured either by a fracture or due to stretching following a dislocation of the knee joint. It may also be injured by direct pressure, for example, if a plaster cast is too tight and occasionally by direct pressure over the nerve following unsatisfactory positioning on the operating table.

The patient usually has a complete foot drop in complete nerve lesions, together with numbness over the medial half of the dorsum of the foot and big toe, and part of the lateral side of the calf.

Treatment is usually conservative with a padded back support or caliper. Occasionally neurolysis or repair and grafting of the nerve may be required.

Patients who do not recover may require a tendon transfer of the tibialis posterior to the dorsum of the foot and occasionally an arthrodesis of the subtaloid joints.

Tibial nerve (Medial popliteal nerve)

The tibial nerve may also be damaged in dislocations of the knee or by open injuries. Examination of the patient may reveal numbness over the heel and sole of the foot. The patient may develop a pressure sore on the plantar surface of the foot as a result of absent or impaired sensation.

There is either partial or complete paralysis of the calf muscles and plantarflexion of the toes. The patient may also develop a cavus foot due to muscle imbalance or paralysis.

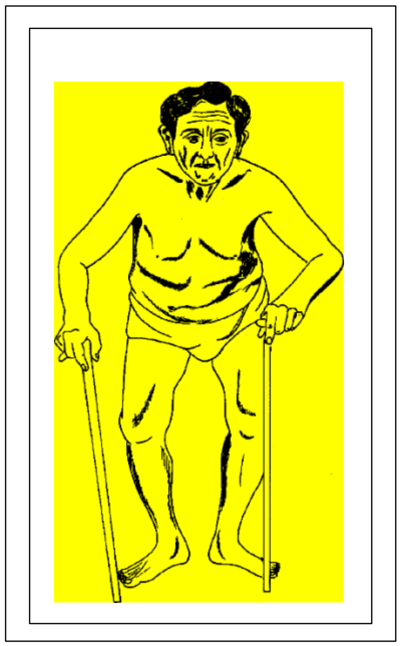
Treatment includes soft footwear to prevent pressure areas, and sometimes skin grafting for ulcers. Weakness of foot plantarflexion may require special splinting to enable the patient to walk.

Chapter 12

Metabolic and Endocrine Bone Disease

Metabolic disorders

Endocrine disorders



Classification

Metabolic disorders

Osteoporosis

Paget's disease

Hyperparathyroidism

Osteomalacia and Rickets

Osteomalacia

Nutritional rickets

Coeliac or gluten-induced rickets

Familial hyperphosphataemia (vitamin D resistant rickets)

Cystinosis (renal tubular rickets)

Osteodystrophy (renal glomerular rickets)

Miscellaneous conditions

Scurvy

Industrial poisons

Mucopolysaccharidoses

Endocrine disorders

Cushing's syndrome

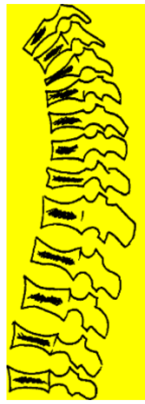
Congenital hypothyroidism (cretinism)

Hypopituitarism

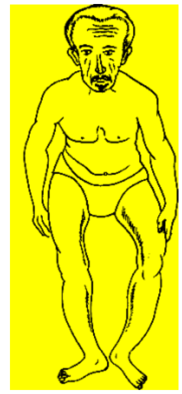
Acromegaly

Gigantism

Metabolic and Endocrine Bone Disease

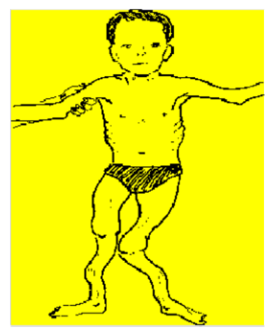


X-ray of osteoporosis



Paget's disease

Facial appearance in Cushing's syndrome



Rickets

465 **Metabolic and Endocrine Bone Disease**

Metabolic Disorders

Senile osteoporosis (Diffuse osteoporosis)

This is a common condition in the elderly, especially in women, but it may also occur in middle age and have a hormonal and nutritional basis. There is diffuse osteo- porosis with thinning of the cortices of the long bones, particularly the vertebrae and femora. As a result of this, fractures of the hip, particularly in the trochanteric region, are common, as are fractures of the lower radius (Colles' fractures) which occur with relatively minor trauma.

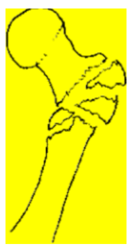
The thoracic spine is often involved with 'ballooning' of the intervertebral discs into the adjacent vertebrae (see illustration). This, together with the generalised osteoporosis, often causes wedging of the vertebrae following minor, or unrecognised, trauma thus producing a gradually increasing kyphosis.

The diagnosis relies mainly on the history and the classical radiological appearance of osteoporosis and is supported by a relatively normal haematological and biochemical profile. This will help to differentiate it from osteomalacia, parathyroid osteodystrophy, secondary carcinomatosis, multiple myeloma and leukaemia. Occasionally trephine or needle biopsy of a collapsed vertebra or a histopathological examination of tissue taken at the time of ORIF of a hip fracture, may be necessary, particularly as osteoporosis and secondary carcinomatosis may co-exist.

The general treatment of the patient should include an adequate exercise programme, especially swimming if possible. Good nutrition is also very important,

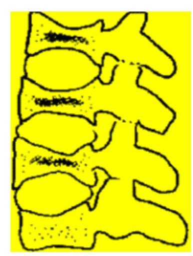
Metabolic Disorders

Senile Osteoporosis



X-ray of an intertrochanteric fracture

X-ray of a Colles' fracture



X-ray of disc ‘ballooning’

including multivitamins and minerals (especially a high calcium diet) as many elderly people have a deficient diet and very little exercise.

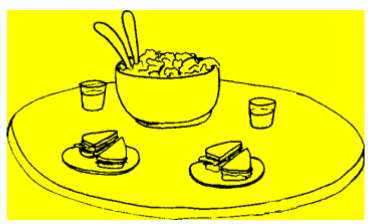
Physiotherapy, heat, and possibly a back support worn during the day, may be beneficial. Fractures of the hip will need internal fixation, with mobilisation of the patient on the day following operation. The patient should be walking within two or three days to minimise the added osteoporosis and other complications occurring in elderly patients with prolonged bed rest.

Fractures which may occur in the elderly are discussed in more detail in Chapter 15.

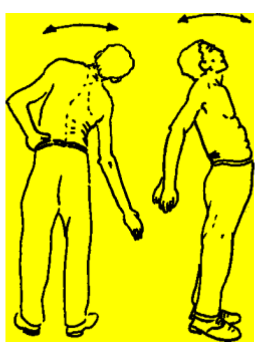
*Further: Rickets-short stature, genu varum, brittle bones. Deficiency of calcium (sometimes phosphorus). Physeal widening, metaphyseal cupping. Is X-linked hypophosphatemic (vitamin-resistant) rickets; defect in cellular endopeptidase (phosphate-regulating neutral endopeptidase. Widened osteoid seams, Swiss cheese trabeculae. Looser's lines.

Senile Osteoporosis — Treatment

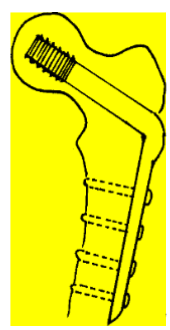
Exercise



Nutrition



Physiotherapy



ORIF of fractures

Paget's disease*(know well for exams)

Paget's disease may affect one or many bones. The cause is unknown but is probably due to a viral infection. It usually occurs after the age of 40. The bones most commonly affected are the skull, humeri, spine, femora and tibiae. They become softened and broadened in the early stages with multiple stress fractures, causing gradual bending and bowing, and sometimes complete fracture of the bone. On palpation the bones are warm, thickened and slightly tender.

The skull gradually becomes larger and the patient requires larger hats due to thickening of the calvarium, particularly in the parietal and occipital region. There may be increasing deafness due to pressure on the eighth cranial nerve.

There is increasing kyphosis and this, combined with bowing of the femora and tibiae, leads to shortening of stature. On X-ray, the whole bone is thickened and bowed with loss of distinction between cortex and medulla. There is widening of the cortex, coarsening of the bony trabeculae with cystic and sclerotic areas giving a spongy appearance. In the early stages the bone is very vascular and because of this high pulse pressure high output cardiac failure may occur. Later this vascularity is replaced with sclerotic areas which may be very hard. Possible com- plications include multiple fractures with delayed healing, OA of the hip and knee, deformity of the pelvis and pressure on the spinal nerves. Osteogenic sarcoma is a rare, but invariably fatal complication.

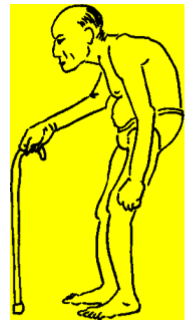
The diagnosis often made on the classical X- ray appearance, and radio-isotope scanning shows markedly increased uptake in the affected bones. The alkaline phosphatase

*UPDATE, 2022. Abnormal bone remodelling, with coarse trabeculae + remodeled cortices. Bisphonates + calcitonin used to retard the osteoclasts. !% form sarcoma (<20% survival).

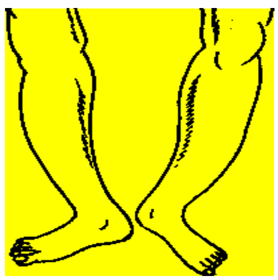
Metabolic Disorders

Paget's Disease

X-ray of a thickened calvarium



Kyphosis



Bowing of the tibia and femur

X-ray of tibial thickening and bowing

level is usually high and the urinary hydroxyproline level is elevated.

In many cases, no treatment is required and despite the severe deformities, there is often only minimal pain. If pain is severe, however, intravenous calcitonin or oral biphosphonates may provide relief, as they reduce bone turnover, but treatment must be prolonged.

Pathological fractures usually require in- ternal fixation, as non-union is common. Bleeding may be severe at surgery, especially in the more acute stages. Added bone graft is important in addition to nails and plates for fractures. Occasionally a total hip re- placement may be necessary. Osteogenic sarcoma is usually treated by palliative amputation and occasionally radiotherapy.

Hyperparathyroidism

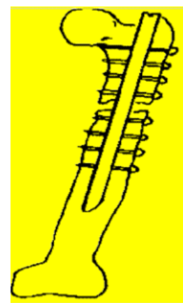
This is usually caused by an adenoma of the parathyroid glands and can also occur in renal failure. The bones become thin with multiple cystic areas (osteitis fibrosa cystica) due to absorption of calcium from the bones and its excretion in the urine. This may lead to pathological fractures, renal calculi or indigestion and generalised weakness.

X-rays show multiple cystic areas in the long bones, the skull shows granular mottling and cystic areas, and there may be cortical erosion in the phalanges. The serum calcium is increased and phosphate diminished while urinary excretion of both is increased. Treatment is the removal of the tumour.

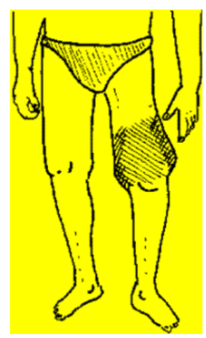
Metabolic Disorders

Paget's Disease

X-ray of a pathological fracture



X-ray of ORIF.



Osteomalacia and rickets*

Rickets is defective calcification in growing bone whilst osteomalacia is the same condition in adults, after the epiphyseal plates have fused.

Osteomalacia

This is similar to nutritional rickets except that it occurs in adults, especially in developing countries and in the elderly. It is due to a deficiency of vitamin D and often calcium in the diet so that calcium is reabsorbed from the bones to maintain an adequate serum level.

The serum calcium is normal or low and the phosphate level is low, whilst alkaline phosphatase readings are usually elevated. Senile osteoporosis is a differential diagnosis but with this, haematological investigations are normal.

Other causes of osteomalacia and rickets include malabsorption syndromes such as idiopathic steatorrhoea where there is deficient absorption of fats, fat soluble vitamin D and calcium.

Nutritional rickets

There is a disturbed calcium-phosphorus metabolism due to defective nutrition and calcium absorption, such as occurs in malnutrition, coeliac disease and various familial genetic defects.

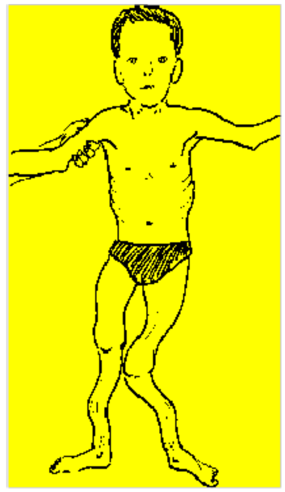
Coeliac or gluten–induced rickets

This is a digestive disorder leading to malabsorption of both fat and vitamin D. The disease starts in early childhood and the stools show excessive amounts of fat.

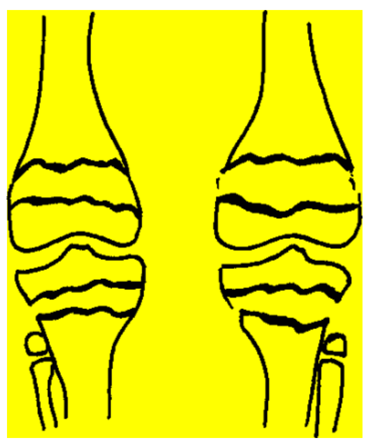
Diagnosis is confirmed by jejunal biopsy and the serum calcium levels. Sometimes the phosphate levels are low (compare this with nutritional rickets above).

Metabolic Disorders

Osteomalacia and rickets



Child with rickets



X-ray of widened epiphyses Metabolic and Endocrine

Familial hyperphosphataemia (vitamin D resistant)

This is a hereditary disorder due to an X- linked gene. It is probably due to a failure of reabsorption of phosphate by the renal tubules or the intestine. There is usually a normal serum calcium and a low serum phosphate (not corrected by vitamin D), an increased alkaline phosphatase and excessive loss of phosphate in the urine.

Cystinosis (renal tubular rickets)

This is due to a recessive genetic defect which results in a failure of the renal tubules to reabsorb not only phosphate but also glucose and some amino acids. There is normal plasma calcium and low plasma phosphate whilst urinary levels of phosphate, glucose and amino acids are increased.

Osteodystrophy (renal glomerular rickets)

This is due to a chronic nephritis or to congenital polycystic kidneys. There is impaired excretion of phosphorus by the kidneys and this is excreted in the intestine where it binds with calcium to form insoluble calcium phosphate which cannot be reabsorbed.

Skeletal changes usually occur between the ages of 5 and 10. The child is deformed and dwarfed with signs of renal impairment. The plasma phosphate is increased and the plasma calcium low. There are signs of renal failure including a high blood urea and se- rum creatinine as well as albuminuria.

In all these types of rickets, although the biochemical changes may be different, the effects on the patient and skeleton are similar.

The general health and skeletal growth is impaired with curvature of the weight-bearing long bones (which are not thickened). The enlarged epiphyseal plates show hollowing out or 'cupping' with an increase in depth

particularly at the lateral part of the epiphysis. The diagnosis is usually confirmed on X-ray of the wrists which shows this characteristic deformity in the lower growth epiphysis of the radius and ulna. A characteristic chest deformity known as a 'ricketty rosary' occurs at the costochondral junctions as well as causing a trans- verse sulcus.

In osteomalacia there is rarefaction of the whole skeleton with bowing of the long weight-bearing bones. There may be multiple spontaneous crack fractures (Looser's zones) which are probably bridged by unmineralised callus. These Looser's zones provide a radiological differentiation from osteoporosis in which they are not seen. A comparison of rarefaction should be made with the hand of a normal patient, using the same exposure for both.

In all these conditions the underlying disease process should be treated, if possible, together with large doses of vitamin D, calcium and phosphorus. In coeliac disease a gluten free diet should be given and in renal tubular rickets, alkalis such as sodium citrate, are administered to combat the as- sociated acidosis.

In addition, surgical correction of severe skeletal deformities may be necessary.

Miscellaneous conditions

Scurvy

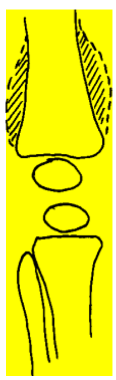
Scurvy results from a deficiency of vitamin C (ascorbic acid). Dietary sources include fresh fruits and vegetables, with very little derived from food of animal origin. A minimum daily intake of vitamin C is 40–50 mg, and the body stores usually last for approx. 3 months, when dietary intake is inadequate.

Vitamin C deficiency produces defective collagen, which may manifest clinically as: swollen gums which bleed easily and may lead to loosening of the teeth or cutaneous bleeding in the form of perifollicular, petechial, and finally, larger bruises. There may also be bleeding from mucous membranes or into joint spaces. Subperiosteal haemorrhages in long bones may later become ossified, leading to thickening of the bones. The severe pain which results from such haemorrhages may produce a pseudoparalysis, in the acute phase. Extensive or prolonged bleeding may produce anaemia.

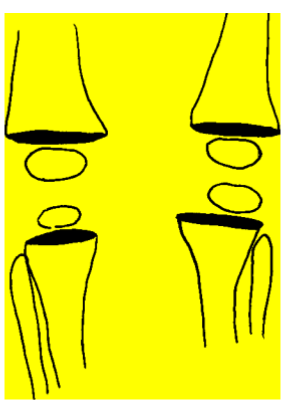
Characteristic radiological changes include a dense line between the metaphysis and epiphyseal cartilage, as well as ossification of subperiosteal haematomata. Treatment is with ascorbic acid supplements, followed by a balanced diet to prevent further recurrences. Industrial poisons

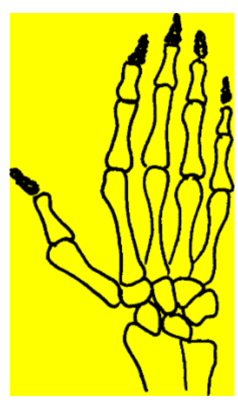
A number of toxins, including arsenic, cadmium, lead, mercury, and thallium may produce heavy metal poisoning. The clinical effects of such toxins will depend on the dose, frequency, and duration of exposure. Virtually any body system may be affected. For example, lead poisoning in children may produce deposits at the growing epiphyseal

Scurvy



X-ray of periosteal haemorrhages





X-ray of dense epiphyseal lines inlead poisoning

X-ray of changes seen in polyvinyl chloride poisoning plates leading to the characteristic radio logical appearance of radio dense ‘lead-lines’.

Certain industrial chemicals, such as polyvinyl chloride (PVC), may produce bony erosions, particularly involving the tips of the fingers and toes.

Mucopolysaccharidoses*

Gaucher’s disease

This is a rare lipoid storage disease due to an autosomal recessive gene. It usually first appears in adult life with infiltration of bone by reticuloendothelial cells which may cause pathological fractures. The spleen and liver may also be involved.

Eosinophilic granuloma

This is usually a solitary cystic lesion containing histiocytes and eosinophils which may cause a fracture. Surgical curettage, bone grafting and internal fixation may occasionally be required or low dose radio-therapy to inaccessible sites such as the spine. The vertebra is often flattened and denser than normal and spinal support may be required.

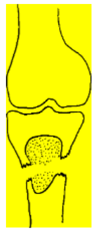
Hand–Schüller–Christian disease

This is a more serious condition with proliferation of reticuloendothelial cells in several bones including the skull. There may be pressure on the pituitary and other intracranial structures causing exophthalmos and diabetes insipidus. The treatment is by radiotherapy.

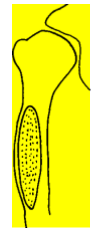
Letterer–Siwe disease

This occurs in early childhood and progresses rapidly with early death. Lipoid deposits occur not only in the bones but also in other organs including liver, spleen and lymph nodes.*Most autosomal recessive (except Hurler’s syndrome, X-linked recessive). Are proportionate dwarfs. Sometimes C1-2 instability.

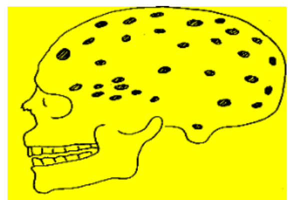
Mucopolysaccharidoses



Gaucher's disease: X-ray of a cystic area with pathological fracture

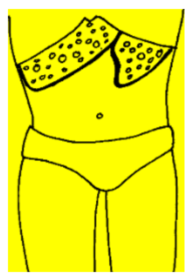


X-ray of an eosinophilic granuloma



X-ray of bony lesions in Hand– Schuller–Christian disease

Osteopetrosis (marble bone, rugger jersey spine), failure of osteoclastic resorption, dense bone, mild form is autosomal dominant,



Letterer–Siwe disease

malignant form is autosomal. recessive.

481 **Metabolic and Endocrine Bone Disease**

Endocrine Disorders

Cushing's syndrome (glucocorticosteroid excess)

This may be caused by an endocrine disorder, more commonly, by prolonged administration of steroids following renal transplantation or for chronic conditions such as severe asthma or RA. Diagnosis is usually made on the characteristic plump, florid face and pattern of obesity. In women there is usually amenorrhoea and hirsutism. There may also be associated hypertension and general rarefaction of the bones with pathological fractures. Avascular changes in the major joints, especially hips and knees, may necessitate joint replacement but these avascular changes in bones can be markedly diminished by reducing the steroid dosage.

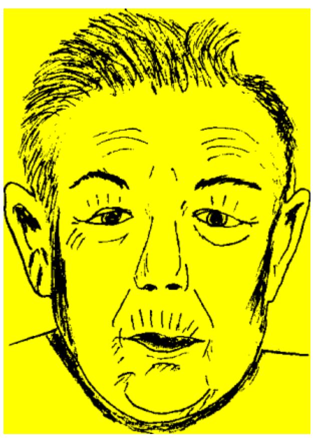
In primary Cushing's syndrome the cause can be excessive secretion of adrenocortical hormone from a tumour or hyperplasia of the adrenal gland, or secondary to a basophil adenoma of the pituitary (Cushing's disease), either of which may require ablation of the adrenal.

Congenital hypothyroidism (cretinism)

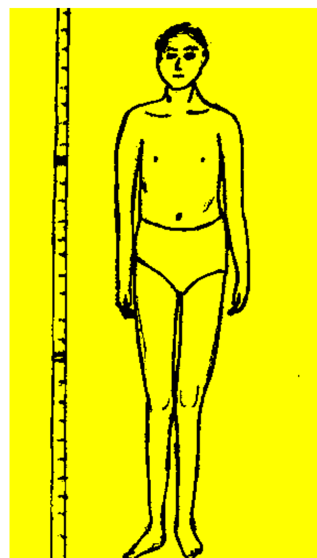
This is due to a lack of thyroid hormone and causes dwarfism with mental retardation. Early diagnosis is essential. This is made clinically by the classic heavy dull facies, deposition of fat, the lack of the outer two-thirds of the eyebrows and mental and physical retardation.

The detection of a lack of thyroid hormone is diagnostic. There is usually dramatic improvement following the administration of thyroxine.

Endocrine Disorders



Hypopituitarism



Gigantism

Acromegaly

Congenital hypothyroidism

Hypopituitarism

This is due to a lack of secretion of one or more of the anterior pituitary hormones. This may cause dwarfism with mental impairment and delayed sexual development, or the patient may be obese and of normal height. Both types may develop slipped femoral epiphysis.

Acromegaly

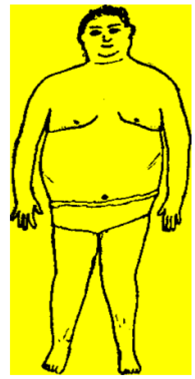
Excessive secretion of growth hormone after the epiphyses have fused will cause enlargement of the mandible, skull, face, hands and feet. The skin is thickened and course and the patient becomes weak. X-rays may show enlargement of these bones and the sella turcica of the skull may be expanded by growth of the adenoma. Diagnosis is made clinically and by radio-immune assay of excessive growth hormone levels. Early treatment by excision of the adenoma is essential.

Gigantism

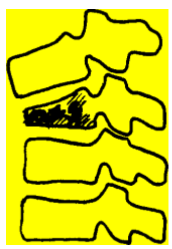
This is caused by an acidophilic adenoma producing excessive amounts of growth hormone which may cause gigantism if the epiphyses have not yet fused. The patient may be mentally subnormal and have impaired sexual development.

Endocrine Disorders

Glucocorticosteroid Excess



Cushing's syndrome -'moon face' appearance Obesity



X-ray of a pathological fracture of a lumbar vertebra X-ray of AVN of the hip

Chapter 13

Upper Limb Conditions

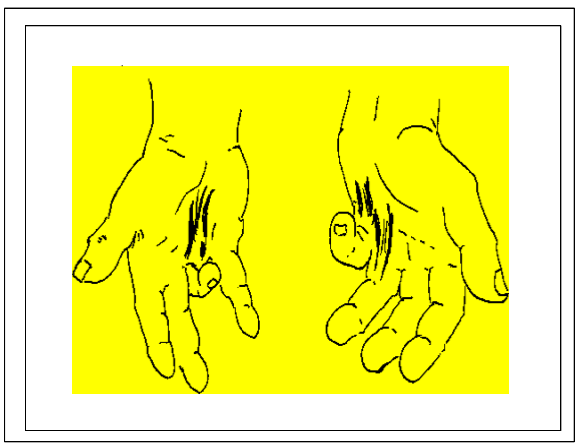
Aetiological classification

Anatomical classification

Shoulder

Elbow

Wrist and hand



Classification

Aetiological classification

Congenital abnormalities

- Amelia and phocomelia
- Macrodactyly
- Syndactyly
- Synostoses
- Osteochondroma and other neoplasms

Neoplasia

Benign -- bony

cartilaginous

soft tissue

Malignant -- primary -- bony

cartilaginous

soft tissue

secondary

Trauma

Soft tissue injuries—tendons and ligaments

Subluxation and dislocation fractures

Infection

Soft tissue

Bone

Joint

Arthritis

Paralysis

Cerebral -- Cerebral palsy, CP

neoplasia
vascular conditions
trauma

Spinal --fractures

Disc protrusion
syringomyelia
poliomyelitis
spina bifida

Peripheral nerves -- carpal tunnel syndrome

peripheral neuritis and toxins diabetic neuropathy

Anatomical classification

Shoulder conditions

Supraspinatus and rotator cuff
Acromioclavicular and sternoclavicular joints
Biceps tendon

Elbow conditions

Tennis elbow
Golfer's elbow
Ulnar neuritis
Olecranon bursitis

Wrist and hand conditions

Ganglion
Dupuytren's contracture
Carpal tunnel syndrome
Trigger finger
de Quervain's syndrome

Aetiological Classification

Most of the conditions affecting the upper limb are discussed in other chapters. This chapter will therefore describe only those conditions that do not 'fit' into any specific category. The following is a summary of conditions which are described elsewhere.

Congenital abnormalities

These include deficient growth, overgrowth or fusion of limbs and various other con-genital abnormalities due to genetic defects such as achondroplasia*. Developmental abnormalities may also be secondary to ante-natal insults such as infections, drugs and radiation.

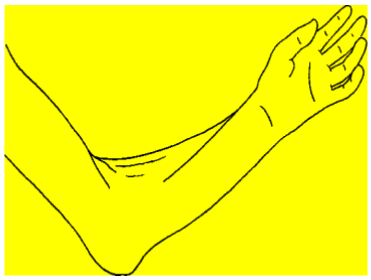
Neoplasia

Some bony neoplasms are inherited in an autosomal dominant pattern such as multiple osteochondromata, (diaphyseal aclasis). Most neoplasms, however, are of unknown aetiology. Examples are benign neoplasms such as bone cysts and fibrous dysplasia, or malignant neoplasms such as osteogenic sarcoma, chondrosarcoma and Ewing's sarcoma.

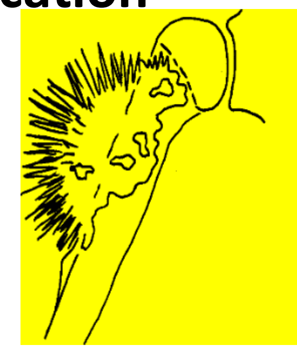
Trauma

The differential diagnosis in many orthopaedic conditions must include old or recent injuries to bone, ligaments, tendons or other

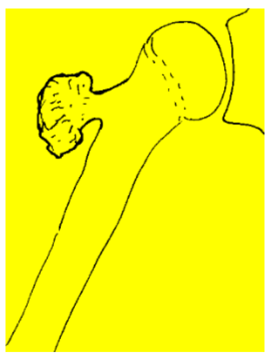
Aetiological Classification



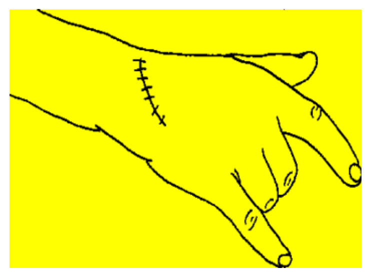
Congenital webbing of the elbow



X-ray of an osteogenic sarcoma



X-ray of an osteochondroma of the upper humerus



Traumatic tendon injury

structures, which otherwise may cause difficulty in diagnosis.

Infection

Bone and joint infections may be acute or chronic and may cause osteomyelitis (OM) of bones or pyogenic arthritis of joints. Acute infections may result from organisms such as pyogenic staphylococci, whereas chronic low grade infection may be due to an organism such as Mycobacterium tuberculosis. The behaviour of an acute pyogenic organism may be modified by antibiotics so as to mimic that of a chronic organism.

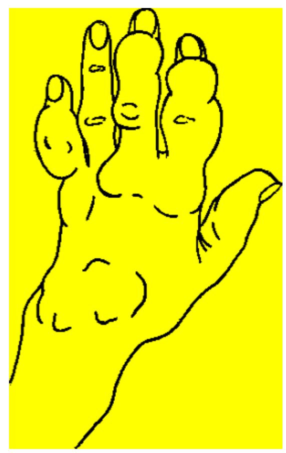
Arthritis

Degenerative OA and RA are the most common types. Gout and haemophilic arthritis are two other non-infective causes of arthritis in the upper limb.

UPDATE, 2022, Achondroplasia-most common disproportionate dwarf (not allowed to participate in weight lifting in Olympics as great strength advantage; whereas you do see hypochondroplasia, less marked, with small stature and short arms/legs/hands/feet, called short-limbed dwarfism as champion weight-lifters and football players). Caused by mutation in fibroblast growth factor receptor 3 (FGFR3) genes. Kyphosis resolves when start walking. XRs-champagne glass pelvic outlet (wider than deep) and tombstone pelvis (squaring of iliac wings).

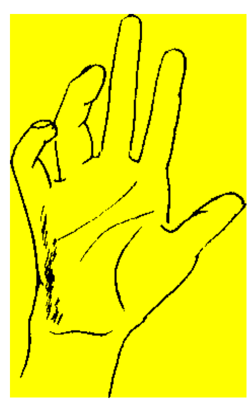
Sponyloepiphyseal dysplasia, SED, is a defect in type II collagen, similar to multiple epiphyseal dysplasia, MED (due gene mutation in COMP and type IX collagen) but has spinal involvement (scoliosis).Bilateral, symmetric, early acetabular changes and no metaphysealysts. Retinal detachment and respiratory problems.

Aetiological Classification



X-ray of osteomyelitis

RA



Ulnar nerve palsy

Paralysis

Paralytic conditions can be divided into those of cerebral, spinal cord, or peripheral nerve origin.

These are described in detail in both Chapter 3 and Chapter 11.

Anatomical Classification

Shoulder conditions

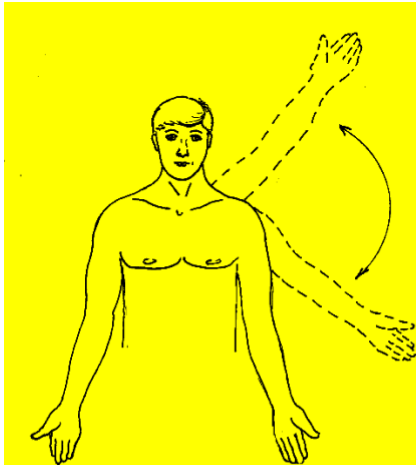
Supraspinatus and rotator cuff

The rotator cuff inserts into the upper end of the humerus, and particularly the tuberosity and posterior and upper part of the head of the humerus. This allows the deltoid, which inserts into the deltoid tuberosity one-third of the way down the shaft, to acta s an abductor. The posterior insertion also acts as an external rotator of the shoulder. Complete rupture of the rotator cuff is not uncommon in older patients with degenerative arthritis, and may be caused by minimal trauma. Partial rupture also occurs, but may appear to be complete as pain limits any movement. It may be differentiated from complete rupture by injecting the supraspinatus with local anaesthetic to eliminate the pain and thus allow the remaining fibres to act.

In partially degenerated tendons, calcification in the supraspinatus tendon may occur and lead to a painful arc of movement between about 60½ and 120½ of abduction, as the

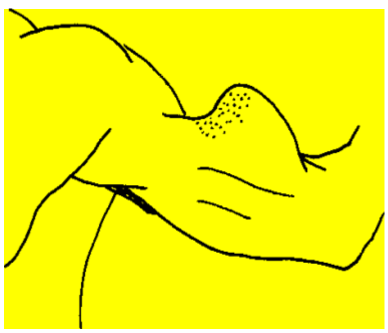
*UPDATE, 2022, asymptomatic full-thickness rotator cuff tears need no surgery ONLY when pain. Diagnose subscapularis tear where incr. ext. rotation and +ve lift-off test or belly-press.

Shoulder Conditions

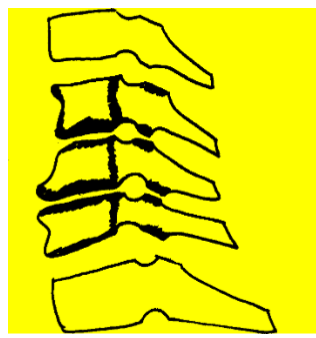


Chronic tendinitis — the painful arc syndrome

Acromioclavicular joint subluxation



Ruptured biceps tendon



X-ray of cervical spondylosis

formation.

Inflammation of the subacromial bursa may also cause pain and is often associated with degenerative changes in the tendon. In addition to X-rays, and injection of a suspected partial rupture, investigations include an arthrogram, a computerised tomogram (CT) or magnetic resonance imaging (MRI) to show a ruptured tendon. Arthroscopy may also be carried out both for diagnosis and treatment.

Surgical repair of the tendon, (especially when full-thickness) is indicated in most symptomatic patients now as surgical techniques and equipment have improved a lot over the last 20 years giving very good results. Reverse shoulder replacements are used where there is also advanced OA.

Supraspinatus calcification is often dispersed by an injection of hydrocortisone and local anaesthetic into the area, but sometimes operative decompression may be necessary for the acute pain associated with this condition. Treatment of the associated shoulder arthritis and cervical spondylosis may also

Sternoclavicular joint

Sternoclavicular OA or subluxation usually also requires physiotherapy and rarely operative treatment.

Biceps tendon

Biceps tendonitis may occur over the anterior aspect of the long head of biceps in the anterior upper aspect of the humerus. Occasionally a degenerated tendon may rupture and produce a painless swelling in the arm on contraction of the muscle.

Tendonitis is often relieved by an injection of hydro-cortisone and perhaps physiotherapy. A rupture of the tendon is usually associated with OA of the shoulder which is often accompanied by cervical spondylosis. The actual rupture does not cause any appreciable disability and does not require treatment. If painful a biceps tenodesis may help.

Cervical spondylosis

This may cause referred pain into the shoulder. It is often associated with pain and numbness radiating down the arm and occasional weakness, with stiffness of the shoulder. Cervical spondylosis may also cause tenderness in the extensor muscles of the forearm. The diagnosis and treatment of cervical spondylosis is discussed elsewhere in this book (Chapter 11).

Trauma

Shoulder trauma includes fractures of the neck and tuberosity of the humerus and both anterior and posterior dislocation of the joint. This should always be considered in the differential diagnosis.

Arthritis

Arthritis of various types, including OA, RA and gout are all discussed chapter 10.

Elbow conditions

Tennis elbow

This condition is due to a tear of a number of the fibres of the common origin of the forearm extensor muscles over the lateral epicondyle. It is usually caused by wringing of clothes and similar repetitive actions rather than tennis. There is a localised tender area, mainly over the lateral epi-condyle (not the extensor muscles in the upper forearm). Gripping will usually exacerbate the pain, as will extension of the second and third fingers against resistance. Pain caused by dorsiflexion of the wrist against resistance is of limited diagnostic value.

Injection of hydrocortisone and local anaesthetic into the tender area will relieve the pain in over 80% of cases but may have to be repeated.

A support around the forearm just below the elbow is often successful. In very severe cases operation and freeing of the extensor origin is necessary.

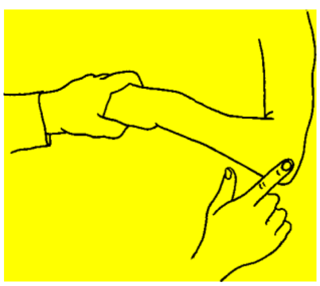
Golfer's elbow

This occurs with tenderness over the common origin of the forearm flexor muscles and is much less common. Treatment is similar to the above.

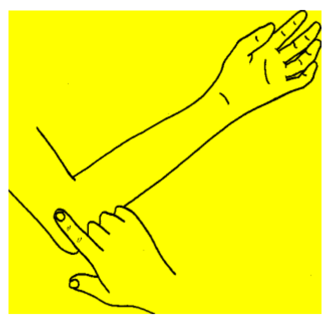
Ulnar neuritis

This is commonly due to trauma to the nerve behind the medial epicondyle. A valgus deformity of the elbow due to a previous supra-condylar fracture may also stretch the nerve. Ulnar neuritis may necessitate transposition of the nerve anterior to the epicondyle.

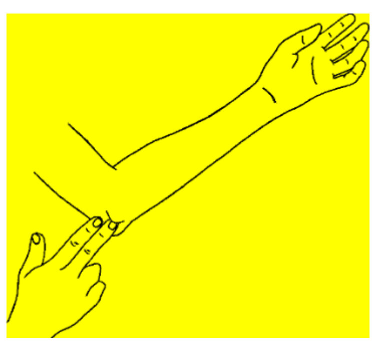
Elbow Conditions



Tennis elbow



Golfer's elbow



Ulnar neuritis

Olecranon bursitis (student's elbow)

This is due to pressure over the bursa which may become inflamed and infected. This occasionally requires antibiotics or incision and decompression.

Cutaneous nodules

Rheumatoid or gouty nodules sometimes occur over the olecranon process. These may also involve the elbow joint itself and cause pain and stiffness.

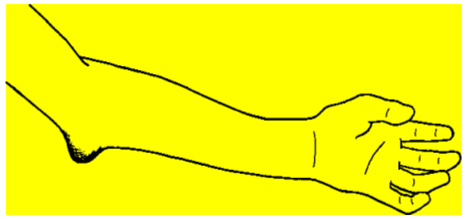
Trauma

Fractures around the elbow, including the supracondylar region, olecranon and head of radius must always be considered in a differential diagnosis. Neoplasms, bone and joint infections and arthritis due to various causes are discussed elsewhere in this book.

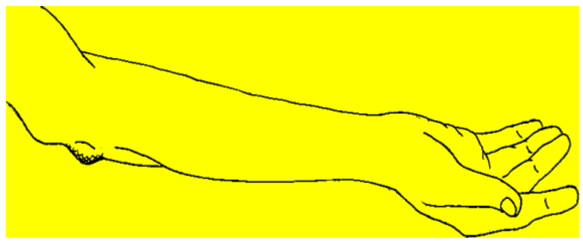
Pyogenic infection of the elbow joint itself may be secondary to an overlying wound or infected bursa, or due to systemic infection.

Osteoarthritis secondary to a previous fracture or injury often causes both deformity and stiffness of the elbow. Associated with this is often limitation of rotation of the elbow joint.

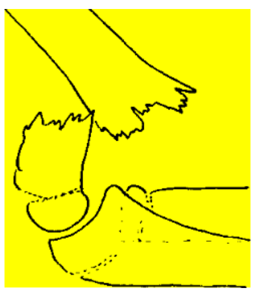
Elbow Conditions



Olecranon bursitis



Rheumatoid nodule or gouty tophus



X-ray of a supracondylar fracture

X-ray of OA of

Wrist and hand conditions

Ganglia

This is a firm cystic swelling, usually over the dorsum but sometimes palmar surface of the wrist. It probably arises from degeneration of the capsule of the wrist joint rather than a true outpouching. It is filled with glairy fluid and is firm and spherical. It may transilluminate, is only slightly tender and may disappear into the joint on extension or flexion of the wrist.

Although it may burst with trauma (the traditional cure is hitting it with the family bible!) it is best excised properly under tourniquet control if symptomatic.

Dupuytren's contracture*

A Dupuytren's contracture is a fascial thickening of the palm, usually most marked over the fourth metacarpal and proximal phalanx. Cytokine-mediated (TGF-beta) transforms fibroplasts into myofibroblasts (with abnormal and exaggerated contractility), increased type III/I collagen ratio and increased free radicals. It maybe associated with a similar condition in the sole of the foot and in the corpus cavernosum of the penis. Some drugs, especially those given for epilepsy, are sometimes responsible, as is trauma. Mild cases in the elderly may not require treatment. Treatment is collagenase injection or needle aponeurotomy (but recurs and best for mild cases). In young patients, and in severe cases excision of the fibrous bands in the palm is indicated. However can recur (up to 50% of cases). Sometimes amputation of severely deformed little finger required. Named after Baron Dupuytren, the richest man in France in the 19thC, whose statue stands in Hotel Dieu Hospital, opposite Notre Dame.

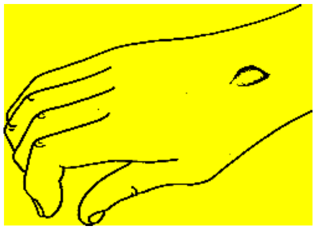
UPDATE, 2022. Hand Tumours-Ganglions are most common (dorsal wrist, volar wrist, IP jnt, distal palm). Then GCT of tendon sheath (excise), epidermal inclusion cyst, lipoma, schwannoma, glomus tumour (painful), haemangioma, pyogenic granuloma. Most common malignant-epitheliod/synovial sarcoma, most common skin-squamous cell carcinoma. Most common bony benign-enchondroma. Most common bony malignant-chondrosarcoma. Most common site for acral metastasis-lung (see below, page 504).

Hand Infections-common is s. aureus, MRSA in cities.

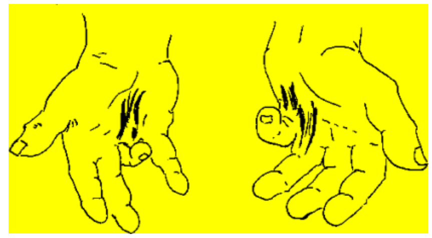
Treat IV vancomycin/clindamycin, oral TMP-SMX or clindamycin. NB-gram -ve in IV drug uses, diabetics, farmyard injuries and bites. Note-paronychia (nail fold infection), felon (finger-tip pulp infection), human bites (can be serious), cat bites (more serious than dog), pyogenic flexor tenosynovitis (Kanavel signs), deep potential-space infections, necrotizing fasciitis, gas gangrene, fungal infection, herpetic whitlow, atypical TB, high pressure injection injuries.

ALL REQUIRE URGENT ANTIBIOTIC AND NO DELAY IN SURGICAL DRAINAGE (I and D) / DECOMPRESSION.

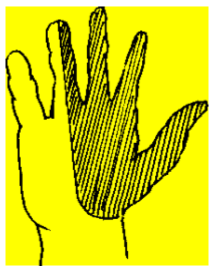
Wrist and Hand Conditions

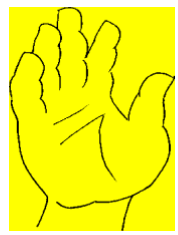


Ganglion



Dupuytren's contracture





Carpal tunnel syndrome - thenar muscle wasting, weakness and paraesthesia In general. Fatty tissue tumours-lipomas, low signal on MRI, if enlarge then excise. Myxoid liposarcoma has classic 12;16 chromosomal translocation. Liposarcoma, 2nd most common sarcoma in adults, MRI shows thicker/more

Rest with a simple detachable splint and anti-inflammatory drugs may give some relief but surgical division of the flexor retinaculum of the wrist is often necessary.

Infections of the hand

Infections of the soft tissues of the hand are common. They vary from infection of the nail fold (paronychia) to infection of the palmar spaces and tendon sheaths.

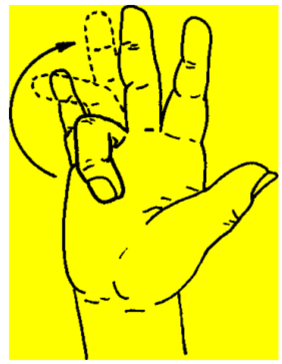
In the palm, considerable swelling may occur and early drainage is essential if infection does not rapidly resolve with antibiotics.

Trigger finger

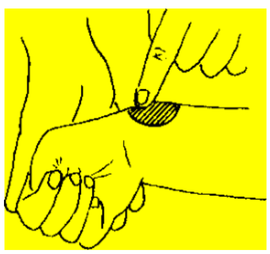
A trigger finger or thumb results from con-striction of a flexor tendon sheath which produces swelling of the corresponding tendon. Repeated friction leads to localised tendon hypertrophy and nodule formation. It can be quite painful and the finger can lock down. A nodule may occasionally be congenital but is usually secondary to repetitive trauma. There is a tender nodule at the base of the affected finger over the metacarpophalangeal joint. The finger can usually be flexed but extension is difficult, producing a 'trigger' or flicking motion as the nodule passes through the constriction. Treatment options include the injection of hydrocortisone and local anaesthetic and if this is unsuccessful, simple division of the (A1 pulley) sheath.

Wrist and Hand Conditions

Paronychia



Trigger finger



de Quervain's syndrome

AVN of the lunate

De Quervain's syndrome

This is a tenovaginitis or constriction of the tendon sheaths of extensor pollicis brevis and abductor pollicis longus over the lower radius. The cause is usually excessive use of the tendons through repetitive movements, such as wringing of clothes. The patient complains of tenderness over the radial styloid which is exacerbated by abducting the thumb against resistance or forcibly flexing the thumb across the palm of the hand (Finglestein's test). The differential diagnosis includes a fracture of the radial styloid process, a fractured scaphoid or fracture or OA of the first carpometacarpal joint. Treatment options include injection of the area with hydrocortisone and local anaesthetic (less than 50% success) or division of the first extensor tendon sheath (beware of anatomic variants/multiple slips of APL/EPB own compartments and take care not to damage superficial radial sensory nerve).

Intersection syndrome

Tenosynovitis/bursitis at junction 1st/2nd extensor compartments where APL and EPB tendons cross. Ice, splint, NSAIDs, steroid injection and rarely surgery.

Avascular necrosis of the lunate

(Kienbock's disease)

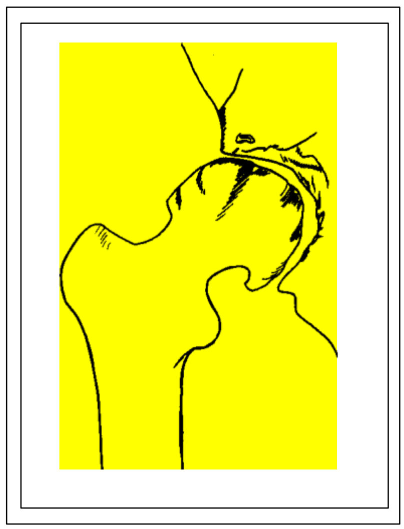
This is a rare condition and is probably caused by injury to the blood supply to the bone and /or negative ulnar variance. In young men, Tenderness over the lunate, unexplained, will occur but the diagnosis is made on the X-ray appearance of an avascular bone which may show collapse. Surgery is challenging. Idiopathic AVN - the scaphoid (Preiser disease). May need re vascularization, partial wrist fusion.

Arthritis

RA, OA and gout are discussed in Chapter 10.

Chapter 14

Lower Limb Conditions



Classification

Aetiological Classification

Congenital abnormalities

Dwarfism - achondroplasia

cretinism

gargoylism

Amelia and phocomelia

CDH and protrusio acetabuli

Coxa vara and valga

Genu varum, valgum and recurvatum

Talipes

Congenital vertical talus

Talocalcaneal - navicular bar

Pes planus and cavus

Metatarsus primus varus

Macrodactyly

Syndactyly and webbing

Neoplasia

Benign-bony cartilaginous soft tissue

Malignant-primary-bony cartilaginous soft tissue secondary

Trauma

Soft tissue injuries-tendons and ligaments nerves vessels

Subluxation and dislocation

Fractures

Infection*

- Soft tissue
- Bone
- Joint

Arthritis

- Degenerative (primary or secondary OA)
- Autoimmune
- Metabolic
- Haemophilic arthropathy

Paralysis

- Cerebral
    - cerebral palsy
    - neoplasia
    - vascular conditions
    - trauma
- Spinal
    - disc protrusion
    - fractures
    - spina bifida
    - syringomyelia
    - poliomyelitis
- Peripheral nerves
    - peripheral neuritis and toxins
    - diabetic neuropathy

Anatomical Classification

Hip and femur

Knee and tibia

Ankle and hindfoot

Forefoot and toes

Aetiological Classification

Most conditions of the lower limb are discussed in detail in the relevant sections of this book. It is the purpose of this chapter to discuss other conditions which do not fall into any of the other categories. Conditions discussed in other chapters are given below.

Congenital abnormalities

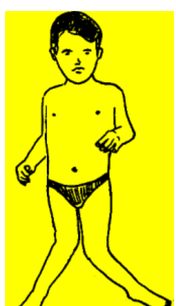
Developmental abnormalities-limb defects, such as overgrowth and fusion, CDH and bilateral coxa, genu vara and valga. They also include ankle and foot conditions such as talipes equinovarus, congenital vertical talus (is irreducible), metatarsus primus varus and other foot deformities. Generalised developmental conditions include achondroplasia and polyostotic fibrous dysplasia.

Neoplasia

Developmental tumours include multiple osteochondroma (diaphyseal aclasis) and benign bone cysts as well as multiple neurofibroma. Most tumours, however, are of unknown origin and develop in childhood or adult life. From benign tumours such as aneurysmal bone cysts, eosinophilic granuloma and non-ossifying fibromata, to malignant tumours such as osteogenic

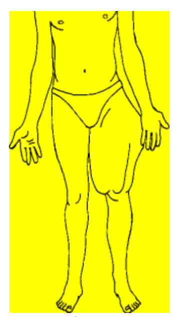
Aetiological Classification

Congenital abnormalities



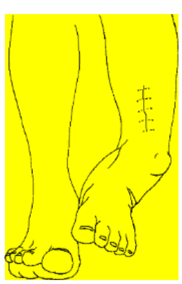
Genu valgum

Neoplasia



Osteogenic sarcoma

Trauma



Deformity due to tibial trauma

Infection

X-ray of osteomyelitis

sarcoma, chondrosarcoma and Ewing’s sarcoma.

Trauma

Various chapters discuss both recent and old injuries to bones, ligaments, tendons and other structures. It is especially important to consider trauma as anaetiological factor when dealing with swellings associated with the bone, as the differential diagnosis includes both inflammatory and neoplastic conditions.

Infection*

A low grade osteomyelitis of the femur or tibia, or a pyogenic arthritis of the hip or knee sometimes is difficult to differentiate from tumours or other inflammatory conditions such as RA.

Arthritis

OA of the hip and knee is common and RA can occur in major joints as well as in the hands and feet. Arthritis may also be due to gout, haemophilia and other non- infective conditions.

Paralysis

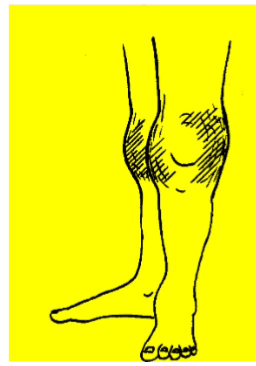
Paralysis of the lower limb may be caused by cerebral, spinal cord or peripheral nerve lesions or a combination of these. They include cerebral palsy, head injuries, spina bifida and poliomyelitis.

Miscellaneous conditions

A miscellaneous group of conditions includes Paget’s disease, hallux valgus and plantar fasciitis.

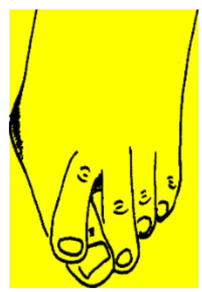
Aetiological Classification

Arthritis



X-ray of OA Paralysis RA

Miscellaneous conditions



Poliomyelitis Hallux valgus

Anatomical Classification

Hip and femoral conditions

Paget's disease

Paget's disease affecting the femur is fairly common and may cause overgrowth, bowing, pathological fractures and, rarely, osteogenic sarcoma.

Infection*

Secondary osteomyelitis is more common than primary osteomyelitis and usually follows operative internal fixation of hip or femur or open femoral fractures. Pyogenic arthritis of the hip is still fairly common, particularly in children and is usually due to bloodborne spread.

Snapping hip

This is a fairly common condition resulting from the ilio-tibial band catching over the greater trochanter. It may be due to unaccustomed exercise and can cause inflammation of the bursa over the greater trochanter.

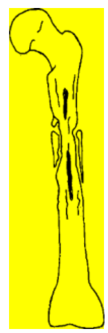
This condition will usually respond to rest and anti-inflammatory drugs. It occasionally requires division of the ilio-tibial band in the mid-thigh.

Tom Smith's disease and Girdlestone's arthroplasty

Tom Smith's disease is a septic arthritis of a major joint occurring in the first year of

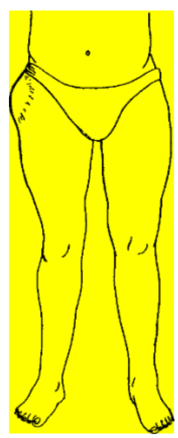
Hip and Femoral Conditions

X-ray of an infected hip



X-ray of osteomyelitis

X-ray of Paget's disease



Trochanteric bursitis

life and leading to complete destruction of the joint. It is now uncommon except in developing countries.

A similar, but more common situation, occurs following Girdlestone's procedure. This is an excision arthroplasty of the hip which is performed following an unresolved infection complicating total hip arthroplasty.

Both arthroplasties may present as a telescoping unstable hip requiring later hip replacement.

Avascular hip conditions

Perthes' disease is due to avascular changes in the head of the femur. It occurs most commonly between the ages of 5 and 10 years. It is discussed in more detail in Chapter 7. Avascular changes of the head of the femur also occur in sickle cell disease and in slipped epiphyses in children. In adults, avascular changes may follow hip dislocation or subcapital fractures of the femur.

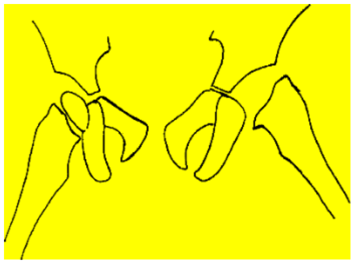
These changes also occur in chronic alco- holism and following prolonged glucocorticosteroid therapy, especially inpatients who have undergone renal or other organ transplantation.

Slipped capital femoral epiphysis, SUFE

Slipped epiphysis is discussed in more detail in chapter 7 and occurs most commonly between the ages of 10 and 15 years. Although trauma plays a part in some cases, in many children an imbalance of sex and growth hormones is thought to be responsible.

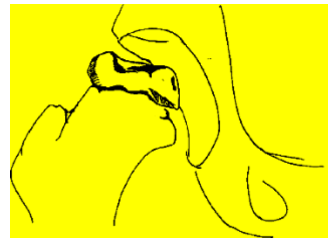
Sickle cell disease-mutation both alleles of beta- globin, to cause sickle haemoglobin (HbS). Trait is HbS, disease is HbSS. Can develop Salmonella osteomyelitis. Exertional sickling.

Hip and Femoral Conditions

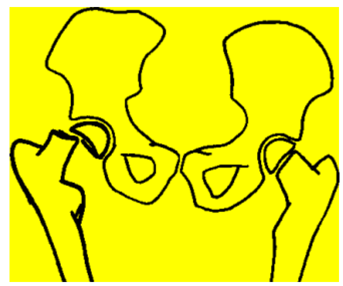


X-ray of Tom Smith's disease and

Girdlestone's arthroplasty



X-ray of Perthes' disease



X-ray of avascular necrosis

517 **Lower Limb Conditions**

Knee and tibial conditions

Baker's cyst and semimembranosus bursa

This is a cystic swelling in the popliteal fossa usually due to synovial outpouching from an osteoarthritic knee. Other causes of chronic arthritis with effusion in the knee can also lead to a Baker's cyst.

The differential diagnosis of popliteal swellings includes lymph nodes, a popliteal aneurysm and a semimembranosus bursa.

Treatment is of the underlying condition and occasionally excision of the cyst.

Bursitis

Prepatellar bursitis (housemaid's knee) is due to traumatic or infective inflammation of the prepatellar bursa, that is, the bursa in front of the knee.

Infrapatellar bursitis (clergyman's knee) has similar causes.

A suprapatellar bursa is an outpouching of synovial fluid and synovia in the knee itself. It is particularly prominent in chronic OA, and also occurs with any knee effusion.

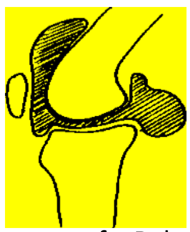
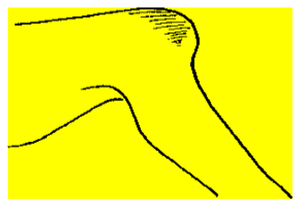
Osgood-Schlatter's disease

This is a traction osteochondritis of the tibial tubercle and is most common in boys of about 14 years of age. Such traction injuries often result from kicking footballs or jumping.

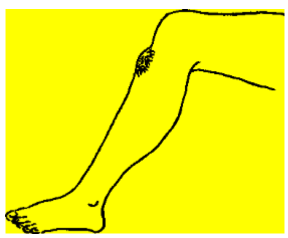
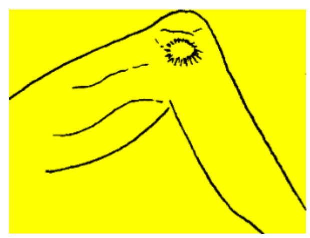
There is tenderness and bony swelling over the insertion of the ligamentum patellae and X-ray often shows elevation and sometimes fragmentation of the tibial tubercle.

Treatment is rest from sport and sometimes a detachable splint behind the knee.

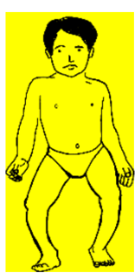
Knee and Tibial Conditions

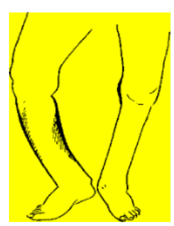
X-ray arthrogram of a Baker's cyst

Osgood–Schlatter's disease



Genu varum



Paget's disease

*From horizontal cleavage tear of lateral meniscus.

Cyst of the lateral meniscus

This is probably a degeneration of the lateral meniscus following trauma rather than a congenital cyst. There is a tender cystic swelling, usually situated over the middle of the lateral meniscus.

Treatment used to be a total meniscectomy but local excision of the cyst alone is adequate.

Deformities of the knee

Premature fusion of the medial femoral or tibial epiphysis will produce a genu varus while early fusion of the lateral femoral or tibial epiphysis will lead to a genu valgum (Chapter 7). Unbalanced paralysis of the knee extensors or flexors may lead to flexion deformity or genu recurvatum.

Degenerative changes in the medial and lateral joint of the knee may lead to narrowing of the joint and a small degree of genu varum or valgum. Swelling of the knee in arthritis of any cause will lead to limitation of full extension and often flexion as well.

Paget’s disease of the tibia

Paget’s disease is discussed in further detail in Chapter 11. There is usually bowing and thickening of the tibia and pathological fractures may occur. Osteogenic sarcoma is a rare complication. High-output cardiac failure may occur in extensive Paget’s disease, as the affected bone is highly vascular.

Osteochondritis dissecans

Osteochondritis dissecans usually involves the lateral side of the medial femoral condyle and occurs most commonly in adolescent boys. It usually results from trauma to the cartilage with avascular changes in the underlying bone. As a result, an area of cartilage about 5-10 mm in diameter, together with the underlying bone becomes avascular. This area may detach and form a loose body in the joint, which may catch in the joint and cause it to lock.

The usual treatment is to re-attach the partially loose fragment with a recessed screw before it detaches, or excise it once it is free in the joint.

Avascular necrosis of one or both femoral condyles may occur after steroid therapy, such as in chronic asthma and renal transplantation.

Treatment is excision of the avascular segment and drilling and revascularizing the remainder of the condyle. Occasionally total knee replacement is required.

Meniscal and ligamentous injuries

These may cause pain and swelling of the knee with instability and eventually OA. Early arthroscopic excision of detached fragments or repair is often indicated.

Ankle and hind foot conditions*

Tendonitis

Tendonitis on the medial side of the ankle is usually due to inflammation of the tibialis posterior/anterior tendon sheaths and on the lateral side to inflammation of the sheaths of the peroneal tendons. In dancers on pointe- a stenosing FHL tenosynovitis.

Posteriorly the sheath of the tendocalcaneus may become inflamed by overuse of the tendon, by rubbing on the back of a shoe or by minor tears of the fibres of the tendon itself. Partial or complete rupture of the tendon may also occur.

Clinically there is tenderness and often swelling over the sheath of the relevant tendon and usually pain on stressing the tendon.

Treatment includes 'resting the tendon' with an elevated heel on both shoes, the application of ice packs and elevation of the leg in the acute stage. In chronic tendon it is deep heat, massage and sometimes injections of hydrocortisone and local anaesthetic into the tendon sheath (not the tendon) may be necessary. Occasionally incision of the tendon sheath may be required. Rupture of the plantaris tendon may also occur and lead to a sudden sharp pain in the mid-calf. The treatment is the same as for a tendonitis of the Tendo Achillis.

Painful heel

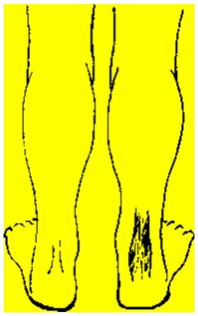
Pain under the heel is usually due to a plantar fasciitis, possibly following bruising of the heel. It may be associated with a calcaneal spur seen on X-ray but this is often unrelated to the pain. The heel sometimes becomes painful in chronic infections, in RA and in other inflammatory diseases. Check the inner sole as a slight step-off can cause as well as poorly made stiff shoes (Brazilian shoes are the best). Called Sever Disease in children.

Ankle and Hind Foot

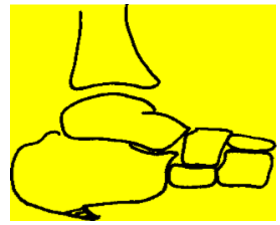
Conditions

X-ray of RA

X-ray of OA



Tendinitis*



Calcaneal spur

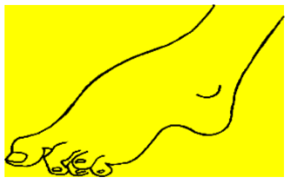
On examination there is usually localized tenderness sunder the point of the heel just in front of the calcaneal tuberosity. Treatment involves treating the cause, if obvious, as well as a soft compressive cheap heel pad to reduce the pressure and better shoes. Rarely surgery. Occasionally physiotherapy or an injection of hydrocortisone may be necessary. The differential diagnosis includes a fracture of the calcaneus and osteomyelitis.

Longitudinal arch conditions

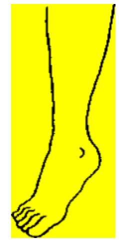
Clawing or cavus of the foot may be associated with a neurological condition such as poliomyelitis, spina bifida or Friedreich's ataxia. More commonly, however, it is idiopathic. The treatment of cavus feet is the treatment of the underlying cause and occasionally operative correction of the deformity. Flattening of the longitudinal arch may be idiopathic in young patients or secondary to poor intrinsic muscles in elderly and over weight patients. Spasmodic flat feet with peroneal muscle spasm occur occasionally, with a congenital calocalcaneonavicular bar.

Ankle and Hind Foot

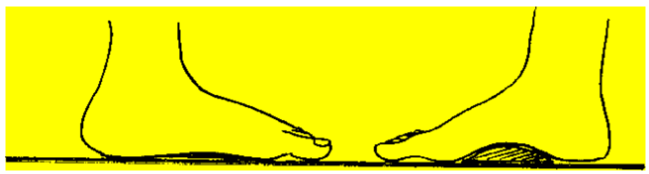
Conditions*



clawed toes



Paralysed foot



Pes planus Arch support

*Pes planus is congenital or acquired. Check if fixed or flexible. Tarsal coalitions cause rigid type. Most children do not need treatment. Adults-is dysfunction of tibialis posterior tendon and incompetence of the spring ligament (CN lig.).Valgus hindfoot, difficulty standing on toes and "too-many-toes sign).May need tenosynovectomy, tendon reconstruction, bony fusion.

Pes cavus- idiopathic, neuromuscular, post-traumatic.

*Foot and ankle conditions can be quite disabling for patients; you have to walk on your painful feet but not necessarily use your painful hand. Don't dismiss such conditions and review carefully. For example, a multi trauma patient treated in the ICU, you miss a dislocated little toe, it becomes a source of chronic pain and you are sued after saving the patient's life! As someone once said- no good deed goes unpunished.

525 **Lower Limb Conditions**

Spastic paralysis from an upper motor neurone lesion may also require a below knee caliper, again sometimes preceded by elongation of the Tendo Achillis.

Forefoot and toe conditions Classification of forefoot conditions can be divided into those affecting the plantar surface, the dorsum and the sides of the feet.

Deformities of the toes are often as- sociated with these conditions.

Plantar surface of foot

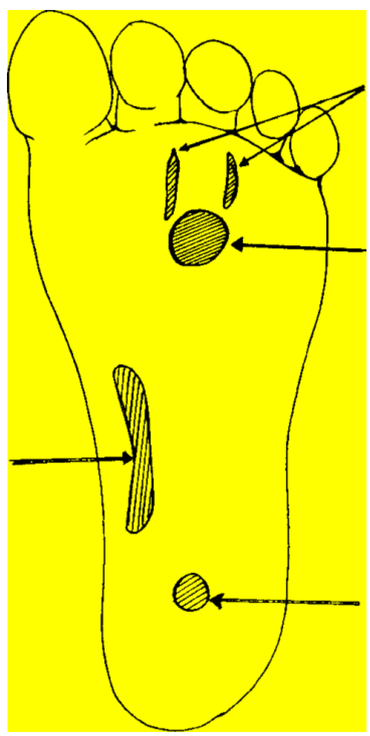
Anterior metatarsalgia

This is a painful area under the metatarsal heads, commonly the 2nd, 3rd, and 4th. It is usually due to weakening of the dynamic muscular structure of the foot. It is often associated with obesity, poor muscle tone, clawing of the toes and sometimes various neurological conditions such as poliomyelitis, leading to weakness of the intrinsic muscles.

Morton’s metatarsalgia (plantar neuroma)

This is due to irritation followed by enlargement of a plantar digital nerve, usually between the 2nd and3rd or 3rd and 4th metatarsal heads. The patient complains of pain in the forefoot, often at night when the feet are warm, and also while walking. The condition is often associated with an anterior metatarsalgia. During examination the main tender area can usually be pinpointed to lie between the metatarsal heads rather than under them as is the case in anterior metatarsalgia. The pain is usually worse on lateral compression of the forefoot which compresses an enlarged neuroma between the metatarsal heads. There may also be numb- ness between the toes supplied by the relevant cutaneous nerve.

Forefoot and Toe Conditions



Plantar surface of the foot

Treatment of both anterior metatarsalgia and a digital neuroma is an anterior meta- tarsal pad or button placed just behind the metatarsal heads, plus good footwear and intensive muscle reduction. If this is not successful the plantar neuroma should be excised. In the case of anterior metatarsalgia correction of claw toes by subcutaneous tenotomy of the extensor tendons, transfer of flexor tendons to the extensor or arthrode sis of the proximal interphalangeal joints of the clawed toes may be carried out. Occasionally excision of a prominent 2nd or 3rd metatarsal head may be necessary. **Dorsum of foot and toes**

March fracture

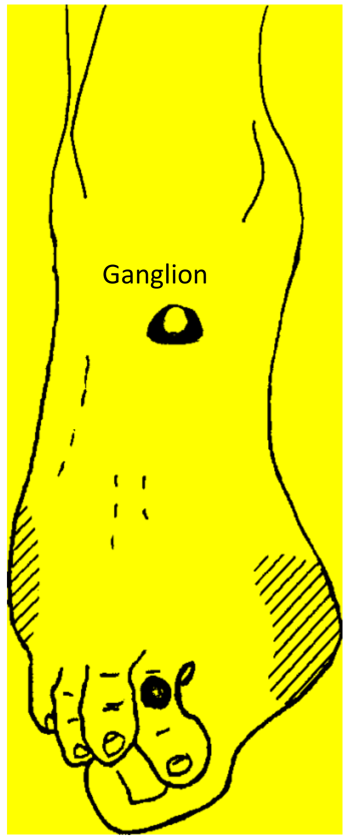
This condition is often missed. It is a stress fracture, usually of the necks of the 2nd and 3rd metatarsals, due to unaccustomed walking, sometimes seen in new army recruits. The tender area, however, is over the dorsum rather than the plantar aspect of the meta- tarsals. X-rays show a fine crack in the bone which may be difficult to see at the time of injury. Three to four weeks later callus formation around the fracture confirms the diagnosis, much to the embarrassment of the treating doctor if the initial fracture was overlooked. The initial treatment is rest followed by gradually in- creased weight- bearing, graded exercises and walking.

Hallux valgus*

This is a valgus deformity of the big toe which may be combined with or due to a varus deformity of the first metatarsal (metatarsus primus varus). The cause is often a combination of a genetic predisposition together with tight shoes (fashionable high heel shoes). This causes a prominence of the first metatarsal head on the

*UPDATE, 2022. Hallux Valgus- Look at the Xrays, measure the hallux valgus, HV, angle; the intermetatarsal angle, IMA; the distal metatarsal articular angle, DMAA and the HV interphalangeus angle, HVI. Also check congruency of the jnt. Based on these measures, the surgeons chooses, usually, a combination of soft tissue release and bony procedures to minimize relapses. Juvenile/adolescent hallux valgus- more challenging to treat than the adult form. Hallux varus-usually from over correction of hallux valgus.

Fore foot and Toe Conditions



"Hammer" toes "corn" over proximal I.P. joint. At the 2nd toe, cross over is from disruption of the plantar plate and attenuation of the lateral ligament.

Dorsum of the foot

medial side of the foot which gradually leads to an exostosis. Overlying this prominence is a bursa which may become enlarged and inflamed to form a 'bunion'.

Treatment initially should be a trial of wider shoes and small pads to relieve the pressure over the prominent metatarsal head plus exercises for the intrinsic muscles of the feet. Operative treatment can include osteotomy of the first metatarsal to correct the valgus deformity, intrinsic muscle transfer, excision of the proximal part of the proximal phalanx (Keller's operation), or arthrodesis of the first metatarsophalageal joint.

Hallux rigidus

This is due to OA of the first metatarsophalangeal joint. It is often secondary to trauma and leads to a fairly stiff joint which causes pain, particularly on dorsiflexion. X- rays usually show a diminution of the joint space and osteophyte formation. If attempts at conservative treatment, including firm soled shoes, a rocker sole or a metatarsal bar on the sole of the shoe fail to prevent excessive movement of the joint, an arthrodesis of the first metatarsophalangeal joint may be necessary.

Exostoses

An exostosis of the head of the 5th metatarsal is referred to as a bunionette. This condition may be associated with valgus or other foot deformities and may require excision if conservative measures fail. Other exostoses, including those over the base of the 5th metatarsal, are treated with better footwear, pads, and occasionally operative excision.

Clawing of toes

Clawing or overriding of the 2nd to 5th toes is common and is often associated with other foot deformities, or weakness of the intrinsic muscles of the feet. The 2nd toe may over-

ride a hallux valgus while the 5th toe may override the 4th. In the latter case this may be due to a symmetrical, congenital deformity. A neurological basis for clawing must always be eliminated, such as polio- myelitis, peripheral neuritis or spina bifida (especially if associated with a cavus foot and sensory deficit or motor weakness). Many cases, however, occur in elderly, over- weight women with poor intrinsic muscles.

Flexed proximal and distal interphalangeal joints may cause pressure and tenderness over the end of the flexed toes which press on the shoe or ground. Correction of this condition includes appropriate footwear, intrinsic muscle reduction, 'corn' pads and occasionally operation, as discussed under anterior metatarsalgia. Other foot conditions, including exostoses, may occur else- where due to rubbing of shoes.

Ganglion

This is a cystic swelling filled with glairy fluid and associated with a joint. Excision of an exostosis or ganglion may be necessary if conservative measures fail and if the condition is symptomatic.

Miscellaneous conditions

The differential diagnosis of foot conditions includes congenital deformities such as talipes equino varus and spasmodic flat feet (often associated with a talocalcaneonavicular bar), tumours, trauma, infections and arthritis. All these conditions, as well as OA, RA, gout and paralytic conditions are discussed elsewhere in this book.

*It can be difficult to differentiate osteomyelitis, OM, from a septic jnt. The initial treatment is quite different; for OM it is initially non-operative whereas for a septic jnt it is surgery/wash out of the jnt ASAP. Here is how to tell: Both patients are septic and unwell, BUT for OM you still move the nearby jnt to a certain extent; whereas for a septic jnt the patient will NOT move the jnt even a few degrees.

Prof S Nade (1939-2013), wrote two excellent books on OM and septic jnts, Musculoskeletal Infections and Infections of Bones and Joints. Worth a read.

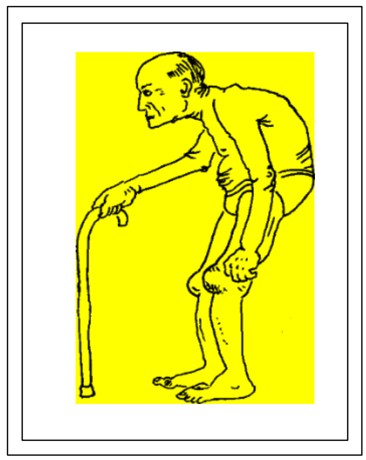
**The foot and ankle may be almost destroyed by RA, with a valgus heel (RA of ankle jnt and subtalar jnt) along with rupture of the tibialis post. tendon, collapse of the midfoot and deformity of all toes. Surgery would involve a triple/subtalar arthrodesis, mid foot fusion, fusion 1st MTP jnt and osteotomies of toes 2 to 4. Results for a grossly deformed and painful foot can be good.

Chapter 15

Orthopaedic Conditions in the Elderly*

Upper and Lower limbs

Spine



Classification

Upper limb conditions

Shoulder and arm – Rotator cuff degeneration

Frozen shoulder

Ruptured long head of biceps

Elbow - Tennis and golfer's elbow

Wrist -Carpal tunnel syndrome

de Quervain’s syndrome

Hand - OA 1st carpo-metacarpal joint Trigger finger

Heberden's nodes

RA

Dupuytren's contracture

Spinal conditions

Cervical spondylosis

Senile kyphosis

Low back strain and disc protrusion

Lower limb conditions

Hip -OA

Knee - OA

Genu varum and valgum

Foot - Chronic foot strain

Plantar fasciitis and plantar neuroma

Hallux valgus and claw toes

Hallux rigidus

Anterior metatarsalgia

Introduction

It is the purpose of this chapter merely to highlight the most common conditions seen in the elderly patient and to refer the reader to the relevant section elsewhere in the book.

In the elderly, degenerative joint disease is common. OA may be primary due to an unknown cause or secondary to trauma, avascular necrosis or RA. Multiple repeated injuries, combined with inadequate synovial lubrication of the joints, are prob-ably the most common aetiological factors. Total hip and knee replacements are the most common joint replacements. Where possible, the aim should be joint mobility rather than arthrodesis.

Neck and spinal conditions are often due to a combination of intervertebral disc degeneration and osteoporotic collapse.

Foot problems are commonly due to obesity and poor muscle tone. Suitable orthotic foot supports, plus physiotherapy, good hygiene and suitable shoes are all that are needed in most cases.

Degeneration of tendons may lead to rupture of the quadriceps, rotator cuff or long head of biceps. Partial tears of tendons may lead to ‘tennis’ or ‘golfer’s’ elbow.

Irritation under the flexor sheath may cause conditions such as carpal tunnel compression of the median nerve and constriction of tendon sheaths leading to trigger finger or de Quervain’s tenovaginitis.

Upper Limb Conditions

Shoulder and arm

Rotator cuff degeneration and frozen shoulder

Rupture of rotator cuff muscles secondary to OA of the shoulder is common. Operative repair may be indicated in early cases of complete rupture. Frozen shoulder, often secondary to cervical spondylosis, may also occur (inflammation and fibrosis-similar to histology of Dupuytren's).

Ruptured long head of biceps

Rupture of the long head of biceps may be secondary to OA of the shoulder but causes little disability and does not require treatment.

Elbow

Tennis and golfer's elbow

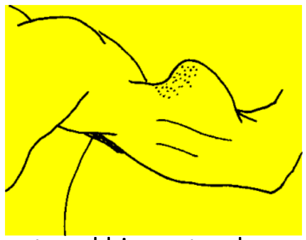
'Tennis' and 'golfer's' elbow are usually due to partial rupture of a few fibres at the origins of the extensors or flexors respectively of the wrist and hand and are seldom due to sport. They can be treated by a support just below the elbow, but over 80% of patients find relief by injection of hydro-cortisone acetate into the tender area.

Wrist and hand

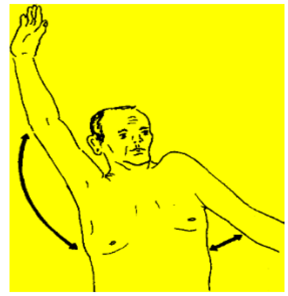
Carpal tunnel syndrome

In elderly patients irritation of the median nerve, producing a carpal tunnel syndrome, may be secondary to a previous Colles' fracture, RA or OA. Conservative measures such as rest may fail, and decompression of the nerve by division of the flexor retinaculum is usually very effective.

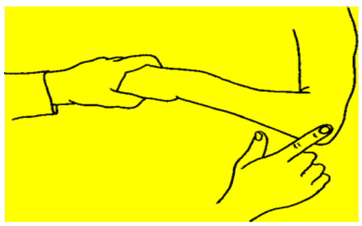
Upper Limb Conditions



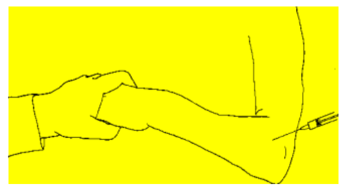
Ruptured biceps tendon



Frozen shoulder



Tennis elbow



Cortisone injection

de Quervain's tenosynovitis

deQuervain' s tenosynovitis is due to an inflammation or constriction of the tendons of extensor carpi radialis brevis and abductor pollicis longus over the radial styloid There is tenderness over the radial styloid exacerbated by abduction of the wrist and thumb against resistance and full adduction of the thumb across the palm for 30 seconds (Finglestein's test). This may respond to an injection of hydrocortisone but is usually best treated by division of the tendon sheath.

OA

OA of the carpometacarpal joint of the thumb is common and may require a support and physiotherapy and occasionally an arthroplasty

Trigger finger

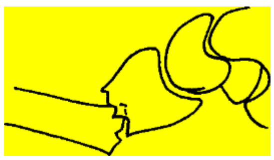
Trigger finger, due to constriction of the flexor sheath over the metacarpophalangeal joint, may respond to a hydrocortisone injection, otherwise division of the sheath.

Spinal Conditions

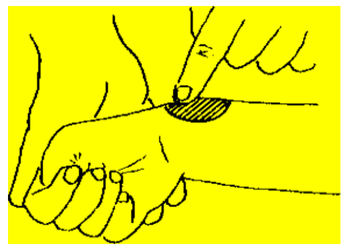
Cervical spondylosis

Irritation of the cervical nerve roots is due to narrowing of the intervertebral foramina from osteophyte formation and disc degeneration, often between C4/5 or C5/6 vertebrae. Irritation of the C5 and C6 nerve roots may cause stiffness, pain radiating down the arm and occasional sensory-motor impairment. There is usually a triad of tender areas over the base of the neck, the insertion of the deltoid and the extensor muscle mass (not origin) in the forearm. Treatment is conservative, with analgesics and anti- inflammatory drugs as well as a collar, heat, exercises and occasionally neck traction with rotation and flexion to the affected side.

Upper Limb Conditions

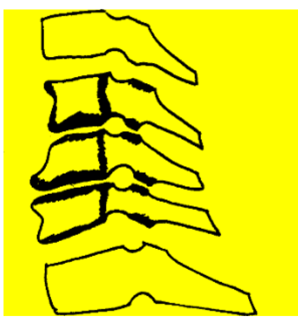


X-ray of a Colles' fracture

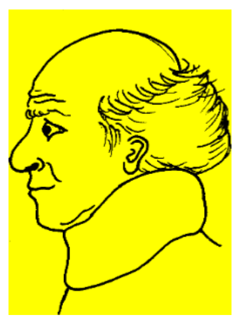


de Quervain's tenosynovitis

Spinal conditions



X-ray of cervical spondylosis



Treatment: physiotherapy, supportive collar and traction

Senile kyphosis

A senile kyphosis due to osteoporotic collapse is common, usually in the thoracic spine, and leads to deformity and chronic back pain. The differential diagnosis, especially in isolated collapse, is metastatic deposits (Chapter11).

Low back strain and disc protrusion

Apart from osteoporotic collapse of the vertebrae themselves and possible secondary deposits, low back strain is common in the elderly. This is often due to obesity, poor muscle tone and an inadequate diet.

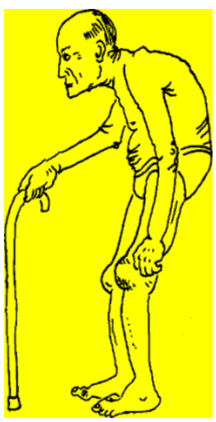
Disc degeneration is common in the lower lumbar region, especially in the L4/5 and L5/S1 disc spaces, with irritation of the L5 and S1 nerve roots causing sciatic pain.

Treatment in the acute stage is usually conservative with bed rest, heat and exercises. Traction on both legs or the pelvis or an epidural injection of local anaesthetic and hydrocortisone for sciatic irritation may be indicated followed by gradual mobilization with a back support.

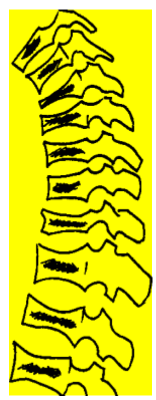
Occasionally removal of a protruding disc causing root pressure may be indicated and this can be done either by a limited laminectomy approach or by a nucleotome. A nucleotome is similar to a knee arthroscope and allows a disc to be removed through a small tube without a major operation. In acute disc protrusions injection of the disc with chymopapain (which digests the disc) may occasionally be effective. There is, however, an appreciable complication and failure rate. Long term treatment is by heat, back exercises (including swimming), education regarding diet, a firm mattress, upright chairs and education regarding safe lifting techniques. A back support may also be indicated (Chapter11).

Spinal Conditions

Thoracic Spine

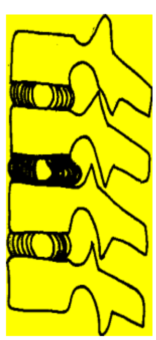


Kyphosis



X-ray of senile osteoporosis

Lumbar Spine



X-ray of collapsed vertebrae

disc

Lower Limb Conditions

Hip conditions

OA

OA of the hip is common in the elderly and may be unilateral or bilateral. It is often associated with OA of the knee and low back strain due to the excessive compensatory strain caused by the flexed and adducted hip.

Physiotherapy with short wave diathermy, exercises and a raise on the heel to compensate for the flexed hip and shortened leg should be tried initially in mild cases. In elderly patients with advanced osteoarthritis a THR is the procedure of choice.

Knee conditions

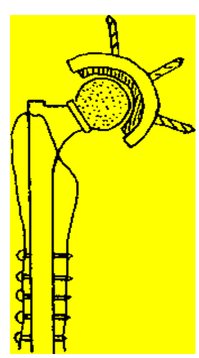
OA and genu valgum and varum

OA of the knee is common, especially after a meniscus injury. This may lead to an increasing varus or valgus deformity of the knee which sometimes causes increasingly asymmetrical wear on the articular cartilages in either the medial or the lateral joint compartments. This leads to increased pain, synovitis and stiffness. A trial of physiotherapy with short wave diathermy and exercises plus a knee support, analgesics and anti- inflammatory drugs may be all that is required in mild cases.

Severe OA is usually treated with a valgus or varus osteotomy of the tibia or femur or a total knee replacement.

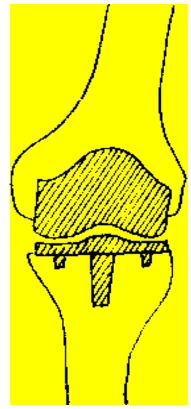
Lower Limb Conditions

X-ray of OA



X-ray of a THR

X-ray of OA



X-ray of a TKR

Foot

Chronic foot strain

Obesity and poor muscle tone often lead to painful feet in the elderly. Chronic foot strain with collapse of the longitudinal arch is common and is often improved with molded longitudinal arch supports. Plantar fasciitis and plantar neuroma Plantar fasciitis with pain under the heel, and anterior metatarsalgia with tenderness under prominent second and third metatarsal

Hallux valgus and claw toes

Hallux valgus and clawing of the toes are often relieved by suitable shoes, physiotherapy and relieving pads, but may require operative correction.

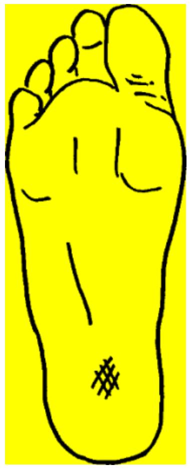
Vascular insufficiency due to atherosclerosis or spasm secondary to hypertension or smoking may lead to ischaemic changes and ulceration. Diabetes may lead to peripheral neuritis and poor healing of sores, particularly if foot hygiene is inadequate.

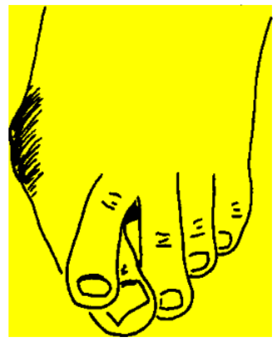
Foot conditions are discussed in further detail in Chapter 14.

Then again what is elderly? Life expectancy is reaching 100; people are retiring at 70+ and staying very active. Regeneration medicine is keeping us more active and healthier.

Diabetic Foot, UPDATE, 2022.Diabetes mellitus isa devastating disease for the foot and lower limb. More than 80% amputation start with a foot ulcer. Proper foot care has seen amputations reduce by half last 20 yrs (Mayo Clinic, accessed 9/8/22). Use HbA1c to monitor glucose levels. Loss of protective sensation(polyneuropathy)causes ulcers. 60-70% long term diabetics have peripheral vascular disease. Grade ulcers and exclude osteomyelitis. Debridement may be required- associated Charcot arthropathy, chronic/progressive/destructive(usually of midfoot), difficult to operate on. Diabetics may come to amputations which are quite disabling.

Lower Limb Conditions

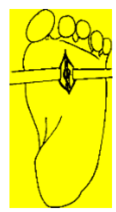




Hallux valgus Treatment: ‘bunion’ pad or operation

Treatment of metatarsalgia

Anterior metatarsal support



Excision of neuroma

545 Orthopaedic Conditions in the Elderly

Chronic Pain

Patients develop acute pain after an injury which indicates the presence of an injury and usually settles after the injury heals. It is an important indication of healing. However sometimes the pain does not settle and becomes chronic. It is then important to exclude underlying infection, failure of bony healing (non-union, delayed healing) or a missed tumour.

If these conditions are excluded and the patient still has pain then a condition called Complex Regional Pain Syndrome, CRPS may have developed. It is defined as a condition where the pain is out of proportion to physical findings with sensory changes (hyperparaesthesia), vasomotor changes (temperature asymmetry, skin colour changes) sudomotor/oedema changes (swelling and seating changes) and trophic changes (stiffness). In effect, the sympathetic system has become dysfunctional.

The two types of chronic pain are nociceptive (from damaged tissues) and neuropathic (from damaged nerves or the CNS).

However more subtle than CRPS is the condition of chronic pain where there may be few clearly defined physical signs yet the patient is clearly suffering and disabled with the pain.

In the world of medicolegal medicine, where the patient (now called the client) is seeking financial

compensation for their injury, we need to consider other factors such as symptom magnification, deception and malingering (basically not telling you the truth). Here there may be Pain behaviour (facial grimacing, holding the body part, distorted gait, frequent shifting o posture, slow movements, rigid posture, moving in guarded way, moaning, using a walking device, stooped posture- Physician's Guide to medicolegal Practice, M I Ranavaya, page 123;you can also check out Waddell's Signs in regard to non organic back pain signs).

The problem is that pain is subjective and there is no readily available objective way to measure it. The system used, the visual analogue of pain (levels of severity 0 to 10), VAS, has been around since the 1970s, when I first used it and it remains imprecise and subjective. The fact that no better technique has superseded it shows the challenge/failure to progress in the clinical management of pain.

Professor Michael Cousins, of Sydney, Australia, is a major pioneer in the management of Chronic Pain and the establishment of Pain as a valid Medical Specialty (requiring further training after becoming a specialist in GP, anaesthesia or orthopaedics). He established the concept of Pain Clinics where such problems are expertly managed by a team.

Pain has been described in a Biopsychosocial Model which puts it into a social context but does not necessarily help the clinician.

Nevertheless, the whole area of chronic pain can become quite bewildering, so my flow chart below will guide you.

Chronic Pain Flow Chart

Resolves

Acute

Organic Basis found*

Chronic

(+/-)

True

No organic basis

found*.

Not True Not Truce -can be symptom:

-magnification (as part of pain behaviour)

-exaggeration (as part of pain behaviour)

-malingering

* It is your job as an expert to make this determination.

Summary-

Chronic pain is real, be very careful to dismiss it as not genuine (unless you have strong compelling evidence such as straight forward video surveillance) otherwise you will be doing a great disservice to your patient.

Treatment is demanding and long term. It will require excluding red/yellow flags (infections, problems of healing etc.), skillful use of analgesics (long term use in the context of a Pain Clinic), nerve blocks, pain relief devices (including spinal cord stimulators) and cognitive behavioural therapy.

Keep an open mind about new possible treatments (e.g. Medicinal cannabis); our job is to treat our patients not to offer moral opinions/lessons.

MedicoLegal Medicine

It is inevitable that medicine and the law interface. Especially with trauma and orthopaedics.

Patients who are injured may seek financial compensation from insurance companies or a person/s responsible for their injuries. But it also goes further than this. So it is very important to be prepared as a doctor when you have to formally interface with the legal system. The below considerations will assist you.

1.**Preparing reports to be sent to lawyers or insurance companies**. These usually cover a patient of yours and the insurance company wants to know what has medically happened. Prepare your report factually and as accurately as possible. Your patient maybe depending upon these monies for day to day living after a serious injury.

2.**Attending a Coroners Court**. This is very serious where someone has died and you have been involved in their care. Talk to your medicolegal provider first.

3.**Attending Court**. The Courtroom is the preserve of the legal profession and especially the Judge. Inevitably you may feel uncomfortable but you must play by their rules. Be extremely courteous/polite to the Judge (he/she has the power to take away your liberty and jail you), always tell the truth, dress properly (in a suit/equivalent), take the relevant patient files with you, turn off your phone.

4.**Being sued**. Consult with your medicolegal provider and follow their advice. Stay calm, seldom is all lost. May be adjust down your ego. Good medical records are your best defence. Poor communication is often the cause.

5.**Doing Independent Medicolegal Examination, IME, reports**. This can be a worthwhile part of your practice, especially if you are a senior orthopaedic surgeon. It builds upon your many years of clinical practice and your opinions are highly regarded by the Courts and Judges. However you must take it seriously. There will be several courses you must/should attend to become accredited in the rules for your jurisdiction and almost certainly in the application of the AMAs(American Medical Association) Guides to the Determination of Permanent Impairment. These texts are used around the world and seem bewildering so you need to attend recommended courses to know how to apply these texts. The determination of permanent impairment is essentially about money and so you have to provide an accurate assessment of permanent impairment to allow/assist the legal system and Courts to calculate financial payments. I strongly suggest a read of Professor M I Ranavaya's book, Physician's Guide to Medicolegal Practice, AMA publications, an excellent book if you are considering a career/work here. Your opinion is highly regarded by the Courts and valued.

Being an IME expert is quite different from being a clinician or surgeon, see the table below.

	Surgeon	IME expert
Who are you responsible to?		
DIAGNOSIS (Key Point)	To be made **THEN** proceed to **TREATMENT** (tablets, physio, radiation surgery…)	To be made **THEN** proceed to **Determination of causation and permanent impairment(as per law in your jurisdiction**)
	Start as soon as you can to acquire the necessary surgical skills	Better towards the mature years of your career when your opinions can be based on your invaluable long term experience
Income	Surgeons are deservedly paid well	
Stress levels	High	Much less

6. **Code of Conduct**

Read the code of conduct for your institution, you may be surprised what is required of you.

7**. Child/Elder abuse.**

Most often child abuse MUST be reports and now laws are being enacted regarding Elder Abuse.

8. **Complaints to Medical Boards**

Boards have encouraged patients to complain. A recent Senate Inquiry, 2022, in Australia, found that this had gone too far and doctors' lives were being ruined from vexatious complaints. General advice is to: take such complaints seriously, get legal advice, do not act in a pompous manner or deliver long diatribes at a hearing and beware that a colleague at a hearing may not be supportive.

9. **Bullying and Sexual Harassment.**

The bullying of junior colleagues used to be du jour in teaching hospitals, the so-called Socratic technique. This humiliation of juniors before “wise seniors” is/was a poor method of teaching and only reflected the inadequate ego’s of the seniors (it was akin to drawing blood from a stone).Sexual harassment continues but carries harsh penalties.

553 **Orthopaedic Conditions in the Elderly**

PART 2:

TRAUMA

Chapter 1

Accident site — emergency management (see Notes, end of book)

1 **Accident site — emergency management**

Resuscitation and first*

Many patients die, and many more are incorrectly treated at the site of an accident. This is sometimes due to lack of simple but effective resuscitation, and other emergency first aid measures, by the first person on the scene. Initial resuscitation and the ABCDE of emergency management can usually be taught in 3 hours to most adults and older children.

A — Airway

Causes of airway obstruction

In the severely injured and unconscious patient the airway may become blocked by blood, vomit, broken teeth, or most commonly by the tongue falling back and blocking the oropharynx.

Management of airway obstruction

The first measure is to clear the oropharynx and position the patient in the coma position, as illustrated. This will enable blood, saliva and any secretions to escape. A patient should never be left unattended if other help is available. An oral airway should also be inserted if there is no major facial trauma.

Clearance of airway

The airway should be cleared before artificial respiration is given. This applies to all unconscious patients, and all patients with an injury of the facial skeleton, the jaw or throat, as well as all other unconscious patients, including those who have vomited and in drowning victims.

Clearing and establishing the airway by chin lift may allow spontaneous respiration to recommence or be improved. In these cases, the patient should be placed in the coma position (see illustration) as soon as possible, with the mandible pushed forward. If the patient is to receive expired air ventilation and/or CPR, the patient should remain supine, with , chin lift or jaw thrust. The head may have to be turned to clear the airway. The cervical spine must be carefully protected if there is a possibility of injury.*The Advanced Medical Life Support (AMLS or EMST in Australia) teaches how to assess and manage most common medical crises.

Hypertrophic cardiomyopathy is the most common cause sudden death in athletes.

2

First aid principles*

- **Keep patient alive**
- **Speed not sterility**

Airway **Breathing**

Patient on side Clear the oropharynx

Mouth to mouth resuscitation if needed

Emergency respiration

Mechanism of obstruction

Tongue falls back and obstructs airway

Initial treatment

- **Pull jaw forward**

- **Do NOT extend or flex the neck**

*Trauma management is one of the great success stories of modern medicine. Over the last 100 yrs life expectancy has gone from 30 to over 60.Once when you broke your hip, you died. Also, the death of Ivana Trump from blunt trauma to her torso, from a fall down stairs, July, 2022, reveals all income levels are prone to trauma.

3 **Accident site — emergency management**

Complications

It is important not to hyper extend unnecessarily, flex or rotate the neck in any unconscious patient, or where there is any possibility of neck injury in the conscious patient. This is to avoid a spinal cord or nerve injury in a cervical fracture or dislocation. These patients also require a firm neck collar.

Coma position

An unconscious patient should never be left on his or her back, except when an attendant is present to prevent respiratory obstruction. Obstruction is unlikely to occur while the patient remains on the side in the coma position.

B — Breathing

Once the airway has been cleared, it is important to aerate the lungs artificially if the patient is not breathing spontaneously.

EAR Expired air resuscitation

Ventilation can be done by mouth to mouth, mouth to nose, mouth to mask, or by use of a reservoir bag.

• Infants — In infants mouth to both nose and mouth together should be given.

• Mouth to mouth — This method of expired air resuscitation is by far the best method of artificial ventilation if no other apparatus is available. The use of the reservoir bag or intubation (page 76) of the patient should only be carried outby those trained in the technique.

Technique of expired air resuscitation

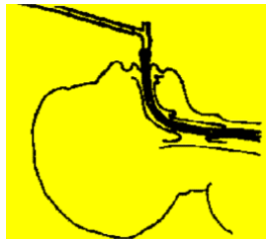
After clearing the airway, push forward the mandible by gently pulling forward with the forefingers located behind the angle of the mandible in the unconscious patient, to keep the jaw held forward, as illustrated. This is so that the tongue does not fall back and block the oropharynx again when the patient is repositioned on the back. Oxygen should be given if possible.

• Mouth to mouth resuscitation — The patient's nostrils should be occluded between the forefinger and thumb of the rescuer's free hand before resuscitation is commenced.

Artificial respiration rate should ideally be 15 breaths per minute (1 per 4 seconds).

Oropharyngeal obstruction

Further treatment

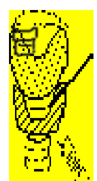


• Coma position — prevent inhalation of vomitus and keep tongue forward

• Oral airway or endotracheal tube if necessary

• NEVER leave an unconscious patient supine when unattended

Cricothyroidotomy



Incision

Needle cricothyroidotomy safest in an emergency

Open cricothyroidotomy only by those trained

5 **Accident site — emergency management**

C — Circulation

Cardiac arrest-CPR, do a practical course.

Do in safe place; Ask if OK; Call/phone for help CPR - Cardio-

pulmonary resuscitation

In cardiac arrest, external cardiac compression must be combined with artificial ventilation. The ratio of compressions to ventilations varies according to whether one or two resuscitators at the accident site are capable of performing cardio-pulmonary resuscitation.

• 30 cardiac compressions should be given for every

2 ventilations delivered.

• Further details

See pages 10-13 and 82 for further emergency care in cardiac arrest.

Complications

Injuries and complications may prevent spontaneous respiration being established despite the administration of adequate ventilatory assistance at the accident scene. These include tension pneumothorax, haemothorax and severe rib injuries (pages 8, 94, 499). It is essential to be aware of these possible complications, especially a tension pneumothorax which can usually be rapidly relieved.

• Haemorrhage from the limbs - This is best treated by direct pressure on the wound, as illustrated, rather than by application of a tourniquet. In addition, an arm or leg with a wound or injury should always be elevated if possible.

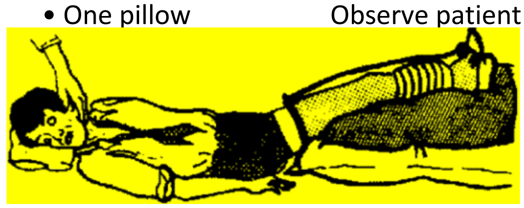
• Shock - A patient in shock should have both legs elevated, as shown. Only occasionally is elevation of the foot of a stretcher required and then only for short periods. This should not be done in the unconscious patient who has sustained a head injury. In such cases prolonged elevation of the legs or the foot of a stretcher may exacerbate cerebral oedema.

•Intravenous infusion of a plasma expander - This should always be established in all severely injured patients, particularly for those in shock or after severe blood loss, with 2 large 14- or 16- gauge intravenous catheters. Severe hypovolaemia may require rapid transfusion of up to 2-3 litres of Ringer's solution or Haemaccel. Tranexamic acid(developed by a lady Japanese obstetrician), a lysine analogue, works in an almost magical way to stop bleeding.

Emergency treatment*

Control bleeding by direct pressure

• One pillow Observe patient

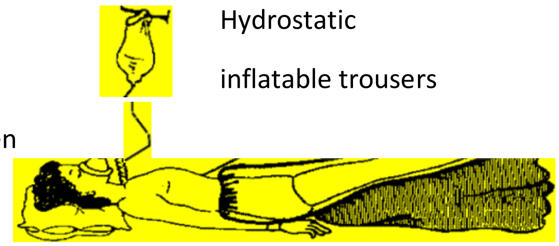


Care in turning spinal injuries

Restore circulation Hydrostatic

inflatable trousers

oxygen



Intravenous drip — Hartmanns — Haemaccel— NSA (normal serum albumen 5%)— Dextran — normal saline— Blood expanders

*Update (2022) - Fluid resuscitation- 2 litres normal saline or lactated Ringer's asap; if still unstable, then blood products (after 30% blood loss). Blood products-universal donor (Group O negative, where specific products not yet available);Type specific blood (X-matched for ABO and Rh type, usu available within 10 mins; Fully typed and X matched; Platelets. If not respond to 2 l crystalloid, 2 units packed RBC given. Recommendation is1:1:1 ratio (packed RBC, FFP and platelets. Base deficit (lactate level <2.5mg/dL indicates adequate resuscitation.

7 **Accident site emergency management**

Thoracic trauma

Chest injuries - These should be treated urgently ahead of any other injuries, except for massive arterial haemorrhage. Signs of shock and respiratory insufficiency may include pallor, sweating, cyanosis, tachypnoea and tachycardia.

Untreated they can lead to respiratory failure and death.

The airway must be cleared and the unconscious patient positioned in the coma position with care to avoid exacerbation of any cervical spinal cord trauma. The mandible should be protracted and oxygen given by mask if intubation is not possible.

Cricothyroidotomy

If an adequate airway is not rapidly re-established by this manoeuvre a wide bore 12- gauge needle and cannula should be inserted through the cricothyroid membrane, if endotracheal intubation is not possible.(see pages 76 and 494)

Penetrating injuries

Wounds and bruising should be looked for, and penetration by a bullet, knife, or other sharp object. These may be associated with an exit wound. Wounds below the nipple line and 5th rib may also injure the liver, spleen and other abdominal organs. The lower half of the chest is level with the upper half of the abdomen because the diaphragm is concave.

Tension pneumothorax (don't delay)

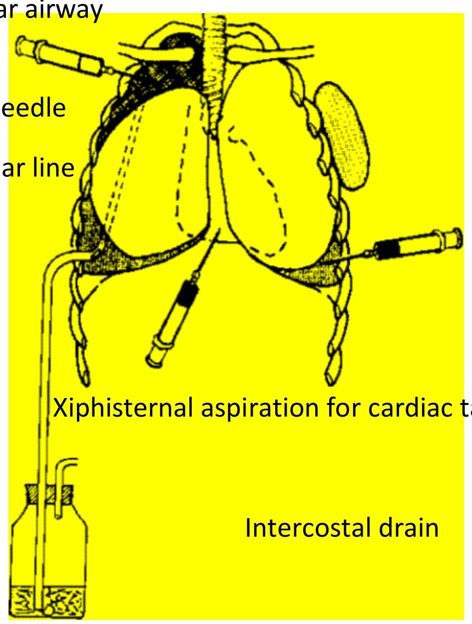
•Pneumothorax— Tracheal deviation and shift of the apex beat may indicate a tension pneumothorax (pages 96 and 499).This is due to a one-way valve between the lung and pleural space, leading to entrapment of air under pressure, collapse of the lung on the affected side and deviation of the mediastinum to the opposite side. Percussion will show hyperresonance on the side of a pneumothorax, while a haemothorax will result in dullness at the base of the lung on the same side. The intensity of the patient's breath sounds during auscultation will be diminished over the side affected in both a pneumothorax and a haemothorax. Increased vocal fremitus will indicate lung consolidation.

Flail chest

Paradoxical respiration refers to abnormal movement of a segment of the chest wall. The affected part of the chest is

Chest injuries

Emergency treatment



Tension pneumothorax — needle through finger of rubber glove for valvular effect in emergency

drawn in, rather than moving out, during inspiration. This is the so-called ‘flail chest’ and is a sign of multiple rib fractures producing an isolated segment of ‘floating’ ribs.

Rib fractures

• Fractures of the upper 3 ribs - These may be associated with damage to the trachea or bronchi, oesophagus, and to the aorta just distal to the left subclavian artery.

• Fractures of the 10th, 11th and 12th ribs - These may cause damage to the spleen on the left and liver on the right. The kidneys, colon and diaphragm may also be damaged. The abdomen must always be examined for peritonism with guarding, tenderness, rigidity, rebound tenderness and the absence of bowel sounds.

• Multiple rib fractures - These are often associated with damage to the sternum and ribs on the contralateral side. A fracture of one or more ribs may also lead to a pneumothorax, haemothorax or haemopericardium.

Cardiac tamponade

Muffled heart sounds, together with hypotension, poor peripheral pulses, pulsus paradoxicus and distended neck veins, may be due to cardiac tamponade secondary to a pericardial effusion or haemopericardium. This usually requires urgent needle pericardiocentesis (pages 100 & 500).

Cardiac arrest

Immediate management

The most common cause of cardiac arrest is a myocardial infarction leading to an arrythmia. The diagnosis is made on a collapsed, unconscious, apnoeic, pulseless (carotid pulse)patient. The following are essential, therefore, even before cardiac massage is carried out:

• Airway — This must be rapidly cleared.

• Breathing — The lungs should be oxygenated by mouth to mouth resuscitation, or via a bag and mask.

• External cardiac compression — This should be commenced immediately after the airway is cleared, without waiting for an endotracheal tube to be passed. 2 large intravenous cannulae should be inserted as soon as possible.

• Time — The time of commencement of cardio-pulmonary resuscitation (CPR) should be noted.

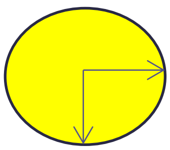
• Endotracheal tube — This is passed, if possible, after initial oxygenation of the lungs.

Cardiac arrest

- Unconscious
- Apnoea
- No carotid pulse

Immediate ventilation and cardiac massage

Check time



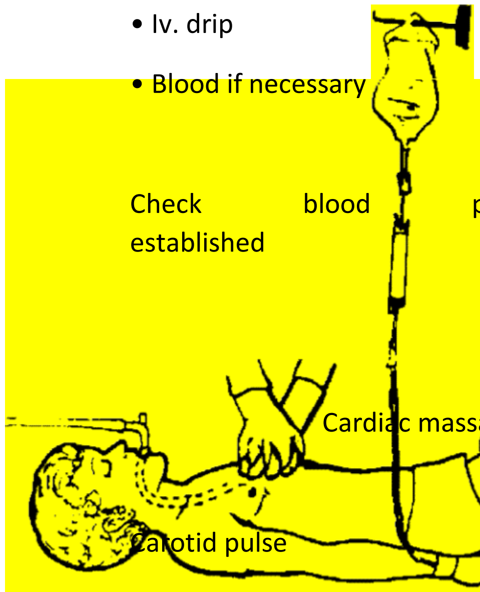
- Iv. drip
- Blood if necessary

Check blood pressure after pulse established

Treat cause

Check pupils after minutes

Clear airway and ventilate



Carotid pulse

- Horizontal patient — elevate legs in hypovolaemia
- Intubate patient as soon as oxygenated and external cardiac massage commenced
- Electrical defibrillation

11 **Accident site — emergency management**

Cardiac massage

Method

External massage is carried out, as illustrated, with two interlocked hands placed over the lower sternum. The elbows should be kept nearly extended. The patient should be on a firm base such as a solid trolley or floor. The legs should be elevated if the cause of the cardiac arrest is hypovolaemia. Give cardiac massage without delay after clearing the airway and commencing positive pressure ventilation.

Adults- 30 Compressions followed by 2 inflations, 5 sets in 2 mins.

Children- Same

• **Rate** — It is currently recommended that at least 80-100 cardiac compressions per minute should be carried out in an adult, and at least 120 compressions per minute in young children and babies.

• **Adults** — The sternum should be depressed approximately 2-4 cm in an adult.

• **Children** — In children 1 hand is used and the sternum depressed less than 2 cm.

• **Babies** — In babies 2 fingers are used to depress the sternum not more than l cm.

Monitoring in cardiac massage

• **Pupil size** — This should be regularly monitored.

• **Carotid pulse** — The adequacy of cardiac compression should be assessed by palpation of the carotid pulse. A single operator should check for the pulse every 2 minutes, and with 2 operators the person ventilating the patient should check the carotid pulse and pupils.

• **Adequate circulation** — If the carotid pulse returns, and breathing starts, the patient should be placed in the coma position unless intubated.

• **Artificial ventilation** — This with oxygen should be continued unless spontaneous respiration is adequate.

• **Duration of cardiac massage** — This should be carried out for at least 20 minutes, unless the patient's illness is terminal, such as in multiple carcinomatosis.

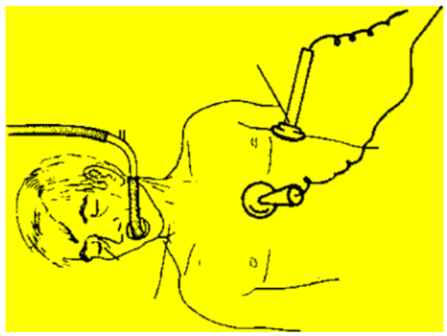
• **Underlying cause** — The underlying cause should be rectified. Other drugs as directed by the team leader.

• **Further details** - See page 82 for further emergency care.

Electrical defibrillation

(DC countershock)

• Right upper lateral border sternum• Left mid-axillary line



• Observe pupils • Carotid pulse

• ECG monitor • i.v. drip • Intubate

Initial emergency procedures

1. Shock for ventricular fibrillation 200-360 joules

2. Repeat shock twice if V.F. persists

3. Adrenaline 1 mg bolus i.v. (repeat every 3-5 min if necessary

4. Repeat countershock x 2 (after 2 minutes)

5. Lignocaine1mg/kg i.v. if defibrillation fails

6. If still fibrillation or asystole repeat adrenaline

7.Lignocaine drip 2-4 mg/min if extrasystoles greater than 6 per minute

NO intracardiac drugs

Also see — pages 11 and 85

D — Disability

Neurological complications

Neurological complications must be considered in all severely injured or unconscious patients.

• **Unconscious patients** — An associated injury may be present, such as a fracture or dislocation of the cervical spine, with damage to the spinal cord or spinal nerve roots. Early splinting of the cervical spine with a firm collar or failing this a soft neck collar, or even a towel, is therefore essential. Flexion, extension or rotation of the neck must also be avoided, if possible, as already stressed above.

Miscellaneous complications

• **Unconscious patient** — Injuries which may be missed include fractures of the cervical, thoracic and lumbar spine, pelvis and limbs. Fractures of the ribs, sternum or pelvis may damage the lungs, heart, liver, spleen, kidneys, bowel or bladder.

• **Compartment syndrome** —Vascular and peripheral nerve injuries and compartment syndrome, secondary to fractures or severe soft tissue damage to the limbs, may also be missed.

Treatment

The management of shock in the injured patient can be divided into immediate life saving measures, diagnosis, management of the cause and long-term treatment.

Emergency management

Emergency measures at the accident site include prophylactic splinting and careful transport. The hospital accepting the patient should be warned if these injuries are suspected.

Further treatment

This is discussed in detail in Chapter 2 (Hospital — emergency care) and in the subsequent chapters.

E — Exposure

In severe injuries the patient should be completely undressed and carefully examined, from head to toes, for other injuries. This should usually be delayed until the patient is admitted to hospital.*Young doctors are often confused as to how to diagnose compartment, cpt, syndrome - So, PAIN out of proportion to the injury, PAIN on active/passive movement of cpt of concern and PAIN on palpation of that cpt. Measuring cpt pressures can be confusing and erroneous.

Examination in major trauma* First priority

- Clear airway
- Re-establish oxygenation
- Stop haemorrhage and treat shock

Clinical examination

Head and neck: conjunctivae and pupils

Tender guarding auscultation for silent abdomen

Bruising injuries

Chest: lungs, heart, ribs, sternum

Spine thoracic, cervical lumbar

Upper and lower limbs

Pelvis: fracture + bladder and urethral damage Look for haematuria

Elevate limb to stop bleeding

Elevate both legs to treat shock

Splint fractures, then check pulse and capillary return

Shock

Shock is a severe haemodynamic disturbance characterized by failure of the circulatory system to maintain adequate perfusion of vital organs.

Hypovolaemic shock

This results from insufficient intravascular volume to maintain adequate cardiac output, blood pressure and, as a consequence, insufficient organ perfusion.

• **Diagnosis** — The shocked patient may be conscious or unconscious. The pulse is usually rapid and weak (compared with slow and bounding following a vasovagal episode or simple 'faint') The patient is usually pale, cold, clammy and hypotensive.

• **Treatment** — Elevation of the feet if there is no head or chest injury, or other contraindication.

• **Clear the airway**, stop bleeding, splint major fractures, and administer oxygen if available.

• **Intravenous drip** — This should be set up routinely at 2 separate sites if possible. A plasma expander or packed cells should be given if indicated. All lifesaving measures should be directed towards perfusion of vital organs with well oxygenated blood as quickly as possible. Up to 2-3 litres of Haemaccel, or other plasma expander, may be necessary. The management of the common causes of shock are illustrated in the hospital resuscitation section of this book (see page 78). In summary, however, the importance in all measures is the early restoration of circulation, the recognition and treatment of the cause of shock, and the emergency treatment of the effects.

Other causes

These include cardiogenic shock due to myocardial infarction, neurogenic shock due to severe head or spinal cord injury, septic shock due to severe systemic infection, and anaphylactic shock due to a hypersensitivity reaction.

Other causes include drugs, endocrine disorders, crush syndrome, burns, and psychogenic, pleural and vasogenic shock (vasovagal syncope). In trauma, the most common cause of the shock syndrome is hypovolaemia due to blood loss. Other causes, or a combination of causes are possible.

A severely traumatised patient, for instance, may be hypovolaemic due to blood loss, and have a poor cardiac output secondary to myocardial contusion and tamponade(see page 78).

Hypovolaemic shock

First aid —initial assessment

Pulse — rapid and weak

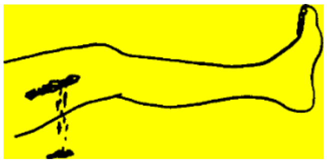
(NB slow in fainting)

- Pale
- Cold
- Clammy
- Conscious
- Unconscious
- Low blood pressure

Breathing; shallow, weak

Causes-Bld. loss visible

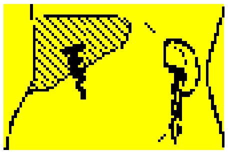
visible



Stop bleeding — replace blood volume direct pressure bandage and elevation of legs –

Bld. loss invisible

Liver



Spleen

Ruptured liver or spleen

Intravenous infusion

It is essential that at least 1 and, if possible, 2 intravenous infusions be set up quickly in a severely injured or shocked patient, at the accident site, before the patient has become shocked further and veins become difficult to find. If there is difficulty in finding the vein, the patient should be transported to hospital without delay.

• **Cannulation** — 2 wide bore cannulas (14- or 16- gauge)should be used in forearm veins, as illustrated, with insertion of a plastic cannula. The butterfly needle is only used for giving drugs or if a larger needle cannot be inserted.

• **Lower limb sites** — In injuries to the upper limb, or where upper limb cannulation is unsuccessful, the femoral vein in the groin, or the saphenous at the ankle, will need to be used, the latter by a cutdown approach (see page 497).

• **Children** — In young children intraosseous transfusion into the tibia should be used where other sites cannot be cannulated. This can even be used in older children or adults as an emergency measure only (see page 498).

• **I.V. fluid giving set** — A plastic blood or i.v. fluid container should be used at the site of accident, as it can be compressed and used as a pressure pump to speed up transfusion.

• **Central line** — A central venous line (in the subclavian or jugular vein), or femoral catheterisation should be inserted in hospital, by a doctor skilled in the technique, in all severely injured patients requiring monitoring and intravenous infusion (see pages 91 and 498).

• **Fluid selection** — Hartmann's solution (compound of sodium lactate), or Ringer's solution should be used to setup the drip, but this should be followed in shocked patients by Haemaccel or another plasma expander such as 5% normal serum albumin (NSA), until blood is available. If blood must be given urgently, or before a cross match is available, O- negative blood should be used.

• **Dangers of blood transfusion** — Due to the dangers, particularly of HIV, hepatitis B and C infection, blood transfusion should only be given in life threatening conditions. This is particularly so because of the 3-month 'window' period in HIV infection (see page 154).

• **Dangers of blood contamination of medical attendants** — Those taking blood should always wear surgical gloves and protective eyewear, if possible, and be cognizant of the potential risks of HIV and hepatitis B and C infection. All medical personnel should also be immunised against hepatitis B.

Intravenous infusion

Apparatus

• Large cannula

• Outer plastic Inner needle (for insertion)

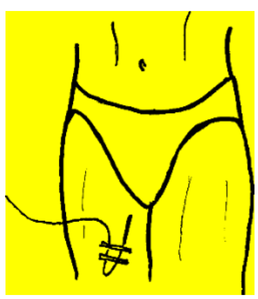
Butterfly needle(ONLY for drug administration)

Sites for infusion

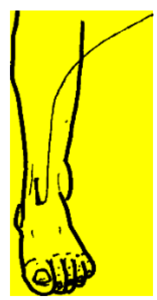
Best in forearm vein away Cubital fossa only if forearm from joints vein inaccessible

• Avoid saphenous vein at ankle if possible

• Hydrostatic (MAST) suit in severe shock except in upper abdominal and chest injuries



Femoral venepuncture



Saphenous vein cutdown

19 **Accident site — emergency management**

Motor vehicle accident, MVA, site*

Call for help

• **Rapidly assess** the situation, call for help, if required, minimise further accidents. This will include warning oncoming traffic, preventing or extinguishing fire, and transporting injured patients away from immediate danger, such as a burning aircraft.

• **Urgent cases** — Arrange for adequately splinted and resuscitated patients to be conveyed to the most suitable hospital by the most appropriate transport. Notify hospitals in advance, if possible, with details of the casualties.

• **Other casualties** — Initial treatment and splinting of all other casualties and their transport to appropriate, usually less specialised, hospitals.

• Dial 000 in Australia, 999 in Britain and 911 in the USA, and ask for the appropriate emergency service.

• Ambulance, fire brigade and police may all be required. Give basic information including location, (the road you are on and the nearest cross street), and the extent of the accident.

Fire

• Extinguish all cigarettes as fuel may be spilt from ruptured fuel tanks.

• Turn off ignition.

• Avoid all sparks. These may be caused by power tools used to free the victims from the wreckage.

ABCDE resuscitation

• Position all victims correctly.

• Ensure an adequate airway and spontaneous respiration.

• Check cardiac output is adequate.

• Stop bleeding by direct pressure on wounds and elevate injured limbs.

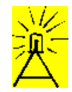
• Splint spine and any limb fractures to prevent possible further vascular or neurological damage.

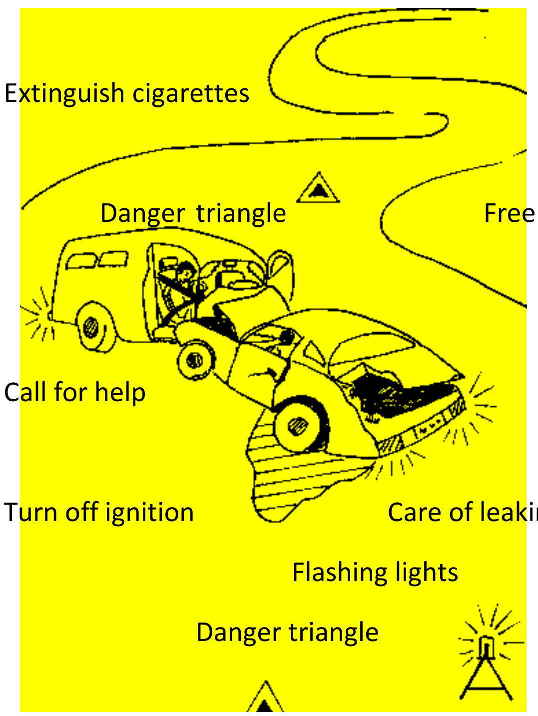
• Other emergency measures — Emergency management of a tension pneumothorax or severe respiratory obstruction is described below and on page 499.

• **Exposure** — Adequate full exposure is best left until the patient is admitted to hospital. *WHO, 2018,in their Global status report , state that annual deaths from MVAs is 1.35 million. The leading cause of death for people aged 5-29yrs.

Accident site

Look for other casualties





Warn oncoming traffic

21 **Accident site — emergency management**

Shock

Treatment

• Administration of oxygen by mask or nasal prongs.

• Intravenous fluids.

• Elevation of the legs and splinting of the limbs by pneumatic splints or a MAST suit if required. Simple slings for the upper limb and tying the legs together for the lower limbs is often the only splinting needed prior to transport of the patient from the accident site.

Wounds

These should be covered by suitable dressings or by clean towels or cloth.

Burns

The pain of severe burns will be diminished by cold wet towels or dressings applied as soon as possible. They should be left undisturbed until the patient arrives at the hospital.

Chest wounds

Open chest wounds will require a simple occlusive dressing (as described below). This should allow air to leave but not enter the pleural cavity (see page 94).

Moving victims

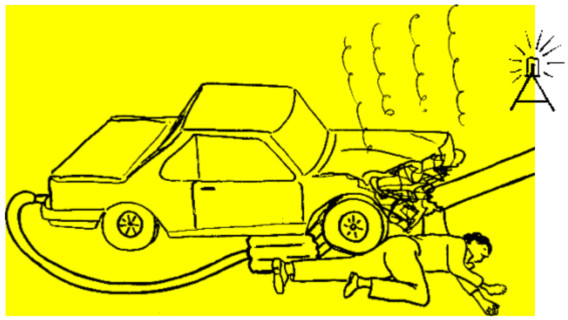
Splinting and immobilisation

Victims who are not in further danger should only be moved once any suspected fractures have been adequately splinted. This is especially important with suspected spinal injuries.

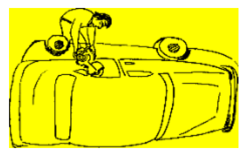
A patient's neck may need splinting with a hard collar, if available, or a soft collar or towel. The thoracic and lumbar spine may require support with a spinal board. Both the neck and back may need to be supported.

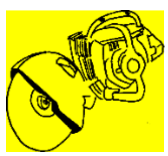
• **Unconscious patients** — These should be considered to have a cervical fracture and possibly other spinal fractures in addition to a head injury, and should be appropriately splinted.*Trauma Assessment (AMLS) is-Prehospital; Primary Survey(ABCDE- airway, breathing, circulation, disability- Glasgow Coma score, exposure-remove all clothing to assess; Secondary Survey after stablized, head-to-toe review.

Automotive accidents Freeing victims

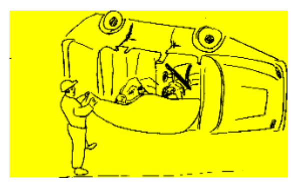


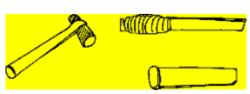
Exhaust driven air bag jack

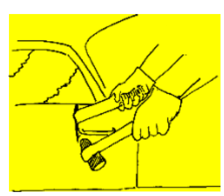




- Hydraulic cutters
- Care with leaking petrol
- Fire extinguisher available







Hand tools

23 **Accident site — emergency management**

Trapped victims

Trapped victims, if not in immediate danger from life threatening injuries, fire or other hazards, should be left until they can be professionally freed by an adequately equipped rescue service. In the meantime, the measures already discussed under ‘ABCDE’ and splinting should be followed and the victims reassured.

• Oxygen and intravenous fluids should be given, and analgesia should be avoided if possible. In cases of delayed rescue any drugs should only be given by the intravenous route due to delayed absorption by any other method of administration. Nothing should be given by mouth, as general anaesthesia may be necessary once the patient has reached hospital.

• **Wounds** — These should be covered, and bleeding areas treated by application of a pressure bandage and elevation of the affected limb if possible.

Freeing trapped victims

Well meaning attempts by amateur rescuers to free victims may, in fact, harm them while they are being removed from the vehicle. Power tools also may produce sparks, with the danger of an explosion or fire if there is spilt petroleum or other flammable liquids at the accident scene.

The freeing of trapped victims is best done by professionals. Adequate access is vital when freeing accident victims, especially in suspected spinal injuries. Patients should be moved with splints already in place and with minimal twisting and bending.

• **Specialised tools** — Professional rescue teams use specialized power tools, including hydraulically operated cutters, to cut through doors, and hydraulic spreaders and winches to open up jammed doors, and free steering wheels, which may trap the occupants of a car. The other wheels of the car must be stabilised, in order to prevent the car rolling. Whole roofs of cars can be cut clear. Before power tools are used, be sure there is no leaking petrol and that in addition a fire extinguisher is available.

A useful method of lifting a car off a trapped victim is an exhaust driven air bag. This is a great advance over the standard jack, for lifting a car (see page 23).

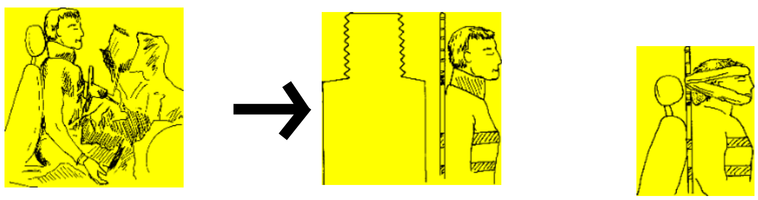
Bush fires are a huge annual problem in California and Australia. It is not unusual for half of NSW State to be burning.

Freeing victims*

Hydraulic spreaders

Hand winch

Rope



*Make a habit of carrying a multi-purpose tool (e.g., Skeletool or Swiss Army Knife/Victorinox) with you/in your pocket as a doctor. Serves multiple emergency purposes.

Injuries on the road

Injuries likely to be sustained by the driver and passengers in a car and by motor cyclists, bicyclists and pedestrians may differ as illustrated (see page 27). It is therefore important to note whether the injured patient was the driver, a passenger, or a pedestrian.

Driver

The driver who is not wearing a seat belt, or is wearing a badly adjusted non-retractable seat belt, is likely to sustain a variety of injuries. The most common of these is a fracture of the sternum. This may be associated with a crush fracture of the mid thoracic vertebrae, as the patient is jack-knifed forward onto the steering wheel. In addition, the driver may sustain a head and neck injury from the head hitting the dashboard or windscreen. A whiplash injury commonly occurs from hyperextension of the neck in a rear end collision, where there is an inadequate or absent head restraint.

Injuries to the pelvis and lower limbs from the steering column, pedals, and even engine being displaced backwards and crushing the lower limbs, are not uncommon. These injuries will even occur with protective airbags which may themselves cause closed eye, chest and abdominal injuries. Air bags, in addition, will not protect the lower limbs and against side and rear collisions. They must always be used in conjunction with adequate seat belts. Despite this air bags save many lives and many injuries.

Front seat passengers

The front seat passenger, if unrestrained or if incompletely restrained, is likely to be projected forward and to sustain not only fractures of the face and skull, but also a fracture of the patella and possibly an associated posterior dislocation of the hip.

Other occupants of the vehicle

All car occupants, if not properly restrained, are likely to sustain not only chest, abdominal and limb injuries, but also multiple injuries. Children may sustain severe head and cervical spine injuries as a result of being thrown through the windscreen of the car.

Any occupant who is not restrained by a seat belt may also be thrown out of the car and sustain a variety of head, chest, abdominal and limb injuries in addition to fractures of the spine.

Injuries on the road Car accident

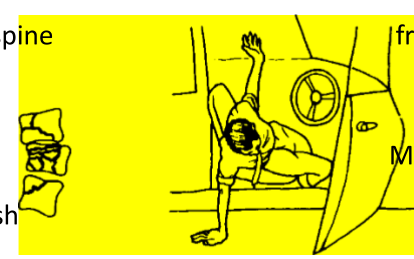
Driver

Driver and passenger

- Fracture patella
- Posterior
- Dislocation hip

All occupants

Crush thoracic spine fracture



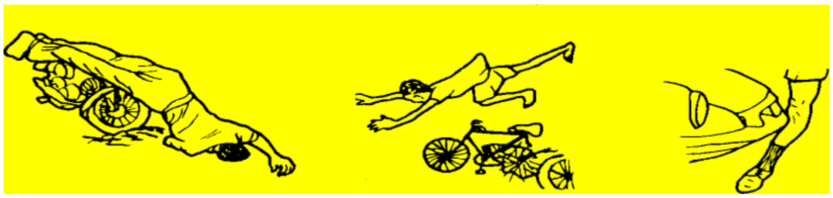
Multiple injuries —thrown out of car

Whiplash

cervical spine

Other accidents

Brachial plexus Multiple injuries • Fracture tibia



Motor cycle Bicycle Pedestrian Tibia

Cervical hyperextension injuries*

Rear end collisions — The driver and passengers in a vehicle which is struck from behind may sustain a 'whiplash' injury as a result of forced hyperextension of the cervical spine. This may tear the anterior longitudinal ligament of the cervical spine, and perhaps cause a fracture and dislocation with spinal cord and cervical nerve injury and quadriplegia. 'Whiplash' injuries are seen more commonly in car seats with no head restraints, or restraints that are too low.

Seat belt injuries

Seat belts save many lives and help to prevent severe injuries in motor vehicle accidents which would otherwise kill the occupants. Seat belts, however, may cause their own injuries in severe crashes.

Lap belts

Lap belts are often fitted to the middle of the back seat of cars. These prevent the passenger being thrown out of a car but may cause the spine to 'jack-knife'. This may cause a crush fracture of the thoracic spine, or a flexion rotation injury to the thoraco-lumbar region and resulting paraplegia. In addition, the transverse part of the seat belt may cause damage to abdominal and pelvic organs, particularly the intestines, pancreas, kidneys, abdominal aorta and bladder. (see page 29) Air bags may also cause closed chest and abdominal injuries, as well as ocular damage including retinal detachment.

Seat belt injuries in children

In children, a simple lap or diagonal belt will allow the child to slide under the seat belt, with resulting chest injuries. A young child must therefore always have a specially fitted child safety seat or, in the case of infants, a special safety cot or 'capsule'.

Non-retractable seat belts

Non-retractable diagonal seat belts, if improperly tightened, may cause a variety of injuries. They include fracture of the ribs with a possible pneumothorax or haemothorax, a fracture of the sternum with a possible haemopericardium and cardiac tamponade, and damage to intra-abdominal viscera, such as the liver or spleen, depending on which side the seat belt is worn.(seepage27) Remember relatively low velocity accidents can produce serious injuries.

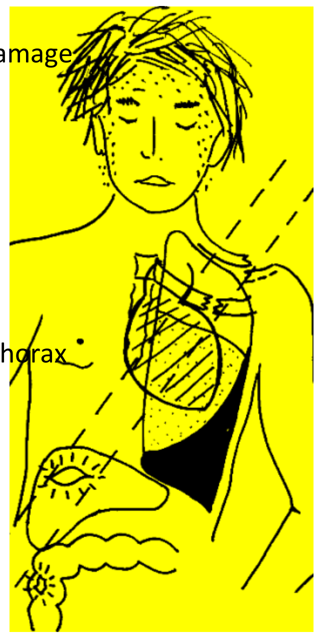
Seat belt injuries

Airway obstruction

Shock

Haemorrhage

Intestinal damage



Fractured sternum

Fractured clavicle

Tension pneumothorax and haemothorax

Haemopericardium
and cardiac damage

Fractured ribs
penetration of lungs

Liver damage

splenic damage

Intestinal damage

Also ruptured aorta, trachea, and oesophagus with upper rib fractures

Note — Many lives are saved by adequate seat belt protection

Also use airbags in addition

Situations where seat belts offer no protection

In high velocity head-on impacts, the head may be accelerated forcibly forward. This may cause a flexion rotation injury with a fracture dislocation of the cervical spine, and sometimes also fractures of the thoracic and lumbar spine. Seat belts afford little protection against these injuries.

• **Side impact** — A seat belt will give very little protection against a side impact. Such accidents may cause fractures of the chest, limbs, and pelvis, with damage to the bladder and membranous urethra. Massive haemorrhage may also occur from rupture of the aorta, the iliac vessels or more commonly from a retroperitoneal haemorrhage.

In future, air bags, and other design improvements will become standard features to maximise the protection to the occupants in side and rear impacts, as well as front end collisions. The injuries mentioned will diminish, but will not be completely eliminated. Air bags may also cause blunt injuries to the face, chest and abdomen. They must always be used in conjunction with seat belts.

Motor cycle accidents

Common injuries

The most common injuries sustained by motor cyclists are head injuries, often combined with an injury to the cervical spine. Other common injuries include brachial plexus paralysis after a fall on the point of the shoulder, and compound fractures of the tibia due to the distal tibia being hit by the bumper of a car.

Prevention

The list of potential injuries following motor cycle accidents is large, and includes fractures of the skull and spine with resultant paraplegia or quadriplegia , chest and abdominal injuries and long bone fractures. It is therefore essential that full face motor cycle helmets are made compulsory. Full face helmets help to protect the cervical spine in an accident, as they limit forced flexion of the cervical spine.

Bicycle accidents

Prevention

• **Helmets** — Over 85% of cyclists killed have sustained a head injury. Compulsory wearing of helmets, both for adults and children, has recently been introduced in Australia, and other countries are following this example.

• **Other safety measures** — These include education of both adults and children and adequate reflectors and reflective clothing, as well as front and rear bicycle lights.

• **Cycleways** — Adequate cycleways are important.

Pedestrians

Common injuries

The classic injury sustained by pedestrians is a lateral plateau fracture of the tibia from the bumper of a car. Associated injuries include compound fractures of the tibia and rupture of the medial collateral ligament of the knee. Many injured pedestrians are also under the influence of alcohol.

Prevention

Preventive safety measures include education, particularly of children and of elderly people. The latter are less mobile and may see poorly in the dark. All pedestrians should wear lighter coloured clothing when walking on the road at night.

General safety measures

• **Alcohol and drugs** — Random breath and drug testing.

• **Speed control** — More adequate speed control measures inbuilt up areas, speed limiting for heavy vehicles, speed traps such as police radar units and red light cameras.

• **Seat belts** — Compulsory use of seat belts for all vehicle occupants. In future driver and passenger air bags as well.

• **Roads** — Improvement to road surfaces, lighting and signs.

• **Safety measures** — Compulsory day driving lights on all vehicles, compulsory use of full face helmets by all motor cyclists and approved helmets for all other cyclists. Other improved safety features in cars include air bags and strengthened passenger 'capsules'. The 'capsule' should also have a protective barrier to prevent luggage acting as 'projectiles' and striking passengers in a front end collision.

• **First aid and resuscitation training** — A good first aid kit should be carried in the car by every doctor. A smaller first aid kit should also be carried in all vehicles (see pages 494- 495). In future a compulsory first aid and resuscitation course should be instituted for all professional drivers as well as the general public, before being issued with a driving licence. It has been shown that those drivers who have had first aid training are much less likely to cause road traffic accidents.

In most motor vehicle accidents members of the general public are the first on the scene. Many deaths or severe disabilities could therefore be avoided by adequate first aid and resuscitation training of all vehicle drivers.

31 **Accident site — emergency management**

Doctors may be called at short notice to attend major disasters. These include air, road or rail crashes, the collapse of buildings, mining accidents, or natural disasters such as cyclones and earthquakes. In all disasters involving large numbers of casualties the role of the first doctor on the scene should be initially one of overall organisation, rather than treatment of individual casualties at the expense of perhaps 50 or 100 other patients who will thereby be neglected. The first doctor on the scene should have the following priorities until relieved by a more senior colleague or by additional help.

Organisations and communication

• **Emergency assistance** — Have police, ambulance, fire brigade (including crash vans), and extra doctors and nurses been summoned and hospitals notified?

• **Traffic diversion** — Has traffic been diverted to save subsequent accidents?

• **First aid post** — Has an emergency first aid post been setup in a central position away from danger of explosions?

• **Communication** — Has the doctor in charge an accompanying police officer with a two-way radio transmitter to ensure communication at all times?

• **Organisation** — Have all available personnel at the crash site been organised to call for additional help, to administer first aid and to look for survivors?

First aid to the severely injured

One doctor available

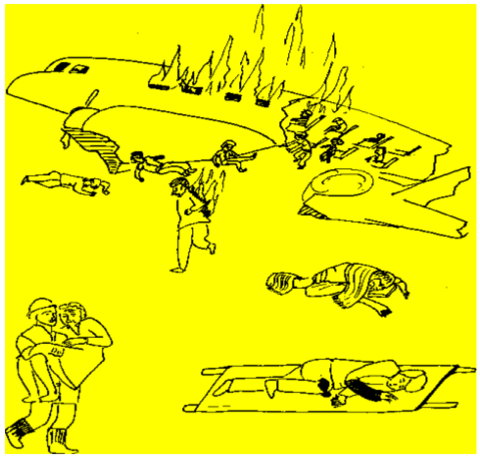
The doctor in charge, if the only doctor available, should normally remain at his temporary first aid post, and casualties, suitably splinted where possible, should be brought to the doctor for resuscitation and treatment.

More than one doctor available

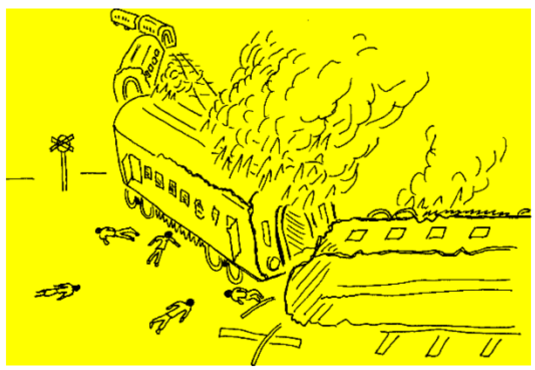
If there is more than one doctor available, the most senior should remain at the first aid and communication post with as much help as needed. The more junior (accompanied by a police officer with a two-way radio, and as many helpers as possible) should rapidly examine the injured at the scene of

Mass disasters

Air crashes



Train accidents



Also, cyclones, earthquakes, bomb blasts and other mass disasters

the disaster. The actual splinting or first aid treatment of non- urgent victims should be left until all patients in need of life- saving measures have been given initial resuscitation. They should be transported as soon as possible to the first aid post and then to the most appropriate hospital.

Types of first aid

Mass disasters — The emphasis should be on speed and resuscitation. Priorities should be directed towards the life- saving measures of clearing airways and maintaining respiratory and cardiac functions, haemostasis, the treatment of shock and the splinting of limbs by pneumatic splints where possible. Appropriate spinal supports or immobilisation where fractures or dislocations are suspected, is important before moving the patient. Wounds and burns should be covered by large clean 'shell' dressings or, failing this, by any large clean piece of cloth. No attempt should be made to clean or suture wounds or apply special dressings except in special circumstances.

Management of minor injuries

These patients should be transported to the central clearing station for first aid dressing and splints prior to transport to hospital.

Labelling of patients and administration of drugs

Triage

All patients treated should be labelled. Different coloured labels used in disasters depend on whether the patient is an emergency, has a non-urgent injury or is deceased.

In preliminary triage, when faced with numerous life- threatening conditions, labels should be attached but not written. These are: red (life threatening conditions), green (another casualty), and white with black stripe (dead).Details should be completed in the casualty clearing station. In an emergency any luggage label or other method should be used.

Drug administration

It is essential that the dose and time be noted in all those requiring medication. Drugs should be given intravenously where possible. If there is no label, drug dosages should be written on the patient's forehead with an indelible pen.

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Notification of hospitals and transport of patients

• **Distribution of patients** — In mass disasters involving large numbers of patients, the careful distribution of patients to hospitals best able to deal with them should be planned. It is not practical to rush patients to the nearest hospital when this may not have the facilities, staff or beds to cope with them.• Helicopters — Helicopters, where available, should be used to transport critical patients with head injuries to centres with neurosurgeons, and those with severe chest injuries to a hospital where thoracic surgical procedures can be carried out.

• **Disaster and transport priorities** — The doctor in charge must decide the priorities of patients transport, and also ensure that they are fit to travel. The hospital requires notification so that the appropriate specialists, operating theatres, resuscitation facilities and beds can be prepared. Supportive facilities such as blood bank, radiology and pathology facilities, both at the hospital or at national level if necessary, should be put on full alert until the extent of the disaster is known.

Communications

Emergency services

The provision of radio links between police and ambulance direct to the hospitals is essential. Individual hospitals should designate a senior doctor to take charge of the reception and organisation of casualties. In addition, hospitals must have regularly rehearsed internal and external disaster plans.

Relatives and friends of victims

Radio and television stations can provide telephone numbers for information of relatives. These should be distinct from those of hospital switchboards, as switchboards will be rapidly jammed to the detriment of the emergency services.*Doctors need to be pro-active. The Sydney 2000 Games prepared for a biological attack but not Trauma (bombs etc.); so, a group of local surgeons led by EG, set-up such a group. Fortunately, no such event occurred.

Quick assessment of conscious patients

The illustrations show a quick assessment of the conscious injured patient. This assessment is not comprehensive, but excludes serious injuries, and allows the doctor, nurse, or ambulance officer to examine several patients quickly in mass disasters. A brief overall inspection of the patient should be made before the quick assessment is carried out.

Upper limb

• **Neurovascular examination** — A quick neurovascular examination of the upper limbs should include palpation of distal pulses, plus assess the power and sensation of the hands. The median nerve can be tested by abduction of the thumb against resistance, the radial nerve by extension of the thumb in the plane of the palm and the ulnar nerve by abduction of the little finger away from the ring finger.

• **Musculo-skeletal assessment** — Exclude any severe injury by asking the patient to grip the examiner's hands and to pronate/supinate against resistance. This tests all bones and ligaments from the fingers to the shoulder girdle. If the patient complains of pain the relevant area should be examined in more detail.

Head and facial skeleton,

• **Skull** — Orbit, eye injuries, and external ear bleeding can be seen on inspection and the patient may be shocked. The skull should be palpated.

• **Maxilla and mandible** — Fractures should be suspected if the masseters do not contract equally when the patient is asked to clench the teeth.

Spine

• **Cervical spine** — The cervical spine is assessed by asking the patient to rotate the head actively (movements by the patient) to the left and right. Only if such active movements are painless, the patient should actively extend the neck against resistance. This will test the paraspinal muscles and may localise a tender area in the thoracic and lumbar spines which should then be examined in more detail.

• **Thoracic and lumbar spine** — The patient should be lying flat and rolled on to the side. The back should then be palpated for tender areas without sitting the patient up. Palpable gaps between the spinous processes indicate rupture of the

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Quick assessment

Upper limbs

Pulse — circulation

• Power
• Major fracture
• Dislocation
• Circulation

Grip examiners hands —twist in and out

Facial skeleton and skull

• Inspect face for signs of shock and injury

• Inspect orbit, eyes, nose and ears for bleeding and injuries

• Clench teeth — equal contraction of masseters = no serious mandibular or maxillary damage

37 **Accident site — emergency management**

interspinous and supraspinous ligament with possible fracture or fracture dislocation.

• **Neurological** — See below.

• **Bladder** — Bladder paralysis with urinary retention may indicate spinal cord or cauda equina damage.

Chest, abdomen and pelvis

• **Inspection** — Examine for distended neck veins. Inspect the chest wall to see if respiration is regular and chest wall movements symmetrical. Note any respiratory distress, deformities or bruising.

• **Palpation** — Palpation of the trachea for deviation indicating a tension pneumothorax, haemothorax or pulmonary collapse. The ribs and sternum should be palpated and the chest 'sprung' gently. Pain may indicate the site of rib fractures.

• **Abdomen** — A quick assessment of the abdomen will assess possible damage to the liver, spleen, kidney, intestine, bladder, and other organs by tenderness, guarding or rigidity.

• **Pelvis** — This should be palpated for any tender areas and should be gently 'sprung' by the examiner. Particular attention should be paid to palpation of the pubic rami for tender areas. If there is any tenderness and evidence of damage to the perineum, this should be examined as well.

Lower limb

Neurovascular assessment

• **Lower limb power** — This can be quickly assessed by testing dorsi-flexion and plantar flexion in the great toe. This is a more accurate method than assessing power in the whole foot because, in a fracture of the tibia or other major bone, the patient will be reluctant to move the foot against resistance.

• **Sensation** — If the power is normal assessment of sensation should be delayed until the patient is in hospital.

• **Reflexes** — These should be assessed in hospital.

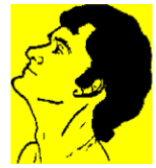
• **Vascular impairment** — Examination of the peripheral pulses and perfusion of the lower limbs should be delayed until the patient is fully assessed in hospital.

Musculo-skeletal assessment

A quick way of assessing the whole lower limb for a major injury is to ask the patient to twist the feet actively against resistance, first inwards, and then outwards. If the patient complains of pain or weakness anywhere from the toes to the pelvis, this area should then be examined in more detail.

Quick assessment

Cervical spine

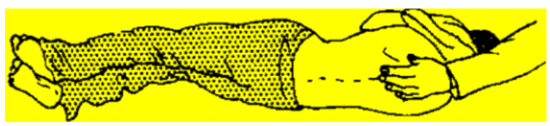
  

Patient actively extends against resistance

Note — all movements active i.e., performed by the patient

No pain — minimises likelihood of severe injury

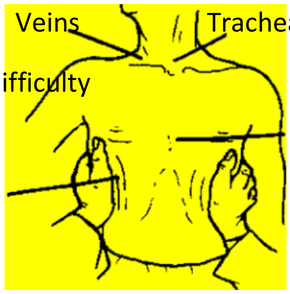
Thoracic and lumbar spine



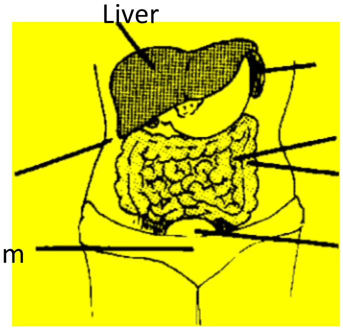
- Roll to opposite side
- Do NOT sit up
- Palpate for interspinous gap, supraspinous processes and other tenderness

Quick assessment

Chest

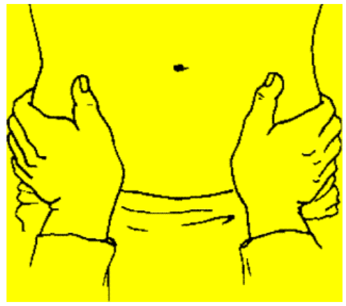


Abdomen



Quick assessment

Pelvis



Palpate tender areas

Spring pelvis gently

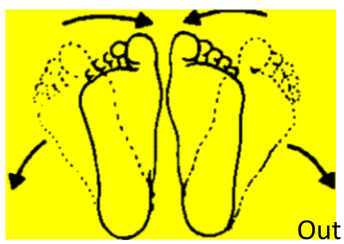
Lower limbs

Power big toes

Inspect limb

Down

UP



Patient actively twists feet against resistance

Out

Out

Both feet

Assesses for all serious injuries ,toes to pelvis

Assessment of the unconscious patient

Causes

There are numerous causes of loss of consciousness. Any combination of the following may be present in a single patient. A simple mnemonic for remembering the major causes of loss of consciousness is illustrated (see page 43).

• **Alcohol** — The patient may be under the influence of alcohol. This will legally require a blood sample to be taken for alcohol levels. This is particularly important if the patient has been the driver of a motor vehicle involved in an accident in which other people have been injured.

• **Epilepsy** — The accident may have followed an epileptic fit.

• **Injury** — The patient may have sustained a head injury following a motor vehicle accident.

• **Opiates and other drugs** — Apart from excessive alcohol intake, illegal drugs and legal medications may have been taken.

• **Uraemia** — Metabolic abnormalities such as uraemia may precede the unconsciousness. They may also follow the accident.

• **Cardiovascular** — Cardiovascular causes of unconscious-ness include hypovolaemia secondary to blood loss, cardiac dysrhythmias or tamponade, myocardial infarction and

• **cardiogenic shock. (see page 82)**

• **Cerebral** — Haemorrhage may be extradural, subarachnoid, or intracerebral.

• **Respiratory** — Causes may include hypoxia or CO2 retention.

• **Diabetes —** Hypoglycaemia or hyperglycaemia may be a cause of unconsciousness.

• **Thermal or tropical causes** — These include heat stroke and cerebral malaria.

• **Functional** — This should only be considered if all other investigations are negative. It is a dangerous diagnosis unless all organic genuine causes of unconsciousness have been fully excluded.

• **Summary** — Multiple causes of unconsciousness may co- exist in addition to a head injury. These must always be considered.

Guide to unconscious patient

Systemic cause

A E I O U

Alcohol Epilepsy Injury Opiates Uraemia

Vascular and respiratory causes

Cardiovascular system
- cardiac
- peripheral

Cerebral haemorrhage
- extradural
- intracerebral

Respiratory — Hypoxia or CO2 retention

Don't	**Forget**	**Them**
Diabetes Hypoglycaemic Hyperglycaemic	Functional Fat embolus	Thermal/Tropical diseases

43 **Accident site — emergency management**

Power and reflexes

1 2 S — Ankle Jerk

3 4 L — Knee Jerk

5 6 C — Biceps Jerk

7 8 C — Triceps Jerk

Guide to circulation

Central

- General appearance — cold, clammy, sweating
- Blood loss
- Shock (pages 16 and 78)
- Blood pressure and pulse rate
- Neck veins and carotid pulse

Upper limb

- Radial pulse
- Circulation in hand — temperature, pallor, cyanosis, sensation and power

Lower limb

- Dorsalis pedis and posterior tibial pulses
- Circulation in foot — temperature, pallor, cyanosis, sensation and power

Emergency amputations*

If a patient needs to be freed urgently from the accident site an emergency amputation may be necessary.

- **Needs** — These include a patient requiring urgent resuscitation and a patient in a dangerous environment, such as a mining disaster or trapped in an earthquake.
- **Technique** — A tourniquet is applied proximal to the site of amputation. Intravenous analgesia, general anaesthesia, Entonox and/or local anaesthesia should be administered.
- **Site of amputation** — All tissues should be divided in the same plane and as far distally on the limb as possible.
- **Bleeding vessels** — These should be ligated if possible or the tourniquet should be released for 5 minutes each hour provided an intravenous drip is in situ and the pulse and blood pressure are stable.

• **Elevation of the limb** — The limb should be elevated and a local pressure bandage applied instead of a tourniquet.

• **Definitive amputation** — This is performed in hospital

* Dramatic as this may seem, as recently as 2011 with the earthquakes in ChCh, NZ, urologists performed such amputations in a collapsed hotel.

Limb trapped at accident site

• **Morphia intravenously**

• **Tourniquet**

• **General anaesthesia**

• **Local anaesthetic block**

• **Divide all tissues as low as possible**

• **Do not attempt flaps**

45 **Accident site — emergency management**

Gunshot, radiation and blast injuries*

In view of the increasing incidence of gunshot and bomb injuries throughout the world, it is important that all doctors and paramedical personnel should have guidelines to follow. The management of gunshot and blast injuries will include the specific problems of the ABCDE of trauma already discussed in this book, with the addition of penetrating injuries, and the additional effects of a nuclear explosion or blast injury. These may be combined with radiation, chemicals, gas, burns, smoke inhalation and crush injuries in explosions.

In addition, because of the legal and police involvement in many of these cases, adequate documentation is important, including the exact site and size of entry and exit wounds. All clothing, personal effects and body parts should be labelled and bagged. The risks of a possible second explosion must be appreciated, and it is essential that injured patients should be moved out of danger as rapidly as possible.

• **Blast injuries** — The high pressure shock wave in a blast travels at over the speed of sound and the effects are multiplied in enclosed spaces and in water.

Following the shock wave, the blast may cause injuries in the following ways:

• **Respiratory tract and abdomen** — The ear drums and eyes may be ruptured and the nasal tract and oropharynx damaged. The upper and lower respiratory tracts may be severely damaged, as may the gastro-intestinal tract.

In patients whose lungs survive the initial blast, a late presentation of lung damage of up to 3 days may be similar to adult respiratory distress syndrome (ARDS) due to oedema of the lungs. The risk is increased with intermittent positive pressure respiration, which should be avoided if possible. A tension pneumothorax is an additional risk.

Closed injury to the abdomen may not manifest itself for several days, and present as an intestinal perforation, backpain due to an abdominal aortic leak and peritonitis.

•**Other blast injuries** — In addition to the above, injuries to the head, trunk and limbs caused by the blast, foreign material such as shrapnel, clothing, glass and other foreign bodies may be driven into the body by the force of the explosion. Detailed assessment and management of penetrating and blast injuries is discussed further on page160.

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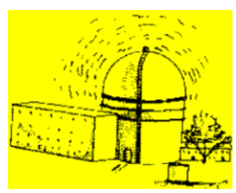
Radiation and blast injuries

Atomic bomb **Nuclear reactor accident**



Examination and treatment

Corneal and ear

drum damage

Lungs — frothy blood

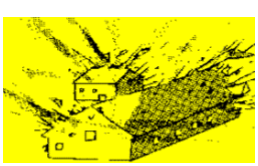
Treatment

• I.V. drip
• Oxygen
• Shock

Respiratory resuscitation abdominal injuries

• Airway

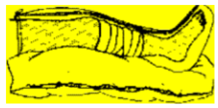
• Blood loss



• Shock

• Pressure bandage for bleeding

• Splint fractures



***Gunshot Fx -** depends upon velocity. High- energy/shotgun-treat as grade IIIA Fxs; low-energy as closed Fx. plus 1st gen. cephalosporin.

Nuclear bomb and radiation

injuries*

A nuclear explosion can cause horrific injuries, burns, radiation induced complications (acute radiation syndrome) and death.

Causes

Blast injuries from bombs are caused from the shock waves generated by an explosion. Missile injuries are generated both from the bomb and the blast combined. Crush injuries are common.(see page 160)

Injuries

Damage to the lungs, eyes and ears, plus the chest, abdomen, head, spine, and limbs may occur.

• **Burns —** These may be from weapons of mass destruction or may be secondary to radiation, chemicals or heat.

• **Shock waves** — These may be caused by bombs or by other explosions. The destructive force of the many new non- nuclear weapons can generate casualties of massive proportions, only equaled by nuclear weapons.

Rescue and treatment

The blast can cause buildings to collapse with patients trapped under the rubble.

• **Treatment** — This includes not only the management of head, trunk and limb trauma, but also the massive crush injuries of muscles with complications of the crush syndrome. (see page 182)

Radiation contamination

Radiation contamination and its management can be divided into immediate decontamination and treatment. This includes resuscitation followed by removal of contaminated clothes, and washing of contaminated skin.

The later systemic effects of contamination need to be managed, as do the effects due to the blast, crush injuries and burns.

Immediate resuscitation

General resuscitation will include analgesia, airway management, intravenous drips with fluid or blood, treatment of shock and other injuries including head, spine, chest, abdomen, and limbs.

48 **Decontamination of patients in hospital**

- **Shave contaminated hair, shower** without clothing, scrub thoroughly, and use a radiation monitor if possible.
- **Dispose of all** clothing and effects into a plastic bag plus metal trunk. Wear gloves and isolate from other patients.
- If material is ingested collect excreta and vomitus and store for disposal. Wash open wounds.
- Watch out for late radiation fallout.

Effects of radiation

The effects include nausea, vomiting, diarrhoea, toxaemia, low white cell count, haemorrhage, desquamation, CNS toxicity, aplastic anaemia, renal failure, alopecia, pyrexia and sterility.

Burns

Emergency management

Presenting history

In addition to the burns themselves, there may be significant complications associated with the inhalation of smoke, fumes and gases, generated from combustion of plastics and other chemicals. The history should include information as to whether the burns occurred in an open or closed space and the length of time the patient was exposed to smoke or fumes.

Past history

This should include a history of allergic reactions and underlying pulmonary disease. It should also include alcohol or drug usage and tetanus immunisation.

Immediate airway complications

Those which are immediately life threatening, such as air way oedema, should take priority over the treatment of the burns themselves.

Exposure

In all cases of severe burns, the patient should be completely undressed in hospital.

Other life threatening complications

A complete examination should include examination of the cardio-respiratory system. Urgent resuscitation of the patient, treatment of shock and blood loss is essential.

49 **Accident site — emergency management**

Respiratory tract — examination in burns

Diagnosis

Indications of airway oedema and damage include:

• **Respiratory complications** — Inspiratory stridor, wheeze, hoarseness and a cough productive of dark carbonaceous sputum.

• **Other signs —** These include facial burns or oedema of facial mucous membranes, such as the eyes, nose and mouth. Any of these findings should alert the examiner to the possibility that respiratory complications may be present or impending.

• **Laryngeal oedema** — If the patient has evidence of laryngeal oedema and stridor, the vocal cords and epiglottis should be inspected by either direct or indirect laryngoscopy.

Emergency treatment of burns

Resuscitation of the patient

This includes airway and breathing, treatment of shock and restoration of the circulation by appropriate fluids. It should also include appropriate emergency treatment of other injuries including head, spine, chest, abdomen and limbs.

Local treatment of burns

• **First aid treatment** — This includes cold, wet dressing slightly applied to the burn area.

• **Definitive treatment** — This is discussed later and includes silver sulphadiazine cream, and appropriate debridement in hospital. (see pages 190-199)

• **Minimisation of infection** — This includes intravenous antibiotics and tetanus toxoid and/or TIG.

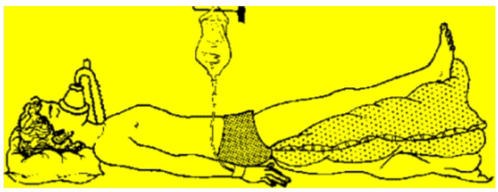
Further burns management

Further details of the treatment of burns is discussed on pages190-199.*See US EPA.

Burns

Emergency management

- **Intravenous infusion**
- **Hartmann's/SPPS/blood**
- **Oxygen**
- **Treat shock**
- **Space blanket**



- **Antibiotics**
- **Tetanus prophylaxis**
- **Silver sulphadiazine locally in hospital**

Immediate large cold wet dressings for large areas with pain

Treat other injuries

- Head
- Chest
- Abdomen
- Spine
- Limbs
- Decontaminate the patient

(following radiation or chemical injuries)

Drowning

Emergency management

Patient breathing

If the patient is unconscious, but breathing, the airway should be cleared of mucus, vomit, dentures and any other debris as quickly as possible. The patient should be positioned in thecoma position as illustrated. Oxygen should be administered if available.

Patient not breathing

• **Airway** — This should be cleared immediately.

• **Expired air resuscitation (EAR)** — This should be commenced. (see pages 2-7)

• **External cardiac massage** — This should also be started if there is no carotid pulse.

• **Intravenous infusion** — This should be set up. 'Water-logged' patients must be given fluids with care. Sodium bicarbonate 8.4% (40-100 ml — 1 mmol/kg) is only used to correct acidosis if this is shown to be present on laboratory tests. Further and hospital management

• **Unconscious patient** — The patient should be intubated as soon as possible, if the patient cannot be ventilated properly.

• **Central venous pressure (CVP)** — This should be set up.

• **Pulmonary oedema —** This may occur late, hours after immersion, and may result from the aspiration of a hypertonic fluid such as salt water. In such cases, pulmonary oedema is not secondary to fluid overload, and diuretics have no place in drowning.

• **Antibiotics —** These should also be used routinely.

• **Oxygen** — Administration of high flow oxygen is important

• **Gastric aspiration** — The stomach should be emptied as soon as possible by a nasogastric tube which should be passed and placed on continuous low suction.

• **Catheterisation** — The monitoring of urinary output is essential.

Investigations

Routine investigations should be done as soon as possible. These include a full blood count, urea, creatinine, electrolytes, arterial blood gases and a chest X-ray.

Drowning first aid

Patient breathing

Patient on side Clear airway

Patient not breathing

Mouth to mouth ventilation

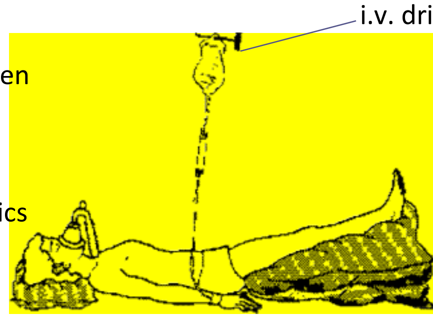
after clearing airway

See cardiopulmonary resuscitation

Further and hospital treatment

Unconscious patient

- Treat cerebral and pulmonary oedema
- Lung complications
- Cardiac failure
- Electrolyte disturbances i.v. drip High oxygen



- Intubate if necessary
- Steroids
- Antibiotics

- Empty stomach large bore tube
- Pass urinary catheter

Bites and stings*

-Animal, shark and human bites

These are particularly likely to become infected. They require debridement, tetanus toxoid or tetanus immunoglobulin, antibiotics and, where relevant, a rabies vaccine. Leave the wound open and effect delayed primary closure.

-Shark attacks, although rare, may cause horrendous wounds with massive haemorrhage and shock. Urgent resuscitation with fluid and blood replacement, oxygen administration and intravenous antibiotics is essential.

-Venomous snake bites, The current recommendation is to apply a firm bandage to the whole limb, toes/fingers upwards and to splint the limb. The patient should be kept still and ice applied around the limb if possible. Broad pressure bandage. Do not hinder circulation.-Spider bites, venomous spider bites are treated in the same way as snake bites. Spiders and snakes, if killed, should be taken for identification. Antivenene is important.

Stings

Jellyfish and marine stingers

These are extremely painful and can occasionally be fatal. Most jellyfish stings, however, require merely to be bathed with vinegar, weak acid or a local anaesthetic cream.

Beestings

These may cause anaphylactic shock and this should be watched for. The sting is removed sideways and local alkali applied. The patient should be treated for pain if necessary.

Wasp stings

These, unlike bee stings, are alkaline and do not leave a sting in place. The wound should be bathed with vinegar or weak acid. Anaphylactic shock and respiratory distress require a systemic antihistamine, adrenaline and resuscitation.

Resuscitation in bites and stings

• **Treatment of shock** — This may be required. Intubation is occasionally necessary. Adrenaline, steroids, or antihistamines by intravenous administration may also be required for severe anaphylactic shock. The Poisons Centre should be telephoned and the snake or spider taken for identification if possible. Give antivenene if necessary.

Bites

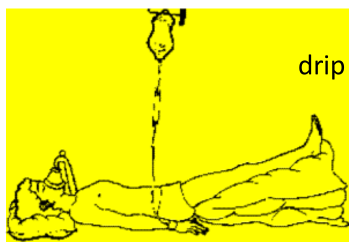
Animal and human

- Adequate debridement
- Tetanus toxoid + TIG
- Antibiotics*
- Rabies vaccine if indicated

*Pathogens-usu staph. and strep. but cats(Pasteurella); dogs (Eikenella) and Human variable(incl Eikenella).

Shark attacks

Treat shock before transporting

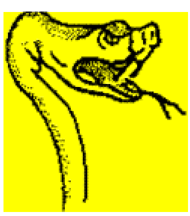


drip with blood or 5%NSA

Direct pressure or tourniquet to stop bleeding

Venomous snake bites

Assisted respiration if patient stops breathing Firm elastic bandage over whole limb



- General resuscitation
- Transport to hospital
- Antivenene
- Phone Poison's Centre

- Splint limb
- Stop movement
- Keep patient still
- Ice if available

Stings

Spider

Treat as for snake bite

Jelly fish

Vinegar or weak acid locally

Bee

• Remove sting sideways

• Alkali locally

Wasp

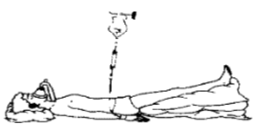
Vinegar or weak acid

General treatment

Clear airway oxygen

General resuscitation

Shock Anaphlylaxis

 Adrenaline, antihistamines

IV fluids if required, assisted ventilation if necessary.

*Dr Struan Sutherland’s book, Venomous Creatures of Australia, has great pictures and is a classic. Well worth a read.

Pediatric resuscitation

Emergency management

The priorities in pediatric resuscitation, as in adults, are:

• **Airway, breathing, circulation, disability and exposure (ABCDE).**

• **Life threatening injuries**

• **Limb threatening injuries**

• **Other injuries**

Important causes of preventable deaths in children are:

- **Inadequate ventilation**
- **Inadequate circulation**
- **Undiagnosed hidden injuries**
- **Delay in resuscitation**

Airway management

- **Pediatric anatomy** — Children have a large tongue, a small oral cavity, a large jaw angle and a 'V' shaped epiglottis.
- **Larynx** — This is high and is opposite C3 in infants, compared to C5 or C6 in adults.
- **Trachea** — This is also short and there is a danger inputting an endotracheal tube down a main bronchus and only inflating one lung, while blocking the other.
- **Oxygen consumption** — Children have a relatively high oxygen consumption and a lower pulmonary residual capacity compared to adults.
- **Gag reflex** — They also have well developed gag reflex and vomit easily, increasing the risk of aspiration.
- **Intubation** — Oxygen should be administered by mask or via endotracheal tube. If the gag reflex is present no oral airway should be inserted as this may induce laryngo-spasm, choking or vomiting. Oro-tracheal intubation should be carried out with a tube size equal to the external diameter of the child's nostril. A loose fit will allow air to escape around the tube. A 'D' tube will prevent gastric distension.
- **Cricothyroidotomy** — A wide bore needle should be used to perform a cricothyroidotomy when orotracheal intubation is not rapidly successful in urgent cases.
- **Cervical spine** — This should be stabilised with sandbags and a collar in all unconscious children.
- **Other injuries** — The management of these is similar to that in adults, but with modifications described in the relevant sections of this book. These include head, chest, abdominal, spine and limb injuries. (See pages 232-253).
- **Assessment of child's weight** — Measure the length of the child and assess weight from table of length/weight.

Normal vital signs for a child (very approximate)

Age	Pulse BP	Respiration	Urine output 0-4
	100+80	30	2 ml/kg/hr
5-11	90+90	20	2 ml/kg/hr

12-16 80 100 15-20 1ml/kg/hr

• **Fluid replacement** — The blood volume of a child is approximately 80 ml/kg. Give warm fluid 20 ml/kg, Hartmann's or Haemaccel initially. Then give 20 ml/kg blood or 10 ml/kg packed cells if necessary.

• **Burns** — Admit to hospital all children with more than10% burns and in the special categories discussed in the chapter on burns (see pages 190-199). Cold dressings should be applied only for the first 15 minutes and then warm dressings. Other treatment is as for adults.

• **Endotracheal intubation** — Pre-oxygenate and use a straight blade laryngoscope and do not rotate. The tube size is approximately the size of the external nostril or the diameter of distal phalanx of the child's little finger. The tube should not be cuffed below 6 mm size. Insert the tube about 3 cm beyond the cords and use cricoid pressure during insertion. High oxygenation is necessary. Check the endotracheal tube position by auscultation and chest X-ray and fix the tube carefully. In addition, always insert a gastric tube and aspirate, and also an indwelling catheter and measure the urine output.

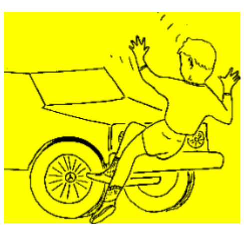
• **Thoracocentesis** — This is at the fifth interspace in the mid-axillary line. Use size 12 for infants, size 16-20 for 3 to 11years, and size 24-28 for 12 to 16 year olds.

• **Head injuries** — Fits are common. Carry out a CT scan if necessary after sedation. Always support the cervical spine in all head injuries.

• **Abdominal injuries** — Always pass a gastric tube and catheterise. Conservative management is indicated for most liver, spleen and kidney injuries. Perform a CT scan or ultrasound instead of peritoneal lavage. Laparotomy should be carried out for all intestinal and bladder perforations, for all penetrating injuries, and if in doubt.

• **Limb and spine injuries** — See pages 232-253.

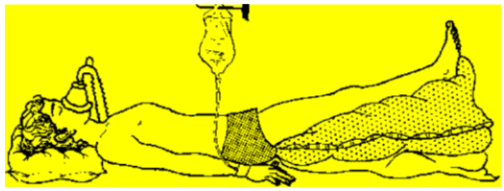
Pediatric trauma



Burns

Resuscitation

High oxygen i.v. drip



Intubate or needle cricothyroidotomy if unsuccessful

59 **Accident site — emergency management**

Splinting of fractures

Pneumatic splints

A pneumatic splint is an excellent method of immobilisation. In the upper limb it can extend from the fingers to the mid humerus and in the lower limb from the toes to the mid femur.

Advantages

The wound can be viewed, and X-rays can be carried out without removing the splint. This is particularly useful in compound fractures which may bleed and need pressure. It will both diminish hypovolaemic shock and excessive movement of the limb.

Disadvantages

Dangers of pneumatic splints include the increase of relative pressure when a patient is travelling by car, or by air at a height of greater than 1000 metres. There may also be an increase in pressure when a patient is left lying in the sun. The splint should only be inflated by mouth or by a pump with a pressure

Temporary splints

If no splint is available one can be made from a rolled newspaper or wood covered with cloth. The limb is then bandaged to this. A splint can also be made out of plaster of Paris. The arm should then be put in a sling. In major injuries the upper limb should be bandaged to the side of the body, and the lower limb bandaged to the opposite uninjured leg.

Upper limb injuries

• **Hand injuries** — Most can be treated by putting a pad of wool in the palm held with an elastic bandage plus a sling.

• **Wrist** — Injuries of the wrist are best treated initially with a simple aluminium cock-up splint, with a sling, as illustrated. It is also useful for fractures of the metacarpals, radius and ulna.

• **Upper limb slings** — These can be divided into those which support the point of the elbow and those that do not.

• **Triangular sling** — This supports the elbow. It is used for fractures of the humeral neck and shoulder girdle injuries, including fractures of the clavicle and dislocations of the acromioclavicular and sternoclavicular joints.

• **Collar and cuff sling** — This does not support the elbow and is indicated in fractures of the shaft of the humerus. This

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Upper limb slings

Wool around wrist and behind neck

Triangular sling

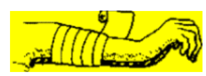
Collar and cuff

Severe injuries

Emergency splinting Upper limb

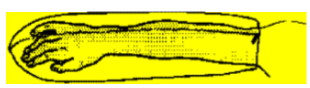
All severe hand injuries

Sling in all cases



Aluminium cock-up splint

Severe injuries fingers tolower humetus



Pneumatic splint — not by air over 1000 metres

61 **Accident site — emergency management**

allows the weight of the arm to pull the fracture into alignment. Either type of sling can be used in other fractures.

In severe injuries, or when the patient has to travel some distance, a simple collar and cuff sling should be applied for support. The arm is then bandaged to the side of the body.

Chest injuries

• **Minor fractures** — These usually require no treatment.

• **Major fractures** — These may cause damage to the lungs, heart or abdominal viscera. These complications sometimes also occur with minor rib fractures and require urgent treatment. A potential lethal complication is an unrecognized tension pneumothorax due to puncture of the lung. This causes a valvular collapse of the lung and displaces the mediastinum and trachea to the opposite side, and compresses the lung.

• **Severe fractures** — In severe fractures of the ribs, a pad of wool placed over the fracture, held by adhesive strapping or an encircling bandage, as a temporary measure only, will often relieve pain and allow the patient to cough. The arm on the affected side should always be rested in a sling. Subsequent treatment is sometimes a long acting local anaesthetic into the fracture site in severe cases.

• **Open chest injuries** — Open injuries of the chest wall should be treated with a large vaseline gauze pad which will allow air to escape from the chest cavity, but prevent air entering.

Spinal fractures

• **Examination** —The patient must be kept supine. The patient should be rolled carefully and never sat up. Spinal cord and nerve root damage should be looked for. This includes power, tone, reflexes and sensation. Retention of urine may require catheterisation under full sterile precautions.

• **Cervical spine** — In suspected cervical injuries a cervical plastic collar or a towel will provide limited support.

• **Thoracic and lumbar spine** — A simple spinal board can be used or the patient should be left lying flat.

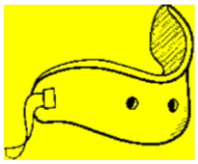
• **Transport —** A simple stretcher can be made from jackets or shirts, as illustrated. If this is not possible, the patient should be carried face down, with the spine hyperextended, as most injuries are in flexion. Never let the spine flex.

• **Further management** — In hospital, the patient is nursed on a mattress supported by fracture boards. In cervical fractures the head is immobilised between sandbags plus a cervical collar.

Emergency splinting

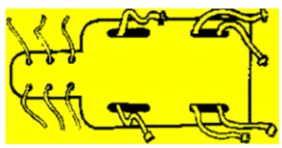
Cervical spine

Simple plastic neck collar



Use a towel in an emergency

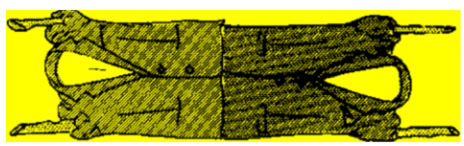
Thoracic and lumbar spine



Spinal board

Transport of patients with spinal injuries

Emergency stretcher



2 poles — 2 jackets or shirts inside out buttoned up

Pelvic fractures*

Complications

The complications of pelvic fractures are much more important than the fracture itself. These include rupture of the bladder or membranous urethra, damage to the sciatic nerve and massive haemorrhage with shock.

MAST pelvic support

The Military Anti Shock Trousers (MAST) suit are inflatable trousers with 3 compartments which are inflated by mouth or a pressure limiting hand pump. They are applied from the ankles to the lower abdomen and can diminish pooling of blood in the lower limbs and pelvis. In addition, they are also very useful for stabilising a fractured pelvis to allow transport of the patient. They should not be used where there are severe chest or upper abdominal injuries, or in the pregnant patient except for the leg parts of the MAST suit.

In shock the patient's feet should be elevated as soon as possible or the inflatable trousers (MAST) suit applied, but do not tilt the head down. The MAST suit compresses the lower limbs and abdomen and has safety valves to prevent over-inflation. This device can return about 1-1.5 litres of blood to the circulation. It is essential that the compartments be released gradually in a controlled hospital environment, with at least 2 large intravenous lines in situ and after respiratory and circulatory problems have been controlled.

Deflation of the MAST suit too rapidly, and/or too soon, may produce irreversible shock.

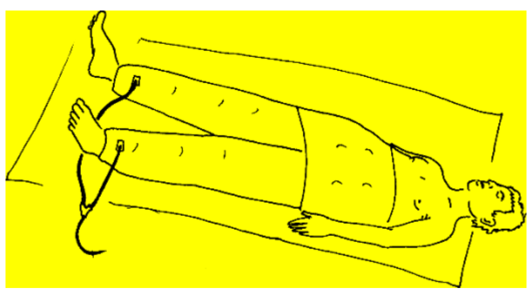
• **Dangers** — Apart from chest and upper abdominal injuries, the MAST suit should be used with care in patients being transported by air, because of a relative increase in pressure due to the pressurisation of commercial aircraft (6 000 ft, 2 000 metres). Pressure increases will also occur in the hot sun. The suit should not be kept continuously inflated for more than 1-2 hours due to possible ischaemia of the lower limbs.

Transport

The patient should be left lying flat. In severe unstable fractures and in the shock due to blood loss, the pneumatic MAST suit will both stabilise the pelvis and diminish haemorrhage.

*Unlike adults, pelvic Fxs in children do remarkably well with great remodelling. Many of these Fxs are avulsion Fxs.

Pelvic fractures MAST suit



• Stabilise patient before deflation

• NOT for chest and upper abdominal injuries

Hip fractures

Emergency treatment

Correct external rotation

Leg flexed over 2-3pillows or bandage legs together

Do NOT use a Thomas splint

Hip fractures

These are best immobilised with the hip and knee flexed over 2 or 3 pillows and not by a Thomas splint. Flexion will correct external rotation. This splinting should usually be used in hospital prior to operative fixation.

• **Transport** — Flexion over 2 or 3 pillows is also the best immobilisation during ambulance transport of hip fractures. In long distance transport both legs and feet should be tied together.

Femoral shaft fractures

In fractures of the mid or lower femoral shaft, tie both legs and feet together or use a Thomas splint, whose length and circumference can be adjusted (see illustration). It should be well padded, both around the ring and between the splint and the leg. The leg should then be lightly bandaged with anelastic bandage on to the Thomas splint.

• **Transport** — The above type of immobilisation is suitable for transport of femoral shaft fractures over short distances. If the patient is to be transported a long distance, however, skin traction should be applied. The foot should be inspected regularly to make sure that the traction is not compromising the blood supply.

In patients travelling long distances the well-padded leg should be supported by plaster of Paris over the Thomas splint. If plaster is used it is essential that this be split before the patient is transported.

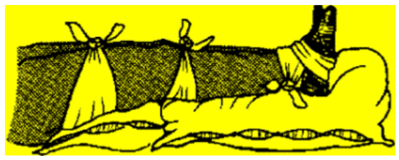
Tibia and fibula

The emergency treatment of unilateral fractures is to bandage the leg onto a Thomas splint with skin traction if necessary. An alternative to a Thomas splint for the lower femur, knee, tibia and ankle is a pneumatic splint. A pneumatic splint is also invaluable for haemostasis and alleviation of hypovolaemic shock. It is also used for splinting the leg in hospital prior to radiological evaluation. If no splint is available, the legs should be tied together.

• **Bilateral tibia and fibula** — If both legs are fractured, splinting can be carried out by using a piece of wood padded with cloth or a rolled up newspaper. This is placed between the legs and secured with elastic bandages.

Femoral shaft fractures

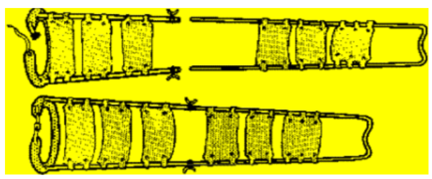
3 triangular bandages Feet together



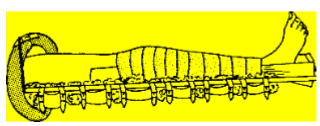
Gently pull injured leg straight and to length

Thomas splint

Adjustable top Adjustable for length



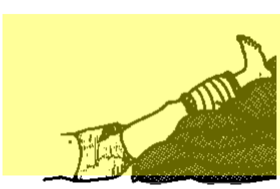
Single splint-L or R. Gent tract



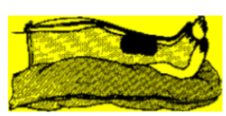
Bandage limb onto splint

Tibial shaft fractures*

Open fractures and injuries Pneumatic splint Useful for bleeding



Direct pressure over large pad of wool for haemorrhage



Do NOT transport by air with a pneumatic splint

Ankle and foot

A below-knee pneumatic splint is the best method of immobilising an ankle fracture or fracture dislocation. A wooden splint covered with wool and an elastic bandage is the most satisfactory temporary measure.

• **Elevation of legs in lower limb fractures** — The lower limb should be elevated to reduce oedema in all severe fractures.

This is particularly important in femoral shaft fractures and in compound fractures of the tibia.

Head injuries**

Head injuries may be associated with cervical fractures and dislocations. All unconscious patients must be treated on suspicion with a firm neck collar and neck support. Suspected associated injuries of the chest, abdomen, pelvis, thoracic and lumbar spine, and limbs must also be treated until excluded by X-rays and other investigations in all unconscious patients. These patients should not be treated head down as this will increase cerebral oedema.

Shock and blood loss

The patient must also be treated for shock, blood loss and other major injuries before transportation and before an X- ray is carried out. It is particularly important in the casualty department. Too many patients have died in X-ray departments because initial resuscitation has not been carried out, and the extent of shock and blood loss has not been appreciated. 2-3 litres of blood may be lost in fractures of the femoral shafts.

**UPDATE, 2022. Traumatic brain injury (TBI), 'silent epidemic' now. Leading cause M&M-children / young adults. Treatment-based on protocol-based guidelines (from Brain Trauma Foundation, UK, 2022). Aims- prophylaxis and early/prompt management of IC hypertension & 2nd brain injury, maintenance of cerebral perfusion, ensuring adequate oxygen to injured brain tissue. Cornerstone- ICU treatment to avoid 2nd injuries. Immediate attention to airway, circulation (prevent hypotension, do GCS, maintain $PaCO_2$ normal range, PaO_2 of 90,earlytracheostomy, careful fluid management, use of high dose barbiturates, monitor ICP, measure $PbrO_2$,mannitol useful for ICP control, anticonvulsant therapy, temp. management, glycaemic control,

Chapter 2
Hospital
emergency care**

**(TBI ctd) Decompressive craniectomy, attention to nutrition, antibiotic therapy (when infected ICP monitors)attention to DVT/emboli. Children, with larger heads, prone to direct head injury, more difficult to assess neurological status.

***Know SIRS (the systemic inflammatory response to trauma), increased cytokines/complement/many hormones. When 2 or more present of: HR>90, WBC< 4,000 or >12,000, resp>20/min, PaCO2 < 33mmHg, temp <36 or > 38. SIRS is associated with DIC, ARDS, renal failure, shock and multisystem failure.

Patient transport

The following forms of transport are recommended for taking injured patients to hospital. If possible they should be manned by specialist retrieval teams.

• Ambulances — These should be used for short journeys.

• Helicopters — For journeys up to 100-200 km.

• Fixed wing aircraft — For journeys over 200 km.

• Four wheel drive vehicles — These should be used in rugged terrain.

• Cars, station wagons and trucks — These should be used where there is delay in obtaining an ambulance, such as in rural communities.

• Inaccessible sites — If patients need to be transported from inaccessible sites, such as from mountains or forests, make shift stretchers made from branches, with jackets or shirts, can be used. Patients with spinal injuries are best transported face down if a stretcher cannot be made.

Reception of casualties at hospitals (Triage)

Considerable improvement is needed at many individual hospitals in the reception and treatment of casualties. Each accident and emergency centre requires an action card/ log in for every member of staff, summarising his or her role in a major disaster.

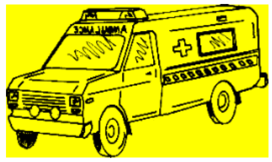
Staff should also have regular tuition in emergency management. This includes cardiac arrest, acute respiratory and abdominal emergencies, as well as drug overdoses, and the immediate resuscitation of the multiply injured patient.

Organisation

Specialists in Emergency Medicine should be in overall charge of organising the reception and distribution of casualties and the organisation of staff. In addition, adequate staff must be put on alert or called in early. Specialists in all the major disciplines should also make themselves immediately available by being on a Trauma Care Team (multi-disciplinary-anesthesiologists, trauma surgeons, orthopaedic surgeons, neurosurgeons, intensivists). *Non-op care of tibial shaft Fxs where shortening (most difficult to correct) < 1-2cm; cortical apposition >50%; varus/valgus <5 degrees; Flx/ Extn < degrees. Assess- tilt (angulation), shift (end to end apposition) and twist (rotation).

Emergency transport

Short journeys

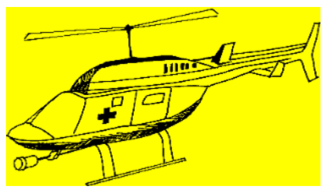


• Ambulance

• 4 -wheel drive ambulance if necessary

• Other vehicles as required

Journeys 100 - 200 km



Helicopter when possible

Journeys > 200 km

Fixed wing aircraft

71 Hospital emergency care

Resuscitation in severe

injuries

• Advanced trauma life support — Guidelines were first evaluated by the American College of Surgeons and are now being introduced in many major trauma centres in the world.

There are 4 main components of the advanced trauma support system. These are: primary survey, resuscitation phase, secondary survey, and the definitive care phase.

• Primary survey —

A —airway maintenance and cervical spine care.

B —breathing and ventilation.

C —circulation and control of haemorrhage.

D —disability and neurological state.

E —exposure by completely undressing the patient.

Emergency procedure in the Accident and Emergency Department

The following are guidelines for treating a severely injured patient in a major accident centre:

• **Airway and breathing** — The airway should be established as a matter of urgency. A cervical spine injury should be assumed until excluded. X-rays of all 7 cervical vertebrae are essential in all unconscious patients.

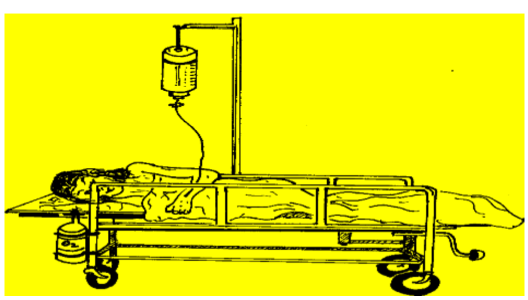
• **Nasopharyngeal obstruction** — Clearance and aspiration of the oropharynx should be followed by insertion of an oropharyngeal or nasopharyngeal airway, or by endotracheal intubation. A needle or open cricothyroidotomy may be urgently required if intubation is not successful (see page 496).

• **External haemorrhage** — This should be treated by direct pressure dressings and elevation of the limb. At least 1 or 2intravenous cannulae with 14 - or 16 - gauge needles should be inserted urgently, and appropriate fluid or blood given as required. A large forearm vein is probably the most satisfactory, or alternatively one in the ante-cubital fossa. The external jugular, femoral, or saphenous at the ankle, the latter by a cut down, may be required. In hypovolaemic shock, urgent fluid replacement, including blood, is required. If more than 8-10 units of blood are given, 10 ml of 10% calcium chloride should be given for each 5 units of blood. Problems with coagulation may also necessitate administration of fresh frozen plasma and platelets after haematological

Emergency department

Special casualty trolley

Oxygen attachment, sucker attachment



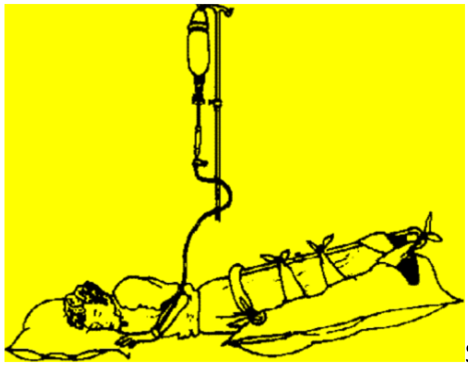
Elevating footpiece

Oxygen and i.v. fluids Anaesthetic trolley

Emergency ward

Transfusion

Trained staff



Oxygen suction

Stretcher with elevating foot

Sutures, dressings, aspiration, cardiac arrest, thoracotomy, tracheostomy, catheter trolley, portable X-ray

investigation. The dangers of blood transfusion are discussed on page 154.

• **Open chest injuries** — Open thoracotomy is required in all cases. This will allow for open cardiac massage and temporary clamping of the aorta, if required, for severe hypovolaemic shock. Open chest wounds should be treated by an occlusive dressing plus a thoracic tube to aspirate air or blood, pending operation.

• **Other large open wounds** — These should be covered with a sterile non-adherent dressing, plus pressure, splinting, and elevation, if required. A transparent pneumatic splint is useful for splinting unstable fractures before X-ray.

• Photograph the wound before application of the dressing will minimise the need to disturb the dressing before the patient is taken to the operating theatre.

• **Investigation and further treatment** — An urgent AP chest X-ray and blood gas analysis is required. Tension pneumothorax will require initial decompression of the 2nd intercostal space in the mid-clavicular line. Both a pneumothorax and a haemothorax will require drainage in the 5th intercostal interspace in the mid-axillary line before ventilation.

• **Drugs** — In lung contusion, smoke inhalation, drowning and lung injuries due to blast, large doses of intravenous corticosteroids may be indicated.

• **Blood** — This should be urgently taken for full blood picture including cell count, electrolytes, urea and creatinine. Arterial blood gases, group and crossmatch, as well as blood alcohol levels and urine analysis, are important.

• **Further management** — Following the initial resuscitation and investigation, further monitoring of the severely injured patient is important. This will include pulse, blood pressure, and respiratory rate. Central venous pressure, ECG, pulse oximetry and blood gas estimations should also be carried out if necessary.

• **Other monitoring** — This should include the level of consciousness and appropriate investigations and treatment for evidence of intracranial haemorrhage, oedema, or convulsions. This is discussed in more detail under the section on head injuries and should be recorded including the Glasgow coma scale (see pages 120-129).

• **Catheter and gastric tube** — An indwelling catheter to monitor urinary output is important. Output should be at least 0.5 ml/kg/hour and ideally 40-50 ml. per hour in an adult. Nasogastric aspiration should be carried out in all unconscious patients and in all shocked patients, and all patients with abdominal injuries.

• **Other investigations** — The patient requires a detailed clinical examination after being fully undressed. X-rays of cervical spine, head, chest, abdomen, pelvis and limbs may be required. These may also include ultrasound, CT scanning and peritoneal lavage. This is discussed in more detail in the relevant sections on head, chest, abdominal, pelvic and limb injuries.

• **Drugs** — It is important that appropriate medication for pain, sedation, resuscitation and infection be given intravenously for most cases. Appropriate intravenous antibiotics should be given in all open wounds. Tetanus prophylaxis should include tetanus immunoglobulin as well as toxoid if the tetanus immune status is uncertain.

• **Records** — It is essential that all records be kept carefully up-to-date. This is especially important in all accidents and all possible legal cases.

Injury severity score

This is a combination of scores used for the assessment of the injured patient. It is an approximate guide to the severity of an injury.

The Glasgow coma score is described under 'assessment of head injury patients' (see page 122)

Glasgow coma score			
13-15 9-12 6-8 4-5	>90 76-89 50-75 1-49	10-29 >29 6-9 1-5	4 3 2 1

The maximum injury severity score is 12 for a minimally injured patient, while a score of 3 would indicate a very severely injured patient with a life threatening condition.

Airway management and ventilation

Airway protection

• **Oxygen** — Effective delivery of oxygen to the patient requires a properly fitting mask, but this does not protect against aspiration of vomitus or secretions.

• **Unconscious patients** — In unconscious patients, and in patients in whom adequate ventilation cannot be obtained by other means, the patient should be intubated.

Inadequate ventilation

• **Bilateral** — Common causes include obstruction of the upper respiratory tract, and a leak between the face and mask.

• **Unilateral** — These include a pneumothorax, haemothorax, lung contusion, a flail rib segment, and obstruction of the bronchus by a foreign body or by intubation of 1 main bronchus.

Intubation

The laryngoscope is usually held with the left hand and the endotracheal tube inserted with the right after dentures have been removed, and the throat cleared of secretions. The tongue is lifted forward with the blade of the laryngoscope.

• **Difficult cases** — Cricoid pressure will make the larynx and vocal cords more readily visible.

• **Check position** — Always check that the endotracheal tube is in the trachea and not in the oesophagus or down the right main bronchus, which may result in blocking of the contralateral bronchus by the tube and collapse of the affected lung.

• **Auscultation of chest** — The chest must also be auscultated to check adequacy of ventilation of both lungs.

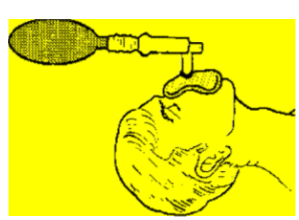
• **Oxygenation** — An oxygen concentration of 100% should be administered initially following intubation with the tube in the correct position.

Emergency airway

• **Cricothyroidotomy** — This should be performed if an endotracheal tube cannot be inserted, due to lack of skill or equipment or if there are severe facial or jaw injuries. In this case a needle cricothyroidotomy is preferable to a tracheostomy as an immediate measure. A wide bore 12 - gauge needle angled caudally at 30° below the larynx, through the cricothyroid membrane is the most effective emergency

Emergency respiration

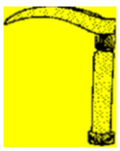
Apnoea-artificial ventilation



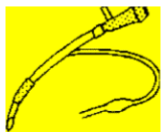
Mouth to mouth or assisted respiration Auto inflatable bag

Always clear airway first

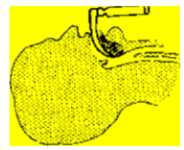
Endotracheal intubation



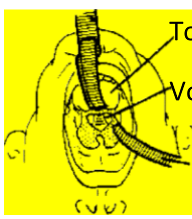
Laryngoscope

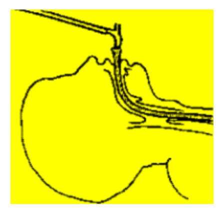


Endotracheal tube



Laryngoscope inserted





measure to bypass an oral obstruction followed by a formal open cricothyroidotomy.

• **Paediatric bronchoscope** — In some cases, however, a blockage may be bypassed effectively in urgent situations using a paediatric bronchoscope.

Airway management in cervical injuries

• **Cervical collar** — Always support the cervical spine in all unconscious patients. The cervical spine must also be protected when administering oxygen, clearing the airway for intubating the patient. Do not hyperextend the neck. An adequate airway can be obtained by the jaw thrust, without hyperextending the neck.

Lift the mandible forward by pulling forward on the angles of the jaw or front of the mandible. Use a mask and oxygen once the airway has been established (see page 3).

Nasotracheal intubation

Insert the tube through the nose. Listen for air expiration from the trachea through the endotracheal tube, and then advance the endotracheal tube during inspiration.

Cricothyroid needle or cricothyroidotomy

This is illustrated and described (see pages 79 and 496).

Hypovolaemic shock

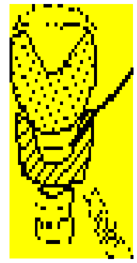
The following are the main symptoms and signs of hypovolaemic shock:

General weakness, thirst, mental confusion, skin pallor, hypotension, tachypnoea, and reduced urine output.

The signs are of much more rapid onset in patients with myocardial insufficiency than in fit young adults who may lose up 2 litres of blood before showing any signs of hypovolaemic shock.

The resuscitation of these patients includes control and replacement of blood loss, and fluid replacement. Fluid replacement should aim to expand the intravascular volume until the urine volume is over 0.5 ml/kg/hour or the CVP is over 15 cmH2O. Adequate oxygen is also necessary. Intubation of unconscious patients may be necessary, and in severe cases at least two intravenous lines of at least 14 16- gauge should be inserted. Arm veins are best but the femoral, subclavian, saphenous by cutdown, or even the internal jugular vein may be necessary, especially in children. In children intraosseous transfusion into the tibia may be necessary (see page 498).

Cricothyroidotomy



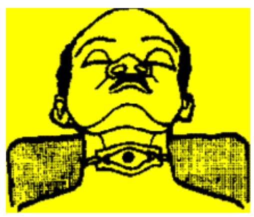
Incision

Open cricothyroidotomy

Lower cricothyroid membrane

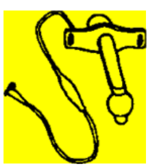
Tracheostomy Technique

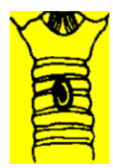
Use cricothyroidotomy in an emergency

General anaesthesia when possible  Sandbag with head extended

• Vertical incision — emergency operation

• Transverse incision — definitive operation





Cuffed tube first for flail chest + positive pressure

Divide thyroid isthmus, excise ellipse or flap 2nd + 3rd tracheal cartilages

Haemorrhage of under 1000 ml can usually be treated by lactated-Ringer solution or colloid solutions such as Haemaccel (polygeline), and over 1500 ml by whole blood plus Haemaccel and lactated-Ringer. Autologous blood should be used with a cell saver, if possible, for patients with massive haemorrhage, especially in spleen and liver injuries.

The use of a MAST pneumatic suit, which exerts pressure on both lower limbs and the lower abdomen, will return up to 1-1.5 litres of blood to the circulation. The 3 pneumatic compartments should not be released until at least 2 intravenous cannulae are in position, and adequate treatment has been initiated. MAST suits should not be used continuously for more than 2 hours or in upper abdominal or chest injuries. Pain should be controlled by splinting of fractures and analgesics. This includes Entonox (50% nitrous oxide, 50% oxygen) supplemented by intravenous morphine 5 mg or other intravenous analgesic drugs.

Monitoring of treatment of hypovolaemic shock The value of treatment is assessed by improvements in pulse rate and blood pressure, central venous pressures, and increase in urine output. Other indicators are oxygen and carbon dioxide tensions, and improvement of peripheral circulation, as shown by the pulse oximeter on the fingers or toes, and the mental state of the patient.

Emergency equipment for resuscitation

• **X-ray machine** — Portable plus X-ray viewer.

• Spotlight and stop clock.

• **Airway and breathing** — A full range of equipment on an anaesthetic trolley, including intubation, suction, masks, airways including pediatric sizes, an automatic ventilator and the appropriate gas cylinders.

• **Circulation equipment** — External defibrillator, pacemaker, pneumatic chest compressor (cardiac sternal compressor), intravenous drip equipment, including stand, cut down tray and pressure infuser, blood warmer, and anti- shock MAST suit.

• **Drugs** — A full range of resuscitation and other drugs including antibiotics and tetanus prophylaxis plus needles, dressings, intravenous fluids, and a tourniquet.

• **Monitoring equipment** — ECG, automatic sphygmomanometer, pulse oximeter, temperature, and central venous pressure manometers. Stethoscope, ophthalmoscope, otoscope and laryngoscope including paediatric sizes.

Traumatic shock

Important causes of traumatic shock are hypovolaemia, cardiac tamponade, and tension pneumothorax.

Hypovolaemic shock

The central venous pressure is not a good indicator of hypovolaemia, since normal levels of less than 5 cmH20 cannot be distinguished from the negative pressures (except in heart failure) which occurs in hypovolaemic shock. The diagnosis and treatment of hypovolaemic shock is discussed on pages 16 and 78.

Cardiogenic shock

A central venous pressure of 30 cmH2O or more is common. This is particularly shown by the high jugular venous pressure on inspection of the neck in cardiogenic shock, plus low cardiac output.

Treatment of hypovolaemic shock

A percutaneous intravenous catheter of 14-16- gauge size should be inserted urgently. In severe cases, this will require at least 2 intravenous drips. If percutaneous insertion is not rapidly successful cut down drips will be required.

The saphenous vein at the ankle or the cephalic vein in the cubital fossa are 2 good veins for accepting large intravenous cannulae and, occasionally, the forearm veins if percutaneous insertion is not rapidly successful.

Alternative intravenous cannulation sites are the femoral, subclavian or the internal jugular veins. There is, however, at least a 5% -10% risk of causing a pneumothorax with a subclavian line. If these are necessary, however, they should be placed on the same side as the chest drain.

In a severely shocked patient, at least two intravenous catheters should be in place before the abdomen is opened. A rapid fall in blood pressure may occur if there is massive intraperitoneal bleeding, which may take time to control.

Adequate intravenous fluids should be given and crystalloids or colloids are both equally effective. A urine output of at least 0.5-1 ml per kilogram per hour should be aimed for, and blood may need to be given rapidly. In an emergency type 0 negative blood should be given to maintain a haematocrit level of 30%-40% in older patients, or those with major cardiac problems, until the correct blood type is available.

Cardiac arrest

Cardiac arrest may be defined as the sudden failure of cardiac output, resulting from acute ventricular dysfunction.

Causes

The most common causes are dysrhythmias such as ventricular tachycardia, ventricular fibrillation and asystole. These in turn are usually secondary to acute myocardial ischaemia. Other causes include: hypoxia, drugs, electrolyte disturbances, cardiac rupture, electrocution, hypothermia and congenital and acquired conduction defects.

Immediate management

The most common cause of cardiac arrest is lack of oxygenation of the vital organs. The following are essential, therefore, even before cardiac massage is carried out.

• **Airway** — This must be rapidly cleared.

• **Breathing** —The lungs should be oxygenated by mouth to mouth resuscitation, or via a bag and mask.

• **External cardiac compression** — This should be commenced immediately after the airway is cleared and positive pressure breathing begins without waiting for an endotracheal tube to be passed, according to the illustration.

• **Time** — The time of commencement of cardio-pulmonary resuscitation (CPR) should be noted.

• **Endotracheal tube** — This is passed as soon as possible after initial oxygenation of the lungs.

Cardiac massage

Method

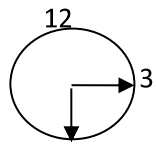
External massage is carried out, as illustrated, with 2 interlocked hands placed over the lower sternum. The elbows should be kept nearly extended. The patient should be on a firm base such as a solid trolley or floor. Give cardiac massage without delay after clearing the airway and commencing positive pressure respiration.

Cardiac arrest

- **Unconscious**
- **Apnoea**
- **No carotid pulse**

Immediate ventilation and cardiac massage

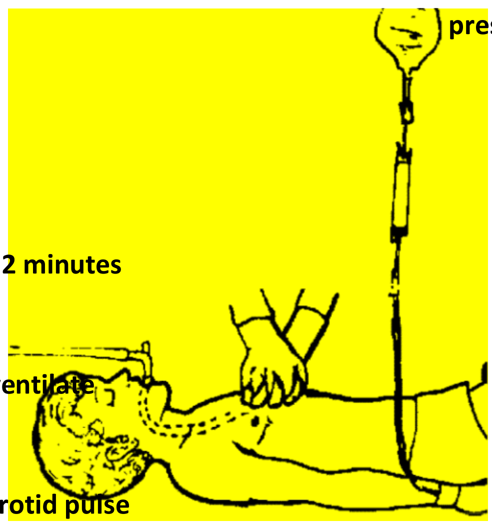
Check time



- iv drip
- Blood if necessary

Check blood pressure after pulse established

Treat cause



Check pupils after 2 minutes

Cardiac massage

Clear airway and ventilate

Carotid pulse

- Horizontal patient — only elevate feet in hypovolaemia
- Intubate patient as soon as oxygenated and external cardiac massage commenced
- Electrical defibrillation

Rate

It is currently recommended that at least 80-100 cardiac compressions per minute should be carried out in an adult, and at least 120 compressions per minute in young children and babies.

- **Adults** — The sternum should be depressed approximately 2-4 cm in an adult.

• **Children** — In children 1 hand is used and the sternum depressed less than 2 cm.

• **Babies** — In babies 2 fingers are used to depress the sternum not more than 1 cm. Monitoring in cardiac massage

• **Pupil size** — This should be regularly monitored.

• **Carotid pulse** — The adequacy of cardiac compression should be assessed by palpation of the carotid pulse.

• **Adequate circulation** — If the carotid pulse returns, and breathing starts, the patient should be placed in the coma position, unless intubated, and the pulse checked regularly.

• **Artificial ventilation** — This, with oxygen, should be continued unless spontaneous respiration is adequate.

Duration

Carry out for at least 20 minutes unless the patient's illness is terminal, such as in multiple carcinomatosis.

• **Underlying cause** — This should be rectified. Drugs should be given intravenously as indicated.

Internal cardiac massage

This is rarely indicated except in the operating theatre where external massage has failed.

Intubation

This must be carried out by someone skilled in this procedure. Do not intubate before initial oxygenation has been attempted.

Intravenous infusion in cardiac arrest

• **Central line** — An intravenous cannula should be inserted as soon as possible. This is the preferred method, but only if

Electrical defibrillation

(DC countershock)

• Right upper lateral border sternum

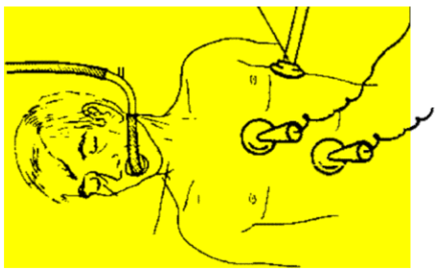
• Left mid-axillary line

• Observe pupils and carotid pulse

• Intubate + 100% oxygen

• i.v. drip

ECG monitor



Advanced life support flow-chart

Ventricular fibrillation or pulseless V.T.		
• 200 joules	• Adrenaline 1 mg i.v.	
• 200 joules		
• 360 joules	• Atropine 1 mg i.v.	
• Adrenaline 1 mg i.v.	• Pacing if electrical activity	
• 360 joules		Calcium chloride (10 ml of 10%)
• Lignocaine 1 mg/kg i.v.		•hyperkalaemia
• 360 joules		• hypocalcaemia
		• calcium antagonist

• **CPR** — Continue for 2 minutes after each drug

• **i.v. line not obtained** — give double doses drugs via endotracheal tube

• **Prolonged resuscitation**— 1 mg adrenaline i.v. every 5 minutes until spontaneous circulation returns

• **Sodium bicarbonate** — 1 mmol/kg if necessary

Also see pages 10-13 and 83

a person skilled in this technique is available for the administration of both fluids and drugs.

• **Intravenous cannula** — An arm vein should be used initially and if this is not successful, a leg vein should be used. There is no place for administration of drugs by the intramuscular or subcutaneous route, in such situations.

• **Endotracheal drugs** — There is occasionally a need for endotracheal administration of certain drugs.

• **Drug administration** — Sodium bicarbonate may be given for metabolic acidosis. Other drugs such as adrenaline, atropine and lignocaine are commonly used as well.

Electrocardiography

This is usually carried out as continuous monitoring and allows for continuous assessment of cardiac rate, rhythm, and QRS and ST segment morphology.

Cardioversion and defibrillation

Definition

• **Cardioversion —** This is the delivery of energy that is synchronized to the QRS complex.

• **Defibrillation** — This is the asynchronous delivery of energy such as the shock is delivered randomly during the cardiac cycle.

After the defibrillator is charged, the paddles are placed on the patient in the left mid-axillary line and to the right of the upper sternum and discharged simultaneously after everyone has stepped clear of the patient.

Investigations in cardiac arrest

Investigations which should be performed during a cardiac arrest include:

• Full blood count.

• **Electrolytes** — These may reveal a potentially reversible cause for the cardiac arrest.

•**Arterial blood gas sample** — This will show the adequacy of cardiopulmonary resuscitation as well as showing any underlying acid base disturbances.

• **Blood grouping and cross matching** — This may be required if hypovolaemia secondary to acute blood loss is suspected as a cause for the cardiac arrest.

• **Pupils and carotid pulse** — These must be monitored continuously.

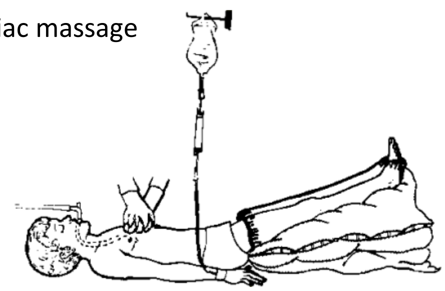
Cardiac arrest

Further management

• Consider sodium bicarbonate (8.4%) 1 mmol/kg i.v. immediately

• Repeat 0.5 mmol/kg for every 10 minutes of arrest

Cardiac massage



Intubate patient plus100% O2

Emergency drugs in trauma

• Adrenaline

• Hydrocortisone

• Atropine

• Calcium chloride

• Sodium bicarbonate

• Frusemide

• Lignocaine

• Aminophylline

• Naloxone

• Flumazenil

• Isoprenaline

• Antibiotics

• Analgesics

• Sedatives

• TIG

• Tetanus toxoid

• Salbutamol

• Verapamil

Ventricular fibrillation

In ventricular fibrillation the co-ordination of the ventricular myocardium is completely upset. As a result, the myocardium actually ‘quivers’ rather than contracts. The electrocardiogram (ECG) will show the distinctive QRST of coordinated sinus rhythm replaced by a continuous random coarse wave form which becomes finer as the quivering of the myocardium finally ceases due to anoxia. Unless appropriate life support or D.C. shock therapy is started within 3-4 minutes irreversible brain damage occurs, and it becomes increasingly difficult to restore sinus rhythm.

• **Initial emergency treatment** — Occasionally a precordial 'thump' over the junction of the middle and lower thirds of the sternum may restore sinus rhythm. This should be followed immediately by defibrillation, and by cardiopulmonary resuscitation with cardiac compression and pulmonary inflation already described if spontaneous adequate cardiac output is not restored. The newer defibrillators are not only rechargeable, but are semi-automatic or automatic and give an electronic 'readout' or even a voice synthesiser readout, with recommendations as to diagnosis and further management from the ECG leads.

Defibrillation

The general recommendations for the emergency treatment of cardiac arrest are as follows: (see page 85).

1. Paddle positions — These are on the left chest wall in the mid-axillary line, and the right chest just below the middle of the clavicle.

2. Defibrillator discharge — 200-360 joules with all standing clear of the patient.

3. 15-20 more sternal compressions if the carotid pulse has not returned.

4. Further 360 joules followed by reassessment of carotid pulse and ECG.

5. Further 360 joules if necessary followed by intubation but only if this can be done rapidly.

6. Adrenaline 1 mg (10 ml of 1 in 10,000) intravenously. 7. Further 360 joules.

8. Lignocaine 1 mg/kg intravenously.

9. Further 360 joules.

• Cardiopulmonary resuscitation should be continued for 2 minutes after each shock.

• Adrenaline 1 mg given every 3-5 minutes intravenously if necessary.

• **Sodium bicarbonate (8.4%)** — 1 mmol/kg intravenously after blood gas analysis, and if required and at the discretion of the team leader.

• Different paddle positions, different defibrillators, and different anti-arrhythmic drugs should then be considered, if cardiac rhythm has not been re-established.

• **Intravenous drips** — If an intravenous drip cannot be rapidly established double doses of adrenaline, lignocaine and atropine should be given, if necessary, via the endotracheal tube. In severe hypovolaemia 2 intravenous drips should be inserted if possible.

• After resuscitation — The patient should be in an intensive care unit and ECG, arterial blood gases, electrolyte estimations, and chest X-rays should be carried out.

Asystole

This is much less common than ventricular fibrillation. The treatment of confirmed asystole is adrenaline 1 mg (5-10 ml of 1 in 10000) intravenously. This may be followed if necessary by atropine 1 mg intravenously. This treatment is then followed by 'cardiac pacing'.

Defibrillation is of NO value in confirmed asystole. Urgent cardiopulmonary resuscitation, followed by 2 charges of 200-360 joules and one of 360 joules, should only be given if ventricular fibrillation cannot be excluded and if an ECG is not available. Defibrillation is then followed by adrenaline 1 mg (5-10 ml of 1 in 10,000) intravenously if previous shocks have been unsuccessful.

Electromechanical dissociation

This usually occurs in hospital. It may be due to pulmonary embolism, hypovolaemia, tension pneumothorax, pericardial tamponade, cardiac rupture or myocardial infarction and occasionally drugs.

• **Diagnosis** — This is made on a lack of a pulse and blood pressure, with an ECG showing a QRS complex which may resemble normal cardiac complexes.

• **Treatment** — The cause, if known, must be treated after an initial dose of 1 mg of adrenaline has been given. Calcium chloride 10 ml of 10% given intravenously has occasionally been successful, but the prognosis is much worse than in ventricular fibrillation.

Post resuscitation for cardiac arrest

• **Endotracheal tube** — Check position with laryngoscope if necessary.

• **Intermittent positive pressure ventilation** — If spontaneous respiration is inadequate.

• **Oxygen** — 100% and check adequate air entry in both lungs.

• **Chest X-ray** — AP.

• **Chest drain** — If pneumothorax present.

• Blood gas estimation.

• Electrolytes including serum potassium.

• **Urinary catheter and nasogastric tube** — Monitor urinary output and aspirate stomach if necessary.

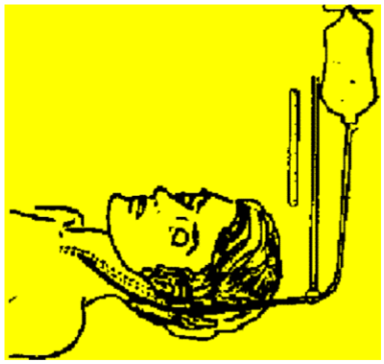
• **ECG** — 12 lead and monitor carefully.

Emergency communication facilities

These include telephone 'hot lines', paging or portable telephones, and direct radio links to ambulances and disaster sites. Computer modem telephone links are now also possible for transmission of ECG, X-rays and other imaging data, as well as haematological and biochemical information.

Central venous pressure and cannulation

Subclavian vein catheter



Internal jugular vein catheter

Normal reading: 5 - 15 cmH2O

Skilled procedure — NOT for initial emergency fluid replacement

Chest trauma

Examination

• **Patent airway** — Assess that the patient has a patent airway.

• **Breathing** — Assess the rate and depth of respiration and equality of chest movement. Look for respiratory distress and evidence of shock.

• **Pulse and blood pressure** — Assess the pulse and blood pressure.

• **Cyanosis —** Look for cyanosis of the skin and nail beds, lips and tongue.

• **Neck veins** — Examine for evidence of neck vein distension, suprasternal retraction and the use of accessory muscles of respiration.

• **Chest wall and wounds** — Bony tenderness or crepitus on gentle palpation of the ribs and sternum indicate the possibilities of a fracture. Look for wounds, however small, which may communicate with the pleural or abdominal cavity.

• **Subcutaneous emphysema** — This indicates possible lung, airway or oesophageal trauma.

• **Trachea** — Palpate the trachea to see if this is deviated to one side. This may indicate a tension pneumothorax, a haemothorax or lung collapse.

• **Apex beat** — Palpate the apex beat which should lie in the 5th intercostal space in the mid-clavicular line. It may be displaced.

• **Auscultate the heart** — Listen to assess whether they are normal (not muffled).

• **Pulse rate** — Assess the pulse rate, rhythm and amplitude. Diminution of amplitude with inspiration may indicate cardiac tamponade. The blood pressure is also often also lowered in such cases.

• **Lungs** — Hyper-resonance (pneumothorax) over the apex of the lung anteriorly, or dullness (haemothorax) on percussion over the lung bases on the posterior chest wall should be looked for.

• Auscultate for adequacy of ventilation and equal air entry on both sides of the chest.

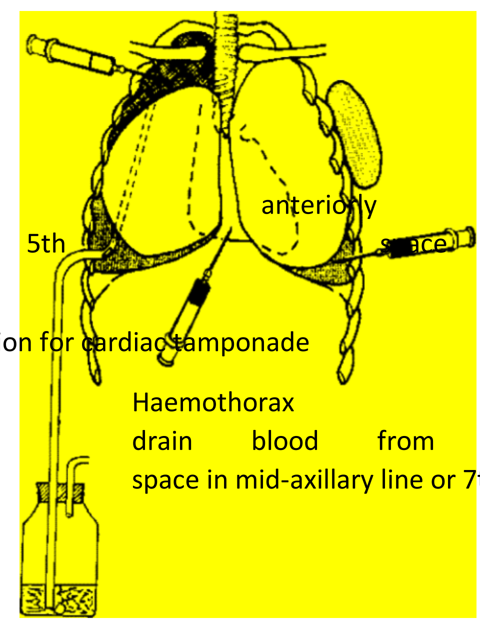
• **Blood pressure** — This must be assessed.

Chest injuries

Emergency treatment

Vaseline gauze plus pad for open wounds

Clear airway

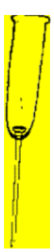


Tension pneumothorax needle 2nd interspace, anteriorly and drain 5th space mid-axillary line

Apical or Xiphisternal Aspiration for cardiac tamponade

Haemothorax — drain blood from 5th or 6th intercostal space in mid-axillary line or 7th or 8th space posteriorly

Underwater seal



Tension pneumothorax — needle through finger of rubber glove for valvular effect in emergency

Investigations

• **ECG** — This should be carried out in all cases.

• **Chest X-ray** — A chest X-ray should be obtained with the patient erect if possible to check for fluid levels and air under the diaphragm in intestinal perforation. Avoid sitting the patient up in suspected spinal injuries.

• **Other investigations** — Arterial blood gases and routine haematological and biochemical investigations are essential in severe injuries. A 'group and screen' or cross matching may also be required.

Vascular chest injuries

Haemothorax — treatment

• **Drainage** — In a haemothorax of less than 1 litre due to a non-penetrating wound, simple drainage through an underwater drain placed in the 5th intercostal space in the mid-axillary line is usually adequate in most cases.

• **Thoracotomy** — If the bleeding continues or, if there is a penetrating wound, a thoracotomy should be carried out. Replacement of blood loss may be necessary, and autotransfusion should be considered in uncontaminated bleeding.

• **Combined haemothorax and pneumothorax** — In the case of a combined haemothorax and pneumothorax, a single haemothorax tube should extend up to the apex of the lung. It will usually adequately drain both the haemothorax and a pneumothorax.

Penetrating chest wounds

• **Complications** — Penetrating chest wounds may cause damage to the lungs, heart, and intrathoracic blood vessels. It may also damage the spinal cord, oesophagus and diaphragm. The intra-abdominal structures may also be damaged as these lie under the lower half of the rib cage.

Treatment

• Blood and fluid replacement.

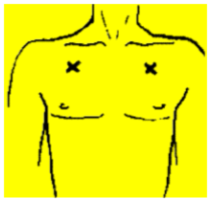
• **Oxygen** — This should always be given.

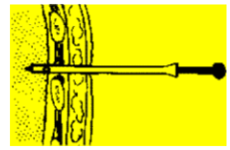
• **Open wounds —** These may require the application of an occlusive dressing such as vaseline gauze. This will act as a valve and allow exit of air from the chest cavity, but not entry and so allow the lung to re-inflate.

• **Thoracotomy** — Exploration and repair, followed by a postoperative intercostal drain, is essential.

Chest aspiration

Pneumothorax





• Mid-clavicular line 2nd interspace

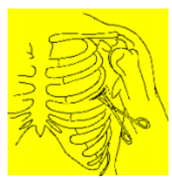
Inside inserting needle outside plastic cannula

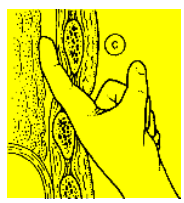
• Local anaesthetic

Alternatively — 5th intercostal space mid-axillary line

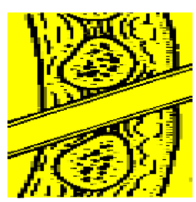
Haemothorax

Insertion of intercostal catheter





5th intercostal space mid-axillary line or 8th or 9th space posterior axillary line level lower border scapula



Pulmonary contusion

This is usually associated with multiple rib fractures, or a flail chest, and the onset may be insidious.

Internal stabilisation

• Flail chest — In severe cases 'internal stabilisation' of a flail chest is achieved by a combination of an endotracheal tube, together with mechanically assisted ventilation with a ‘positive end expiratory pressure' or PEEP. This is mandatory if the $PaCO_2$ is over 55 mm Hg and the PaO_2 under 60 mm Hg with the patient breathing room air. Oxygen should always be administered. Avoid overhydration as this may precipitate pulmonary oedema.

Pneumothorax

A pneumothorax is defined as entrapment of air in the pleural space and a tension pneumothorax if this is under tension.

Clinical findings

A tension pneumothorax may cause any of the following: dyspnoea, cyanosis, tracheal deviation away from the side of the lesion, a hyper-resonant percussion note over the pneumothorax, reduced respiratory excursions of the chest on the affected side and reduced breath sound during auscultation over the pneumothorax.

Investigations

Radiological findings will depend on the severity and the cause of the pneumothorax.

• **Chest X-ray** — A plain chest X-ray (PA and lateral views) should be taken in both inspiration and expiration. Views should be taken erect where possible. Expiratory films provide greater contrast between the air in the pleural space and the lung fields by 'increasing the density' of the normal lung markings. The chest X-ray may reveal both the cause,(e.g., fractured ribs), and the effects of the pneumothorax. The latter include air in the pleural space, lung collapse, tracheal deviation and deviation of the cardiac shadow. This is dependent on the type and severity of the pneumothorax.

• **Rib X-rays** — These may be necessary to define rib fractures or displacement in more detail.

• **Abdominal X-ray** — This is necessary if there is a possibility that the peritoneal cavity has been penetrated or the intestines have been perforated. Air under the diaphragm

can be seen on the plain X-ray. It is important that the patient be sitting up if possible for 10 seconds before the X-ray is taken. If there is a suspected spinal injury, however, the patient should be rolled on the side instead and not sat up.

Tension pneumothorax

A tension pneumothorax is a surgical emergency. It should be urgently decompressed with a wide bore needle, or small catheter placed in the 2nd intercostal space anteriorly or 5th interspace in the mid-axillary line, as illustrated. As an emergency measure this is attached to a one-way Heimlich valve or, failing this, a needle through the cut off end of a finger of a surgical glove will act as a one way valve. As soon as possible, however, an underwater drain should be inserted in the 5th intercostal space in the mid-axillary line.

• **Operative management** — Only occasionally is an open thoracotomy indicated for closed chest injuries.

Non-tension pneumothorax

In the case of a simple, non-tension pneumothorax causing less than 20% collapse of a lung, which is not progressive, non-operative treatment is usually indicated.

• **Associated general anaesthetic** — A non-tension pneumothorax should not be managed conservatively if general anaesthesia with endotracheal intubation and positive pressure ventilation is planned. A thoracotomy tube is then essential, as positive pressure ventilation may convert a simple pneumothorax to a tension pneumothorax.

Penetrating wounds

In penetrating wounds of the chest wall thoracotomy and operative exploration are essential as an emergency.

Sternal fractures(can be hard to see on X rays)

Complications

A fracture of the sternum may damage the heart and cause a haemopericardium and cardiac tamponade.

• **Elderly** — Damage to either the lungs or heart in the elderly may lead to more serious complications, as well as in those patients with underlying bronchitis or emphysema.

• **Children** — Due to the relatively high flexibility of the chest wall, severe underlying lung and heart damage may occur without a fracture of the ribs or sternum

Investigations

• **Radiological** — All patients with a fracture of the sternum may have an associated fracture of the mid-thoracic vertebrae.

A lateral X-ray of the chest may demonstrate both a fracture of the sternum and a fracture of a thoracic vertebra.

Erect plain chest X-rays are the optimum means of showing a pneumothorax or a haemothorax. Inspiration and full expiration chest X-rays should be taken. The X-ray may also show broadening of the mediastinum in the case of a ruptured aorta, or other vascular damage. It may also reveal air under the diaphragm, if there has been penetration of a hollow viscus in the abdomen.

• **Other investigations** — These may include a CT scan, an electrocardiograph, cardiac isoenzymes, arterial blood gas sampling and a full blood count.

Myocardial contusion(easily missed)

Clinical findings

This should be suspected if there is severe bruising or a fracture of the sternum. It may also be associated with a haemopericardium and cardiac tamponade.

Investigations

• **Haematological** — Routine investigations should include a full blood count and biochemical analysis.

• **X-rays** — Chest X-rays are essential

• **ECG and myocardial scanning** — An ECG is essential and myocardial scanning and cardiac enzyme studies such as creatinine kinase and iso-enzymes may be helpful. The patient should also have continuous cardiac monitoring.

Treatment

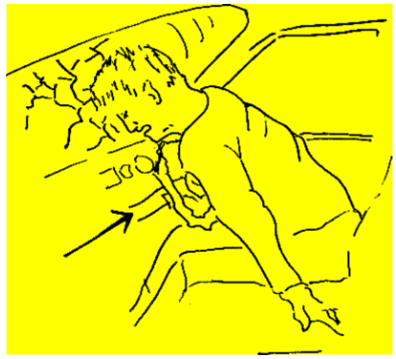
• **Admission to hospital** — All patients with suspected myocardial damage, however slight, should be admitted to hospital under careful observation. This is because the patient may be in danger of sudden cardiac dysrhythmias and death.

• **Intravenous cannula** — Insertion of peripheral intravenous cannulae is essential.

Miscellaneous thoracic trauma

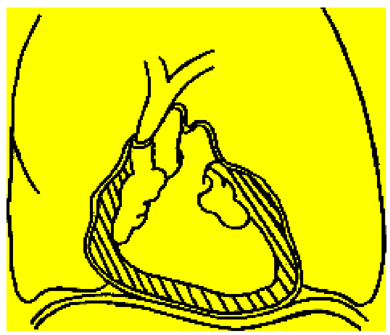
Bony crepitus plus pain over the ribs and sternum are indicative of a fracture. Subcutaneous emphysema indicates rupture of a bronchus or injury to the oesophagus. Engorgement of neck veins, the use of the accessory muscles of respiration on inspiration, may indicate obstruction to

Sternal fractures



Impact against steering column in a motor vehicle accident

Cardiac tamponade



Needle pericardiocentesis

airflow or lack of oxygenation due to collapse of the lung or pulmonary oedema.

Cardiac tamponade

• **Causes** — These include sternal trauma, costal cartilage fractures of the 2nd-7th ribs, and penetrating injuries to the heart.

• **Examination** — A raised jugular venous pressure is especially significant in the case of low blood pressure, muffled heart sounds, high pulse rate and pulsus paradoxus.

Blunt cardiac injury

• **Myocardial contusion** — This is equivalent to acute myocardial infarction. ECG changes may be present, and damage may cause rupture of the heart and damage to the heart valves.

• **Diminished pulse pressure** — Diminished pulse pressure, engorged neck veins which are not pulsatile and hypotension may be present.

• **Apex beat** — This may be difficult to palpate and the heart sounds may be muffled.

As with a pneumothorax, the symptoms and signs are dependent upon the cause and severity of the cardiac tamponade.

Investigations

• **Plain X-ray** — A plain chest X-ray may show a cardiac shadow which has a 'globular' appearance.

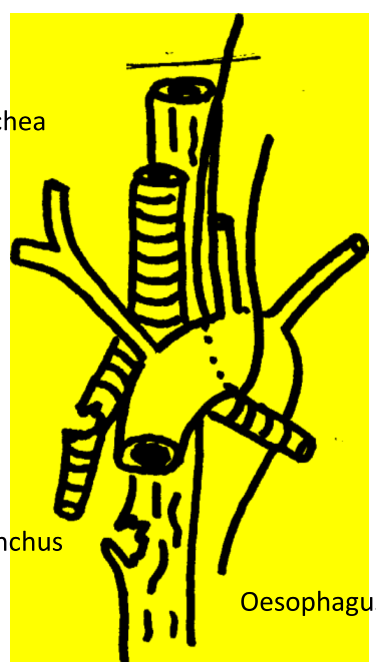
• **Diagnostic aspiration** — A diagnostic needle or catheter aspiration just to the left and below the xiphisternum, as illustrated (see page 99), will usually confirm the diagnosis of cardiac tamponade. It may sometimes damage the coronary arteries or myocardium and must be performed very carefully, usually under ultrasound guidance, or at least with continuous ECG monitoring.(see page 500). Sometimes a haemopericardium is clotted and may require open pericardiocentesis.

• **Urgent echocardiography** — This is a safer alternative, if available, to a diagnostic aspiration.

• **CT scan** — This is now routinely used.

• **Operative decompression** — If the bleeding is not controlled operative decompression should be carried out.

Tracheobronchial and oesophageal rupture



Aortic rupture

Causes

Aortic rupture should be suspected in severe injuries, especially those associated with fractures of the upper 3 ribs and sternum. It may occur in the case of severe head-on collisions with deceleration trauma.

Site of rupture

The aorta is usually ruptured just distal to the left subclavian artery where the fixed part of the aorta joins the mobile part of the vessel. The superior vena cava and other major vessels may also be damaged.

Clinical finding

• **Shock** — The patient may show evidence of severe shock.

• **Pulses** — The femoral pulses will be absent and the radial pulses may be asymmetrical.

Investigations

• **Chest X-ray** — This usually shows a widened mediastinum with obliteration of the aortic knuckle. There may be deviation of the oesophagus to the right, and elevation of the left main bronchus. In about a quarter of all cases, however, the chest X-ray is normal.

• **Angiogram and CT scan** — Aortography and CT scan are essential.

Treatment

Urgent surgical exploration and repair or grafting is required in a thoracic centre.

Major tracheobronchial rupture

Diagnosis

This will cause a massive air leak into the mediastinum. This is due to a transected trachea and bronchus and will often cause extensive mediastinal and deep cervical emphysema. It may also cause a pneumothorax and subcutaneous emphysema. This is confirmed on chest X-ray and bronchoscopy. It will usually require repair. Occasionally a tracheostomy alone will allow a partial laceration to heal.

• **Clinical examination** — This will include pain and swelling of the neck, dyspnoea, and alteration of the voice. Crepitus over the larynx may also be felt.

• **X-rays** — These may show air in the soft tissues, and this must be confirmed by bronchoscopy. Maxillo-facial X-rays are indicated to show bony damage.

• **General examination** — This will include other injuries and assessment of blood loss.

• **Chest X-ray** — The indications for a chest X-ray include any evidence of respiratory distress, evidence of aspiration of a foreign body, or deterioration in blood gas analysis.

Management

• **Intubation** — This should be performed if necessary.

• **Cricothyroidotomy** — This is indicated for severe injuries above the larynx where intubation cannot be carried out. It should be performed initially by needle.

Treatment

Urgent resuscitation and repair are essential. Broad spectrum intravenous antibiotic cover will be required.

Oesophageal rupture

Diagnosis

• **X-ray** — This may also cause a pneumo-mediastinum confirmed with a dilute barium swallow.

• **Thoracotomy drain** — This may only be first suspected when particulate matter is found in a thoracotomy drain.

Treatment

Urgent operative repair is mandatory plus antibiotics.

Indications for thoracotomy

• **Penetrating wounds** — All penetrating wounds of the chest.

• **Injuries to major vessels and other important structures**— Suspected injury to aorta and other major vessels, oesophagus, diaphragm and other thoracic contents.

• Injuries to the bronchus or trachea

• **Cardiac tamponade** — If this is not immediately relieved by needle or cannula drainage.

• **Continued major bleeding** — More than 100 ml per hour for more than 6 hours from the thoracotomy tube.

• **Haemodynamic instability** — Ongoing with any possibility of an associated intrathoracic injury.

• **Doubtful cases** — Always operate if in doubt.

Ruptured diaphragm

This is more common on the left than the right due to the protection of the liver. It is confirmed on X-ray and finding bowel in the pleural cavity. Urgent laparotomy and repair is necessary.

Abdominal injuries

Diagnosis

The history taken in abdominal trauma must include, if possible, the exact cause of the injury, such as a high velocity car accident, a bullet or a knife wound.

• **Car accidents** — In car accidents it is important to ascertain whether the patient was wearing a seat belt, and whether the patient was the driver or a passenger. Seat belt wearers are more likely to sustain hollow abdominal viscus injuries, whilst non-seat belt wearers tend to sustain solid viscus injuries. Older type non-retractable seat belts, which are often not fully tightened, are also more likely to cause injuries, as are lap belts (as distinct from those belts which have a sash extending across the chest and shoulder). Thoraco-lumbar fractures are also more common in lap belt wearers. Blunt injuries to the face, chest and abdomen may be caused by an air bag.

• **Children —** Small children are insufficiently restrained in adult lap belts and may slide under the belt in a sudden deceleration crash, and sustain neck and chest injuries.

• **Organs damaged —** Always consider all the organs likely to be damaged in a closed or open injury of the abdomen. The lower half of the thoracic cavity overlies the abdomen. If there is any doubt whatsoever of visceral damage, the patient should always be admitted to hospital for careful observation.

• **Blunt trauma** — This is much more common than penetrating injuries and may be due to seat belt injuries or to direct trauma from the steering wheel. Fractures of the lower ribs may also cause damage to spleen, liver or intestine, and the major blood vessels may be damaged and the mesentery avulsed. Physical signs may initially be minimal or absent.

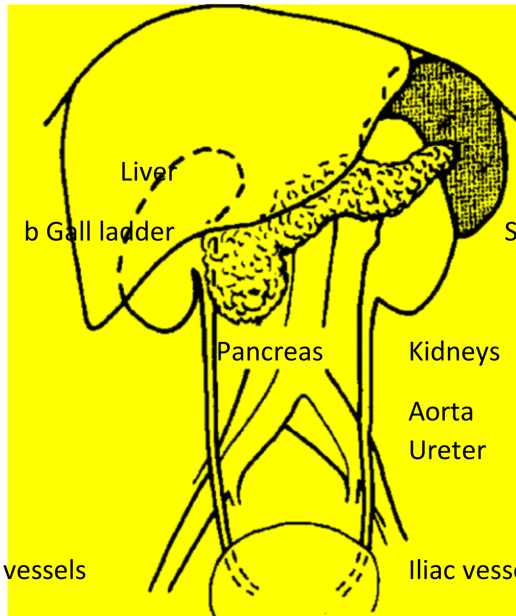
• **Penetrating wounds** — These may be high velocity due to rifle bullets or from shrapnel or low velocity from handguns or knife wounds. Over three quarters of bullet wounds will cause damage to the viscera, but only one quarter of the stab wounds will penetrate the peritoneum.

History

A full history is important from the patient or from relatives. It is helpful in closed injuries to have details about the speed of the vehicle and the cause of the injury, such as the seat belt or steering wheel. In penetrating injuries, the type of trauma is important, such as a high velocity bullet or a long bladed knife.

Abdominal injuries

Inspect Palpate Auscultate



- **CT scan and ultrasound for liver, spleen and kidney damage**
- **Angiogram for major vessel injury**
- **X-ray abdomen — erect**
- **IVP if indicated**
- **Laparoscopy or laparotomy if indicated**
- **Peritoneal lavage if necessary**

Examination

It is important to note whether the patient is under the influence of alcohol or drugs. The general condition of the patient should be noted, as should any other injuries.

The patient should be fully undressed in hospital and completely examined, including the urethral meatus in men, and the perineum and buttocks for entry or exit wounds or other injuries.

• **Abdomen** — This should be palpated and re-evaluated later as peritoneal irritation due to a damaged viscus may be slow to develop. Again, it should be remembered that the lower half of the thorax lies over the abdominal cavity. The abdomen should be palpated for tender areas and guarding and auscultated for bowel sounds.

Pelvis

This should not only be 'sprung' but the pubic ramus should be palpated.

Rectal and vaginal examination should be carried out, and in men the prostate should be palpated. Signs of urethral injury are upward displacement of the prostate, bleeding and bruising at the urethral meatus. In urinary retention due to urethral damage a urethrogram, followed by a suprapubic catheter, may be the procedure of choice, as a urinary catheter may cause further damage.

Investigations

• **Nasogastric tube and catheter** — These should be immediately inserted. An orogastric tube should be passed if a fractured base of skull is suspected. A full examination of the urine should also be carried out, including the presence of blood.

• **Blood investigation** — This should include a full blood count and haemoglobin as well as a group and crossmatch.

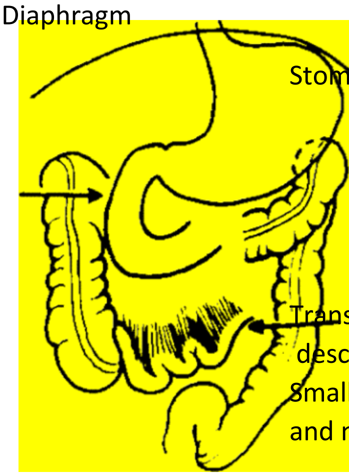
• **Biochemical investigations** — These should include electrolytes, blood urea and blood gas estimation. Serum amylase assessment in blunt trauma will help exclude pancreatic trauma, but may be of limited value.

• **X-rays** — A chest X-ray, erect if there is no spinal injury, will exclude free intraperitoneal air. Fractures of the ribs may damage the liver, spleen, or kidneys. Fractures of the transverse processes of the lumbar vertebrae may damage the ureters. X-rays may also show bullets and other foreign bodies. Other X-rays include the pelvis, cervical spine and any other suspected fractures.

Abdominal injuries

Stomach and intestines

Retroperitoneal structures



- **Spinal cord and cauda equina**
- **Aorta**
- **Inferior vena cava**
- **Other blood vessels**
- **Pancreas**
- **Kidneys and ureters**

• **Ultrasound and CT** — These will help diagnose liver, spleen, renal, pancreas, major vessel and retroperitoneal damage.

• **Intraperitoneal lavage** — This is indicated only if there is doubt as to whether an urgent laparotomy is indicated. This is performed under local anaesthesia by a short midline incision above or below the umbilicus after making sure the bladder is empty. A short intraperitoneal dialysis catheter, without an introducer, is inserted obliquely downwards into the peritoneum and the contents aspirated.

If more than 5 ml of blood, or any intestinal contents, are aspirated an urgent laparotomy is carried out. If no blood is aspirated 1 litre of warm (37°C) normal saline is inserted and after about 3 minutes allowed to drain by gravity into a sterile bag. A sample of about 20 ml of this liquid is then sent to the laboratory for urgent red and white cell estimation and for microscopy. If a red cell count of more than 100 000 per cu mm or white count of more than 500, or if any faecal material, bile, or bacteria are isolated, an urgent laparotomy is carried out.

• **Relative contraindication for peritoneal lavage** — This should not be carried out below the umbilicus in pregnancy, or where there has been a previous lower abdominal operation. It should not be carried out in the upper abdomen in chronic liver disease.

• **Complications of lavage** — These are perforation of bowel or bladder, haemorrhage and infection, but these are rare.

Indications for laparotomy

The indications in abdominal injuries include the following:

• All penetrating wounds into the peritoneum.

• Rupture of the diaphragm.

• Blood or intestinal contents on peritoneal lavage.

• Radiological evidence of intraperitoneal gas and intestinal perforation.

• Unexplained shock after closed abdominal injury.

• Paralytic ileus with abdominal injury.

• If in any doubt, laparotomy should be carried out.

Spleen

• **Cause** — This may be ruptured by minimal violence, especially if enlarged due to disease. Lower posterior left rib fractures are particularly likely to damage the spleen.

• **Examination —** Local tenderness in the left hypochondrium, pain referred to the left shoulder, dullness in the flanks, which may not shift on the left, a rising pulse

Abdominal injuries

Treatment 1

• Resuscitation

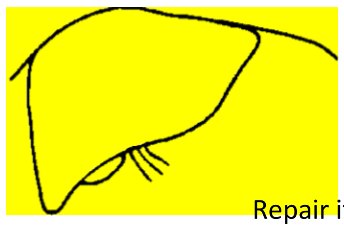
• Intravenous transfusion and oxygen

• Gastric tube

• Urinary catheter

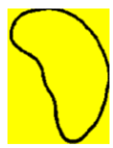
• Peritoneal lavage, laparoscopy or laparotomy if in doubt

Liver, diaphragm, blood vessels



Repair if necessary

Spleen

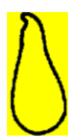


• Diagnostic paracentesis

• or laparoscopy

• Repair or excise

Gall bladder



Explore and excise

rate, increasing anaemia and dyspnoea, are all valuable signs which may not always be present.

• **Investigation** — An ultrasound or CT scan may be diagnostic. Peritoneal aspiration may be indicated for blood.

• **Laparoscopy —** Always perform a laparoscopy or laparotomy if in doubt, and a splenectomy or repair for splenic damage.

Liver and gall bladder

•**Examination** — Local tenderness in the right hypochondrium is present. There may also be considerable bleeding with major lacerations.

• **Investigations** — A plain X-ray of the abdomen is essential. An ultrasound or CT scan will usually be diagnostic. A peritoneal aspiration, or laparoscopy, may show blood in the peritoneal cavity.

•**Treatment** — Minor lacerations can be treated conservatively with blood transfusion if necessary. Major injuries will require operative repair.

• **Gall bladder injuries** — These require exploration, cholecystectomy and drainage in all cases.

Kidney

Renal injuries are usually treated conservatively unless major. Look for haematuria and bruising in the loins. Always perform an IVP to ensure that the opposite kidney is functioning. An angiogram, ultrasound or CT scan will usually be valuable diagnostic tools. Consider exploration if extravasation of contrast is seen. Damage to the kidneys and lower urinary tract is discussed in more detail later (see pages 115 and 394).

Intestine

•**Stomach and small intestine** —These injuries are surgical emergencies. A preliminary erect plain X-ray of the abdomen should always be carried out if there is no spinal injury and may show air under the diaphragm and signs of paralytic ileus. An ultrasound or CT scan may be indicated. Always perform a laparotomy if in any doubt. Injuries are often multiple and the entire gut must be carefully inspected. The mesentery may also be damaged. Small intestine of doubtful viability must always be resected.

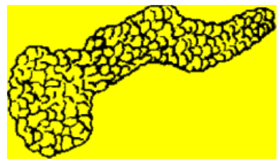
Abdominal injuries

Treatment 2

Stomach and small intestine

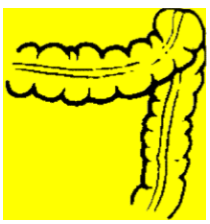
Aspiration, repair

Pancreas



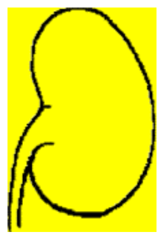
Drain

Large intestine



Colostomy before repair

Kidney ureter



- CT scan
- IVP check opposite kidney
- Explore if extravasation of contrast media
- Conservative treatment usually
- Repair ureter

• **Large intestine** — Damaged large intestine will always require a colostomy before repair.

Bladder and ureter

See page 116.

Other abdominal organs

These include the pancreas, pelvic organs and major blood vessels.

Additional investigations

• **Serum amylase —** This is often raised in pancreatic injuries. It should be routinely tested for in all abdominal injuries. It may not always be positive.

• **Laparotomy** — This is indicated if there are signs of peritonitis, continuing bleeding or if the diagnosis is in doubt.

• **Plain X-ray** — X-ray of the abdomen and chest is essential in all abdominal injuries with the patient sitting up unless There is a fracture of the spine. This may show gas under the diaphragm or a pleural effusion. Fractures of the transverse processes of the lumbar vertebrae may damage the ureter.

• **CT scan and ultrasound** — Computerised tomography and ultrasound of the abdomen may show evidence of haematoma with rupture of the liver, spleen or kidney.

• **Isotope scan** — Radioisotope scanning of the liver or other organs can also be helpful.

• **Cystogram and IVP** — Investigation of the urinary tract includes a cystogram. This may show extravasation of urine into the extraperitoneal space as well as into the abdominal cavity following a rupture of the bladder. An intravenous pyelogram is essential for renal or retroperitoneal injuries.

• **Abdominal lavage** — Abdominal lavage, with a small catheter into the upper abdominal cavity through the mid line, above or below the umbilicus, and lavage with 500-1000 ml of saline, is valuable if blood, air or abdominal contents are suspected from damage to spleen, liver or gut. It is not helpful in retroperitoneal or bladder injuries (see page 108).

• **Laparoscopy or laparotomy** — It is important in all abdominal injuries to perform a laparoscopy or laparotomy, and inspect the abdominal contents if there is any doubt as to rupture or damage to any major organs.

• **Aortic rupture** — It is also important to check the femoral pulses in severe retroperitoneal injuries, as rupture of the abdominal aorta may occur with absent femoral pulses. Aortic rupture may sometimes present as severe back pain and necessitate an angiogram and exploration.

Pediatric trauma

Children, if not properly secured with child restraints in cars are likely to slide beneath lap belts, with resulting thoracic and abdominal damage. Children without seat belts in either the front or back of cars are also likely to be catapulted through the windscreen in head-on crashes, or out of the door, as are unrestrained adults.

The management of trauma in children is discussed in more detail in the paediatric sections of this book (see pages 57, 232-253). In summary, the management of pediatric injuries can be divided into the following categories:

• Emergency resuscitation — The methods employed in pediatric resuscitation differ from those in the adult. This is due to differences in the anatomy of the child's oropharynx and larynx, and the need for special paediatric sizes of equipment for intubation. In addition, their tolerance to fluid replacement and to drugs and antibiotics differs to an adult.

• Head, chest and abdominal injuries — Due to the pliability of the skull and rib cage, head, chest and abdominal injuries may occur without bony damage.

• Spine — Diagnosis may be difficult, due to the pliability of the vertebrae and the appearance of the epiphyseal plates, especially in a young child.

• Limbs — Damage to the epiphyseal plate and the presence of radiotranslucent cartilage make growth disturbances common and diagnosis sometimes difficult.

Pelvic and urinary tract trauma

Urological complications

Bladder and urethral complications of a pelvic fracture, and particularly pubic rami fractures due to antero-posterior force, are far more important than the fracture itself. They must be looked for carefully, because left untreated they are potentially fatal.

Upper urinary tract

Over 90% of renal injuries are the result of blunt abdominal trauma. In severe multiple injuries the possibilities of associated renal trauma must be considered. In children renal trauma is the most common blunt abdominal injury, partly due to the relative lack of perinephric fat.

• **Causes** — These include sport, road traffic, industrial and domestic accidents and assaults. Injuries of the ureter may also be associated with fractures of the transverse processes of the lumbar vertebrae. In penetrating injuries of the abdomen, the kidneys are involved in about 10% of cases.

Over three-quarters of all renal injuries are minor contusions and lacerations, while about 10% cause deep tears and damage to the calices. About 5% of major injuries will cause vascular disruption of the kidney.

Clinical findings

• **Signs and symptoms** — The patient will usually complain of tenderness in the loin with haematuria in about 90% of cases. Note that haematuria is not invariable. Examination will show tenderness and guarding in the loin with variable bruising or abrasion. There may be associated paralytic ileus and hypovolaemic shock.

• **Urethral bleeding** — Bleeding from the urethra should be looked for and the patient asked whether urine has been passed since the accident. The urine should be examined for blood. A urethrogram should be carried out if possible before catheterisation in urethral injuries.

•**Abdominal examination** — Careful abdominal examination should always be carried out.

• **Rectal examination** — A rectal examination must never be omitted, as displacement of the prostate and bladder superiorly occurs in ruptures of the membranous urethra. If there is any doubt, the patient should be catheterised under full sterile precautions or a small suprapubic catheter inserted.

Investigations

• **Intravenous pyelogram (IVP**) — This is indicated in all patients with frank haematuria. It is also indicated where there is microscopic haematuria and a blood pressure of less than 90 mmHg. It may not however be of value if the blood pressure is under 80 mmHg due to the kidneys not excreting contrast media in a shocked patient.

Evidence of a fracture of the transverse process of the lumbar vertebrae must also be looked for. The loss of the renal shadow, the presence of a mass over the kidney, and its effect on the psoas shadow should also be noted. The IVP may show abnormalities of the cortical and calyceal pattern, and extravasation or lack of contrast medium.

• **Other investigations** — These include ultrasound to show haematoma and the renal outline and a CT scan. In cases where the vascular pedicle may be damaged, renal arteriography is indicated. There is also an occasional place for a retrograde pyelogram.

• **Cystogram and urethrogram** — A cystogram and urethrogram are often necessary.

• **CT scan and ultrasound** — These may be indicated for suspected trauma to the kidneys. Occasionally an angiogram may also be necessary.

• **Conservative management** — This is indicated in over 90% of cases. In the case of minor renal injuries, the patient should be treated in hospital with bed rest, antibiotics and analgesia as required. Observations should include blood pressure, pulse, temperature, abdominal palpation and urine investigation, plus serial ultrasound of the kidney. Treatment of hypovolaemic shock is also important.

• **Operation** — This is only indicated in severe cases with renal fragmentation, calyceal or vascular disruption. All penetrating wounds, as well as the severe cases mentioned above, require operation. It is essential to ensure that the opposite kidney is functioning before operation. Partial nephrectomy, or repair of the renal vessels or calyces, is sometimes possible.

• **Complications** — The early complications of severe renal trauma include hypovolaemic shock and associated injuries of the chest and abdomen. Late complications include hydronephrosis, pyelonephritis, complete loss of renal function, calculi formation, arteriovenous fistulae and hypertension.

Intraperitoneal rupture of the bladder

This often occurs when a full bladder is traumatised.

• Treatment — The bladder should be repaired in 2 layers and an indwelling urethral catheter inserted. In the case of severe bleeding or damage, it is safer to leave in a suprapubic catheter or fine plastic tube as well for 2-3 days, to help with bladder irrigation. The urethral catheter is removed after about 2 weeks.

Extraperitoneal rupture of the bladder

This is relatively common.

• **Treatment** — The tear should be repaired, but this is often not possible. A suprapubic drain should always be inserted and left in situ. A suprapubic catheter or tube may be advisable as well as a urethral catheter. The suprapubic catheter is removed in 2 or 3 days and the urethral catheter in 2 to 3 weeks.

Lower urinary tract

• **Cause** — The usual cause of lower urinary tract injury is a fracture of the pelvis or direct trauma to the perineum. Penetrating wounds may also damage the urethra.

• **Investigations** — The urinary meatus and perineum should be examined for bleeding or bruising, the pelvis and pubic rami for fracture and the abdomen for tenderness or guarding. A rectal examination is essential to palpate the prostate. A vaginal examination may be indicated.

• **Bladder injuries** — An IVP will detect damage and displacement of the bladder, as well as upper urinary tract injury. A cystogram will also detect tears and displacement, but should only be carried out if there is no damage to the urethra. Ascending urography should be performed if necessary.

Membranous urethra

The membranous urethra is damaged in about 10% of men with pelvic fractures. Strictures and impotence are important complications. In severe cases the whole prostate may be displaced upwards off the pelvic floor, together with the bladder, due to the disruption of the puboprostatic ligaments.

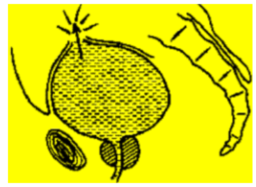
• **Examination** — In pelvic fractures signs of rupture of the membranous urethra are bleeding from the urethral meatus, bruising of the perineum, urinary retention, and a high prostate on rectal examination.

• **Treatment** — It is important not to pass a catheter except under expert guidance as this may not only further damage

Bladder injuries

Intraperitoneal rupture

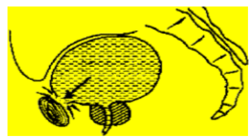
Peritonitis



Bladder Sacrum

Pubis

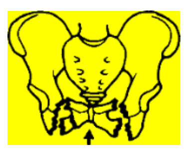
Extraperitoneal rupture

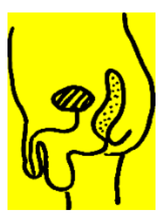


- Laparotomy and attempted repair
- Urethral catheter, suprapubic drain
- Urethrogram, cystogram, and IVP or CT scan if necessary
- Suprapubic catheter as well in all severe bladder injuries

Membranous urethra

Lower abdominal Prostate





Fractured pubic rami Bleed from urethra Bruising perineum

Bladder and urethral damage

the urethra, but also introduce infection. As with bulbar injuries, a suprapubic catheter should be inserted by either an open or closed technique, prior to exploration and possible urethrography. Late strictures are common.

• **Women** — Urethral damage is rare in women. A catheter can be passed, and a cystogram carried out if necessary to assess any bladder damage.

• **Rectal examination —**The importance of a routine rectal examination in all fractures of the pelvis has already been mentioned.

• **Treatment** — The rupture is treated by opening the bladder and passing a metal sound into the prostatic urethra, to insert a Foley catheter. The catheter should then be secured in the bladder by inflation of the 30 ml balloon in the tip of the Foley catheter with sterile water. The prostatic urethra and prostate are drawn down to the pelvic floor and the Foley catheter left in place. The Foley catheter itself must not be removed for 2- 3 weeks. In all cases of bladder and urethral injuries, the patient should receive appropriate antibiotic prophylaxis for at least 3 weeks.

Complications

The main complication of urethral damage is a urethral stricture. The patient may require regular dilatations to treat this and sometimes surgery to reconstruct the urethra.

In all urethral injuries, it is essential that regular urethral dilatations should be carried out for several months post- operatively. In cases where a rupture of the membranous urethra has been missed for several days, severe scar tissue may necessitate ureteric transplant into the large intestine to bypass the obstruction.

Rupture of the penile urethra

• **Bulbar injuries** — These are usually caused by direct trauma. It is important not to pass a urethral catheter in patients with bulbar injuries. In the case of urinary retention, a suprapubic catheter should be inserted by open or closed cystoscopy. Antibiotic cover is essential and urethrography may be indicated in about 5-7 days.

• **Testicles and penis** — Injuries of the testicles may be caused by direct trauma. If there is tense haematoma, exploration, drainage, repair and occasional orchidectomy is required.

Damage to the penis and penile urethra will occasionally require repair by microsurgical techniques.

• **Treatment** — If a partial or complete rupture of the penile urethra is suspected a soft catheter should be passed with

full sterile precautions under expert guidance. A urethrogram is often of assistance. Complete ruptures should be repaired if seen early.

Partial ruptures should be treated conservatively with a urethral catheter inserted for 2-3 weeks.

Complications of pelvic fractures

Haemorrhage

Retroperitoneal bleeding is potentially the most dangerous and rapidly fatal complication of severe pelvic fractures, especially with disruption of the pelvic ring. Urgent resuscitation, plus blood transfusion and reduction of the fracture dislocation with external fixateurs, is essential. Vascular embolisation under radiological control may also be useful.

Intestinal damage and paralytic ileus

In severe disruptions the pelvic floor may be disrupted with damage to the pelvic colon and rectum. Paralytic ileus, however, is a more common complication.

Sciatic and sacral nerve damage.

This is common, especially with 'vertical force' fractures, with upward displacement of one side of the pelvis. A foot drop and sensory loss due to injury of the lateral popliteal component of the sciatic nerve, is more common than a complete paralysis.

Acetabulum

Damage to the acetabulum may be isolated or be associated with other pelvic fractures. The risk of osteoarthritis and shortening may be considerable, and reconstruction of the acetabulum may be necessary, preceded by a CT scan (see page 402).

Backpain

Chronic low back pain is common, especially when one or both sacroiliac joints have been disrupted.

119 **Hospital emergency care**

Head injuries

Immediate management

These are surgical emergencies. Always seek expert neurosurgical advice immediately in severe head injuries, and in the unconscious patient following cerebral trauma.

Severe head injuries may lead to severe residual disability or death. Many side effects of head injuries can be lessened by the prevention of complications.

• **Airway** — Respiratory obstruction may lead to cerebral oedema. Airway maintenance must be the first priority in the unconscious patient.

• **Cervical spine** — Fractures of the cervical spine are commonly associated with head injuries. All unconscious patients who have sustained suspected trauma should be treated as having an associated cervical fracture, until proven otherwise, and should be given a firm neck collar. They should also be examined for other spinal injuries as well as chest, abdominal and limb injuries. Fractures of the limbs may be associated with a compartment syndrome of the limbs which may be missed in the unconscious patient (palpate cpt. and see pain response or incr. intra-cranial pressure).

• **Cervical spine X-ray** — A lateral X-ray of the cervical spine is essential in all unconscious patients.

Clinical findings

• **Skull fractures** — These are more common in adults than in children, due to children's elastic skulls. Linear fractures may indicate deep bleeding. Compound fractures may cause intracranial infection and require immediate debridement and elevation of depressed bone.

• **Extradural haemorrhage** — This can cause secondary cerebral compression.

• **Subdural and intracerebral haemorrhage** — These are 4 times more common than extradural haemorrhage and require early decompression. If unconsciousness supervenes, associated respiratory complications and bradycardia may lead to secondary ischaemic cerebral damage.

• **Causes of raised intracerebral pressure** — These include focal cerebral oedema due to a haematoma or localised injury or diffuse oedema after ischaemia. If the oedema and increased cerebral pressure persists, herniation of the brain stem or coning downwards may occur. This in turn will lead to respiratory and cardiovascular impairment, loss of consciousness and fixed dilated pupils.

Head injuries

General examination

Jaw falls back

- Cervical spine fracture
- Other injuries

Cerebral compression

- Slowing pulse or tachycardia
- Rising BP
- Neurological signs
- Deterioration level consciousness
- Temperature and respiration affected

State of consciousness

A — alert

V — vocal stimuli

P — painful stimuli

U — unresponsive

1-2 hourly check

Eyes

Papilloedema

Pupil dilated on side of lesion

Test pupils reaction to light

Fundi

Evidence of increasing cerebral compression includes:

• Bradycardia worsening.

• Hypertension with rising blood pressure.

• **Deterioration in level of consciousness** — A careful neurological examination is essential to assess this.

• **Neurological signs** — Deterioration between regular neurological examinations. This will include a dilated pupil on the side of the lesion.

• **Level of consciousness**

This can be initially assessed by the AVPU mnemonic:

A = alert

V = responds to vocal stimuli

P = responds to painful stimuli

U = unresponsive

• **Glasgow coma scale** — This is a more detailed method of assessing the level of consciousness according to the following 3criteria:

Eye opening (E)	**Best motor response (M)**
4 — spontaneous	6 — obeys commands
3 — to speech	5 — localises pain
2 — to pain	4 — flexion withdrawal
1 — none	3 — decerebrate flexion
	2 — decerebrate extension
	1 — none

Verbal response (V)

5 — orientated	2 — incomprehensible sounds
4 — confused	
3 — inappropriate words	1 — silent

Coma score — E+M+V =315

The maximum score — fully conscious patient = 15

Anterior fossa trauma

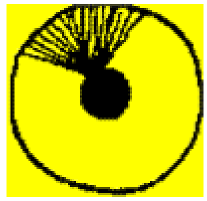
Damage to the anterior fossa may produce a posterior conjunctival haemorrhage, a CSF leak from the nose, and an epistaxis.

Middle fossa trauma

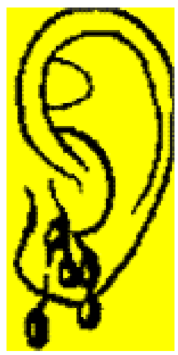
This may cause bleeding from the ear and a CSF leak. An associated seventh or eighth cranial nerve lesion may occur, but is rare.

Basal skull fractures

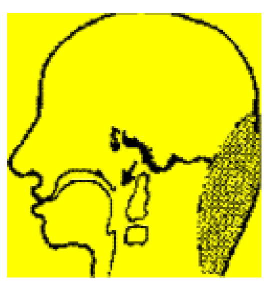
Anterior fossa



- CSF leak
- Nose epistaxis
- Posterior conjunctival haemorrhage



- Bleeding ear
- CSF leak
- 7th and 8th nerve damage



- Bleeding back of throat
- Suboccipital bleeding

Cerebral damage

Reticular formation affected

Concussion

Contusion

Cerebral

Cerebral haemorrhage

Extradural	Subdural	Intracerebral
•Unilateral • Early signs • Young patient • Lucid interval		

Posterior fossa trauma

Posterior fossa damage should be considered if there is bleeding from the back of the throat or a suboccipital haematoma.

Investigations in head injuries

• **Skull and cervical spine X-rays** — A minimum of an AP and lateral X-ray of the skull, and a lateral X-ray of the entire cervical spine including the odontoid peg and 7th cervical vertebra is essential in all severe head injuries.

• **CT scan** — Computerised tomography is invaluable in demonstrating the formation of a haematoma, localised cerebral pressure by clot, or oedema.

• **Magnetic resonance imaging (MRI)** — This is not very useful in acute head injuries.

Management of head injuries

• **Unconscious patient** — The first priority is to ensure that respiration and circulation have been stabilised in order to prevent further cerebral damage. Progress is assessed by recording pulse, blood pressure, respiration, temperature, degree of consciousness, movement of the limbs and the pupil diameter and reaction to light.

• **Cervical spine** — In all unconscious patients this should be stabilised with a cervical collar, and the airway kept patent.

• **Blood gas analysis** — This should show adequate oxygenation with the PaO2 greater than 70 mm Hg. In addition reducing the arterial PaCO2 will reduce intracranial pressure.

• **Systolic blood pressure** — This should be kept greater than 80 mmHg by intravenous fluids.

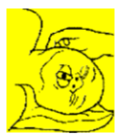
• **Intubation** — This is indicated in head injuries with an absent gag reflex, severe oropharyngeal injuries with bleeding, vomiting, or potential nasopharyngeal obstruction. If blood gas levels or spontaneous respiration are inadequate, intubation will also allow for hyperventilation. This is also important if the patient is to be transported by air, and especially by helicopter.

• **Skull X-rays** — These are indicated in all patients with neurological symptoms and signs and all penetrating injuries or severe swelling of the scalp. Leakage of cerebrospinal fluid from the nasopharynx or ear is also an absolute indication. Radiological evidence of fracture, rather than artery, vein or suture line markings includes a straight line which may be stellate if depressed, an absent cortical margin, a variable calibre, and an atypical anatomical site.

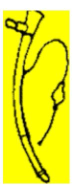
Head injuries

Emergency treatment Respiratory obstruction

Clear airway



Head down and to side oral airway



Intubate, cricothyroidotomy or tracheostomy if necessary

Open wounds

• Inspect for foreign bodies and fractures
• X-ray, chemotherapy, suture

Cerebral oedema

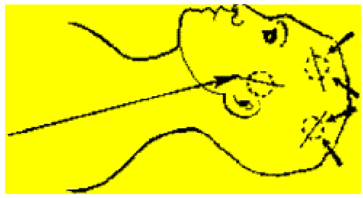
• Restrict fluids give diuretics
• Steroids special cases only
• Elevate head
• Cool patient by fan or cold sponging for pyrexia
• 30% mannitol
• 3 X strength plasma i.v.

Brain compression

Operate if in doubt

Acute subdural haemorrhage —

Extradural haemorrhage



• Burr hole

surgery usually not effective

• Head shaved

• Head rest

• Skin incisions

• Burr holes

• Always explore both sides if no localising signs

• CT scan preoperatively in ALL cases

• **Computerised tomography (CT scan)** — This is indicated if there is a suspicion of an intracranial haemorrhage causing symptoms and signs which could be relieved by operation. Guidelines for neurosurgical consultations are given below.

Neurosurgical consultation

British neurosurgeons have formulated the following guidelines for urgent referral of patients to a neurosurgical unit after initial urgent investigation and treatment:.

• Skull fractures with mental confusion or impairment of consciousness or any neurological symptoms, signs or fits.

• Coma continuing after resuscitation, even if there is no fracture of the skull.

• Leakage of CSF due to fracture of the base of the skull.

• All penetrating injuries of the skull.

• Mental confusion or other neurological manifestations persisting for more than 6-8 hours, even without a skull fracture.

• **Exploratory burr holes** — The indication for immediate burr holes is limited and is usually only indicated if there is delay in transfer of more than 2 hours to a neurosurgical centre, if there is a rapid deterioration in consciousness or a fixed dilated pupil on the side of the fracture. It should be preceded by intravenous mannitol. It is performed under general anaesthesia and at the site of the fracture, or 3 cm above the zygoma and 3 cm behind the zygomatic frontal ridge. If no clot is found, frontal and parietal burr holes are indicated on the side of the fracture and dilated pupil.

• **Cerebral compression** — In cerebral compression by haematoma, if CT scanning is not available, the pressure on the brain should be relieved by burr holes. Both sides of the skull should also be drilled if there is any doubt about bleeding. Burr holes should be both anterior and posterior, as a haematoma at both sites may be present.

Inter-hospital transfer

The following criteria should be fulfilled before transfer :

• Airway control with endotracheal tube or Guedel airway, plus, oxygen administration.
• Cervical spine stabilisation.
• Maintain breathing with Ambu or other bag.
• Intravenous infusion with Ringer's or Hartmann's solution, or with plasma.
• Intravenous antibiotics and other drugs as indicated.
• Send all X-rays, CT scans and detailed documentation.

Antibiotics and drugs in head injuries

• **Antibiotics** — These are indicated for all compound fractures or in those cases with suspected meningitis. Appropriate antibiotics should be given.

• **Sedation** — Before sedating patients, causes of restlessness, such as a full bladder, pain due to other injuries, hypoxia, hypotension and metabolic disturbances due to dehydration, low blood sugar, elevated blood urea or electrolytic imbalance must be excluded. A CT scan may also be necessary to diagnose a missed intracranial haematoma.

• **Treatment** — Suitable sedation will include paracetamol for pain and metaclopramide or prochlorperazine for nausea. Epileptic fits can usually be controlled by phenytoin intravenously, clonazepam and diazepam. Mannitol is an osmotic diuretic, but should only be used in consultation with a neurosurgeon. Steroids have not been shown to be of benefit.

Complications

• **Compound fractures** — Compound fractures must be explored and elevated if depressed. Debridement should remove all contaminated material and fragments of bone.

• **Cerebral compression** — This may develop with extradural, subdural or intracerebral bleeding. The signs associated with these lesions are illustrated. Examine initially and then regularly for localised cerebral compression.

• **Cerebral oedema** — The treatment of cerebral oedema is by elevation of the head of the bed and restriction of fluids. Diuretics, intravenous mannitol and an infusion of triple strength plasma may be considered. The use of glucocorticosteroids is controversial.

• **General treatment** — Non-surgical treatment of head injuries should include keeping the airway clear, preventing decubitus ulcers and contractures of limbs, and management of urinary retention.

• **Hyperpyrexia** — Hyperpyrexia is best treated by cooling with a fan or air conditioner.

• **Convulsions** — Anti-convulsants may be indicated.

Nursing and rehabilitation

Good nursing is essential in the unconscious patient, in order to prevent bed sores and joint contractures and to minimise bronchopneumonia and urinary infection.

• **Skin care** — Nursing the patient on a waterbed or a well padded mattress with a sheepskin cover, to prevent formation of decubitus ulcers, is important. Turning the patient two

hourly day and night is important for the care of the skin. Air mattresses are now available with numerous inflatable segments for the prevention of decubitus ulceration. Additional mattress overlays will also dispense pressure more evenly and facilitate air flow.

• **Joint contractures** — The prevention of joint contractures is important, particularly in the lower limbs. Daily physiotherapy and moving all the joints through a full range is essential.

• **Bladder** —The patient may need to be catheterised. Sterility is essential to diminish the likelihood of urinary infection.

• **Nasopharynx** — The nasopharynx needs to be regularly aspirated to prevent respiratory obstruction or aspiration pneumonia.

• **Feeding** —The feeding of unconscious patients is best done by a nasoduodenal tube, but supplementation with intravenous fluids may be necessary. In certain situations, total parenteral nutrition (TCP) may be required.

• **Sedation and anticonvulsants** — Drugs may be needed for restlessness (chlorpromazine) and anticonvulsants may be necessary for the control of epilepsy. Urinary retention is an important and often unrecognised cause of restlessness in the unconscious patient.

• **Antibiotics** — These may be necessary to prevent both bladder and respiratory infections.

• **Chest physiotherapy**— This is important to prevent atelectasis and bronchopneumonia.

• **Rehabilitation** — Long-term management will include rehabilitation, preferably in a specialised centre with a multidisciplinary team. This will include the social worker, and the rehabilitation of both the family and the patient.

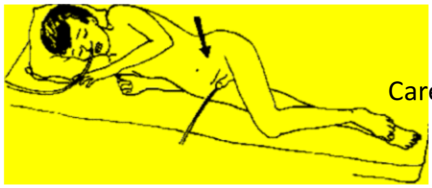
• **Epilepsy** — There is only very rarely a place for surgery in the management of epilepsy, such as when convulsions are secondary to a depressed skull fracture causing scarring of the meninges.

Head injuries

Nursing

- Head must be elevated
- Aspiration of oropharynx

Catheter if necessary



Care: skin, joints, bladder

Prevent bed sores and contractures

Respiratory infection

- Breathing exercises
- Chest physiotherapy
- Antibiotics

Bladder and bowels

- Catheter — avoid infection
- Penrose tube later
- Prevent faecal impaction

Rehabilitation

Early ambulation and retraining

Face and jaw injuries

Emergency treatment

• **Airway** — The airway must be cleared and made patent, with the patient prone with the head turned to the side and the jaw protracted.

Maxillo-facial injuries

The first priority in severe maxillo-facial injuries is to maintain the airway. In severe cases this may necessitate an immediate needle or open cricothyroidotomy or tracheostomy (see pages 79 and 496) if early endotracheal intubation is impossible.

Considerable blood loss may require replacement, while associated injuries to the cervical spine, head, chest, abdomen and limbs will require appropriate urgent treatment.

Airway

This may be blocked in the oropharynx or by fractures of the maxilla or mandible in the following ways and require the specific management discussed.

• **Blockage of the oropharynx**— Bone fragments, broken teeth and dentures, blood and vomitus may all obstruct the upper airway. The debris should be cleared with a gloved finger and suction. A laryngoscope is then used to clear the oropharynx.

• **Haemorrhage** — This may be controlled by packing ribbon gauze into the wounds. In the case of posterior pharyngeal bleeding a tamponade balloon, or a 30 ml Foley catheter, can be inserted through the nose, as far as the oropharynx, and pulled back and strapped to the face after inflation to stop posterior oropharyngeal bleeding. The nose anterior to the balloon is then packed with ribbon gauze soaked in bismuth iodoform paste if necessary.

• **Emergency cricothyroidotomy or intubation** — This may be necessary in cases of severe and intractable respiratory compromise. A needle cricothyroidotomy with a 12-gauge needle is an effective and easy temporary emergency measure.

• **Bandaging** — The barrel bandage used for mandibular fractures is illustrated. This should be used with care if the airway is impaired. It should never be used if the maxilla is fractured.

Face and jaw injuries

Mandible

Treatment

- Clear airway
- Emergency bandage

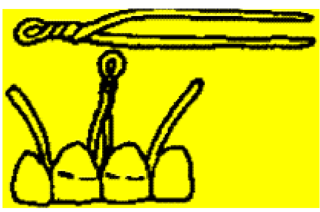
Never with fracture maxilla

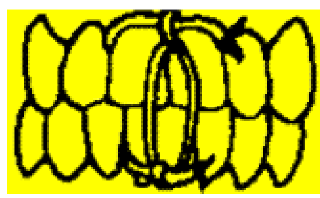
Only for displaced fractures of the mandible OPG (panoramic) X-ray for diagnosis

Interdental eyelet wiring against sound

only for long distance travel

maxillary arch





Dentures and jaw fractures

- Dentures even when broken should be kept
- Dentures make the best splints
- Wire cutters available

Post operative

- Sedate
- Anti-emetic
- Aspiration mucus

- Fluids only by mouth
- Antibiotics
- Antibiotics
- Mouth wash

- Check respiration 1/4-1/2 hourly
- Cut wires in

emergency and laryngoscope

Fractures of the zygoma and zygomatic arch

The fracture should be elevated with the use of a retractor inserted above the hairline. If the fracture is unstable internal fixation is needed. Check for diplopia which may indicate a blow-out fracture of the orbital floor.

Dislocations of the mandible

The mandible is displaced anteriorly and down. The mouth cannot be closed. The dislocation is reduced by pressing down on the external oblique ridges of the mandible (not on the molar teeth), while pressing upwards under the chin. An anaesthetic may not be necessary.

Fractures of the mandible

• **Clinical findings** — There will be a history of recent trauma. The patient may complain that the teeth of the upper and lower jaw do not occlude properly. There will be pain and swelling at the fracture site.

• **X-rays** — Radiological investigation should include an AP X-ray of the mandible as well as an orthopantogram (OPG)

• **Treatment** — In anterior mandibular fractures the tongue may drop back and block the oropharynx. The mandible or tongue should be pulled forward by a towel clip or strong suture. In cases where the reduction has not been complete, a gap may be palpated or the teeth will not occlude correctly.

Splinting of the teeth is required if there is displacement. The maxilla must, however, be intact. Most of the natural teeth must be intact for eyelet wiring or arch-bar splints.

Injuries to teeth

Injuries to the teeth are often more significant to the patient than laceration of the soft tissues. The soft tissues heal but the teeth remain broken and discolour. Consultation with the dentist is a matter of urgency if the patient is to be treated properly.

• **Fractured teeth** — Broken teeth and even teeth bumped and not broken, need urgent dental attention if they are not to discolour.

• **Totally or partially displaced teeth** — These should be gently, but firmly, pushed back into the socket. The dentist should be urgently consulted for splinting and endodontic therapy. Totally displaced teeth should be kept in gauze soaked in warm saline or milk, if not reimplanted, until urgent reimplantation can be carried out. Missing teeth may necessitate a chest or abdominal X-ray.

Face and jaw injuries Maxilla

Emergency treatment

• Prone head to side

• Tongue pulled forward

• Cricothyroidotomy if necessary

• Remove broken teeth or

dentures from mouth

• Disimpact if necessary

• Direct mini-plating

• Orbital floor may be depressed

• Expert advice essential

• Elevate depressed zygoma

if necessary

Teeth

Broken tooth

See dentist quickly to avoid discoloration

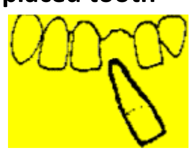
Loosened or

• Push back in to place
• See dentist for splinting

Children

Difficult to stabilise deciduous or newly erupting permanent teeth

Completely displaced tooth



• Replace in socket or keep moist with warm saline or milk

• See dentist for splinting

• **Edentulous patients** — Edentulous patients must keep their dentures with them, no matter how badly broken, as these make the best splint. All parts of broken dentures must be accounted for as denture material is radiolucent. Call the dentist early if the denture is to be adapted or a Gunning splint made for an edentulous patient. A barrel bandage is of use only for a bilateral fracture with displacement.

Fracture of the maxilla

• **Examination** — Conscious patients will complain that their teeth will not occlude. This is diagnostic. Displacement is usually posteroinferior and thus may threaten the airway.

• **Airway** — Check that the airway is clear and that bleeding has stopped.

• **X-ray** — Radiological investigation should include: a true lateral, films taken at 10° and 30° together with occipitomental views.

• **Reduction** — The loose fractured maxilla may be displaced backwards and downwards and block the nasopharynx. It should be disimpacted by pulling the maxilla forward with

2 fingers behind and above the soft palate.

• **Maintenance of reduction** — This will require skilled treatment with splints and cranial fixation. The patient must be kept under close observation. Aspirate the oropharynx regularly.

• **Intubation** — Intubation, where possible, is preferable to tracheostomy or cricothyroidotomy. If this is not possible an emergency needle cricothyroidotomy or a definitive cricothyroidotomy or tracheostomy may be necessary.

• **Treatment** — An experienced dentist should be notified as early as possible, as splint production is time consuming.

Damage to the face

• **Venous engorgement of the face** — This may be due to damage or constriction of the blood vessels in the neck or thorax.

• **Surgical emphysema** — If this occurs around the face, a fracture of the frontal or maxillary sinuses may be communicating with the subcutaneous tissues.

• **Clear fluid leakage** — This may be due to division of the parotid duct.

• **Stove - in face (dish face)** — This is due to bilateral maxillary fractures. Other deformities of the face may similarly be due to maxillary fractures.

• **Orbit** — Deformities of the orbit or zygoma indicate a fracture.

Injuries to nose

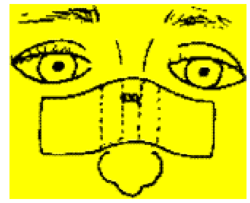
Fractured nose

Immediately manipulate or within 5 days of accident

Suture lacerations over fracture

Small plaster of Paris

mould strap on



Epistaxis

- Suck out blood
- 4 ml 4% lignocaine +

0.5 ml 1/1000 adrenaline pack

- Cauterise if necessary
- Insert epistaxis balloon or Foley catheter into nasopharynx and pull back for intractable bleeding

Septal haematoma

- Always needs incision on both sides
- Look for septal deviation
- Foreign bodies in nose: seek expert attention

Drain and antibiotics

Injuries to the nose

Fractures of the nose

A nasal fracture, if causing a deformity, will need reduction irrespective of the appearance of an X-ray.

Examine clinically for pain, mobility and crepitus, and blockage of one or both nasal cavities, with difficulty in breathing. Apart from bleeding, cerebro-spinal leakage will signify a fracture of the cribriform plate.

Lacerations should be sutured over a fracture, and a small plaster of Paris mould strapped on as illustrated after reduction. The nose should be manipulated within 5 days of the accident. The best time for manipulation is immediately after the injury when the nose is often anaesthetised from the trauma, and before swelling has occurred. A general anaesthetic may therefore not be necessary.

Mild epistaxis

This may settle without treatment, provided the patient can sit up rather than lie down, the latter increasing intravascular pressure. Severe epistaxis may require packing with vaseline gauze or with 4% local anaesthetic plus 0.5 ml of 1 in 1000 adrenaline. This should only be left for 5 minutes. Occasionally, a bleeding vessel may require cauterisation. A posterior source of bleeding may require a tamponade balloon or an inflated 30 ml Foley catheter (see above).

Septal haematoma

A septal haematoma will always need incision on both sides and drainage plus antibiotics. A septal deviation, either clinically or on X-ray, should also be reduced.

Retained nasal foreign bodies

Foreign bodies in the nose will often need expert removal if well impacted and cannot be dislodged by blowing of the nose. The latter, however, may cause bleeding.

Ear injuries

Bleeding and CSF from the ears

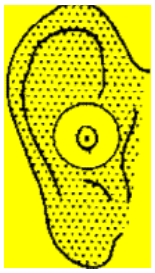
• **Anterior wall of the external auditory meatus** — Bleeding indicates a fracture of the neck of the mandible.

• **Posterior wall or a haematoma over the mastoid** — This indicates a middle fossa fracture. A CSF leak should always be looked for.

Ear injuries

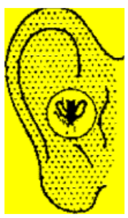
Foreign bodies

Beads and stones



- Remove with proper instruments
- (NOT forceps)
- Never attempt to remove hard
- foreign bodies
- Send patient to ENT surgeon if possible

Insects

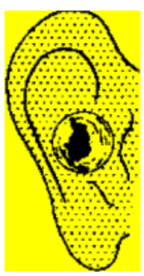


• Kill with any kind of spirit

(even whisky or gin!)

• Remove carefully

Perforation of tympanic membrane



Do NOT
- Remove clot or wax
- Syringe
- Insert ear drops

• Cotton wool in outer ear

• Commence antibiotics

• Refer to ENT specialist

Foreign bodies

Foreign bodies in the ear are common, particularly in children. These require removal with the correct instruments in an Ear, Nose and Throat department, rather than with forceps. Hard foreign bodies should not be removed with forceps.

Insects

Insects in the ear may be attracted out of the ear with a bright light. If not, they should be killed with spirit before removing. Whisky or gin can be used in an emergency.

Perforation of tympanic membrane.

Emergency management — Cotton wool in the outer ear, packed lightly, with antibiotics, and commencement of oral antibiotics is the best emergency management before sending the patient for specialist treatment.

This should be done without removing wax, syringing the ear or inserting eardrops.

Oropharyngeal emergencies

These may cause considerable distress, often out of all proportion to their seriousness.

Tongue

A cut or bitten tongue is common. It will bleed considerably. These injuries heal well, except when very large. They do not usually require sutures. Absorbable sutures should be used if suturing is required.

• Antibiotics — These are seldom necessary.

Fish bone

A fish bone caught in the throat or larynx is a surgical emergency. If not seen by indirect laryngoscopy the patient should have a lateral X-ray of the neck. A small piece of cotton wool impregnated with barium if swallowed may catch on the bone and show its position on X-ray.

Swallowed or inhaled foreign bodies

• **Chest X-ray** — AP and lateral views are essential in all cases.

• **Oesophagoscope or bronchoscope** — Perform if necessary and may require bronchial lavage.

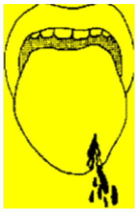
• **Admission to hospital** — Admit all patients.

• Antibiotics may be required

Crushed larynx

• Surgical emergency — Admit all patients. The presence of a swollen neck, surgical crepitus, and loss of laryngeal

Oropharyngeal emergencies



- Suture only large lacerations: 2% Xylocaine with adrenaline and absorbable sutures
- Mouth washes
- Antibiotics are rarely needed

Fish bones — throat or larynx

- Inspect tonsils
- Indirect laryngoscopy
- If radiograph negative — barium on cotton wool and re-X-ray

Swallowed or inhaled foreign body

Give 5 blows to back, if does not work, then 5 abdominal thrusts. Repeat if required.

Chest X-ray — PA / Lateral

- Oesophagoscope or bronchoscope if necessary
- Surgical emergency — admit patient for inhaled foreign body

Crushed larynx— may require intubation

landmarks indicate a laryngeal fracture with or without displacement. Attempt intubation only if the airway is patent. The wiser alternative is a cricothyroidotomy or tracheostomy.

Laryngeal foreign bodies

- **Surgical emergencies**— Laryngeal foreign bodies are common in children. The patient must always be admitted to hospital. Foreign bodies such as peanuts may not be seen on radiographs. The peanut may act as a valve causing over- inflation and thus radiolucency of the lung on the obstructed side.
- **Bronchoscopy** — This is usually necessary.
- **Antibiotic cover** — This is important, as pneumonia may develop distal to the obstruction.

Eye injuries

History

• **Types of injuries** — An adequate history is essential. This will include details of the injury, including a history of power tool use, an explosion, or any injury where small high velocity particles may have damaged the eye.

• **Visual acuity** — Check whether this was immediately affected.

Examination

• **Visual acuity** —This should be estimated using a Snellen chart and documented prior to assessing an injury or administering treatment.

• **Local anaesthetic** — A topical local anaesthetic such as 0.5% amethocaine may be necessary if the patient cannot open the eyelids. If a local anaesthetic is used a pad should always be applied to protect the eye until the anaesthetic has worn off.

• **General examination** — The conjunctiva and cornea should be inspected with magnification such as with a binocular loupe. Fluorescein should be instilled in the lower conjunctival fornix to stain any corneal epithelial defects. The eyes may then be examined under a slit lamp.

• **Upper eyelid** — The upper eyelid should be everted to look for superficial foreign bodies along the sub-tarsal fold and in the upper conjunctival fornix.

• **Lower eyelid** — The lower eyelid should be everted and the bulbar and palpebral conjunctivae inspected, preferably with slit lamp illumination following instillation of fluorescein.

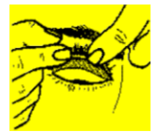
Eye injuries

Examination

History

Eliminate other causes with similar symptoms

Fluorescein



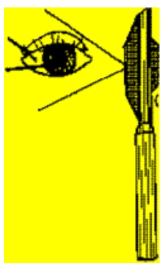
Direct inspection
0.5%amethcaine

Evert upper and lower eyelids

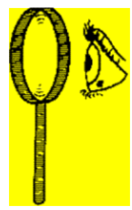
Ophthalmoscope

Magnifying glass

- Sclera
- Cornea



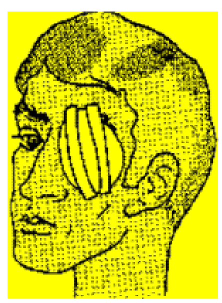
Short acting mydriatics such as tropicamide or 0.5% mydriacyl (NEVER atropine)



Care (shallow anterior chamber)

After examination

- Always pad eye with local anaesthetic instilled
- Avoid padding both eyes if possible



- **Opposite eye** — Always examine both eyes even though the patient may only complain of a foreign body in one eye.
- **Lacrimal lacerations** — The medial canthal area should be inspected for lacerations involving the lacrimal system.

• **Retina** — If a retinal lesion is suspected the pupil can be dilated with 1-2 drops of a short acting mydriatic such as 0.5% tropicamide. If a reversing agent is not used following pupil dilatation the patient should be warned not to drive a motor vehicle or operate machinery.

• **Orbital fractures** — Fractures of the orbital bones may cause enophthalmos and vertical diplopia due to trapping of the inferior rectus muscle, with limitation of elevation of the eye. An X-ray is essential to show the sinuses and orbital floor.

Treatment of eye injuries

• **Small foreign bodies** — These may easily be removed from the conjunctiva with a 25 - gauge needle. Great care must be taken not to abrade the cornea with cotton wool. Irrigation with sterile saline may also remove a foreign body.

• **Corneal foreign bodies** — Corneal foreign bodies should be removed by a sharp instrument such as a 25 - gauge needle after the instillation of a local anaesthetic. If possible, magnification with a loupe should be used with the patient's head in a fixed position in a chair with a head rest or lying on a couch. Alternatively, it may be removed under slit lamp guidance.

• **Intraocular foreign bodies** — Patients with possible retained intraocular foreign bodies or penetrating injuries should have the eye padded, an antibiotic instilled and be admitted to hospital under the care of an ophthalmic surgeon. A radiograph is essential.

• **X-rays** — X-rays will confirm the presence of a retained foreign body in the orbit or eye, provided the foreign body is radio-opaque. An X-ray of the orbit is required to exclude a retained orbital or intraocular foreign body if this is a possibility.

• **Hyphaema** — Bleeding in the anterior chamber of the eye (hyphaema) following a blunt injury to the eye, for example from a squash ball. This requires padding of the eye and admission to hospital for bed rest to prevent further bleeding.

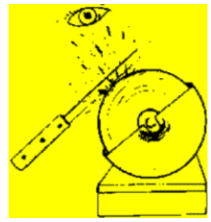
• **Alkali injuries** — These should be treated by the immediate instillation of local anaesthetic, prolonged irrigation of the conjunctiva with a solution made of 2 ml sodium versenate in 100 ml sterile normal saline solution. If this is not immediately available the eye should be copiously washed out immediately with warm water.

Eye injuries

Corneal foreign bodies

Fireworks

Grinding wheels

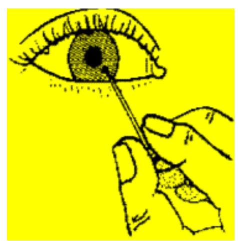


Multiple abrasions - use fluorescein

Use protective goggles

Removal

- Chair with head rest or lie patient on couch
- Use magnification
- Amethocaine 0.5%



Foreign bodies

- Fix patient's head
- Sharp instrument (25-g needle)

NB Danger of corneal abrasion with cotton wool

After removal

- Local antibiotics and eye pad
- Care — do not mistake scleral perforating vessels with subconjunctival pigment for foreign bodies

- **Cement and lime** — In cement and lime injuries the upper eyelid should be everted and particulate matter urgently washed out and the conjunctival fornices continuously irrigated with 2% sodium versenate or sterile water.

• **Acid injuries** —In all acid injuries, the eye should be irrigated immediately with sterile normal saline solution or warm water.

• **Chemical injuries** — First aid remedies should be immediately at hand. Irrigation with tap water at the work place is essential. In all cases of chemical injuries, the eye should have an antibiotic such as chloramphenicol instilled and the eye padded.

• **Analgesic tablets** — The patient may also require analgesic tablets but should not be given a local anaesthetic to take home.

Prophylaxis

• **Protective goggles** — These are essential when grinding or any power tools are used. In certain sports, such as squash, protective goggles are also recommended, and also when dealing with potentially infected body fluids (e.g., HIV, hepatitis B and C).

• **Goggles for swimming** — Swimming pools are often either chlorinated or incompletely protected against coliforms and other bacteria. Rivers, lakes and the sea are often polluted by chemicals from factories, as well as faecal contamination, particularly after heavy rain. Infections of the conjunctivae, and external ear, are common direct complications. Unrecognised indirect complications include upper respiratory, middle ear and gastrointestinal infections caused by drainage into the nasopharynx of contaminated water through the lacrimal ducts.

• **Chemicals** — Care in handling chemicals is important. First aid remedies and eye baths should be immediately at hand.

• **Seat belts** — Seat belts in cars have lowered the incidence of windscreen injuries to the eyes.

• **First aid workers** — First aid workers must treat all eye injuries urgently, and be educated in emergency care.

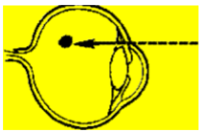
Complications of eye injuries

Complications include eyelid, corneal and conjunctival scarring, hyphaema, glaucoma, cataract formation, retinal detachment and retained foreign body. Damage to the lacrimal system may follow lid lacerations and is manifested by excessive lacrimation. Diplopia may follow orbital damage.

Eye injuries

Perforating injuries

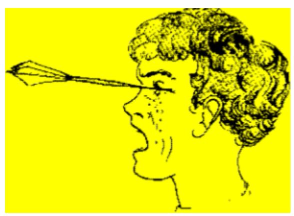
Intraocular foreign body



- Electric drills and other power tools
- Hammer on metal
- Copper and alloys very destructive
- Steel siderosis

Always admit and X-ray

Children



- Dart
- Air gun
- Pellet
- Pen nib

Care — may be little clinical evidence except for small subconjunctival haemorrhage

Scissors and windscreens

- Irregular pupil
- Antibiotics
- Pad
- Admit and refer to eye surgeon

Eye injuries

Chemical and thermal burns Acids

- Amethocaine 0.5%
- Irrigate immediately and copiously with saline

Alkali and lime burns

• Amethocaine 0.5%

• Irrigate immediately —

2 ml sodium versenate

in 100 ml saline or with warm water

• Evert lids and remove lime from fornices

• Conjunctival adhesions may occur

Flash keratitis

• Severe ocular irritation

• Watering several hours later

• Amethocaine and fluorescein

• Numerous small stained areas

• Recovers within 24 hours

Antibiotics **Analgesia** **Eye pad**

Eye injuries

Blunt injuries

Hyphaema

• Squash ball or fist injury

• Early or late (5-7 days

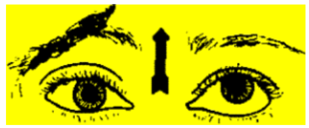
• Admit to hospital

• Pad the injured eye

• Check intraocular pressure

Fractures of orbital bones

Enophthalmos



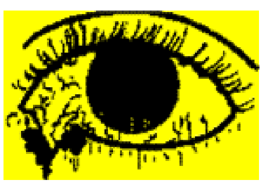
Look for bruising of

- X-rays may not always show fractures
- Blow out fracture through orbital floor
- Surgical crepitus
- Defective elevation of eye — inferior rectus trapped by orbital fat or bone
- Diplopia

Eye injuries

Complications

Lid laceration



- Damage to inner canthus
- Lacrimal canaliculi may be damaged
- Epiphora

Lens subluxation

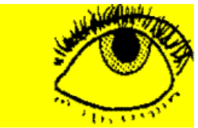
- Admit
- Late cataract formation

Detached retina

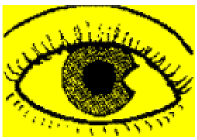
- Admit
- Flashes of light
- Floaters
- Shadow

Enophthalmos

Strabismus

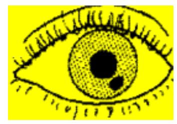


Distorted cornea (due to scarring)



- Prevent infection
- Refraction
- May need corneal graft

Rust staining of cornea



Remove foreign bodies early

Chapter 3

Musculo-skeletal emergencies

*How to describe a fracture(s)- Age/gender/General health/ Mechanism injury ?MVA; First ABCDE; then which bone; open or closed; which end of the bone or mid bone; transverse/oblique, spiral, comminuted; minimal/no displacement, partially or totally displaced; Fasting status; OR availability; associated soft tissue injuries-nerves/blood vessels.

There are numerous classifications of fractures- stick to the basics, especially in the middle of the night (your senior will not recall such detail at that time).

Open wounds and fractures

Compound or open fractures are any fractures which communicate with a body surface, whether directly or indirectly. These should be operated on within 6 hours of occurrence, where possible, as they are all potentially infected.

Debridement

All dead tissue and foreign material should be excised.

• **Primary skin closure** — This should usually only be attempted in clean wounds, following adequate debridement, and if there is no skin tension. A suction drain should be used in all cases. There is an occasional place for immediate or delayed free flap coverage, especially in high energy injuries.

• **Delayed primary closure** — This is indicated in all dirty wounds, where swelling may occur or where the skin cannot be closed without tension. A relieving incision may relax tension. An incised area is then grafted with a split skin graft, or can be closed when the swelling has subsided. Delayed primary closure is the treatment of choice if there is any doubt or if the wound is contaminated.

Foreign material

Plates, screws and wires must not normally be inserted into open fractures except in special cases. These include wounds which are compound from within out and otherwise clean, or where vascular repair has necessitated internal fixation. These also include fractures which cannot be reduced without operative fixation, or external fixateurs, or where early mobilisation is important.

There is also a place for immediate fixation of some compound fractures, combined with delayed primary or secondary wound closure. Antibiotic cover is important in all these cases.

Cut tendons

These, if seen, should usually be sutured. It is seldom justified to extend the skin incision to effect a major repair in dirty wounds. Hand injuries are discussed below.

Divided nerves

Nerve ends, if seen, may be approximated with 1 or 2 non- absorbable sutures. A definitive primary repair of nerves should not be attempted, unless there is a clean sharp wound.

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Open wounds and fractures*

Skin

Fat, muscle and tendon

Vessels

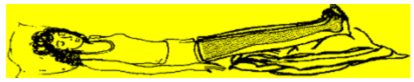
Bone and joint

Nerves

Brain, chest and abdominal organs may also be damaged

Emergency treatment

Resuscitate as necessary

Pneumatic splint  Elevate and splint limp

- Shock
- Haemorrhage
- Respiratory obstruction
- Other injuries
- Intravenous drip
- Blood and oxygen if indicated

*Pressure sore from too tight a cast or POP. This is quite common and the cause of much litigation. REMOVE cast asap and check.

Micro-surgical techniques should be used where available. The ideal time for repair in a contused or potentially infected wound is 3 weeks after injury, provided the wound has completely healed.

The exceptions to delayed repair in potentially infected wounds are digital nerves of the fingers. These are difficult to repair if operation is delayed.

All but the most minor cases of nerve injuries usually require hospital admission.

Fractures

These should be reduced and held either by a padded backslab, or a well-padded split plaster with a window cut over the wound. Excision of the dead bone should not be too radical lest a gap be left which may be difficult to graft. External Fixateurs or nail fixation should always be considered. These are discussed under individual fractures.

Dirty wounds

If muscle is involved, these wounds are particularly liable to infection with:

Pyogenic organisms, i.e., staphylococcus
Tetanus
Gas gangrene.

Patients with major compound fractures should be given intravenous prophylactic antibiotics, such as one of the cephalosporins, plus large doses of penicillin, except in suspected allergy. They should be watched carefully also; in case they develop tetanus or gas gangrene. Prophylactic tetanus toxoid or TIG should be given in all cases.

• **Fully immunised patient** — If more than 2 years have elapsed since the last dose of toxoid, give a booster dose.

• **Non-immune or partially immune patients** — Give TIG (Tetanus immunoglobulin human) plus a dose of adsorbed tetanus toxoid into a different site.

Further doses of toxoid should be given, where appropriate, to complete the course of immunisation.

Dosages of TIG

• **Normal dose** — 250 IU of TIG by intramuscular injection.

• **Grossly contaminated wound** — If there is to be more than 48 hours before treatment is started — 500 IU of TIG by intramuscular injection.

• **Clinical tetanus** — 4 000 IU of TIG intravenously — There is no necessity to repeat this dosage due to the half-life of 3-4 weeks in circulation.

General debridement

Remove all foreign material if possible

Clean well with saline

Secondary suture all dirty wounds

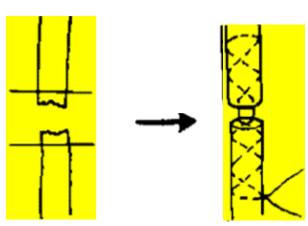
Fat and muscle

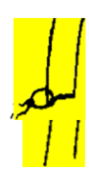
Excise all dead fat and muscle, clean well,

minimum deep sutures

Leave open and delayed primary or secondary suture

Tendons





Unabsorbable sutures to or anchor tendon - note position

Suture if easy

Secondary suture or graft later for defects

• There is no indication for equine or bovine ATS now that TIG is available.

Other treatment

• **Gas gangrene** — Occasionally gas gangrene serum is indicated in very dirty wounds. Its value is in doubt, and huge doses of penicillin intravenously are better. A loading dose of up to 5-10 million units and then 2 million units 2-hourly in proved severe cases, plus probenecid, has sometimes been recommended. In established very severe cases penicillin may sometimes be increased. It is important to check for penicillin sensitivity and watch for the complications of penicillin overdose.

• **Hyperbaric oxygen** — This should be given 2 or 3 times a day. Hyperbaric oxygen will not supersede adequate debridement, but is a useful adjunct. It may either save a limb or permit selective amputation at a lower level than might otherwise be necessary.

Operative treatment

• **Prophylaxis** — In all suspected cases of gas gangrene, the wound must be opened widely and left open and all necrotic muscle excised. It must be stressed that the diagnosis must be mainly clinical.

• **Definitive treatment** — This should not be delayed until gas is seen on X-ray, or a Gram stain shows the typical 'drumstick' bacteria and spores.

• **Amputation —** Where hyperbaric oxygen is not available, amputation of the lower limb is usually indicated to save the patient's life in proven gas gangrene. This is especially so where the patient is toxic and extensive debridement and antibiotics have not been effective.

HIV infections

All patients requiring operation should be asked to have their

HIV status tested. There is now a quick 3-minute test available. Over 95% of patients will agree because of the potential risk of operation both to themselves and their medical attendants. Those who refuse or who are HIV positive should be treated with extra sterile precautions. These include full face masks, or suction headgear, and triple gloving (including a middle glove of needle resistant fabric). Other precautions include great care with disposal of all contaminated dressings, drapes and other infected material.

In addition, the patient who has developed AIDS will require appropriate medical treatment and resuscitation.

General debridement*

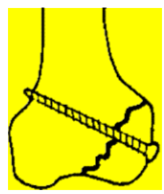
Delayed primary or secondary suture in all contaminated wounds

Treat fracture as for closed injury

• Excise loose bone fragments only
• Do not leave large defect
• Avoid internal fixation if possible
• External fixateur, if indicated

EF is very useful for early stabilization of a complicated Fx; where gross contamination and ORIF(open reduction with internal fixation) not safe; to hold a Fx before ORIF. Being used extensively in Ukraine now(2022)

Joints



*High-pressure injuries of the hand should never be underestimated (often small puncture from water, air, paint or grease) with underlying extensive soft tissue damage. Wide debridement of necrotic tissue and foreign, material needs to be done.

Hepatitis B and C

Both hepatitis B and C are much more infectious than HIV infection. The status of patients should be obtained, and every precaution taken. It is also essential that blood transfusion with autologous blood should be carried out, where possible. This is because of the ‘window period’ of 3 months in HIV infection and the difficulties of laboratory testing blood for transfusion for hepatitis C infection.

Covid Infections (2022)

Check vaccination status, don’t hesitate to do covid test and best advice is to wear mask.

Prophylactic exploration of puncture wounds

• **Debridement** — It is essential to explore and carry out adequate debridement in all puncture wounds where there is any underlying muscle or bone damage. Many apparently superficial injuries of the limbs have extensive underlying muscles and soft tissue damage with haematoma formation. Always perform delayed primary or secondary suture in all contaminated and severely contused wounds.

• **Head and trunk** — Injuries of the trunk and head and neck may also cause damage to essential underlying structures, including the brain, lungs, heart, major blood vessels and abdominal viscera.

• **Fasciotomy** — In addition to adequate debridement of wounds, the fascia overlying damaged muscle or bone should be extensively divided and left open if there is any danger of tension with the danger of a compartment syndrome.

• **Delayed primary closure of skin** — This should always be carried out if there is much damage or any likelihood of tension under the skin. Always leave a dirty contaminated wound open and close this later by delayed primary or secondary suture if in doubt.

• **Suction drain** — This should be used for most major wounds that have been closed.

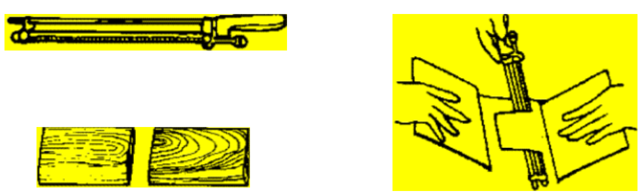
Scalp and facial lacerations

Scalp

Shave at least 5 mm of hair around wound. The wound should be closed in at least 2 layers with deep chromic catgut. The skin sutures should remain for 4-7 days. A rotation flap should be used for missing periosteum.

Open wounds and fractures

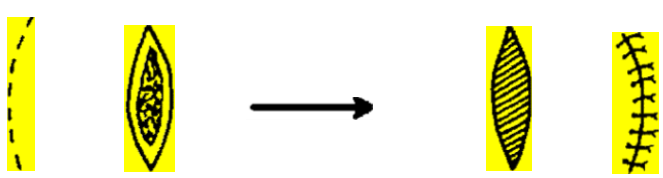
Skin cover
Split skin grafting



Skin graft knife for large grafts under G.A. and then mesh.

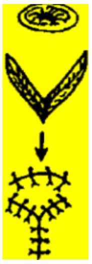
Relieving incision

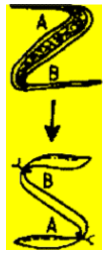
Save skin

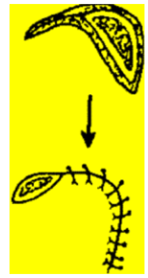


Incision Skin graft defect

VY advancement | Z plasty | Rotation flap







(easy to do)

Cover bone

157 **Musculo-skeletal emergencies**

Eyebrows

Do not shave the eyebrow and debride as little as possible. Feel the orbital rim for fractures. Use very fine sutures and remove these after 4-6 days.

Eyelid

Minimal debridement and close wound in layers plus subcuticular skin sutures. Never debride the tarsal plate and take great care of wounds near the medial canthus because of the lacrimal duct. It is important to refer all lower eyelid injuries near the medial canthus to an ophthalmic surgeon. Skin graft should be used if necessary for avulsion injuries.

Ear

A ring block around the base of the ear may be satisfactory and will anaesthetise the ear except for the external auditory meatus.

Torn cartilage should be sutured and a wedge removed, if necessary, if avulsion has occurred.

Nose

Debride a minimum of cartilage and close the wound in 3 layers. A septal haematoma should be incised on both sides and drained, followed by anterior nasal packing and antibiotics.

Lips

- **Full thickness injuries** — These should be closed in 3 layers and with subcuticular sutures.

Face

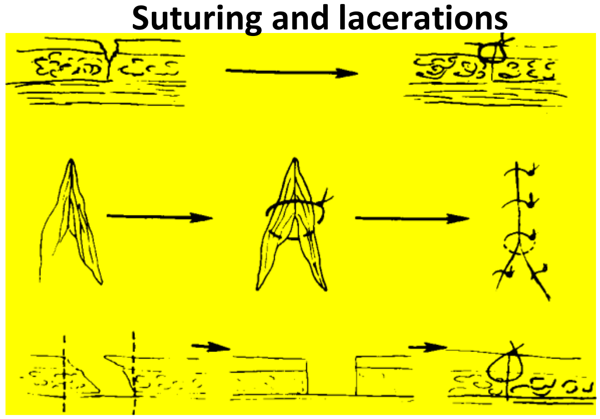
Suture in multiple layers with fine sutures. Always consider the need for a 'Z' plasty. Do not sew under tension. Where possible use fine subcuticular sutures and steristrips.

Skin cover

• **Split skin grafting** — This is indicated for contaminated wounds as a temporary and often permanent cover for skin deficits in most patients with clean wounds. The donor site is usually the thigh. Small deficits in the hand can usually be covered by split skin graft from the flexor surface of the forearm (easy to do).

• **Relieving incisions** — Types of relieving incisions for a small skin deficit may eliminate skin tension and wound breakdown. These include VY advancement, 'Z' plasty and rotation flaps, as illustrated (see pages 157 and 159).

Suturing and lacerations



Excise skin edges

Skin graft if necessary

Subcuticular sutures for facial wounds

Nylon
Plain catgut

Chromic catgut

Excised skin edges and devitalised deep tissue

Damaged skin edges

• Not excessive tension

• Skin graft if necessary

Suction drain for all large wounds Delayed primary suture for contaminated wounds. Never hesitate to use a drain.

Blast and penetrating wounds

Examination

This will involve a detailed examination of the head, chest , abdomen and limbs. Injuries may involve the central nervous system, the eyes, ears, nasopharynx, lungs and abdominal contents. This will also include assessment of the limbs and documentation of all injuries, with entry and exit wounds of missiles, after completely reassessing the patient.

Urgent resuscitation

In severe injuries this will include oxygen administration by endotracheal intubation or cricothyroidotomy, plus positive pressure respiration, if necessary. Fluid and possibly blood replacement by at least 2 size 14-16 intravenous drips should be started. The ABCDE of assessment and management should be followed by a chest drain, a gastric tube and catheter if necessary.

The treatment and resuscitation of the individual injuries of the patient are described in the relevant sections of this book, plus the methods described under penetrating injuries (see pages 46 and 74). It is important that urgent erect chest and abdominal X-rays be carried out as soon as possible provided there is no thoracic or lumbar spinal injury. Other investigations include lateral X-ray of all 7 cervical vertebrae, plus AP X-ray of the pelvis if indicated.

Missile injuries

Missiles may cause considerable damage in tissue planes and in tissues far from the entry and exit wounds. It is therefore essential that extensive exploration of all penetrating injuries be carried out, with extensive debridement of dead tissue and foreign material, as well as fasciotomy of all tissue planes.

Large doses of intravenous antibiotics, including penicillin plus tetanus prophylaxis, are important.

Hyperbaric oxygen is indicated for gas gangrene and severe tissue necrosis. All major fractures should be internally fixed or stabilised by external fixateurs as soon as possible. In addition, all penetrating and compound wounds should be left open and closed later by delayed or secondary suture. Finally, psychiatric counselling may be important for survivors of bomb blasts and terrorist attacks. •

Penetrating injuries — These may have been caused by a bomb explosion, or by high or low velocity bullets from rifles or handguns and by stab wounds.

The high velocity missile may not only lacerate and crush tissue in its path, but may also transfer its kinetic energy to the body when it encounters bone. This will then result in both a shattered bone as well as disruption into tissue planes, both in the limbs and trunk, far from the initial missile tract. The higher the velocity of the missile the greater this transfer of kinetic energy.

Foreign material, such as clothing, may be sucked into the tract and contaminate the wound with aerobic and anaerobic bacteria.

Operative management

• **Clean wounds** — After adequate examination for underlying neurovascular or bony damage, these should only be closed in three layers, if clean and not crushed (see pages 157 and 159). It is important that all non-essential devitalised tissue is excised and the wound closed in most cases by delayed primary or secondary suture. It should not be sutured under tension. Damaged skin edges should be minimally excised with care and skin grafting, rotation and advancement flaps should be used if wound tension is likely (see pages 157 and 159).

Exploration of puncture wounds

• **Debridement** — It is essential to explore and carry out adequate debridement in all puncture wounds where there is any possibility of underlying muscle or bone damage. Many apparently superficial injuries of the limbs have extensive underlying muscle and soft tissue damage, with haematoma formation.

• **Head and trunk** — Injuries of the trunk and head and neck may also cause damage to essential underlying structures, including the brain, lungs, heart, major blood vessels and abdominal organs.

• **Fasciotomy** — After adequate debridement, the fascia overlying damaged muscle or bone should be extensively divided if there is any danger of tension with a compartment syndrome.

• **Delayed primary closure of skin** — This should always be carried out if there is much damage, or any likelihood of tension under the skin. Always leave a dirty contaminated wound open, and close this later by delayed primary or secondary suture if in doubt.

• **Suction drain** — This should be used for most major wounds that have been closed.

Regional and local anaesthesia

• **Local anaesthesia** — This is given directly into the surrounding skin, to allow operation on minor wounds, with lignocaine 0.5%-1%, with or without adrenaline.

• **Proximal nerve block** — Manipulation of certain fractures and dislocations may also be carried out with a proximal nerve block. 1% -2% lignocaine , with or without adrenaline, is the usual anaesthetic. This lasts for 1 -1.5 hours. Adrenaline (1 in 200000) will prolong the effect and reduce toxicity .

• **Danger** — Injections into the digits of either the fingers or toes, however, should never be given with adrenaline as this may cause spasm of the digital vessels and subsequent gangrene of the digit.

• **Brachial plexus block** — If carried out by a skilled anaesthetist, this is useful for reduction of fractures of the upper limb.

• **Femoral nerve block** — This, combined with sciatic and obturator nerve blocks, is useful for analgesia in all femoral shaft fractures and especially in patients in severe pain.

• **Spinal or epidural anaesthesia** — This can be given for lower limb operations in unfit patients.

• **Injection of local anaesthetic directly into the fracture site**— This is not used as a routine due to the risk of infection.

• **Young children** — Local anaesthetic should be avoided wherever possible in young children.

• **Intravenous retrograde (Bier) block** — This is a block by local anaesthetic into veins used with a tourniquet in adult patients, and is only used by those skilled in the technique.

• **Local nerve blocks** — Blocks into the median and ulnar nerves are not popular.

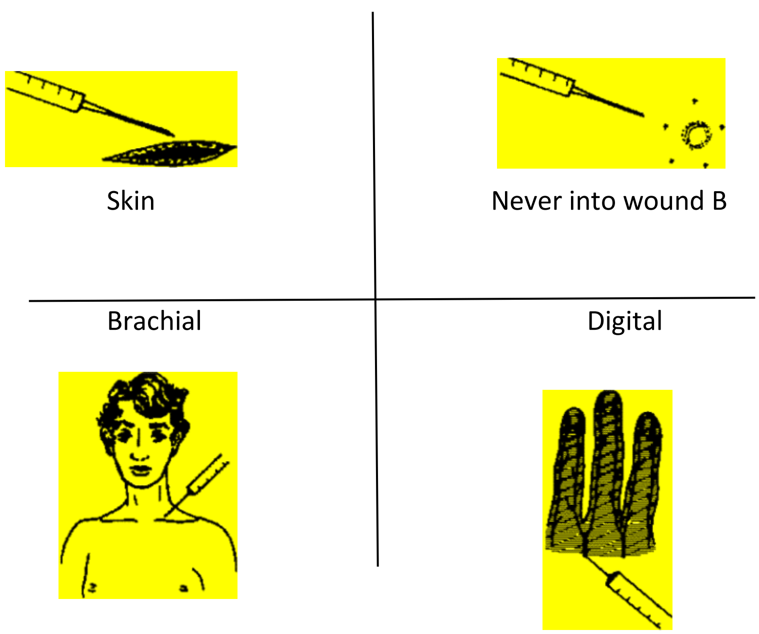
• **Lignocaine toxicity** — This may occasionally cause a drop in blood pressure, anxiety, drowsiness and convulsions.

• **Entonox (oxygen + nitrous oxide)** — under the control of the patient has a useful place in ambulances, and for minimal anaesthesia in obstetrics and some other conditions.

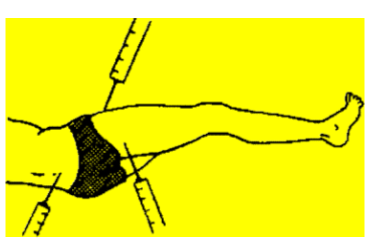
• **Post-operative patient controlled analgesia (PCA)** — This provides intravenous analgesia under the direct control of the patient. There are safeguards to prevent overdosage and many patients can be virtually pain free postoperatively.

• Long-acting post-operative local anaesthetics. Many anaesthetists will now give long-lasting local nerve and epidural blocks just before the patient leaves the operating theatre, for pain control. These can be continued for up to 3-4 days post-operatively if necessary.

Regional and local anaesthesia



• Never adrenaline in digital nerves
• Use 1-2% lignocaine alone



Femoral nerve

Sciatic

Spinal epidural

Avoid local anaesthesia in uncooperative children

Vascular injuries

• **Arterial injuries** — If in any doubt as to injury of a major vessel, urgent exploration is indicated, particularly if there is frank ischaemia, uncontrolled open bleeding, or with distal paralysis or sensory loss due to suspected ischaemia.

• **'Doppler' ultrasound stethoscope —** This is a valuable aid in diagnosing blood flow only if performed by an expert in the procedure. A diagnosis of 'spasm' of an artery is seldom correct. It is usually associated with intimal damage. Evidence of damage to a major artery includes:

• Colder limb with sensory loss and paralysis.

• **Distal pulses** — diminution or absence.

• **Haematoma** — increasing in size.

• Persistent arterial bleeding.

• **Bruit** — This is heard over or beyond an arterial injury.

• **Anatomical proximity** — If this is close to a major artery or if an anatomically related nerve is damaged.

• **Shock and hypotension** — Without any other cause.

Angiography

Angiography should only be used:

• Doubt about the diagnosis or the exact site of division.

• Arterial damage has been present for more than 24 hours.

• Dislocation of the knee, with possible popliteal artery injury.

Operative technique

• **End to end suture of the artery** — Even under tension this should be attempted if possible, rather than grafting.

• **Lateral suture** — Only for partial clean division of an artery. The danger of trauma to the intima is very real.

• **Embolectomy** — Only indicated if the intima is intact.

• **Repair of small arteries** — Microsurgical repair in the vicinity of the ankle and wrist may save the need for amputation.

• **Restore blood flow** — Essential beyond the knee and elbow in damage to the popliteal and brachial arteries. Popliteal artery division may cause gangrene of the foot.

• **Compartment pressure** — Assessment of compartment pressure can be carried out comparatively simply by either a special manometer or with a standard mercury manometer. It should be less than 40 mmHg.

• **Fasciotomy** — This should always be carried out if there is any doubt as to compression of a fascial space. In the leg, fasciotomy by incision behind the medial border of the tibia

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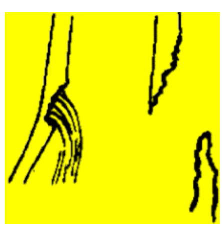
Vascular injuries

Types

Direct pressure by fracture

Compression under fascia



Partial or complete division

Major vascular injury

- Colder limb with paralysis and sensory loss
- Diminished distal pulses
- Increasing haematoma or persisting arterial bleeding
- Bruit over or beyond arterial injury
- Assess fascial compartment pressure in all compartment syndromes.
- Angiogram and Doppler only by expert in procedures
- Extensive fasciotomy in all suspected cases.

and just behind the fibula will allow decompression of all the 4 compartments of the leg. The wound is closed by secondary suture.

Arterial damage plus fracture

The fracture should be stabilised first before arterial repair or grafting is carried out, unless delay would jeopardise the circulation of the limb.

A reversed vein graft should be inserted if repair is not possible. Synthetic grafts in the limbs usually lack elasticity for limb re-attachment and arterial repair. It is also important to establish venous drainage of the limb before arterial repair.

Upper limb re-attachment

Re-attachment of an upper limb, by microsurgical repair of vessels and nerves, is often much more satisfactory than in the case of the lower limb. Upper limb prostheses are much less effective than lower limb prostheses and seldom worn in older patients. The upper limb also has a relatively better blood supply than the lower limb. The patient's own disabled upper limb is often much more useful than a prosthesis. In severe hand injuries, the thumb should always be saved if possible. In isolated severe injuries, especially if infected, fingers may not be worth saving.

Lower limb re-attachment

A good lower limb below-knee prosthesis is preferable to a poorly functional, badly deformed or painful existing limb.

Emergency procedure for amputated limbs

The amputated limb or digit should be:

- Wrapped in a sealed plastic bag, with air excluded, and put into another plastic bag containing cold saline or water.

• The whole package is then placed into a container of iced water.

• Severely damaged limbs, which cannot be re-attached, may still be used for skin grafting, and should not be discarded.

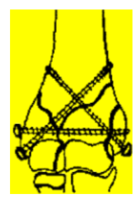
Free flap grafts

The use of free flap vascularised grafts may save limbs. Large flaps of skin, combined with the underlying muscle such as part of the trapezius, are taken from elsewhere, and anastamosed to the local blood supply by microsurgical techniques. This is particularly valuable in obtaining a full thickness skin graft over a fracture denuded of skin, particularly over the tibia.

Vascular injuries

Treatment closed injuries

Brachial



Supracondylar fracture — humerus

Severe injury — elbow

• Internally fix

• Explore artery if necessary plus, fasciotomy forearm

Popliteal

• Dislocated knee

• Supracondylar fracture of femur

• Reduce fracture or dislocation

• Repair artery

• Establish venous drainage before arterial repair

Peripheral nerve injuries

Classification

There are 3 grades of nerve injuries.

Neuropraxia

This is temporary physiological division that results from minimal trauma and usually fully recovers.

Axonotmesis

This is damage of the axon of the nerve in continuity with varying degrees of recovery.

Neurotmesis

This is complete disruption of the stromal and parenchymal elements of the nerve by complete division or scarring. There is no spontaneous recovery. Surgical treatment involves excision of the nerve ends, if necessary, and accurate approximation and suturing of the proximal and distal ends of the nerve trunk by microsurgical techniques. Nerve grafting may also be used.

Diagnosis

Clinical examination will show evidence of motor, sensory and autonomic involvement. Variations may occur and certain nerves are more likely to be injured than others.

Upper limb

- Axillary (circumflex) nerve in fractures and dislocations of the shoulder.
- Radial nerve in fractures of the mid-shaft of the humerus.
- Radial, median and ulnar nerves in injuries of the elbow.
- Median nerve in wrist fractures and lunate dislocations.

Lower limb

- Sciatic nerve in posterior dislocations of the hip and fractures of the pelvis.
- Common peroneal (lateral popliteal) nerve in dislocations and fractures of the knee and proximal fibula.

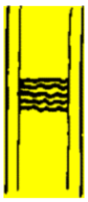
Autonomic system

In addition to sensory and motor involvement, autonomic changes such as sweating and changes in skin texture, may occur. This is particularly so in brachial plexus injuries.

Peripheral nerve injuries

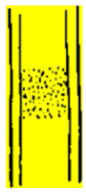
Classification

Physiological division



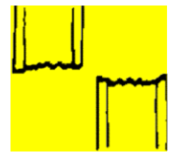
Neuropraxia
Early complete
of recovery

Division of
axon in continuity



Axonotmesis Varying grades
recovery

Complete division



Neurotmesis

Treatment

Closed injuries

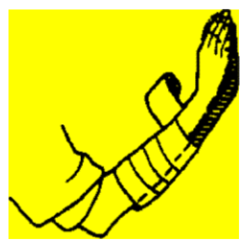
Humerus

Axonotmesis likely
— 90% recover

Daily passive

movement

Splint



Recovery estimate

- 1 mm/day — 3 cm per month, nerve growth plus 1 month
- Explore if no recovery to nearest muscle in expected time

Investigations

Electromyographic (EMG) studies not less than 3 weeks after injury may be valuable in assessing the likelihood of recovery.

Recovery

• **Closed injuries** — Recovery is likely in many cases. The speed of regeneration is approximately l mm per day (approximately 1 inch per month). Recovery can be estimated clinically by assessing the length of time taken by the nerve to reach its nearest muscle group, and adding an extra month.

Treatment

Closed injury

If no recovery has occurred the nerve should be explored. It may be compressed by callus, particularly in fractures of the shaft of the humerus or by bone in a posterior fracture dislocation of the hip.

Open injury

In an open injury with a clean division, immediate microsurgical suture should be carried out if possible.

Contaminated wounds

In contaminated wounds, repair should be delayed for at least 3 weeks, until the wound is healed. This will allow the scarring of the nerve to be consolidated. The nerve can then be sliced until unscarred neurofibrils are seen. Microsurgery should be used, if possible. A cable nerve graft may occasionally be used to bridge defects.

• **Dirty wounds** — The nerve ends seen at operation are merely anchored in place with unabsorbable sutures. Their position is carefully noted for future identification and repair.

• **Haemostasis** — The tourniquet should be removed before the wound is closed and careful haemostasis achieved.

Permanent nerve deficit

• **Sciatic nerve injury** — This may be associated with a foot drop and may require a below-knee caliper, or a tendon transfer or bony operations such as triple arthrodesis.

• **Upper limb paralysis** — Numerous types of tendon transfers have been developed, occasionally combined with a joint arthrodesis.

• **Splints** — If operation is contraindicated, splints can compensate for weakness. These include below-knee calipers

Open injuries

Refer to specialised centre early

Note position

Dirty wounds

• Only anchor nerve ends in initial wound

• Slices until neurofibrils seen

After wound healed — 3 weeks +

Suture without traction

- Release tourniquet before closing wound
- Early microsurgery gives best results
- Primary suture only in clean sharp wounds and digital nerves

Nerve grafting

Cable grafting of nerve

with springs or backstops for a foot drop, and wrist and elbow supports for upper limb weakness (see page 262).

Axillary nerve

The axillary nerve may be damaged as it winds around the neck of the humerus by fractures or dislocations of the shoulder. There will be paralysis of the deltoid muscle and an area of numbness over the insertion of the deltoid.

Median nerve

The median nerve supplies the thenar muscles and the radial two lumbricals. The patient is unable to abduct the thumb at right angles to the palm.

The median nerve is usually partially paralysed in a carpal tunnel syndrome where there is oedema in the carpal tunnel, such as in pregnancy and rheumatoid arthritis. Narrowing of the carpal tunnel may also occur following wrist fractures or lunate dislocations.

Sensory loss in a median nerve palsy involves the radial two and a half fingers and thumb, as illustrated. There is paralysis of the thenar muscles and weakness of abduction of the thumb.

Ulnar nerve

The ulnar nerve supplies all the small muscles of the hand, with the exception of the lateral 2 lumbricals and the thenar muscles. Wasting occurs of the hypothenar muscles and interossei. The adductor of the thumb is also paralysed. The affected hand is usually held in a semi clawed position. The ring and the little finger are slightly flexed at the interphalangeal joints and the metacarpophalangeal joints are hyperextended. The index and middle finger can still be fully extended by the lumbricals supplied by the median nerve.

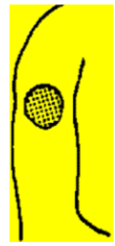
• **High ulnar nerve lesion**— The flexion deformity of the ring and little fingers may be much less because the long flexors to the ring and little fingers are paralysed. This is called ulnar paradox, because a higher lesion produces less deformity than a more distal lesion.

• **Other tests for ulnar nerve function** — These include testing for the inability of the little finger to abduct or adduct against resistance, and the inability to hold a card between the little finger and ring finger as a result of paralysis of the interosseous muscles and lumbricals.

• **Froment's sign** — This is a test of adductor pollicis. A card is held between the thumb and the forefingers of both hands, and the examiner pulls the card away while the patient resists. If the ulnar nerve is paralysed, the interphalangeal joint of

Peripheral nerve injuries

Dislocation or fracture shoulder



Axillary nerve

Sensory loss

Fracture shaft humerus

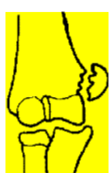
- Wrist drop
- Sensory loss

Radial nerve

Inability to extend thumb

Medial epicondyle

Inability to abduct little finger



Ulnar nerve

Paralysis interossei + sensory loss

the thumb will flex fully to hold the card, whilst on the normal side the interphalangeal joint is extended. This is because the long flexor of the thumb is brought into play to hold the card to the forefinger. There is also wasting of the adductor pollicis and interossei between the 1st and 2nd metacarpals.

• **Sensory disturbance** — In an ulnar nerve palsy this involves one and a half fingers on the ulnar side of the hand. It may also extend up the ulnar side of the lower forearm in high nerve palsies. There may be a lack of sweating. Autonomic changes also cause loss of hair and trophic changes in the skin

Radial nerve

Radial nerve palsy is commonly caused by a fracture of the mid-shaft of the humerus. Other causes include pressure in the axilla by crutches that are too long (crutch palsy), and falling asleep in a drunken stupor with one's arm over the back of a chair (Saturday night palsy!).

• **Testing** — The power of extension of the thumb should be assessed in the line of the palm. Another less accurate method includes extension of the wrist against resistance. Extension of the fingers at the metacarpal-phalangeal joints is also affected. Extension of the interphalangeal joints of the fingers themselves, however, is performed by the interossei and lumbricals which are not supplied by the radial nerve.

• **High lesion** — This will result in a complete wrist drop.

• **Low lesion** — A low lesion, or the posterior interosseous nerve, may affect dorsiflexion of the thumb and the fingers at the metacarpophalangeal joints alone.

• **Sensory loss** — This involves a small area at the base of the thumb which may extend to the back of the hand.

Lower limb

Paralysis of the common peroneal nerve alone will cause a foot drop with numbness on the dorsum of the foot. Posterior tibial nerve palsy will result in paralysis of plantar flexion, and numbness over the sole of the foot and back of the calf.

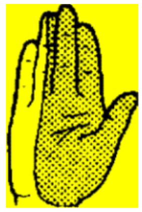
Complete sciatic nerve division will cause complete paralysis and loss of sensation of the foot, and variable sensory loss and paralysis in the calf.

Peripheral nerve injuries

Dislocated lunate

Median nerve

Paralysis abduction thumb

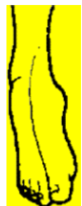


Sensory loss

Fracture pelvis

Sciatic nerve

Foot drop + paralysis

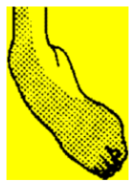


Variable sensory loss and paralysis

Dislocated knee

Common peroneal →

Inability to evert and dorsiflex foot



Sensory loss

Also see individual fractures

Amputations

Upper limb amputations

Fingers

Radical amputation of the fingers may be necessary for severe infection, but always save as much thumb as possible. A bone or skin graft may be required later to achieve length of the thumb. It is sometimes possible for a toe to be grafted to replace an amputated finger, with microsurgical techniques.

Arm and fore arm

• **Optimum site** — The optimum sites for arm and forearm amputations, in terms of fitting upper limb prostheses, are the junction of the proximal 2/3rds and distal 1/3rd of the humerus, and the junction of the proximal 2/3rds and distal 1/3rd in forearm amputations.

• **Minimum stump length** — The minimum stump length for the fitting of an effective artificial limb is 3 in (7.5 cm.) below both the shoulder and the elbow.

• **Developing countries** — A below-elbow amputation can be converted into a pincer grip by dividing the skin and soft tissues between the radius and ulna, to separate the two bones (Kruckenberg amputation).

Shoulder

The head and neck of the humerus should be preserved. If possible the acromion process should be left in place.

• **Forequarter amputation** — This radical amputation includes the whole arm and the scapula and clavicle. This amputation is usually performed for malignant tumours, and is occasionally indicated in massive shoulder girdle trauma. If possible, some muscle and part of the scapula and clavicle should be left, both for cosmetic appearance and to help anchor a prosthesis.

Lower limb amputations

Hind quarter amputation

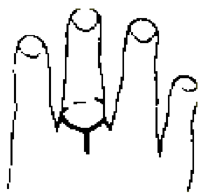
This removes half the pelvis and hip and is usually only required for malignant tumours.

Disarticulation of hip

This may be indicated in severe chronic infection of the hip and upper femur where the remaining limb has severe vascular or neurological impairment.

Amputations

Upper limb



Preserve joint

if possible

Strength — men

Cosmesis — women

Fingers

Shoulder

Sites of election

20 cm

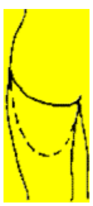
Arm

Forearm

17 cm

Always save forearm if possible

Disarticulation hip



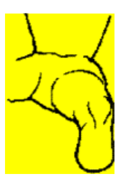
Large posterior musculocutaneous flap

Thigh amputation

Above-knee amputation

11" (27 cm) below trochanter

Myoplasty



- Myoplasty whenever possible
- Slightly bulbous stump, better stump control
- Muscle sutured over bone

Femoral amputation

• **Site** — Ideally this should be performed 10 cm above the knee just above the femoral flare.

The head of the femur and the greater trochanter should be preserved if possible. The minimum stump length is 6 cm below the perineum for an adequate artificial limb.

Below-knee amputation

Ideally this should be carried out 12 cm below the tibial plateau. Six centimetres or less is much less acceptable.

• **Operative procedure** — Bevel the tibia anteriorly. Cut the fibula 2 cm shorter than tibia and bevel laterally.

Use anterior 2/3rds and posterior 1/3rd flaps for simple artificial limbs. A large posterior flap is indicated in the case of a myoplasty with poor blood supply. A below-knee amputation gives much better function than an above-knee amputation.

Symes amputation

This is a useful procedure in elderly patients and in developing countries where a prosthesis will not be worn or is not available.

• Operative procedure — The distal tibia and fibula are divided at the level of the ankle joint. The bone ends are covered with a full thickness skin flap from the heel.

Forefoot and toes

• Metatarsals — Amputations at the necks or bases of metatarsals may be satisfactory.

• Toes — Use a racquet incision.

Amputations in developing countries

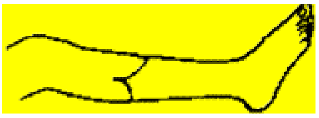
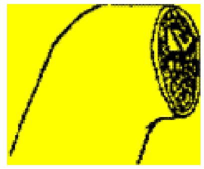
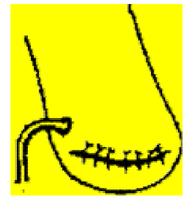
Save the limb if possible. Knee disarticulation, kneeling peg, below knee and Symes amputations are best.

Mangled extremity severity score (MESS) This is a recently introduced method of assessing the severity of an injury of the lower limb in particular, and will help decide whether an amputation is indicated or likely. This is scored with the following 4 variables

A - Degree of soft tissue/bony damage — This is by using a score of 1-4. 1 — a simple fracture/soft tissue injury, 2 — medium energy open or multiple fractures, 3 — high energy or crush injury, 4 — grossly contaminated due to a very high energy injury.

B - Degree of limb ischaemia — This is scored from 1 — pulse reduced to 3 — limb cool, paralysed and without sensation.

Below-knee amputation

Always save knee if possible

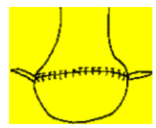
Front of tibia cut obliquely

skin closure with

Syme's amputation

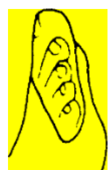
Dissect heel out carefully

Amputation of malleoli



Skin closure

Metatarsals and toes


Base of metatarsals

Neck metatarsals

Toes

C - Shock — The score is from 0 — BP above 90, to 2 — severe hypotension.

D - Age — 1 — younger than 30 years, 2 — 30-50 years and 3 — over 50 years.

If the sum of these 4 variables is over 7, for the lower limb, amputation is usually invariable. Some limbs with lesser scores will also require amputation.

General operative procedures

• Skin flaps —These must be loose and always drained.

• Large vessels — These should be transfixed and double tied. Always tie off arteries before veins.

• Large nerves — These are pulled down and diathermised in order to minimise painful neuromata at the site of division and phantom pain. Careful haemostasis is essential.

Myoplasty

Suturing a muscle flap over the end of the stump and provides better control and should be used if possible in amputation of the femur, tibia, forearm and humerus.

Post-operative care

• Immediate — Careful bandaging and suction drain are important. Early physiotherapy and prevention of flexion contractures, including detachable padded plaster backslabs.

• Early weight-bearing — This should be encouraged, with a temporary limb if possible.

• Definitive limb — This should be fitted in about 2-3 months.

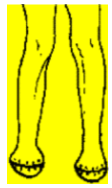
Artificial limbs

• Artificial arms — Above-elbow protheses are seldom worn, especially in elderly patients. Below-elbow limbs move far better and are often used. The patient should also be taught how to use the prosthesis properly as soon as possible after amputation.

• Above-knee prosthesis — This is much less satisfactory than a below-knee limb, and the gait is much poorer. It may need to be a suction fit. The minimum length of stump measured from the perineum for a satisfactory limb is 6 cm.

• Below knee prosthesis — This allows for a very satisfactory walking gait, with a patella bearing socket (PTB). It is important to save at least a short below-knee stump if possible, provided it is at least 6 cm in length.

Developing countries

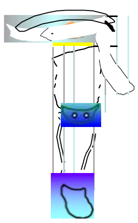


- Save as much arm as possible
- Drain well or secondary suture

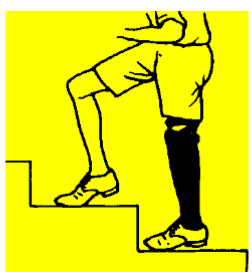
Post-operative care

- Tourniquet at foot of bed
- Face down
- Prevent contractures with physiotherapy
- Firm bandaging or stump sock
- Always suction drain

Artificial limbs



Post-operative — temporary modular above-knee prosthesis for weight-bearing



Below-knee artificial limb

Crush syndrome*

Causation

Crush syndrome may be a lethal condition if not adequately treated and is usually due to a severe crush with severe muscle ischaemia. The damage is the result of a prolonged major limb crush injury of more than 4-6 hours. It may also be due to a tourniquet constricting the blood supply for more than 6 hours, or to an unrelieved compartment syndrome following a fracture, particularly of the tibia or femur in an unconscious patient.

Local examination

This is illustrated, showing all the signs of diminished or absent circulation (See page 184). The distal pulses, however, may still be present in less severe cases. There is usually flaccid paralysis, with patchy sensory loss but with viable skin. There may also be myoglobinuria. It must be stressed that occasionally these signs may be minimal. If there is any doubt, assessment of the compartment pressure, a Doppler test or angiogram may be necessary.

General effects

These are again illustrated, together with the essential investigations.

Local treatment

This is illustrated (see page 185). The importance of adequate complete fasciotomy, if distal gangrene is imminent, is stressed. All involved compartments should be exposed and radical excision of all dead muscle carried out. This ischaemic muscle does not contract, but still bleeds if cut. Delayed primary or secondary closure of the wound is essential. Skin should not be excised. Amputation of the lower limbs may be required if the patient's life is in danger. If in doubt, operation should always be carried out.

General treatment

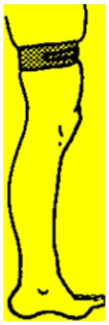
This may include not only blood transfusion, antibiotics, and tetanus prophylaxis, but also adequate oxygenation of the patient and occasionally hyperbaric oxygen. Renal dialysis may also be required in severe cases for renal failure.*Rhabdomyolysis occurs from crush injury/untreated cpt syndrome/strenuous endurance exercise. Myoglobin is released from damaged muscle into bloodstream, causing renal failure. There is elevated serum creatine kinase, hyperkalaemia, ECG abns, DIC. Treatment is supportive- $NaHCO_3$, glucose, diuretics.

Crush syndrome

Causation

Crush limbs more than 4-6 hours

Amputation of lower limbs may be necessary in life threatening injuries and if more than 6 hours in severe crush



• Tourniquet lower limb over 6 hours

•Consider amputation if general effects life threatening

Consider hyperbaric oxygen in severe cases plus extensive muscle excision

Crush syndrome

Diagnosis

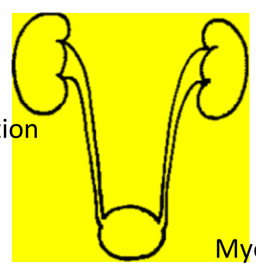
Local examination

Pallor, coldness, diminished sensation and power, tenseness diminished, pulses, fascial compartment pressure over 40 mm and Doppler test positive

NOTE — pulses may still be present and skin viable

General effects and complications

Examine chest and abdomen



Shock, acute megaloblastic anaemia,

septicaemia, gas gangrene and pyogenic infection

• Full blood investigation Coombes test

•Chest and abdominal X-rays

Myoglobinuria and renal failure

Crush syndrome

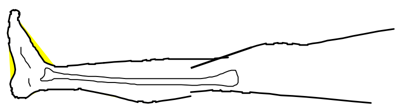
Treatment

transfusion SPPS., sodium bicarbonate and oxygen - early

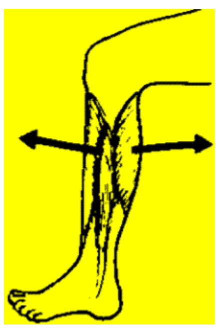
Split tight fascial sheaths early

- Maintain urine output
- Renal dialysis early
- Antibiotics and tetanus prophylaxis

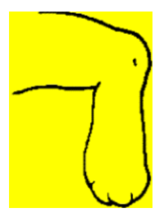
Fasciotomy(don't delay)



Decompress: anterior , lateral and posterior 2 compartments



- Incisions – posterior medial over tibia and postero-lateral over fibula
- Thigh— decompress all compartments



Radical excision of all dead muscle

Lower limb amputation may be necessary in prolonged ischaemia with life threatening myonecrosis

Post traumatic syndrome

(Fat embolus)

Causation

Post traumatic syndrome may follow any injury, particularly if it is associated with closed comminuted fractures of the pelvis, femur or tibia with blood loss. Intramedullary reaming of bones in a severely anaemic patient may also be a precipitating factor. Subclinical cases are common following any major fracture.

Examination

This is illustrated (see page 187) and this syndrome must be suspected in all cases of major trauma. This must be suspected when a sudden deterioration occurs commonly from 12-72 hours after the injury. Petechial haemorrhages in the conjunctivae, fundi and over the chest wall are particularly diagnostic.

Investigations

These again are illustrated. The importance of a chest X-ray, ECG and blood gas assessment is emphasized.

Prophylaxis

The importance of adequate replacement of blood loss, maintenance of high oxygenation, adequate splinting of injured limbs and minimal reaming of long bones must be stressed.

Treatment

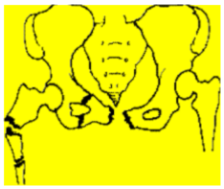
In addition to the prophylactic measures discussed, the major aspects of treatment are illustrated. Steroids, heparin and Trasylol have all been tried in the past, with minimal success. The most important measures, however, are adequate oxygenation, if necessary hydration, adequate correction of anaemia and splinting of limbs.

It is also important to treat associated adult respiratory distress syndrome (ARDS). Subclinical cases are common following any major injury and the prognosis is usually good.

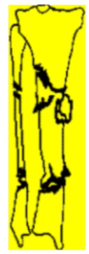
Post traumatic syndrome

(Fat embolus)

Pelvis and shaft femur fractures



Tibia fractures



Symptoms in 4-72 hours

Comminuted closed fractures

Examination

- Apprehension
- Restlessness
- Hypertension

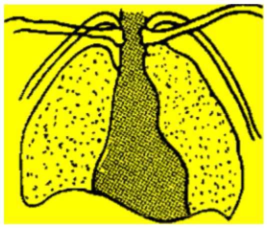
- Tachypnoea
- Pyrexia
- Petechial haemorrhages chest, abdomen and fundi

Post traumatic syndrome

Investigations

'Snow storm'

chest X-ray

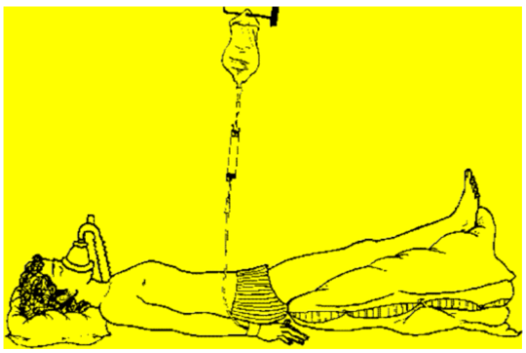


ECG — right heart strain

Blood gases: hypercapnia or hypocapnia, hypoxaemia $PO_2 < 65$ mmHg breathing air

Subclinical cases common

Prophylaxis



- Avoid hypovolaemia
- Replace blood loss
- High oxygenation
- Splint injured limbs
- Minimal reaming long bones

Post traumatic syndrome

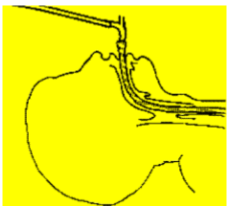
Treatment

• High oxygenation

• Intubate for constant positive airways pressure ventilation

PO2

80-100 mm Hg



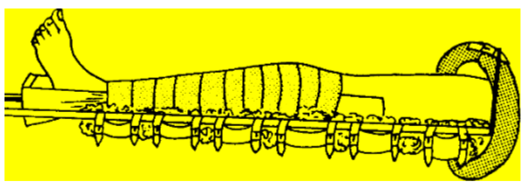
• Correct anaemia — packed cells

• Steroids

• Heparin

• Trasylol

• Monitor blood gases and chest X-ray



• Early stabilisation of fractures

• Treat adult respiratory distress syndrome (ARDS)

Burns

History

• History — This should include whether the burns occurred in an open or closed space and the length of time exposed to smoke or fumes. This may be the result of combustion of toxic materials such as plastics and chemicals.

• Past history, medications and allergies — The past medical history should include details of respiratory conditions such as asthma or emphysema. Current medications and allergies should be noted, including alcohol or drug dependencies, plus the tetanus immunisation status.

Emergency examination

Respiratory complications

•Oedema of the respiratory tract — This presents as laryngeal stridor and difficulty in breathing due to oedema of the mouth and nose.

• Local singeing — This may be evident on the face and nose.

• Coughing and hoarseness — Due to hyperaemia of the endothelium of the lungs and the coughing up of dark carbonaceous sputum.

• Laryngeal oedema and stridor — The cords and epiglottis should be inspected by laryngoscopy for oedema or consolidation.

• Lungs — These may show changes to vocal fremitus and resonance, a decreased or dull percussion note, bronchial breathing, decreased breath sound intensity, rales, rhonchi and crepitations.

In all cases of severe burns, the patient should be completely undressed and a complete examination carried out, with special attention to the cardio-respiratory system.

Depth of burns

• First degree burns — Redness of the skin i.e., severe sunburn.

• Second degree burns — Fairly superficial, very tender, pink, blistering, oozing and capillary filling.

Deeper second degree burns are usually white.

• Third degree burns — These are full thickness, and usually

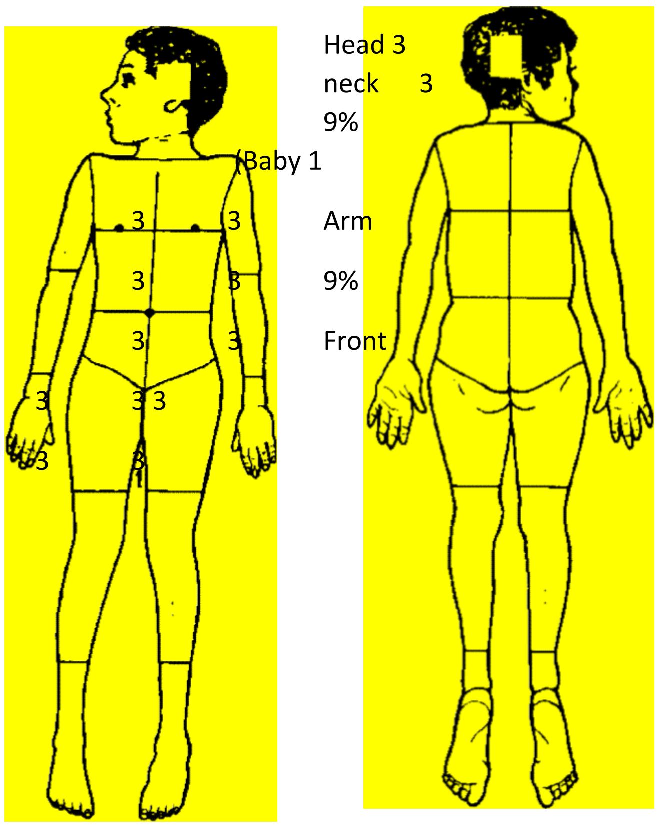
white, charred and anaesthetic, and feel thickened and 'leatherlike'.

• Fourth degree burns — These involve the underlying structures, such as muscles and bone.

Assessment in burns

Rule of 3

(Applied to rule of 9)



Babies and children

NOTE — Head, neck and trunk form a much larger proportion of the body

• Electrical burns — Electrical burns may cause severe tissue damage, and may produce both entrance and exit burns.

Extent of burns

The extent of the burns should be assessed according to the 'Rule of Three', applied to the 'Rule of Nine' (see page 191). This guide does not apply to babies and young children where the head, neck, thorax and abdomen form a much larger proportion of the whole body than in the adult.

Investigations

• Blood investigations — The patient may be very anaemic and have lost a considerable amount of protein. Patients may also have an electrolytic imbalance. A full blood count and electrolyte measurements are essential initial investigations in all patients with burns. These should also be regularly monitored and the haematocrit level kept to less than 0.55.

• Closed spaces — When the patient has been exposed to smoke and fumes, assessment for carboxyhaemoglobin should be carried out. In addition, arterial blood gas sampling to determine pH, $PaCO2$,$PaO2$, the bicarbonate level, and base excess, should also be carried out on all unconscious patients and in all patients who are mentally confused.

• Urine — This should be tested for myoglobin and a Foley's catheter inserted in all patients requiring intravenous fluids.

• Chest X-ray — Severe cases require a chest X-ray to exclude evidence of aspiration of vomit and respiratory oedema.

• ECG — This is particularly important in all severe burns and in all patients subjected to smoke inhalation.

Treatment of burns

• Oxygen — Oxygen should be administered to all patients who are suspected to have been exposed to smoke inhalation, until a carboxyhaemoglobin level is available.

• Airway — Intubation is important in all inhalation injuries as oedema of the glottis may occur. A large bore needle or catheter should be inserted if intubation is impossible, through the cricothyroid membrane as a temporary measure, pending an open cricothyroidotomy.

• Fluids — All patients with greater than 15% burns should be given intravenous fluids through a large intravenous cannula of 14-16 gauge. Subclavian or internal jugular cannulation may be necessary if the burn is greater than 40%.

Burns

Depth of burn

• First degree — Bright red, dry, hypersensitive

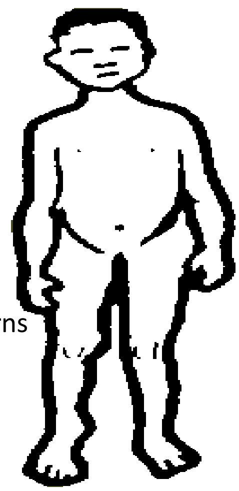
• Second degree — Mottled, red, moist, painful

• Third degree — Full thickness, white or black, dry, anaesthetic

• Fourth degree — Underlying soft tissue or bone

• Electrical burns — Both entrance and exit wounds

Fluid balance i.v. route



All adults Ideal

urine volume

- Baby — 2 ml/kg/hr
- Child (3 - 12 years) — 1.5 ml/kg/hr
- Adult — 0.5-1 ml/kg/hr

Fluid replacement

- **First 24 hours** — Saline 0.9% (500ml) should be given immediately in all burns over 15% in an adult, plus Hartmann's solution according to the chart on page 195. Blood or plasma should be also given if required.

Half the fluid should be given in the first 4-8 hours, and the remainder in the next 16 hours (see pages 193 and 195).The fluid intake should be adjusted according the urine output assessed through the indwelling catheter. Optimally it should be 1-1.5 ml/kg/hr in children and 0.5-1 ml/kg/hr in adults. Intravenous fluid should be increased if necessary, and oral fluid intake should be encouraged. Do not overhydrate with intravenous fluid as this may increase the oedema. A CVP pressure of less than 10 cmH20 and a pulse of less than 100- 110 beats per minute should be aimed for.

- Second 24 hours — 250 mls of intravenous 5% dextrose solution should be given, in addition, plus plasma and blood if necessary.

Urine output

• Indwelling catheter — An indwelling Foley's or silastic catheter should be inserted. Urine output should usually be between 30-50 mls per hour in an adult, and more in a child (see page 193). The colour of the urine should be noted as this may be very dark or black in myoglobinuria or haemoglobinuria.

Gastrointestinal tract

• Nasopharyngeal and gastric aspiration — The insertion of a nasogastric tube to aspirate the stomach is important in all severe burns of over 15-20% as a paralytic ileus may occur. Infection prophylaxis

• Tetanus toxoid ± TIG — This is important.

• Antibiotics — These may include intravenous penicillin, and a cephalosporin in patients without penicillin sensitivity problems. Appropriate antibiotics should always be given intravenously.

Analgesia

Analgesics will include morphine 2 — 5 mg intravenously every 2 to 4 hours, plus intravenous or intramuscular metoclopramide anti-emetic 10 mg every 6 hours, if necessary.

Entonox (50% nitrous oxide and 50% oxygen) administered by an 'on demand system', is often a very effective initial method of analgesia particularly in the ambulance and the accident centre.

Wound care

• Irrigation — All clothing should be removed and in chemical burns, the area well irrigated with sterile water. Tar burns

Burns

Open treatment

Moist burns

• No dressings

• i.v. fluids

• Netting cradles

• Rest burnt area

Insecticide

Silver sulphadiazine

Prevent anaemia, check Hb every 3rd day

Fluid requirements

1 in first 4-8 hours 1st 24

hours { 2 / 1 } in next 16 hours

• Fluid required — % burns x weight patient (kg) x 0.5 ml

• i.v. fluids — First 24 hours: 0.9% saline (500 ml/adult) + Hartmann's solution + plasma or blood if necessary

• Oral fluids — 2500+ ml in adults

• Urine output — see page 193 — increase intravenous and oral fluids if necessary

should be cooled with cold water and cleaned with a polysorbate such as neosporin. The wounds also should be soaked in cool sterile normal saline for 30 minutes, to minimise the extent of tissue damage and ease the pain.

• Dressings — The burn should then be cleaned with non- alcoholic based antibacterial solution and covered with silver sulphadiazine cream and gauze.

Debridement

All damaged tissue should be removed. Blisters should be left intact except for sterile aspiration of the fluid.

Admission procedure for patients with burns

All high voltage electrical burns or patients with respiratory damage and all burns of the hands, feet, eyes and ears should be admitted to hospital.

All patients with third degree burns of more than 5-10%, and all second degree burns of more than 10-20% in adults, and more than 5-10% in children should also be admitted.

Never underestimate the severity of a burn. Patients may die with a 20% burn if not properly managed.

Hands

Elevate and dress with silver sulphadiazine cream with the hand in a plastic bag or disposable plastic glove, with the wrist extended, metacarpophalangeal (MP) joints flexed, and interphalangeal (IP) joints extended, plus daily physiotherapy. Early excision and grafting should be carried out if necessary.

Respiratory burns

An endotracheal tube should be inserted urgently.

Electrical burns

Excise the burnt area immediately and graft, if possible, with

a full thickness skin graft.

Chemical burns

Wash immediately with copious amounts of water to remove surface chemical and repeat frequently by showering or a bath.

Corneal burns

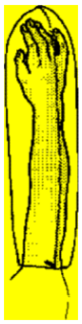
Apply chloramphenicol ointment and an eye pad and consult an ophthalmic surgeon urgently.

Burns — local management

- Sterile theatre • Clean with Cetavlon
- Aspirate blisters
- Prevent infection
- Graft: when slough separates
- Remove slough by 21st day
- Homograft from relative
- Temporary dressing in large burns

Closed treatment

Hands



- Elevate in plastic bag
- Wrist dorsiflexed
- MP joints flexed 90°
- Dressing with silverdiazine
- Daily physiotherapy

Other wounds

- Minor burns
- Infected wounds
- Eye lids
- Circumferential burns
- Separated eschar

Circumferential burns

These may cause peripheral circulatory embarrassment due to oedema beneath inelastic eschar. Careful observation is essential, plus escharotomy and/or fasciotomy if signs of vascular compromise are present.

Burns to flexor areas

These include the axillae, cubital and popliteal fossae. Early splinting and split skin grafting is necessary to prevent contractures. This is replaced later with a full thickness skin graft if necessary.

Complications

• Infection and toxaemia — Infection of the skin and underlying tissues is common. Involvement of the underlying bones and joints may lead to osteomyelitis, severe contractures and joint destruction.

• Contractures — These are common, due both to scarring of the skin, plus deep fibrosis across muscles and joints. Severe deformities of the hands and feet are common and cosmetic disfigurement, especially of the face. Splinting to prevent contractures, together with early movements, is important. Operative correction and skin grafting may be necessary.

• Anaemia — Check haemoglobin levels at least twice weekly. Blood transfusion may be required, but only if strictly necessary, due to the potential risks of HIV and hepatitis C infection*.

• Infection — Swabs should be taken for culture to identify wound and skin bacteria flora. Appropriate antibiotics should be administered as a skin graft will fail in the presence of haemolytic streptococci. Silver sulphadiazine cream is the best local application at present available for infection.

• Deep vein thrombosis and pulmonary thrombo-embolism — Early physiotherapy and ambulation are essential to prevent these complications. TED stockings and prophylactic administration of subcutaneous heparin is also important.

• Cosmesis — Early reconstruction and grafting will be required, especially for burns involving the face and neck.

*Hep C can be cured with oral medication after 2 to 6 mths.

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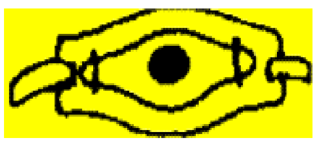
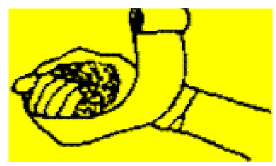
Burns complications

Respiratory obstruction



Intubation or cricothyroidotomy

Stiff hands



• Flex metacarpophalangeal joints and elevate

• Plastic bag with saline

Infection and toxaemia

Treat anaemia, antibiotics, dressings, early grafting

Deep vein thrombosis

• Early movements and ambulation

• Venous thrombosis and embolism prophylaxis

• Elastic stocking for oedema

Contractures

- Daily physiotherapy
- Splinting — constant passive motion (CPM) machine

Deformity

Early grafting and later reconstruction

Soft tissue injuries*

Soft tissue injuries are extremely common, in labourers and athletes; can be quite disabling.

• Minor injuries — The disabilities from some relatively minor soft tissue injuries can be quite severe, and are often treated badly and late. A vicious circle of complications may ensue.

• Haematoma — A haematoma, may be followed by lack of use and lead to rapid muscle wasting.

• Ligamentous instability — Muscle wasting in turn may cause ligamentous instability. This may progress to further trauma, joint effusion and joint stiffness.

Haematoma

Treatment

• Small — All haematomata even if small, should be treated with wool padding and an elastic pressure bandage, ice, rest and elevation.

• Large haematomata — These often need evacuation and drainage.

• Drugs — Newer drugs may help disperse a haematoma.

• Early active exercises — These will also help disperse both haematoma and oedema fluid.

Sprains and tears

Treatment

• Acute injuries — Minor muscular tears and ligamentous sprains may require ice, an elastic bandage, elevation and wool padding followed by exercises. Minor strains and sprains may also require some support, such as a padded elastic bandage initially.

• Chronic injuries — In chronic strains and sprains, injection of a local anaesthetic, together with hydrocortisone acetate into the tender area, may be indicated. There are dangers of tendon and ligament rupture following steroid injection.

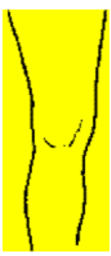
• Intra-articular steroid injections — These must never be given into the knee or hip joints, except in special cases, because of the risk of a steroid arthropathy.

*VAC, vacuum-assisted closure, is a cheap (you can just use hospital wall suction and a sterile sponge)very effective way to clean-up, sterilize and heal chronic wounds. Lawn mower injuries (hand and foot)can be severe; do multiple debridements, leave open, much later close and reconstruct.

Soft tissue injuries

Haematoma

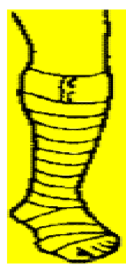
Elastic bandage



ICE

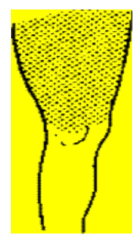
Minor

Strap, ICE, elevate



Moderate

Evacuate early
followed by pressure
bandage



Severe

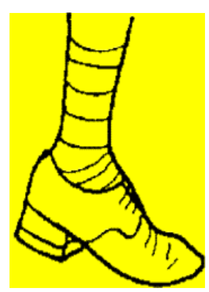
Muscular tears

• Elastic bandage

• Physiotherapy

Biceps

Calf



Minor strain
• Support
• Extra heel

Radiant heat and exercises

Complications

Myositis ossificans (traumatic/heterotopic ossification).

Occasionally, after soft tissue injuries associated with a fracture or dislocation, myositis ossificans (traumatic ossification) may occur. This is particularly common if there is any paralysis of the limb. Also, where head injury, hip, elbow and shoulder fractures.

• Treatment — This is best treated with rest rather than exercises until the new bone growth has become quiescent. Excision may then be indicated, followed possibly by low dose radiotherapy, within 3 days of excision, to prevent recurrence. Non-steroidal anti-inflammatory drugs have also been tried but are only of limited use.

Athletic injuries

The athlete may present with only a minor sprain of a joint, or minor tear of the muscle. In an elite athlete this may make the difference between successful performance in a competition and being excluded from a team. Many of these injuries are discussed under separate headings. These include damage to the menisci and knee ligaments in football players, tennis or golfer's elbow, and tendinitis or rupture of the tendocalcaneus in athletes involved in track and field events.

Causes

• Sports injuries — These are particularly common in unfit athletes, or in those who embark on physical activity without an adequate warm-up.

• Older patients — Injuries are common in older patients who start jogging or playing sport without sufficient preparation. Muscle tone, endurance, and bone and joint integrity decrease with age. Previously elite athletes hoping to return to previous form, in spite of being 10 or 20 years older than when they were at their peak, should be especially conscious of this.

• Clothing, footwear, protective helmets or eye protection — If these are inadequate, injuries may occur which could have been avoided. This is particularly so in body contact sports such as ice hockey, skiing and American football. Eye injuries are common in squash.

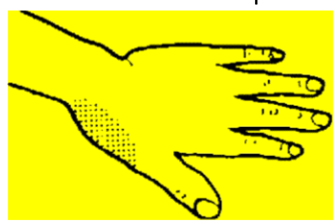
Other injuries

Traumatic ossification

Rest initially, then excise and low dose radiotherapy (DXR) if necessary

De Quervain's tenovaginitis

Constriction in sheath of extensor pollicis brevis and abductor pollicis longus



Radial styloid tender swelling or pain on forced

adduction of thumb or abduction against resistance

- Hydrocortisone and local anaesthetic
- Surgery if necessary

See relevant sections for other injuries

Prevention

Adequate strengthening, conditioning and stretching of muscles, (both prime mover and synergists) involved in the biomechanics of a particular sport is also essential in the prevention of sports injuries.

General treatment

• Physiotherapy and supports — Most athletes require energetic physiotherapy, often combined with supports for the knee and ankle, to enable them to regain their peak form. They are usually more co-operative and motivated than the average patient, but also more introspective.

• Injections — Occasionally injections of hydrocortisone and local anaesthetic are necessary into a tender area which is not resolving by other means. Care must be taken, however, that this is only into a muscle or ligament and not into the joint itself.

• Pain under the foot — This may require padded supports and re-education of the intrinsic foot muscles.

• Minor ankle sprains — These usually require ice, support, and a brief period of rest followed by active exercises, heat, massage and a skin counter irritant.

• Acute ligamentous and muscular injuries — These, and even some minor fractures, only require ice wrapped in a plastic bag and a towel applied to the site of injury plus elevation. Swelling should diminish in the first few hours. In convalescence, active and passive exercises and stretching, together with support if necessary, are essential before returning to sport.

• Summary — In summary, minor muscle and ligament tears are best treated by ‘RICE ' (rest, ice, compression and elevation). Ice and compression bandages are used to diminish swelling and provide support together with elevation and graded exercises to facilitate the absorption of haematomata and prevent stiffness.

Upper limbs

‘Tennis’ and ‘Golfer's elbow

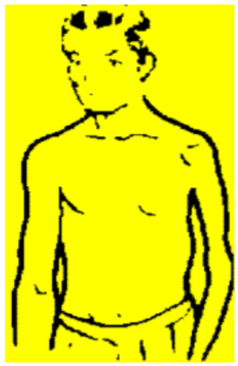
• Tennis elbow — This is usually due to tears of a few fibres of the extensor muscle origin from the lateral condyle of the humerus.

• Golfer's elbow — Tear of a few muscle fibres of the flexor origin from the medial epicondyle is the usual cause of ‘golfer’s elbow’.

Minor athletic injuries

Upper limb

Shoulder



spondylosis

Capsular injuries (see page342)

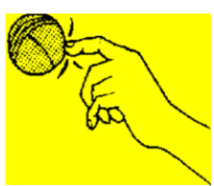
Elbow

'Golf' elbow flexor origin

Treatment

- Support 'Tennis' elbow extensor origin
- Hydrocortisone
- Local anaesthetic

Fingers



- Bruising
- Mallet finger
- Fractures

Synovitis

Wrist synovitis can affect golfers and tennis players and all those using racquets or clubs, such as squash and hockey players, and cricketers.

Muscle strains and tears

• Javelin throwers — These athletes may strain not only their acromioclavicular joints, but also the rectus abdominis.

• Archers — Archers may strain their deltoid muscles and their upper back muscles such as the trapezius and rhomboids.

• Minor tears of muscles — These often affect the musculotendinous junction with the formation of a small haematoma.

Tendon injuries and avulsion fractures

Tears at the insertion of muscles may either pull off a small flake of bone, which is known as an avulsion fracture, or rupture the tendon just proximal to its bony insertion.

Examples of this are:

• Mallet finger — This is often due to a forced flexion injury such as in cricket players. The insertion of the extensor tendon is pulled off from the base of the distal phalanx of a finger, with or without a small flake of bone (see page 286).

• Collateral ligament of the thumb — This is on the medial aspect of the metacarpophalangeal joint. This injury occurs in skiers and those who may forcibly abduct the thumb in certain sports, such as hockey.

• Supraspinatus tendon — This is most commonly ruptured when degenerative, as in the elderly patient (see page 342).

• Acromioclavicular joint — This is likely to be damaged in contact sports, such as rugby league and union football. It may also occur when a cyclist or motor cyclist is thrown over the handle bars and falls on the point of the shoulder (see page 338).

• Dislocation of the shoulder — This is particularly common in contact sports (see page 334).

• Shoulder — Shoulder 'capsulitis' and 'frozen shoulder' may sometimes be related to C5/6 pressure in cervical spondylosis.

Examination and treatment of the cervical spine, as well as the shoulder, is essential.

Spine and trunk

Injuries are common in the lower lumbar spine and include

sacroiliac strain and stress fractures.

MRI is best to detect stress fractures. Femoral neck stress fractures occur on the inferior neck (no surgery required)

Minor athletic injuries

Neck and back

Cervical

• 'Cervical spondylosis'

• Exercises + neck traction with rotation and flexion to side of lesion

Thoracic

• 'Fibrositis' muscular tears

• Exercises + hydrocortisone injection

Lumbar

Minor injuries:

• Sacro-iliac strain

• Prolapsed disc

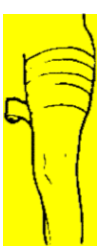
• Muscular re-education to prevent recurrences

• Neck or back support if necessary

• Physiotherapy — heat, massage, active exercises

Lower limb

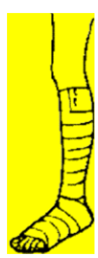
Quadriceps



• Ice
• Strapping
• Exercises

Minor tears

Calf



Bruising

Foot strain

• Ice

• Insoles

• Exercises

See knee and ankle for major injuries (Chapter 8)

Cricket injuries

Fast bowlers in cricket — These players may rupture not only the external oblique muscle, but also sustain stress fractures of the lumbar vertebrae, particularly the pars interarticularis. These stress fractures may be difficult to treat and occasionally require an arthrodesis of the spine.

Football injuries

Footballers, particularly soccer players, may sustain fractures of the tibia. They may also tear the insertion of the adductor muscles in the upper thigh.

• Back strain and fractures — Severe back strain, as well as fractures of the spine and particularly fractures or fracture dislocations of the cervical spine, may also occur in rugby footballers due to collapsed scrums, tackles and falls. These may cause neurological signs including paraplegia and quadriplegia.

• Examination — It is essential, in all severe back injuries, to examine not only for power reflexes and sensation in the lower limbs, but also for possible perineal numbness and paralysis of the bladder following damage to the corda equina. This may be due to a prolapsed disc or a fractured vertebra in the lumbar region (see chapter 6). Emergency decompression of the corda equina may be necessary.

Lower limb

Fatigue and stress fractures

• Causes — Fatigue related fractures may occur following unaccustomed exercise or an 'over use syndrome’. This may be particularly apparent amongst novice athletes or in army recruits with specific muscular imbalance, or those who have not had muscular conditioning.

• Common sites — Stress fractures of the upper tibia, fibula, and the 2nd and 3rd metatarsals are particularly common. They are difficult to see on X-ray and may not become apparent for up to 2 or 3 weeks later (see page 476).

Stress fractures of the tibia, in older boys may show up as an area of new bone formation in the metaphysis of the upper tibia or elsewhere. These may mimic an osteogenic sarcoma, as there may be no history of recent trauma.

Chondromalacia patellae

Those who are involved in regular weight-bearing exertion such as joggers may have pain in the knees with recurrent effusion. This is usually caused by a chondromalacia patellae

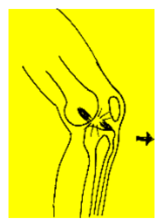
Sporting injuries

Common lower limb injuries

Knee

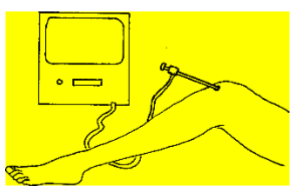
Shin splints

Anterior cruciate ligament



Rugby football rotation strain

Ruptured anterior cruciate ligament



Arthroscopic repair of ACL

and is often due to damage to the cartilage on the back of the patella. This requires static quadriceps exercises.

Extensor mechanism of the knee

• Elderly joggers — Elderly joggers may rupture the insertion of the quadriceps into the superior border of the patella.

•Younger athletes — In these patients a few fibres of the ligamentum patellae may rupture at the inferior border of the patella.

• Jumpers — Those who jump in basketball, or high jumpers, may pull off the origin or insertion of the ligamentum patellae or rupture the ligament itself. They may also rupture the quadriceps insertion into the patella, or sustain a transverse fracture of the patella itself (see page 436).

Osgood-Schlatter's disease

In young adolescents, Osgood-Schlatter's osteochrondritis may occur due to unaccustomed activity such as football or running. Here, part of the insertion of the ligamentum patellae 'pulls away' from the tibial tubercle producing a chronic traction apophysitis (see page 434).

Ligaments of the knee

• Football players — Footballers may sustain not only damage to the medial and lateral menisci of the knee, but also injure the collateral ligaments. The anterior cruciate and, less commonly, the posterior cruciate, may also be injured in twisting injuries and require repair.

• Swimmers — Breast stroke swimmers may complain of pain on the medial aspect of the knee. This may be due to straining the insertion of the medial collateral ligament, due to a valgus strain in the breast stroke. They may also complain of pain over the lower medial side of the femur due to the pull of the abductor magnus insertion.

Miscellaneous lower limb trauma

• Inadequately protected athletes — These may also sustain injuries when protective equipment is badly adjusted or not worn.

• Weight-bearing sport — Those taking part in weight- bearing activities such as running sports, particularly when unaccustomed, may injure the medial belly of the gastrocnemius. Strains or ruptures of the Tendo Achillis may also occur. These athletes may also develop a paratendinitis of the Tendo Achillis due to a repetitive strain.

Chapter 4

Specific fracture management

Types of fracture*

Direct trauma

This will usually result in a comminuted fracture. This is commonly compound, or open, if the bone is subcutaneous, as in the tibia or ulna.

Bones commonly affected are the tibia and the calcaneus. 'Bumper' fractures of the lower third of the tibia in pedestrians or motor-cyclists are particularly common. Indirect trauma- this will usually result in a transverse fracture, if caused by an abduction injury, or an oblique or spiral fracture when caused by a twisting force.

Complicated fractures

A complicated fracture is one where there is a major injury to a structure other than the bone itself.

• Compound or open fractures — Communication from the skin or viscera can lead to bone infection.

• Head, chest and abdominal injuries — Damage to the brain or viscera may also progress to numerous complications, which are described in Chapter 2 (pages 92-129).

•Injury to the spinal cord and peripheral nerves — Neurological complications are common. They may lead to paraplegia or quadriplegia, with paralysis of the bladder.

• Vascular complications — Bleeding may be considerable from damage to a major vessel. Popliteal or brachial vessel damage may lead to ischaemia or gangrene of the foot or hand. Severe fractures of the pelvis may lead to considerable blood loss from the smaller retroperitoneal blood vessels, in addition to the iliac arteries and veins.

• Systemic complications — Considerable blood loss due to major fractures may cause severe hypovolaemic shock and adult respiratory distress syndrome (ARDS). Fat embolus and crush syndrome may also be a complication of severe fractures.

Complications of fractures and dislocations are discussed under the individual injuries.

Healing of fractures

Haematoma

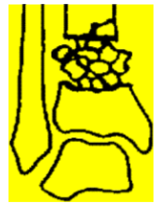
A haematoma will always form following a fracture. This may be extensive in vascular bones, such as fractures of the shaft.*Know classification open Fxs-Gustilo and Anderson:

Type 1-Skin wound <1cm; II-skin wound 1- 10cm; III A-high energy, contaminated; III B- also requires flap; IIIC-plus vasc. injury.

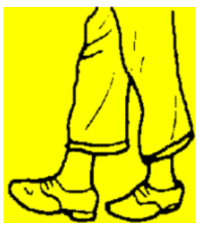
Types of fracture

Direct trauma

Bumper



Comminuted — often compound



Fall on calcaneus

Crush fracture

Indirect trauma

Transverse force

Oblique: twisting force

of the femur and in major fractures of the pelvis. The haematoma is not normally visible on X-ray.

Granulation tissue

Granulation tissue forms by organisation of the haematoma with ingrowth of osteoblasts and osteoclasts. Granulation tissue again is not usually seen on X-ray, except as a soft tissue shadow.

Callus formation

Callus formation is due to calcification within the granulation tissue with laying down of cartilage across the bone ends. This will show as a shadow on X-ray.

Bony consolidation

Bony consolidation with the formation of woven bone occurs due to ossification in the cartilage. This can be seen on X-ray.

Remodelling

Remodelling of the fracture site occurs due to the stresses on the fracture site by muscle pull and weight-bearing. This is due to activity of the osteoblasts which lay down bone and osteoclasts which remove unstressed new bone. The woven bone is then replaced with definitive bone.

Bone union in children

Bone union in children takes approximately half the time of that seen in adults. In babies and young children union is much more rapid.

Bone union and type of fracture

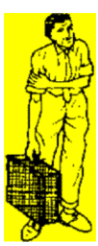
Union usually occurs earlier in oblique fractures than in transverse fractures. It is also more rapid in fractures with a good blood supply, such as the metacarpals, metatarsals and phalanges, than in the shaft of major long bone fractures, due to less vascular supply to the fractured bone ends.

Delayed union

Excessive movement, or alternatively too rigid internal fixation can delay fracture union. Infection or pathological bone due to secondary neoplastic malignant deposits in bone, or diseased bone in Paget's disease will also delay union or lead to established non-union.

Pathological fractures

Types of fracture



Minimal force

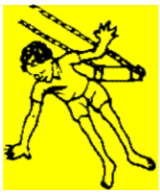
Secondary
deposit

Fragilitas ossium
osteo

Senile
porosis

Children

Poor history



X-ray both sides if in doubt

Greenstick fracture

Slipped epiphysis ± fracture

Immobilisation times

Upper limb

The union or immobilisation times are illustrated. These are very approximate and there are many exceptions. Some fractures, such as the shafts of metacarpals, require almost no immobilisation. Other fractures, such as the waist of the scaphoid or the shaft of the radius and ulna, require rigid splinting or internal fixation.

• Internal fixation — This is now the usual treatment of most displaced fractures of the shaft of the radius and ulna and of the olecranon. Limited mobilisation of the limb is usually permitted after a few days.

Many pathological fractures of long bones, due to secondary deposits, are now also treated by early internal fixation followed by radiotherapy, with or without chemotherapy or hormones.

Spine and pelvis

Isolated minor fractures of the pelvis, sacrum and coccyx without complications require little or no immobilisation. Major fractures and dislocations of the cervical, thoracic and lumbar spine, often with instability, need protection for 2-3 months.

The same applies to severe central dislocation of the hip, and unstable fractures and disruptions of the pelvis, which may require internal fixation.

Lower limb

Fractures requiring minimal immobilisation include isolated fractures around the hip which do not affect stability, such as isolated fractures of the greater and lesser trochanters, and fractures of the fibula, metatarsals and toes.

Major fractures of the hip, shaft and lower end of the femur, and major fractures of the tibia, neck of the talus and the calcaneus involving the subtalar joint, take 3 months to heal. Except for the calcaneus they often need internal fixation to obtain early mobility. Internal fixation is especially indicated in elderly patients with major fractures of the hip, avoiding the many complications associated with prolonged bed rest.

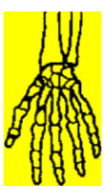
Immobilisation

Injuries of the upper limbs Approximate times

3 weeks

- Clavicle
- Shoulder dislocation

- Minor elbow fractures
- Head of radius fractures



- Triquetral
- Scaphoid tuberosity

3-6 weeks

Acromioclavicular

joint dislocation

- Dislocated elbow
- Supracondylar fracture
- Fracture olecranon

- Colles and Smith's fractures
- Dislocated lunate

8-12 weeks

Shaft humerus

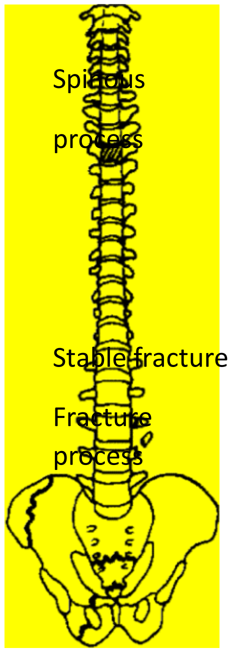
Shaft radius and ulnar fractures

Scaphoid (body)

Immobilisation or non-weight-bearing

Injuries to spine and pelvis Approximate times

3 weeks



Spinous

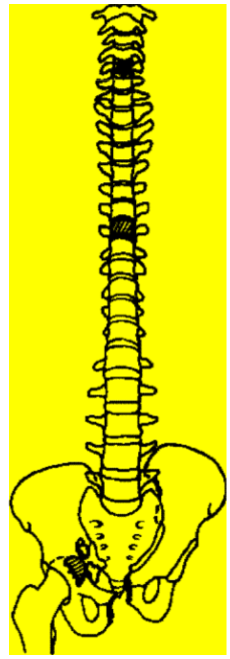
process

Stable fracture spine

Fracture

process

2-3 months



Fractures and major dislocation cervical

spine

transverse

Unstable fractures an
Dislocation thoracic and
Lumbar spine

Fractures and dislocations of pelvis

Central dislocation of hip

Bladder, vascular and neurological complications first priority in treatment

Immobilisation

Injuries of the lower limbs

Approximate times

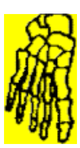
3 weeks or fewer

Isolated fractures trochanters

Tear menisci

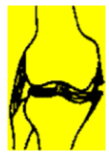
Fibula no ankle damage

ankle fractures and sprains



Metatarsals and toes

6 weeks



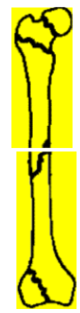
Ligaments of knee

Rupture-extensors knee

2-3 months

Cervical and trochanteric fractures

Shaft femur



Femoral condyles

Plateau tibia

Shaft tibia

Major fractures ankle

Neck of talus

Calcaneus

- ORIF/ or repair will allow earlier mobilisation
- Physiotherapy is important

Pathological fractures

Pathological fractures occur in bones that have been weakened for any reason.

Causes

• Senile osteoporosis — This is the most common cause.

• Secondary tumour deposits — These also commonly cause pathological fractures, particularly from carcinoma of the breast, lung, thyroid, kidney, prostate, cervix, bowel, and from multiple myeloma. The treatment of pathological fractures resulting from secondary deposits usually involves internal fixation plus radiotherapy. Hormones or chemotherapy may also be necessary.

• Other causes — These vary from congenital bone cysts and fibrous dysplasia, through to Paget's disease. They also include osteopenic bone in paralysis, such as in poliomyelitis and paraplegia.

History

The history of a previous primary tumour, particularly of the breast, lungs, kidneys and prostate, associated with one or more fractures or potential fractures occurring with minimal trauma, would make one strongly suspect a secondary deposit.

In elderly patients, senile osteoporosis may lead to fractures of the spine, hip and wrist following fairly minor injuries.

Examination

Examination of the patient with a suspected pathological fracture must include a complete physical examination, including a rectal examination. Bones which may be particularly susceptible to secondary deposits are the spine, ribs, pelvis, humeri and femora and, unless fractured, may cause little or no pain or tenderness. Secondary deposits below the knee or elbow are much less common.

Investigations

Blood investigations

A full haematological and biochemical pre-operative assessment is essential, as anaemia is common and an uncorrected pre-operative hypercalcaemia a potentially lethal post-operative complication.

Pathological fractures

Diagnosis and pre-operative assessment

Chest X-ray and CT scan

Secondary deposits

Sometimes positive when X-rays clear

Skeletal survey

X-ray tender bones or if scan positive

Preoperative X-rays (minimum)

- Chest — PA/lateral
- Lumbar spine — lateral
- Cervical spine — lateral
- Both humeri — AP
- Pelvis — AP
- Both femora — AP

Imaging techniques*

The appearance on X-ray of an ill-defined, osteolytic destructive lesion, which is often multiple and usually proximal to the knee and elbow, is strongly suggestive of a secondary deposit. Carcinoma of the prostate, however, is usually osteoblastic. Occasionally other secondaries such as from carcinoma of the breast, may also give osteoblastic secondaries.

The minimum X-rays necessary when an operation is planned for a secondary deposit, are:

• PA and lateral view of the chest — This may also show secondary deposits, both in the lungs and in the ribs.

• AP of pelvis.

• AP of both femora and humeri — These bones are often involved in secondary deposits. They may also have a potential pathological fracture which could be stabilised at the time of initial operation.

• Lateral view of the cervical spine — A secondary deposit may be asymptomatic. There is a risk of fracture or dislocation during anaesthetic intubation, which may cause a paraplegia or quadriplegia.

• Lateral view of lumbar and thoracic spine — The lateral view of the chest may adequately show the thoracic spine.

• Lateral skull view — If multiple myeloma is suspected.

• Other views — AP and lateral views of any bones which are tender and which may require internal fixation.

• Nuclear bone scan — A bone scan may be a useful additional investigation and may show secondary deposits when the X-ray is negative. Conversely, in multiple myeloma and secondary deposits from the thyroid and kidney, the bone scan is sometimes 'cold' due to a large haematoma at the site of the lesion, while the X-ray may demonstrate the lesion.

• Thallium scan — Occasionally a thallium scan is indicated. This is more specific than technetium 99 for rapidly dividing cells in malignant tumours.

• CT scan — In most cases of secondary deposits, these are not necessary. A CT scan may be useful, however, in diagnosing secondaries in the chest and showing the extent of tumour spread up the medullary cavity of a bone.

• MRI scan — This is a more accurate, but an expensive investigation for routine investigations and for most secondary tumours. It may be invaluable, however, in assessing the extent of primary tumour spread. It is not necessary for most secondary deposits.*PET scans(2022),very useful but very expensive, to evaluate cancers, brain and heart.

Pathological fractures

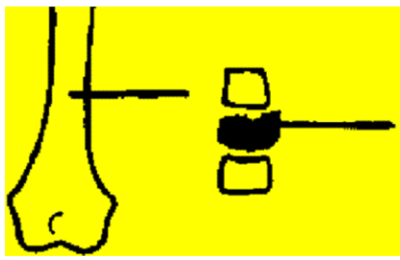
Most due to secondary deposits or osteoporosis

Cervical spine

Also X-ray thoracic and lumbar spine if indicated

Pre-anaesthetic assessment must always include X-ray of cervical spine

Trephine biopsy



Spinal biopsy under image

3 mm trephine core or needle biopsy

Biopsy spine only if other diagnostic tests in doubt

Trephine biopsy

A trephine biopsy is sometimes necessary where the diagnosis is uncertain. A simple needle biopsy may sometimes be sufficient for soft tissue. A trephine will produce a bony core of about 10 - 30 mm in length and 2 - 3 mm in diameter, suitable for a histological diagnosis. Only occasionally will an open biopsy be necessary. The biopsy specimen may, however, take several days to decalcify and a definitive diagnosis can seldom be made by frozen section alone.

Pathological fractures — upper limb

Treatment

• Forearm and hand — Pathological fractures due to secondary deposits below the elbow are uncommon. They should be internally fixed if possible, or braced followed by radiotherapy. Chemotherapy or hormones should also be given if indicated.

• Humerus — Fractures, or potential fractures of the shaft of the humerus, should be treated by internal fixation by the simplest method possible, such as by a Rush nail.

Fractures of the lower end of the humerus are best treated with a plaster backslab or plastic support, followed by radiotherapy.

Fractures of the head and neck of the humerus, due to secondary deposits, can be treated by a simple triangular sling plus radiotherapy. A prosthetic shoulder and upper humeral replacement may sometimes be indicated, and possibly chemotherapy or hormones.

Pathological fractures of the spine and pelvis

Treatment

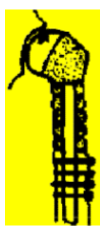
• Cervical spine — Fractures of the cervical spine should be treated either with a neck collar or, if unstable, by a halo jacket support, or other type of neck splint. Sometimes internal stabilisation by wire fixation is required. Radiotherapy should always be given, plus chemotherapy or hormones, if indicated.

• Cervical collar — In stable cervical spines with secondary deposits and no neurological signs, a simple cervical collar, as illustrated, is usually sufficient during the day, while a soft cervical collar is worn at night. Radiotherapy, with or without hormones and chemotherapy, must always be given in

Pathological fractures

Upper limb treatment

Shoulder and humerus



Huckstep locking ceramic and titanium shoulder and humeral replacement

Humerus

Upper end and shaft

Sling or collar and cuff if necessary

Rush nail

Radius and ulna

Rush nail (useful) or plate

• Radiotherapy post-operatively in all cases

• Bone cement, chemotherapy and hormones if indicated addition In more severe cases a SOMI (suboccipital mental immobilising collar) will prevent rotation as well as flexion. • Minerva support — A plaster support may be necessary for unstable fractures or potential fractures.

• Halo-vest — A halo-vest support, as illustrated, incorporates a halo attached to the outer table of the skull and is supported in turn on to a lightweight vest. This will give additional support for unstable fractures and will also allow radiotherapy. It will provide additional stability following operative stabilisation.

• Thoracic and lumbar spine — Most fractures without neurological signs require either a Taylor brace for the thoracic spine, or a lumbo-sacral corset for the lumbar spine.

Fractures with neurological signs require emergency decompression and stabilisation.

• Pelvis and acetabulum — These are usually treated conservatively with skin traction, non-weight-bearing and radiotherapy, plus hormones and chemotherapy if indicated.

Combined fractures of the neck of the femur and the acetabulum may require a cemented total hip replacement, if the patient is fit and has a life expectancy of at least 3-6 months. It is also essential that any hypercalcaemia is corrected pre-operatively, as this is a possible lethal complication following operations for secondary carcinomatosis.

Pathological fractures of the lower limb

Treatment

• Upper femur — Fractures of the neck or trochanteric region of the femur require a blade plate strengthened with methyl methacrylate cement. Destruction of the head of the femur will usually either require a cemented hemiarthroplasty, or total hip replacement if the patient is young with a reasonable life span.

• Shaft of femur — Fractures, or potential fractures of the shaft of the femur, should be treated by internal nailing with

a locked nail, if possible. They may also require extra stabilisation with methyl methacrylate cement.

• Prophylactic internal fixation — Potential pathological fractures should be internally stabilised.

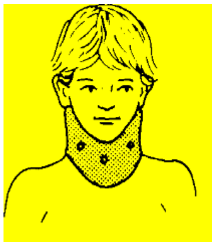
• Pathological fractures of the tibia — These are uncommon and usually will require internal fixation by nails or plates, plus methyl methacrylate cement.

It is essential that radiotherapy is given post-operatively in all cases and, if indicated, chemotherapy and/or hormones.

Pathological fractures

Treatment

Cervical spine



Cervical collar

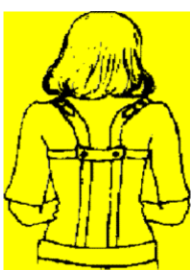
Halo-vest

All require radiotherapy ± chemotherapy and hormones in addition

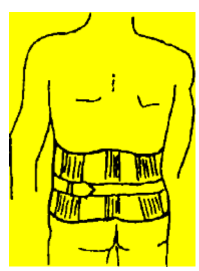
Pathological fractures

Treatment

Thoracic and lumbar spine

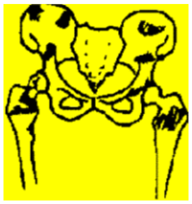


Taylor brace — thoracic spine urgent decompression and stabilisation for paraplegia



Lumbo-sacral corset — lumbar spine

Pelvis and upper 1/3 both femora



Pelvis and acetabulum

Examination and pre-operative blood assessment including serum calcium

• Always give radiotherapy ± chemotherapy/hormones

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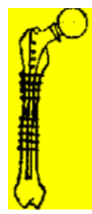
Pathological fractures

Treatment

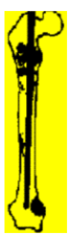
Upper femur

Blade plate + methyl methacrylate cement



Huckstep titanium and ceramic locking hip

Shaft femur



• Intramedullary nail inserted 'cl

• Image intensifier

Huckstep locking nail, screws and cement

Tibia

Plate and cement

Post-operative radiotherapy ± chemotherapy and hormones

•Locked nail

•Bone cement

Trauma in pregnancy

Overall treatment

Treatment will require modification; especially as fetal survival is dependent on maternal survival. An obstetrician should be informed. The intravascular volume is increased, and gastric emptying is delayed in pregnancy. There may also be a respiratory alkalosis, and an increase in tidal volume.

Other changes include the risk of eclampsia.

Management of mother

This includes the ABCDE of trauma, with the exception that only the leg compartments of MAST suit should be inflated for severe lower limb trauma. X-rays of the abdomen and pelvis should be minimal and ultrasound used where possible. Peritoneal lavage, if indicated, should be performed by the supra-umbilical route. The risk of increased retroperitoneal haemorrhage in pelvic fractures due to the dilated pelvic veins should be borne in mind.

Various other physiological changes occur in pregnancy. These include an increase of pulse rate of up to 90 per minute, and decrease in blood pressure of about 10 mmHg

Fetus

The fetus is well protected by the thick uterine wall in the first trimester of pregnancy, and by the amniotic fluid in the second trimester. In the third trimester the uterus is thin walled and placental disruption may occur, particularly with hearing forces.

Clinical assessment

Assessment will include the date of the last menstrual period, and assessment of the uterus for contractions, tenderness and height. The fetal heart should be auscultated and fetal movements felt for. Finally, a catheter should be passed and the urine assessed, and a vaginal examination carried out for bleeding or amniotic fluid. The normal fetal heart rate is 120- 160 beats per minute and bradycardia is a sign of fetal distress. There can be delay in the onset of fetal distress, so observation should be repeated, if necessary, over several days following the initial trauma.

Investigations

Ultrasound is a useful diagnostic test in later pregnancy to assess the volume of amniotic fluid, the presence of intra-amniotic haemorrhage, and also to assess the position of the placenta. Doppler ultrasonography can be used to assess the fetal heart rate from about the third month of pregnancy.

Later in pregnancy cardiotocography will compare fetal heart rate with uterine contractions. The Kleihauer test can be used to assess feto-maternal haemorrhage and anaemia in the fetus. If this occurs in a Rhesus negative mother prophylactic anti-D is indicated to protect the fetus against Rhesus sensitisation.

Signs of placental separation

Fetal distress may be the only sign of this complication. Other signs are maternal hypovolaemic shock, abdominal tenderness increasing height of the fundus, increased irritability of the uterus, vaginal bleeding and amniotic fluid loss In major separation there is a risk also of disseminated intravascular coagulation.

Penetrating trauma

This is another cause of fetal death although the mother is likely to survive.

Burns in pregnancy

In burns affecting over 50%-60% of the body after the 5th month of pregnancy the fetus should be delivered immediately. This is due to the otherwise poor prognosis for both mother and foetus.

Indications for an emergency Caesarian

In severe injuries there is a need for an immediate Caesarian section for a viable fetus in the event of maternal death from whatever cause.*Trauma is the most common cause of death in pregnancy; place pregnant patient > 20 wks. in the left lateral decubitus position; vena cava may be compressed by uterus to reduce cardiac output by 30%; radiation from most XRs is <threshold to damage fetus; the 1st trimester fetus is most at risk.

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Pediatric trauma

Emergency treatment

The emergency treatment of the child with multiple or severe injuries may be difficult for the inexperienced. The emergency resuscitation of the injured child is summarised on pages 57- 59.

In adults with multiple severe injuries adequate emergency treatment in the first, or ‘golden’ hour may make the difference in survival.

With children this is only half an hour, the so called ‘platinum’ half hour.

Drug dosages and fluid replacement in children should be based on the weight of the child. In the severely injured child this is best achieved by measuring the length of the child and assessing approximate weight and drug dosages from pediatric charts, which should be available in all accident centres.

Airway

The anatomy of the child is also different. Children have a relatively large head and small oropharynx, with the glottis at the level of C3 or C4 instead of C6, as in the adult. The trachea is also shorter and this may cause problems in intubation. A conscious child also has a well-developed gag reflex. As a result, an oral airway may cause vomiting and should be avoided if possible.

Diagnosis

Children are not small adults, and their fractures and dislocations may be difficult to treat and also to diagnose. This is because much of the epiphysis in young children may be made of cartilage which is radiolucent. Damage to the epiphysis may not be fully appreciated, especially in a crush injury (Grade V Salter-Harris), and the X-ray may appear to be virtually normal. If in doubt the opposite joint should be X-rayed in the same position or an ultrasound or arthrogram used to make a diagnosis.

Types of fractures

Specific fractures usually seen only in children include fractures in fragilitas ossium (a history usually of multiple previous fractures, and X-ray with clinical evidence of these), fractures through bone cysts, and fractures due to child abuse. Child abuse may account for many of the fractures under the *By law, child abuse cases must be reported in most countries.

Fractures in children

Infection
may mimic fracture

Battered babies

• Systematic examination includes

chest and abdomen

•Admit to hospital and photograph

Look for other injuries and causes

Emergency treatment

UPDATE (2022). Must report. Suspect where child < 3 yrs with inconsistent/developmental histories. See skin injuries then Fxs, head injuries. Do skeletal surveys (under 5yrs) or bone scans in older child. Fxs seen in humerus, then tibia and femur. Note spiral femur Fxs where not walking, distal humeral physeal separations and corner Fxs (junction of metaphysis/physis. Outcome linked to brain injury. DON'T MISS AS NEXT PRESENTATION COULD BE OF A DEAD CHILD

age of 1 in some countries, and must always be considered in all fractures in babies, particularly of the long bones.

Investigations

Imaging techniques

A CT scan by itself or combined with an arthrogram may also be necessary to define cartilage which is not visible on a plain X-ray.

Other investigations which may be indicated are a nuclear bone scan or magnetic resonance imaging. The latter has the advantage of not exposing the child to unnecessary irradiation, but is an expensive investigation which may be frightening to small children and require general anaesthesia. The need for anaesthesia should always be a consideration, when prescribing any investigation for children.

Another useful investigation in children is ultrasound imaging for soft tissue swellings, and for cartilage injuries particularly of the elbow, provided it is performed by a skilled operator. It can also be very useful for injuries of the abdomen. Ultrasound is safe, painless and inexpensive, but is not as diagnostic for bone injuries as X-rays.

Haematology and biochemistry

Routine blood, urine and other investigations will help to differentiate infection from a fracture. The white blood count may sometimes not be raised in infections in children, and therefore may be of limited diagnostic help.

Children also have relatively little subcutaneous tissue. This may result in shivering, which in turn leads to biochemical disturbances such as metabolic acidosis.

Epiphyseal and physeal injuries

In children the growth plate is the weakest part of the bone. Injuries which would cause ligamentous rupture or a fracture in an adult will often result in a growth plate fracture separation in the child.

Diagnosis

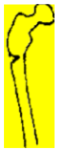
Diagnosis of an injury to the growth plate is essential. Follow up of a child with growth plate damage for at least 1-2 years after the injury is important.

Investigations

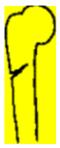
The routine X-ray which will show a definite fracture in an adult, may show very little, or just a flake of bone, in a child.

Common fractures in children*

Greenstick fractures



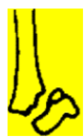
Femur



Humerus

Clavicle

Epiphyseal injuries



Femur

Tibia

Radius

Supracondylar fracture humerus

*Note: most children's fractures are straightforward and managed with closed reduction and casting; problem fractures needing ORIF are of: elbow, hip, knee, ankle (i.e., involving growth plates or blood supply).

235 **Specific fracture management**

This is particularly so in elbow injuries in children. An apparent small epicondylar fracture may actually be a fracture of the entire lateral condyle. An epiphyseal separation may also have spontaneously reduced itself and then would only be apparent on a stress X-ray.

If in doubt, take X-rays of the opposite joint in exactly the same position, for comparison. In young children an arthrogram may also be necessary to show the outline of the radiotranslucent cartilage. An ultrasound or magnetic resonance imaging (MRI) can also help in the diagnosis.

Classification and treatment

• Epiphyseal injuries — These may be subdivided into shearing, avulsion, splitting and crush types. Such injuries may cause considerable disturbance of growth.

Salter-Harris classification, SH

Epiphyseal injuries

The Salter-Harris classification describes damage to the epiphyseal plate with or without a fracture.

• Type I — No fracture. There is separation of the epiphysis at the level of the growth plate.

• Type II — This involves separation of part of the epiphysis from the metaphysis through the epiphyseal plate, plus a metaphyseal fracture.

• Types I and II Salter-Harris epiphyseal fractures, if adequately reduced by closed reduction, usually have a good prognosis, even if less than perfectly reduced. Salter Type II injuries, however, may lead to growth disturbance in 5% of children.

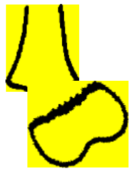
• Type III — The fracture line extends from the joint space to the growth plate. It then extends laterally to the edge of the plate separating the fractured epiphysis from the metaphysis. It must be reduced perfectly and may require open operation and wire fixation. The prognosis is usually poor.

• Type IV — These fractures extend from the joint space through the growth plate and across the metaphysis. These commonly occur in the lateral condyle of the humerus and almost always require open reduction and smooth wire fixation. The prognosis is poor. In the elbow this may result in a valgus deformity with a tardy or late ulnar nerve palsy due to stretching of the ulnar nerve. The valgus deformity increases due to the cessation of growth of the damaged lateral part of the epiphysis, and the continued medial growth.

Epiphyseal damage

Salter-Harris classification, SH

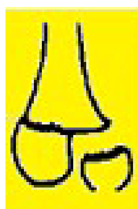
Type I



- Complete separation
- No fracture
- Easy reduction
- Good prognosis

Type II

- Commonest type
- Older children
- Easy reduction
- Good prognosis in most cases



Type III

- Reduction and Kirschner wire fixation
- Prognosis usually poor— same as type IV

Type IV

- Intra-articular open reduction and fixation
- Prognosis poor unless perfect reduction

Type V

- Crushing injuries
- Diagnosis-difficult
- Prognosis poor

• Type V — This is a severe crush injury of the growth plate itself. Displacement is unusual and injury may be unnoticed. There is almost always a poor prognosis with cessation of growth of the epiphyseal growth plate.

It is essential to be very gentle with reduction of children's injuries and not damage the epiphysis with sharp instruments at the time of operation.

It is also important to warn relatives about the risks in these injuries and to follow the child up with X-rays for at least 2 years from the time of injury.

Complications

Damage to the epiphyseal plate, especially in Salter-Harris Type III, IV or V injuries (see illustration), may lead to premature fusion of part of the epiphysis. This in turn may lead to continued growth of the remaining germinal layer with

a resulting varus or valgus deformity. If the whole epiphysis is damaged in this growing period the leg or arm will be short. Conversely, after a fracture of the shaft of a long bone, growth stimulation may actually occur with up to 2 cm of overgrowth. This is mainly due to the hyperaemia following injury.

Growth arrest

• Treatment — If this is less than 50% of the epiphysis, the fused area of the epiphyseal plate should be excised and replaced with a fat graft. If more than 50% of the plate is involved the fused epiphysis is usually left without operation, and any later deformity corrected by an osteotomy when the child is skeletally mature.

Shortening

Shortening of a limb can be treated by lengthening with Ilizarov* wire external fixateurs. The alternative is to carry out an epiphyseal arrest on the opposite leg at an appropriate age to equalise the leg lengths by the time growth has ceased. This is done either by temporary epiphyseal stapling, or by permanent epiphyseodesis, which entails excision of the epiphyseal plate.

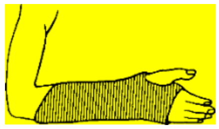
Operative treatment

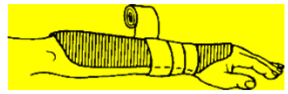
In children, operative internal stabilisation should be avoided if possible, as this may interfere with growth at the epiphyses.

• Smooth wire fixation — Even when this extends across epiphyseal plates, it seldom causes major problems provided the wires are removed within 4-6 weeks. They are particularly*A brilliant but complicated system developed by a Russian surgeon, Gavriil A Ilizarov, 1921-1992).

Fracture-separation of the distal radial epiphysis

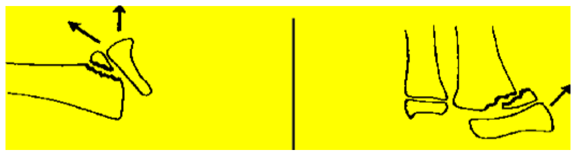
Type I — no fracture





• Manipulation and plaster

Type II

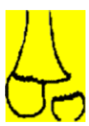


Lateral X-ray **AP X-ray**

• Manipulation and plaster

Types III, IV and V

• Often require operative reduction and Kirschner wires



Type III **Type IV** **Type V**

Paediatric scaphoid Fx.,-If XR OK but suspected then do CT; treat with thumb spica for 4-8 weeks; displaced mid waist to avoid AVN do ORIF.

indicated in unstable fractures such as a supracondylar fracture of the humerus.

• **Older child** — In the older child, screws, plates and even an intramedullary nail may be sometimes used, provided they do not damage the epiphyseal cartilage. Compound fractures In compound fractures, as with the adult, external fixateurs, after adequate debridement, may be indicated. As with adults, however, all compound fractures, even with minimal skin damage, should be opened, explored, and left open. In most cases delayed primary closure is the treatment of choice.

Healing

Fractures in children heal much more quickly than in adults.

• **Femoral shaft fractures** — These will usually be united in 1 week in an infant, 1 month in a 1 year old, and 2 months in a 10 year old, compared to 3 months in an adult.

Remodelling

Remodelling of the growth plate may also occur, with up to 20°-30° of correction possible. An angulation of the bone, which may not be acceptable in an adult, will often be acceptable in the child, especially in an infant, when 45°-60° of correction can occur in bones such as the upper humerus. This will only occur if the deformity is in plane of movement of the nearest joint.

Upper limb

Lower radius (most-MUA; huge re modelling potential)

Fracture-separation of the distal epiphysis This is the pediatric equivalent of a Colles' fracture.

• **Diagnosis** — The distal radial fragment is both dorsally displaced and rotated. There is also radial displacement and impaction of the fragment. There may be an associated metaphyseal fracture of the radius.

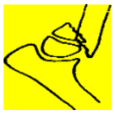
• **Treatment** —The methods of reduction and the prognosis have already been discussed under the Salter-Harris classification of epiphyseal injuries.

In summary:

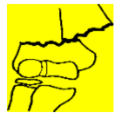
Type I — Separation of the epiphysis with no fracture requires a closed reduction and has a good prognosis.

Type II — This involves separation of the epiphysis, plus a metaphyseal fracture, as illustrated. Again, closed reduction with a good prognosis except in 5% of cases.

Supracondylar fractures of the humerus*



Lateral view



AP view

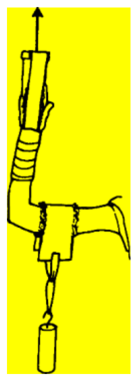
Condylar fractures

Treatment

Manipulation and reduction

Immobilisation: padded backslab

Kirschner wire fixation if necessary



Difficult fractures may require

countertraction

*UPDATE (2022), SC Fxs. -Diff. Diagnosis - dislocation; AIN (ant. interosseous nerve inj in extension type; lateral-entry pins used but cross pins considered more stable. Treat vascular problem with reduction NOT angiography.

Types III and IV — These were described earlier in this chapter and are illustrated on page 237. They must be accurately reduced and may require wire fixation. The prognosis is usually poor in both Type III and Type IV injuries.

Type V — This causes a severe crush of the growth plate. The prognosis is poor.

Forearm fractures (MUA can be difficult)

These are very common fractures in children and account for 55% of all children's fractures. Fractures of the distal one third of the radius account for 75% of forearm fractures.

Treatment

• Simple fractures — Many of these fractures are greenstick fractures and, as a result, the bone may have to be ‘refractured’ to reduce the fracture satisfactorily.

• Young children — Nearly all diaphyseal fractures in young children can be treated without an operation, and with an above elbow plaster in either 45° of pronation or supination, after reduction if necessary.

• Over the age of 8 years — In this age group, open reduction and plating or nailing may be necessary with displaced and angulated fractures if adequate closed reduction has failed.

• Compound fractures — In compound or open fractures the wound should be explored and always left open with delayed primary closure. External fixateurs may have to be used to stabilise these fractures.

Malunion and non-union

The following is an approximate working rule in children provided a good reduction cannot be easily obtained by manipulation.

• Under 8 years — In children some molding can occur and, under the age of 8, 20° of angulation and 20° of malrotation can sometimes be accepted.

• Over the age of 8 years — In this age group only 10° of angulation may correct as the child grows.

• Forearm fractures — Apposition of bone ends should be 50% or more in all forearm fractures. If less than this is present, manipulation or operation will be required. Otherwise malunion is likely, and occasionally non-union may occur.

Elbow injuries

Elbow injuries in children are common and can cause vascular and neurological complications.

Fractures of the lateral humeral condyle (difficult)

• Diagnosis — Fractures of the lateral condyle may be difficult to diagnose on X-ray in young children due to the large amount of cartilage which is radiolucent. As a result, an ultrasound, an arthrogram, a CT scan, or MRI may be necessary.

Often markedly displaced.

• Treatment — Cases with slight displacement of the epiphysis (less than 2 mm) can usually be treated by a cast alone. Those with a moderate or severe degree of displacement, however, will require open reduction and internal fixation, usually with Kirschner wires, to obtain a perfect result.

• Complications-Lateral overgrowth(spurring), delayed/non-union, premature fusion with deformity, late ulnar nerve palsy or AVN.

Fractures of the medial epicondyle (usually associated with elbow dislocation)*

• Treatment — Undisplaced or only slightly displaced fractures can usually be treated with a cast alone. Moderate displacement will require open reduction and wire fixation.

• Complications — Severe displacement may lead to entrapment of the medial epicondyle which will always require ORIF with smooth Kirschner wires. Damage to the ulnar nerve must always be looked for pre-operatively and at the time of operation. The ulnar nerve can also be damaged by incorrectly placed Kirschner wires.

Supracondylar fractures, SC,*

These fractures are most often seen in children aged 6 to 7 years. Approximately 85% of fractures are displaced posteromedially and about 10% posterolaterally. In 5-10% of fractures the displacement is anterior due to a flexion force. It is essential to diagnose and treat this fracture well, due to the high complication rate, including vascular, neurological and bony complications.

This is a surgical emergency — always admit the patient to hospital and treat the fracture as a matter of urgency if manipulation is required.

Examination

The elbow is swollen, painful and deformed. Always examine for both vascular and nerve impairment of the hand immediately.

• Diagnosis of vascular insufficiency — The earliest and most important diagnostic sign is pain on passive extension of the fingers.

The other criteria of vascular occlusion are pallor, pulselessness and paraesthesia. Paralysis is a late sign and its presence may signify irreversible damage. A normal pulse may sometimes be present with a compartment syndrome, and it is essential to be aware of this potentially serious complication.

Treatment

• Vascular insufficiency — Careful examination for insufficiency includes the use of a pulse oximeter and assessment of flexor compartment pressure. A digital subtraction angiogram may sometimes be indicated. Do not delay in reducing the fracture under image intensifier in theatre. The reduction is held with 2 Kirschner wires. In most cases (13 out of 17 in one series), the pulse will return and exploration of the artery will not be necessary.

Following successful reduction, it should be possible for the fingers to be fully extended passively, and the hand should have normal sensation and normal vascularity. There may, therefore, be a place for not exploring the brachial artery, but if there is any doubt as to the patency of the brachial artery it should be explored.

• Undisplaced fracture —This usually only requires an elastic bandage over wool until the swelling has subsided, plus a collar and cuff sling for 3 weeks.

• Displaced fracture — In the case of a displaced supracondylar fracture treatment is anatomical reduction, followed by internal fixation with two smooth Kirschner wires through the lateral condyle or crossed pins.

• Unstable fracture — In a very unstable fracture, one or two wires carefully inserted under image intensifier control in the medial epicondyle may be indicated through a small incision, after the lateral condylar or crossed wires have been inserted. The arm is then immobilised in 60°-90° of flexion with a padded backslab.

• Difficulty in reduction — In cases where reduction is difficult due to severe swelling, skin traction on the forearm with the hand suspended from an overhead beam, together with counter-traction downwards on the upper arm with a sling for about 3 days, see page 241, may be necessary.

The contraindications to pinning a fracture are inability to obtain an adequate closed reduction, extensive comminution and massive swelling. In these cases, the arm should be suspended, as illustrated, from a beam with the elbow in 90° of flexion as discussed below. *SC fractures need skillful reduction to avoid compartment syndrome.

• Open fractures — In the case of open fractures, an adequate debridement should be carried out before the Kirschner wires are inserted.

Post-reduction care

The limb should be elevated and careful observation made for symptoms and signs of vascular impairment. This includes:

• Terminal finger perfusion — This is the most important observation and will include the use of a pulse oximeter on a finger.

• Distal radial pulse — This should be examined every hour for 48 hours following reduction, but is less diagnostic than adequate finger perfusion and the ability to extend the fingers.

• Fingers — These should be examined for warmth, sensation and inability to extend the fingers, associated with severe forearm tenderness.

• Manipulation — A supracondylar fracture should never be manipulated more than 3 times, however poor the position. Immobilise for about 3 weeks in total.

• Immobilisation in extension — Occasionally immobilisation in extension is required.

Early complications

• Vascular complications — Forearm ischaemia — This requires urgent treatment. The plaster should be removed immediately, the elbow extended, and the fracture reduced with Kirschner wires. Do not waste time on sympathetic blocks or vasodilators. Operate immediately if the circulation does not return with closed reduction and Kirschner wires.

• Operative exposure — Extend elbow, incise the lower third of the upper arm and most of the forearm overlying the brachial artery. Split the fascia and lacertus fibrosus.

• Brachial artery — Identify the artery medial to the biceps tendon. Open the artery if in spasm, or if there is any doubt, and look for an intimal tear. Consider inserting a reversed vein graft. Intimal damage is common in these cases and may not be apparent on external exposure of the artery.

• Wound closure — Never suture fascia, and close part of the skin only if this can be done easily. Leave the wound open and perform a secondary closure.

• Compartment syndrome — This is due to swelling due to ischaemia, and to a lesser extent to bleeding into the flexor compartment of the forearm. This may occur with or without major damage to the brachial artery. A fasciotomy of the entire flexor compartment should be carried out. Delayed primary closure of the wound is a necessity.

Late complications

• Vascular impairment — Volkmann's ischaemic contracture or gangrene of the arm.

• Neurological complications — The nerves which are commonly damaged in a supracondylar fracture are the radial and the median nerves. The anterior interosseous and ulnar nerves may also be damaged. The continuity and function of the flexor pollicis longus, and the flexor digitorum longus to the index finger must always be tested. A cubitus valgus deformity may also produce a late ulnar nerve palsy.

• Bony complications — Bony complications of a supracondylar fracture of the humerus include a cubitus varus or cubitus valgus deformity. This is usually due to an incomplete reduction, or to epiphyseal damage, and will result in poor appearance and function.*Little Leaguer elbow is over use injury, SH I, of med. Epicondyle physis.

Humeral shaft fractures

Causes

Birth trauma, child abuse* and benign bone cysts must always be considered in the diagnosis.

Common sites

• Metaphysis — This occurs commonly in the metaphyseal region from 4 -12 years.

• Diaphysis — The diaphysis is most often affected under the age of 3 and over the age of 12.

Treatment

• Conservative treatment — Most cases can be treated merely in a collar and cuff sling or hanging cast.

• Operative treatment — The only indication for exploration in closed fractures in children is in cases where radial nerve paralysis is increasing, or where there is obvious muscle interposition between the bone ends which cannot be corrected by manipulation alone. Open fractures will require exploration and adequate debridement and delayed primary closure, if necessary.

• Angulation of up to 45°— In the newborn this can sometimes be accepted.

• Overgrowth — This may be due to increased vascularity. Complications

Radial nerve injury is less common than in adults. The prognosis is excellent and most cases recover completely in closed injuries without operation.

Proximal humeral fractures

80% of the growth of the humerus occurs in its proximal segment. It has three ossification centres but only one growth plate, and so the diagnosis of a fracture is more difficult in children.

Fracture displacement

• Children under 5 years — Considerable remodelling is possible up to the age of 5 years. In these young children 40° of angulation, and total displacement of the fractures can sometimes be accepted provided there is some bony apposition.

• Children 5 - 12 years — Between the ages of 5 and 12 years up to 40° of angulation can often be accepted.

• Children over 12 years — Over the age of 12 up to 40° of angulation with more 50% apposition of the bone fragments can sometimes be accepted, provided there is at least 2 years of growth remaining.

Treatment

• Conservative treatment — The patient can often be treated merely by a collar and cuff sling. In the case of severe displacement, a shoulder spica or an abduction brace may be required for up to 6 weeks.

• Operative treatment — Only occasionally is open reduction and K wire fixation required. This is in patients where displacement cannot be controlled by conservative measures. Open fractures, again, will require adequate debridement and delayed primary closure, if necessary.

Lower limb

Hip and upper femur

Causes

In some countries in children under the age of 1 year, 70% of femoral shaft fractures have been reported as being due to child abuse. Overall, 30% of fractures in children of all ages are also said to be due to child abuse. This diagnosis should be especially suspected if there is a history of previous child abuse, if there is delay in attending hospital, or if there is evidence of other acute fractures or of multiple past fractures. This cause must be particularly considered if fractures of long bones are transverse, diaphyseal, or short oblique.

• Pathological fractures — About 12.5% of fractures in children are pathological and include osteogenesis imperfecta, rickets and fractures through bone cysts. Pathological fractures must always be excluded in all cases where a fracture has occurred with minimal trauma.

Diagnosis

The upper end of the femur has 3 ossification centres.

• Diagnosis — In children, due to these ossification centres, the X-ray appearance may be deceptive. If in doubt an X-ray of the opposite hip, an arthrogram, or ultrasound, may be indicated.

• Neck of the femur — These are the most common fractures and usually occur without comminution.

• Displacement — This is usually minimised by the thick joint capsule in children.

Investigations

If a plain X-ray does not show a concentric reduction, further investigations are essential. A CT scan or arthrogram are important and may show an osteochondral fracture of the head of the femur.

Treatment

The treatment should be to

• Aspirate, or evacuate the joint of haematoma as soon as possible, to minimise the risk of avascular changes occurring in the femoral head, due to capsular compression.

• Reduce and accurately internally fix the fracture with fine wires and a hip spica. If compression screws are used they should not cross a physis.

Complications

Hip injuries in children have a high complication rate. If not treated adequately these may lead to a deformed hip, a short leg and secondary osteoarthritis.

• Traumatic dislocated hip — This is very unusual in a child and the femoral head may rarely buttonhole through the capsule. It may be difficult to reduce by closed manipulation.

• Ligamentum teres — This may pull off an osteochondral fracture from the head of the femur. This in turn will prevent reduction of a dislocated hip.

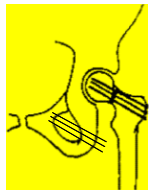
• Sciatic nerve — This is very close to the back of the acetabulum and may be stretched or contused.

• Intracapsular haematoma — This may cut off the blood supply of the femoral head due to obliteration of capsular vessels.

• Associated fractures of the femoral head, pelvis, femur and patella may be present, and should be looked for.

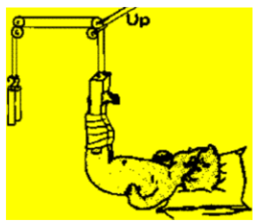
Fractures in children

Neck femur threaded in adolescent *(3 smooth wires in younger)



• No screws across physis in young children

Femoral shaft fractures



Child under 15 kg

weight

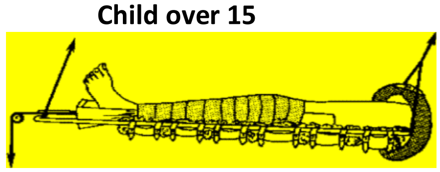
Knees should be splinted with backslabs

in about 10° flexion

90/90 hip spica

Plaster or plastic hip spica allows young child to be treated at home

Child over 15



Adjustable Thomas splint

*UPDATE, 2022, transphyseal - AVN almost 100%;

ALL are surgical emergencies.

UPDATE, 2022, femoral shaft Fxs

Birth-6 moths: Pavlik harness

6mths-6yrs: Spica

6 yrs-11yrs: Flexible IM nails when stable, submuscular plate when unstable, Ext. Fx

for polytrauma

>14 yrs: IM nail (troch. entry)

Femoral shaft fractures(see UPDATE page 249)

Treatment under 6 years

• Gallows traction — In children under the age of 3 years gallows traction for 3-4 weeks with both knees flexed about 10° in simple padded plaster of Paris back splints. • Hip spica — In the child under the age of 6 years, with less than 2.5 cm of shortening, a hip spica in the sitting position (90° flexion of hip and 90° flexion of knee) is often the best method of management, once the fracture is stable.

• Special cases — Compound fractures may require either skin or skeletal traction. The fractured leg should be in slight valgus as the femur tends to displace into varus.

Treatment 6-13 years

Skin or skeletal traction in a Thomas splint for 3 weeks, followed by a spica, is indicated. Shortening should not be over corrected as 0.5-1.5 cm of shortening will allow for future bone overgrowth which commonly occurs following femoral shaft fractures in children, and may be up to 2 cm due to increased vascularity.

Treatment over 14 years

Over the age of 12, and in patients with head injuries, either Enders nails or locked intramedullary nails may be indicated if closed reduction and traction in a Thomas splint is unsuccessful.

Complications

• Avascular necrosis — The rate is very high in children and occurs in the head of the femur in about 40% of cases. It has been reported present in 80% of cases with a displaced epiphysis, 35% with displaced fractures of the cervical region of the femur, and 25% in those with displaced fractures of the base of the neck of the femur.

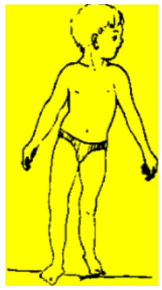
Tibial fractures

Treatment

Tibial shaft fractures in children should usually be treated conservatively by a padded above-knee plaster with the knee flexed to about 10°.

Fractures in children Complications

Overgrowth



Overgrowth of 1-2cm common

Avoid over distracting fracture

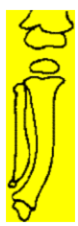
Malunion

Correct angulation

Shortening

Epiphysiodesis opposite side

Growth disturbances



Epiphyseal damage causes varus, valgus or shortening

Avascular necrosis

Late osteoarthritis

251 **Specific fracture management**

Complications

The most common complication of proximal metaphyseal fractures of the tibia in children is a valgus deformity. This deformity often corrects spontaneously. Operative correction, if necessary via a tibial osteotomy, should be delayed until growth has ceased.

Occult fractures in children

Occult or hidden fractures are common in children. This is because there is a large amount of cartilage in immature bones, particularly about the epiphyses, which have not yet ossified, and are therefore radiolucent.

Diagnosis*

•Epiphyseal fractures — These may masquerade as dislocations.

•Condylar fractures — These may appear to be epicondylar fractures.

•Difficult fractures — Those which are particularly difficult to diagnose, especially in young children, are fractures of the hip, knee and distal humerus.

• Elbow — If an X-ray appears to be normal with a swollen elbow, suspect a fracture. X-ray the opposite elbow in the same position as the injured side. If there is still doubt an ultrasound should be carried out Consider performing an arthrogram in all children under 3 years and most under 6 years. An apparent dislocation may be a Type I or Type II epiphyseal fracture and an arthrogram or MRI may be the only method of demonstrating this.

• Humerus — Condylar fracture — This is easy to miss under the age of 3 years and may appear merely as a flake or as an epicondylar fracture. Open reduction and K wire fixation is often required.

• Head injuries — Due to the resilience of the skull, severe brain damage may occur without evidence of fracture.

• Spine — Spinal cord damage may occur without radiological evidence of fracture.

• Chest and abdomen — The resilience of the ribs may result in severe lung, heart and upper abdominal trauma, without evidence of rib fracture.

• Hip — Hip fractures may be difficult to diagnose and lead to avascular changes to the femoral head.

*Patella sleeve Fx children where appears to be patella alta. ORIF when extensor lag, no SLR or intra-articular.

• Femoral shaft and tibia — Crush injuries and minor displacements of the epiphyseal growth plate may be difficult to diagnose and may result in epiphyseal growth arrest or deformity, particularly in the lower femur and upper and lower tibia. In addition, greenstick fractures may be missed and cause overgrowth of the affected limb.

Specific complications of fractures in

children

The complications in children include those seen in adults, such as vascular and neurological complications, non-union and malunion, plus those specific to children. These specific injuries are due to the pliability of children's bones and the presence of epiphyseal plates with growth potential, which may be affected when damaged. Only those complications specific to children will be discussed.

• Bone overgrowth — This is common following a fracture, particularly in young children. Overgrowth of 1-2 cm is common. So important not to over distract fractures, and sometimes even to leave a fracture of the lower limb l cm short, to allow for this later overgrowth.

• Malunion — Although a small degree of angulation in bones such as the humeral shaft will correct itself in young children (as discussed earlier), more than 10° of angulation of some bones, such as the radius and ulna, will require correction to prevent a residual disability. In assessing the likelihood of remodelling, this is much more likely to occur if the deformity is in the planes of motion of the nearest joint, and if there is at least 2 years of residual growth remaining.

• Lower limb shortening — This may require stapling or epiphysiodesis of the opposite leg at an appropriate time, to equalise leg lengths.

• Growth disturbance — Apart from shortening, epiphyseal damage may cause a varus or valgus deformity. This may necessitate early insertion of a fat graft across a prematurely fusing epiphysis after excision of the bony bridge. Later osteotomy to correct the deformity may be necessary once skeletal maturity has been reached*.

• AVN and OA — The head of the femur is particularly liable to progress to AVN following a fracture of the neck of the femur in children. It may require a vascular bone graft to diminish the likelihood of OOA.*Distal femur physeal Fxs, children, are prone to growth arrest(50% of cases, with LLD 1cm.yr or angular deformity),in 40% also injury to cruciates.

Fractures in the elderly

Causes

Metabolic

The elderly patient is more likely to slip and fall, and also, having fallen, to sustain a fracture.

• Osteoporosis — This is a relatively common finding in the elderly and is an important factor in fracture aetiology.

• Vertebrae — These may sustain crush fractures following little or no trauma. This is partly due to prolapse of the intervertebral disc into the soft osteoporotic body of the vertebrae. Multiple vertebrae, particularly in the thoracic region, commonly show stable crush fractures and cause the smooth thoracic kyphosis seen in the elderly.

• Hip — This also is osteoporotic in the elderly, and most likely to fracture following a fall.

Pathological fractures

• Secondary tumour — Deposits in bone from carcinoma elsewhere, particularly from the breast and lung in females, and prostate and lung in males, may lead to fractures following little or no trauma.

• Paget's disease — Pathological fractures may also occur in Paget’s disease.

Medication

Medication for conditions such as Parkinson’s disease may also cause osteoporosis. Long term use of oral glucocorticosteroids for conditions such as asthma, chronic airway limitations and various connective tissue disorders, such as rheumatoid arthritis, will often result in bony demineralisation, thus making the patients more prone to pathological fractures.

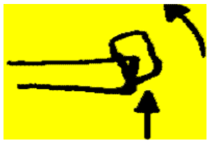
Common fracture sites

The following are the most common fractures in the elderly. The detailed treatment of all these fractures is discussed in the relevant section of this book.

Colles' fracture*

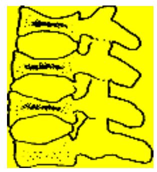
This is a very common injury, particularly in elderly females. It is often secondary to a fall on the outstretched hand. They are easy to reduce but can quickly lose position over next 2 to 6 wks. to cause the resulting dinner fork deformity.

Common fractures in the elderly

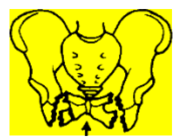


Wrist Colles' fracture

Shoulder Fracture / fracture dislocation



Fracture in several osteoporotic vertebrae + ballooning / secondary deposits



Fractured pelvis

Femoral neck or trochanter

*Colles/distal radius Fxs-instability where initial radial shortening >5mm or dorsal comminution > 50% (then need ORIF).Also ORIF for large fragments with dorsal tilt > 15 degrees,

IM fixation within 24 hours if possible

IM fixation - within 24 hours if possible 1-2mm articular displacement plus bone grafting for comminution. Ext Fix for severe comminution.

Fracture of the neck of humerus

The fall on the hand may cause both a fracture of the neck of the humerus and a Colles' fracture.

Fractures of the spine

Fractures of the thoracic and lumbar spine frequently occur without any recognised trauma due to ballooning of intervertebral discs into the osteopenic vertebrae. Several vertebrae are usually involved and may lead to an increasing smooth kyphosis in the thoracic region.

• Differential diagnosis — Secondary deposits from a carcinoma are more likely to cause isolated fractures.

Pelvic fractures

Fractures of the pubic rami and floor of the acetabulum are the most common and are usually minor and stable.

• Treatment — Most of these fractures can be treated conservatively in the elderly with mobilisation of the patient, and full weight-bearing, within a few days of injury.

Hip fractures

Both transcervical and intertrochanteric fractures are

common.

• Treatment — Operate, if possible, on the day of injury and internally fix the fracture and mobilise the patient with full weight-bearing within 2 or 3 days following operation. A hemiarthroplasty is used for displaced subcapital fractures and a screw plate for trochanteric fractures.

Fractures of the lateral tibial plateau

Fractures of the lateral plateau of the tibia are particularly common, both as a result of a fall, and also when a pedestrian is struck by a car bumper bar on the lateral aspect of the tibia.

Ankle fractures

Fractures of the ankle are common in the elderly.

• Treatment — Early mobility and weight-bearing, with internal fixation or a walking plastic support, are important in these patients.

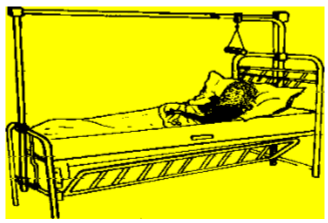
Complications

Complications of prolonged bed rest and immobilisation in the elderly may include decubitus ulcers, joint contractures of the lower limbs, urinary retention and infection, deep vein thrombosis and pulmonary embolus, bronchopneumonia and delirium (see page 257).

*Colles Fx-may get attritional rupture of EPL tendon near Lister’s tubercle.

General principles in elderly patients*

- Early mobilisation of all joints and physiotherapy
- Internally fix if necessary and early weight-bearing
- Avoid pressure sores and joint contractures
- Prevent bladder and lung complications
- Deep vein thrombosis prophylaxis
- Mobilise patients and home early



*Elderly patients do poorly with bed immobilization – Get anaesthetic assessment (anaesthesia is a lot safer now), operate early (if not asap)on hip, femoral shaft and supra-condylar fractures and mobilize asap.

WHO Fracture Risk Assessment Tool (FRAX) calculates the 10 yrs risk of hip fracture (Miller et al, review of Orthopaedics, 8th ed, page 736).

Note-Low energy stress Fxs seen with bisphonate use for osteoporosis(cortical thickening/transverse/min. comminution).

Fx proximal humerus predicts risk for subsequent hip Fx.

Locking fixation systems now in use for more effective ORIF osteoporotic Fxs (to avoid cut out).

Elderly Abuse

This is now recognised as a new entity (one in 6 elderly) akin to child abuse and subject to legislation(reporting).Most likely as a result of ageism. Features are -sexual assault, financial exploitation(more likely to self-report this one), done by friends/relatives/carers, self-neglect, psychological abuse (most common).Includes soft tissue/bony injuries and head injuries. There is a fear or shame of reporting. Signs are repeat visits to ED/hospital(often different EDs to hide),delayed and poor explanations.

Female Athlete Triad is low energy levels (with eating disorder),menstrual disorder, altered bone density. Usually from not eating enough.

Falls from a height

Falls from a height, mainly from ladders, may involve window cleaners, painters, tilers, builders, and plumbers. Parachutists are also at risk.

• Spine — Fractures, particularly of the lumbar spine, are common in falls from a height. These are often missed if a routine X-ray of the lumbar spine is not always taken in all patients with calcaneal fractures, however minor.

• Calcaneal fractures — A fracture may be unilateral or bilateral. They may be of any gradation from a minor crush, to complete comminution and severe flattening with involvement of the subtaloid (subtalar) joint.

• Fractures of the talus — A fracture of the neck of the talus may lead to avascular necrosis of the body of the talus and secondary osteoarthritis at a later stage.

• Ankle fractures — Any fracture of the ankle may occur. A plafond or comminuted fracture into the lower tibial articular surface, may be due to a fall from a height.

• Pelvic fractures — These vary from a minor fracture of the acetabulum, to compound or comminuted pelvic fractures with damage to neurovascular structures and pelvic organs. • Multiple fractures — Other types of fracture may occur when the force of a fall directly onto the heel is transmitted up to the hip and pelvis and thence to the spine and in particular to the lumbar spine.

• Coexistent fractures — Fractures of the calcaneum and lumbar spine are common and often missed, because the patient may complain more of the painful calcaneal fracture. Lateral X-ray views of the lumbar spine are essential in all cases of calcaneal fractures.

• Central dislocation of the hip — This causes a fracture of the acetabulum with late osteoarthritis.

• Pelvic vertical shear fracture —The sciatic nerve and other pelvic structures, including blood vessels, may be damaged.

• Crush fracture of other vertebrae — These may be missed.

Treatment

This is discussed in the relevant sections of this book, under the individual fractures.

Fractures due to falls from a height

Fracture spine

Central dislocation of- hip

Pelvic shear

Fracture calcaneum

Falls on the hand

Hand and wrist injuries

• Bennett's fracture — This is a fracture dislocation of the carpo-metacarpal joint of the thumb.

• Scaphoid — This may fracture alone, or half of the scaphoid may dislocate with the lunate — the so called trans-scaphoid perilunar fracture dislocation.

• Distal radius — Colles', Barton's and Smith's fractures are common. Forearm fractures

• Radial shaft — This may fracture with or without an associated fracture or dislocation of the ulna.

• Head of the radius — Force transmitted through the lower radius crushes the head of radius on to the lower end of the humerus.

Humeral and shoulder injuries

• Lower humerus — This may cause a comminuted fracture which may split the lower humeral epiphysis.

• Children — A fall on the outstretched hand will often cause a supracondylar fracture.

• Adults — In adults the capitellum may be fractured or the lower humerus comminuted.

• Shaft of humerus —An oblique fracture of the shaft.

• Neck of humerus — In elderly patients fractures of the neck of the humerus are common and are often impacted and stable. Most do not require reduction.

• Dislocation of the shoulder — If the arm is abducted and externally rotated, an anterior dislocation of the shoulder may result. This is common in patients with a limited normal range of external rotation.

Clavicular trauma*

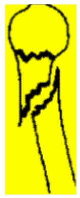
The force of a fall on the hand may be transmitted through to the clavicle.

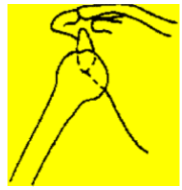
• Clavicle — A fracture is common at the junction of the lateral two-thirds and medial one-third of the shaft.

• Sternoclavicular joint — This may also dislocate.

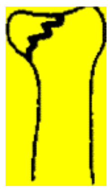
*Most mid-third clav. Fxs treated with sling. ORIF (dynamic compression plate, IM rod with screw) for displaced and shortened Fxs. Maybe be associated with pulmonary and closed- head injuries. Lateral clav. Fx have higher nonunion rate. NB- ORIF with plate may cause catastrophic major vessel rupture/tear.

Falls on the hand





Neck and shaft of humerus

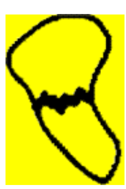


Head radius

- **Supracondylar in children**
- **Intercondylar in adults**

Colles' fracture

Radius and ulna fracture



Scaphoid fracture

Lunate dislocation

Orthopaedic splints

• Aluminium splints — Aluminium and plastic splints are used in both emergency splinting and in the convalescent stages of upper limb injuries. In lower limb trauma they will allow some mobility of the injured joints such as the knee and ankle, whilst still protecting against unwanted movement, such as full extension of the knee in fractures of the tibia or after knee reconstruction.

• Thomas splint — This is usually used for fractures of the lower limb, particularly of the femur. It can also be used for the knee and tibia as an emergency splint.

• Detachable splint — Detachable splints may be made of various plastics, or of other materials. They are used for injuries of the wrist, elbow, knee, tibia and ankle. They are particularly useful in ligamentous injuries to allow limited mobility with protection.

• Calipers — These are removable ‘leg irons’ to support a weak or short leg and may be combined with a toe raising spring or back stop.

Slings

Collar and cuff and triangular slings are used mainly for the upper limb and these have already been described.

Traction

This may include skin traction such as is used in fractures of the femoral neck. Skeletal traction is used where more traction is needed. It is used for some fractures of the shaft of the femur and tibia.

Plastic supports

Plastic supports, particularly the newer lightweight versions are being used increasingly. These are plastics that can be dipped in either hot or cold water and molded to the patient.

• Indications — They have a place where there is not much swelling or following a preliminary treatment with plaster where further support is required.

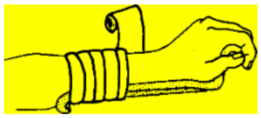
• Advantages — These supports can be permanent or detachable with 'velcro' straps and are lighter and more comfortable than plaster of Paris.

• Disadvantages — The disadvantages of plastic supports are their cost and their difficulty in application. They cannot be molded as well as plaster of Paris.

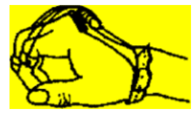
• Spinal supports — There are many neck and spinal supports and some of these are illustrated. They are usually

Orthopaedic splints

Hand and wrist

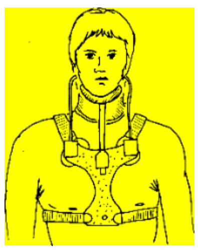


Aluminium cock-up splint



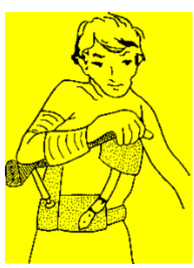
Lively hand splint for nerve injuries and stiff fingers

Cervical spine

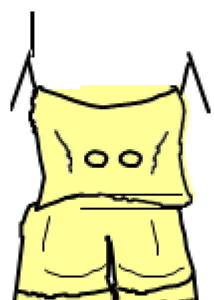


Shoulder

Lumbar spine



Abduction splint-not used so much now



Lumbar support

adjustable and are used to support the cervical, thoracic and lumbar spine.

• Cervical supports — These vary from simple pneumatic or plastic neck supports, which merely give limited support to the neck, to complete halo-thoracic braces to give full support to a fracture of the cervical spine.

• Thoracic supports *— For the thoracic spine, where adequate support is required, a Taylor brace may be used. This has shoulder straps which support the upper and lower thoracic as well as the lumbar spine.

• Lumbar supports — The lumbo-sacral brace gives limited support in stable fractures of the lumbar spine and in back pain and sciatica.

• Miscellaneous spinal supports — Supports which brace the whole spine from the cervical to the lumbar region are used in scoliosis surgery and following arthrodesis of the spine. They include halo- pelvic traction which connects pins in the pelvis to pins in the outer table of the skull.

Hip spicas

Spicas can support the upper femur alone or one or both legs, together with the back. These are used in patients who have severe injuries in the upper femur or following arthrodesis of the hip. A long below-knee spica extending down to the foot will also support the knee and tibia.

Lower limb

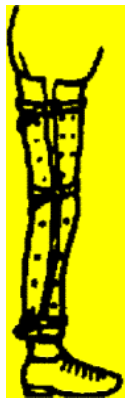
Splints for the lower limb mainly support injuries to the knee and ankle. They include a variety of detachable knee braces used mainly for ligamentous injuries of the knee. Elastic supports and plastic and light-weight metal splints will support collateral and cruciate ligament laxity. Similarly, ankle supports and a variety of footwear are available for lateral ligamentous and other ankle injuries. A pneumatic ankle support, which allows dorsiflexion and plantarflexion, is a particularly comfortable and useful support for ligamentous ankle injuries as it prevents inversion and eversion.

*TLSO, thoracolumbar spina orthosis is often used for (stable) Fxs of thoracic and lumbar spine.

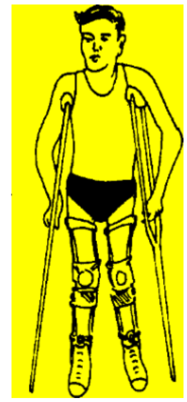
Lower limb supports

Protection for unstable knees and fractures

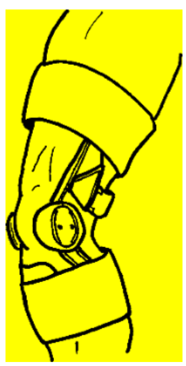
Supports for fractures and paralysis



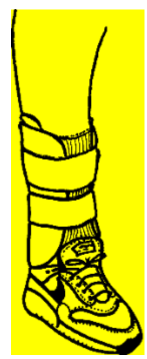
Expanded polyethylene and other plastics



Above knee caliper and boot



Knee support for ligamentous injuries



Pneumatic

ankle support

Plaster of Paris (POP)

• Plaster of Paris —Cheap, easy to apply, for most acute fractures requiring either emergency splinting or immobilisation after manipulation.

Expands on setting.

• Padded backslab — This is applied to splint acute fractures and is completed when the swelling has subsided.

• Full plaster — In the acute stage it should be split along its entire length so that it can be opened if severe swelling occurs.

• Lower limb — A completed plaster may be either weight- bearing or non-weight-bearing.

Types of plaster bandage

Plaster bandages come in the following sizes.

• Hands and arms — 5, 7.5, 10 and 15 cm.

• Legs, hip spicas and plaster jackets — 10, 15 and 20cm. Plaster hardens completely in 24 to 48 hours, but is fairly strong in 1-2 hours and firm in about 5 minutes, depending on the type of plaster. Weight-bearing should be delayed for at least 48 hours to allow the plaster to harden properly.

Preparation of plaster application

It is important that plaster bandages are applied quickly and evenly. Padding with plaster wool and foam is important if pressure sores and other complications are to be avoided, especially in acute fractures where oedema is common. Immersion of the plaster bandage

• Cold water — This is usually used. Warm water can be used if more rapid setting is required.

• Dip the plaster — This is done in the water until the bubbles stop appearing.

• Removing the bandage — The bandage is lifted out of the water and the surplus water drips back into the bucket (not onto the floor!). Squeeze gently to extract water and not plaster.

Application of plaster bandage (see practical demo)

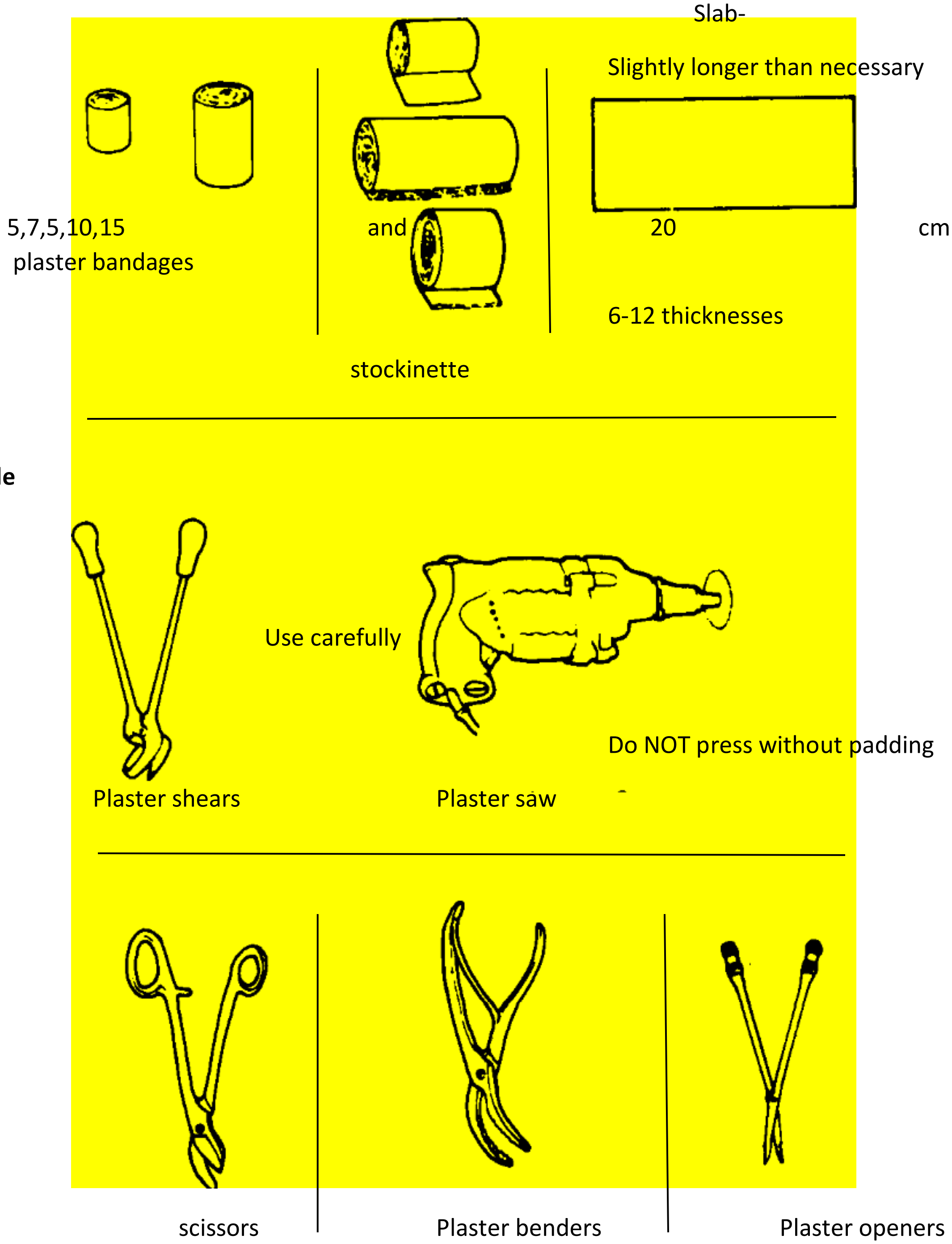
• Acute fractures — Those needing manipulation will usually require a well padded plaster or backslab. A thin layer of plaster wool should be used, plus a stockinette under the plaster. Additional padding with wool or foam should be used over pressure areas.

• Apply the plaster evenly and make sure that the joints are in the correct position. Use a backslab to strengthen a plaster where possible.

• Pad pressure areas carefully with plaster wool or foam plastic. Toes and fingers must be free to move.

Plaster of Paris

Equipment



• Split the plaster(to the skin) or cut a window if there is any possibility of a pressure area, or if oedema is to be expected following application of the plaster. It is better to do this 100 times unnecessarily than risk a single pressure sore with its resulting complications.

Immobilisation

For many fractures the following sites should be immobilised:

• The fracture site itself.

• The joint above the fracture

• The joint below the fracture.

Exceptions to excessive immobilisation

• Certain fractures involving joints (e.g., Colles' and Pott's fractures). These only require the joint itself to be splinted.

• Fractures that usually unite without rigid support (e.g., fractured clavicle, metacarpals and metatarsals).

• Where joint stiffness would be more troublesome to the patient than a poorly immobilised fracture site or a plaster would be too heavy or unnecessary (e.g., neck of humerus).

• Aluminium splints — Always use aluminium splints for finger and minor wrist injuries, where possible.

• Slings — These are used for elbow, humerus and shoulder injuries with appropriate splints if required.

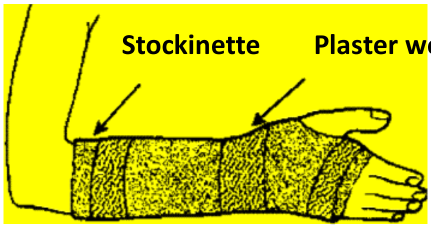
Disadvantages

The disadvantage of plaster is that, unless properly padded, pressure areas may occur. Plaster may also get wet and may break or fragment. In addition, it takes 2 to 3 days to harden properly, so a patient with a lower limb plaster needs to avoid weight-bearing while the plaster is hardening. Completed plasters tend to be heavy and hot, particularly those above the knee.

Plastic materials

There are numerous new waterproof plastic materials available which will harden, after dipping in cold water, in about 5-10 minutes. They come in different colours and are much lighter and stronger than plaster. They are used when manipulation of a fracture is not required. They also allow for almost immediate weight-bearing (see individual fractures for details of splints and plasters).However can have sharp edges around the base of the thumb(need to trim).

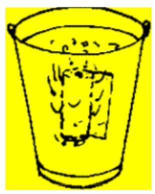
Plaster of Paris Technique



Acute fractures quire adequate wool

Padding

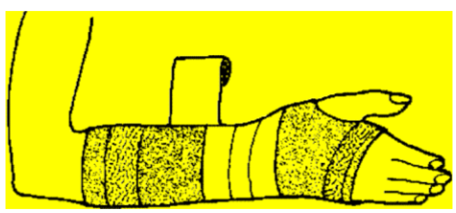
Split plaster for potential oedema



Wait until bubbles cease

Squeeze gently

Dipping plaster



- Application of plaster
- Slab held with elastic bandage
- Complete plaster when oedema settled

Skelecasts

The skelecast is a simple concept of lightweight fixation of the limbs and trunk invented by RLH in 1966. It is based on the premise that most fractures and dislocations merely require 3 or 4 point fixation and not complete encasement with hot, heavy plasters, except where a fracture requires manipulative reduction. It is a brilliant invention but for some reason, seldom used now.

Advantages

There are many advantages in using the skelecast including:

• Skin — The ability to inspect the skin. This is particularly important if there are vascular and neurological complications or infection. The skin can be seen, wounds can be dressed and radiotherapy can be given.

• Skin and muscle tone — This is maintained with earlier union of fractures in most cases.

• Adjustment — The ability to tighten, loosen or change individual struts means better fixation, in most cases, than with complete encasement in plaster.

• Lightweight and waterproof — Skelecasts are lightweight, cool and can be easily adjusted or removed and are usually made of waterproof plastics or other materials. This enables patients to have daily showers, to swim, and often to return to work.

• Joint mobility — Hinges can be incorporated in the knee and elbow to allow for even better mobility.

• Contraindications — They are not indicated when manipulation of a fracture is necessary. In most weight- bearing supports they are not as strong as a complete plaster wrap.

• Union of fractures — Many thousands of skelecasts have been applied since this concept was first developed by the author in 1966. The average time of union of fractures is approximately two-thirds of the equivalent time of complete plaster encasement. This is presumably due to the better tone of muscles, the increased use of the limb and the good skin care in limbs supported by skelecasts. Joints regain their movement much more rapidly following removal of a skelecast, even without a hinge, compared to plaster immobilisation.

Disadvantages

Skelecasts require more skill in the application and are not indicated in most acute fractures requiring manipulation.

Types of material

Thermoplastic skelecast

Thermoplastic bandage in hot water 60-80½C Apply strips over foam padding

Light cast skelecast

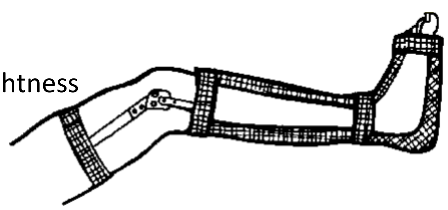
Light cast bandage 2.5 cm-15 cm bandages
+
Light source 3,2000-4,000 A
Hardens 15 seconds-cures 3 minutes

Polyester resin skelecast

- Polyester resin putty + hardener — impregnate fibreglass tape or bandage
- Cheap and useful for developing countries

Hinged skelecast

Adjustable for tightness



Hinge preventing last 20½ of extension

They are also not as strong as a completed plaster or complete plastic splint for weight-bearing.

Removal and X-rays

The supports can be removed easily by simply cutting through the struts with ‘tin snips’, and in most cases, X-rays can be taken through the gaps in the skelecast without removing the skelecast, as is often necessary with plaster. Deep X-ray therapy can also be given for pathological fractures.

Acute fractures

• Oedema — In acute fractures oedema is controlled initially by merely putting a little wool and an elastic compression bandage around the limb and the struts until the swelling has settled.

• Contraindications — Skelecasts are not usually indicated where a complete wrap is necessary after a manipulation of fracture. The skelecast can be applied, however, as soon as the fracture is sufficiently stable, to enable the support to be changed without the danger of the fracture slipping.

Material

The skelecast can be made out of a variety of materials, as illustrated. Many of the newer plastics can be used. These include thermoplastics which are softened in hot water at 65- 80°C. They are applied to the patient as struts directly over waterproof lining. Some cold water plastics can also be used. They are dipped into cold water and applied directly to the patient in the form of struts. Ordinary hardware shop polyester resin, or a light sensitive polyester resin, can also be used. Newer materials are constantly being developed. The one most suited, and available, should be used.

• Longitudinal struts — These are usually thin aluminium struts covered by one or two layers of the plastic or other material used in the manufacture of the support. The exact type of plastic or metal used is unimportant, provided that good rigid fixation is obtained. The support should also be waterproof and strong, and the points of contact between the struts are properly molded and strengthened if necessary.

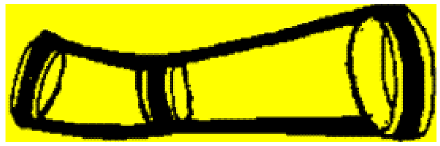
Indications

Upper limb

• Specific indications —The scaphoid skelecast is ideal. Other suitable indications for this type of support include above- elbow skelecasts for the radius and ulna following internal fixation of fractures. The Colles' type of skelecast is also

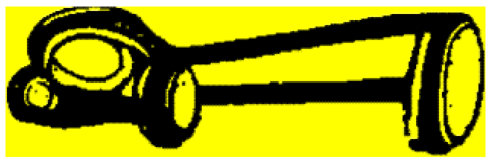
Skelecasts Upper limb

Colles' fracture type



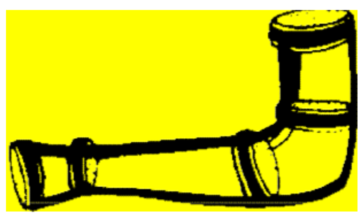
Elastic bandage over wool for oedema

Scaphoid fracture



- Cast is waterproof and light
- Patients can bathe and swim

Above elbow



Adjustable by cutting struts and repairing

indicated for fractures of the wrist not requiring manipulation.

• Other indications — Injuries of the upper limbs which do not have much swelling, such as the wrist, radius, ulna and elbow, after initial treatment by internal fixation or plaster, respond well to protection with a skelecast.

Lower limb

• Indications — In the lower limb the cylinder skelecast for knee injuries, and above and below the knee skelecasts for fractures of the tibia and ankle. These supports are particularly indicated for protecting the lower limb where only non-weight-bearing or partial weight-bearing is planned. A complete plastic wrap is indicated for patients who require a stronger support.

Other indications

• Children — In children with congenital dislocation of the hip and other hip lesions, a waterproof skelecast hip spica allows immobilisation with lightness and mobility.

• Compound fractures — They are particularly useful in compound fractures, or in the case of wounds. The struts can be easily positioned so that the skin can be seen and dressings changed. In those cases where the fracture is being held by external pins, fixation can be strengthened by the plastic skelecast struts.

• Neurological deficit — In patients with diminished sensation, such as in nerve injuries and paraplegia, the ability to see the skin under the struts diminishes the likelihood of pressure sores occurring.

• Radiotherapy — In patients with secondary deposits with a pathological or potential pathological fracture a skelecast will enable radiotherapy to be given.

• Post-operatively — In the operating theatre, for patients undergoing operations such as a patellectomy, screwing of an ankle fracture or internal fixation of fractures of the radius and ulna, lower humerus or olecranon, a plaster backslab over wool should be applied for about 3 days. After the suction drain has been removed, and the post-operative oedema has diminished, it is a simple matter for a skelecast to be applied. The wound can be viewed and sutures removed without removing the support.

Method of application

The method of application of a skelecast is illustrated on page 277, and is relatively simple. It often takes longer to apply

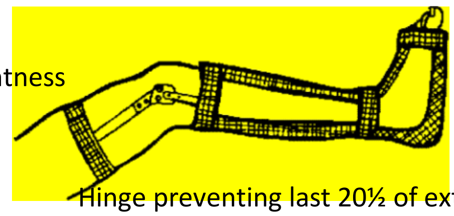
Skelecasts

Above-knee skelecast

Adjust strips for dressings

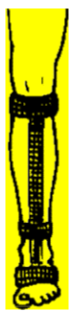
Hinged skelecast

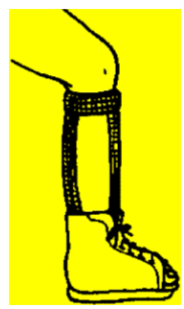
Adjustable for tightness



Hinge preventing last 20½ of extension

Partial weight-bearing skelecast





Overboot

Complete plastic wrap to allow full weight-bearing

than a simple complete wrap of plaster or synthetic material, but its many advantages more than compensate for this. Patients who have experienced a skelecast will not return to plaster fixation.

• Lining — Firstly, thin strips of waterproof lining, in one layer of thickness, are put around the arm or leg, as illustrated, and overlapped slightly and held with strips of tape.

• Circular struts — While one circular strut is being applied, the next is dipped for a few seconds in hot water at about 70°C by an assistant. Some cold water plastics can be similarly dipped. It is important that each circular strut be carefully molded and made to adhere to itself before the next one is applied. All the circular and longitudinal struts should be cut to the right length from 5 or 7.5 cm wide plastic, before they are dipped. It is then a simple matter to dip each one in turn in the water, lay it on a towel, fold it on itself 2 or 3 times and then apply it directly over the lining. Rubber gloves are not necessary due to the low conductivity of the plastic but can be worn to protect the hands. A special water soluble lubricant supplied prevents the thermoplastic sticking to the gloves.

• Longitudinal struts — After application of the circular strut, 2 or 3 longitudinal struts of aluminium strips, about 1-1.5 cm in diameter, covered with a layer of thermoplastic and cut to the correct length and overlapped by about l cm at each end by the plastic, are dipped into the hot water. These can then be applied to the patient. Extra circular strips of thermo- plastic, or other plastic or polyester resin, are then applied to hold the longitudinal struts in place. It is important that these are carefully molded at the joints with the longitudinal struts, and to the circular struts to make sure they adhere.

• Removal — Individual struts can be easily removed for X- ray or radiotherapy. Circular struts can be cut or opened out for oedema or closed in. The area can be repaired later with an epoxy resin glue or the original material.

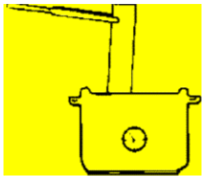
• Hinges — A hinge for elbows and knees can be inserted to allow for flexion of the joint. The last 20°-30° of extension can be prevented if necessary.

Conclusion

A skelecast, if applied properly and carefully and for the correct indications, is superior to complete encasement with plaster-of-Paris or other plastic material where a fracture has not needed to be manipulated. It has a potential for application of over 50% of all fractures and for many other orthopaedic conditions.

Thermoplastic skelecasts

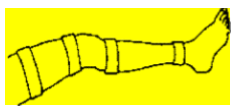
Technique



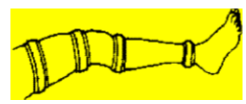
- Water 65-80½ for thermoplastics
- Dip thermoplastic briefly into water

Towel

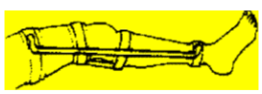
- Fold hot plastic into 2 or 3 thicknesses
- Aluminium covered plastic with 1 cm overlap at ends



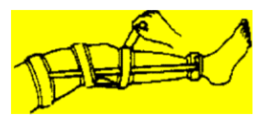
Waterproof lining



Circular strips of plastic



Longitudinal strips of covered aluminium



Further circular strips

Complications of trauma

Injuries may involve not only bones, joints, nerves, blood vessels and muscles but also the brain, spinal cord, lungs and heart, together with the abdominal and pelvic organs. Bone and joint complications-

Delayed and non-union*

• Poor blood supply — This is the most common cause of delayed and non-union. The head of the femur, the proximal half of the scaphoid and the body of the talus are particularly prone to avascular changes due to their mainly peripheral blood supply being interrupted.

• Other causes — These include excessive movement at the fracture site, interposition of soft tissue between bone ends, infection and pathological bone, such as in secondary deposits from carcinoma and due to Paget's disease.

• Over-distraction — This, together with operative periosteal stripping, may also delay bony union.

Mal-union(crooked)

• Radius and ulna — This is a particularly important complication as it affects forearm rotation.

• Femur and the tibia — Malalignment may result in osteoarthritis due to asymmetrical weight-bearing on the hip, knee and ankle.

UPDATE, 2022-Tibial Spine Fxs in children can be considered as same as adult ACL injuries. Stiffness (arthrofibrosis) and instability are common (over 50%). -Non-displaced tuberosity Fx is non-op treatment -Proximal tibial metaphyses Fxs (Cozen fractures), where minimally displaced can manifest as late genu valgum that spontaneously resolves. -Toddler’s Fx is a non displaced oblique/spiral tibial shaft Fx which can be thought to be osteomyelitis. Treat with long leg cast(repeat XT at 2 weeks to confirm callus and so diagnosis). -Tillaux Fxs ar SH III, do CT.> 2mm displacement then ORIF. Triplane Fx is SH IV. Do CT.>2mm displacement then ORIF.

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General complications

Bones

Head of femur

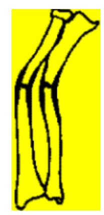
Impaired blood supply

Delayed and non-union

Scaphoid

• Avascular necrosis
• Nonunion

Radius and

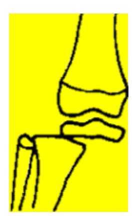


• Mal-union
• Cross-union

Tibia and fibula

Shortening

Epiphyseal damage



Growth disturbances

compound fractures

Osteomyelitis

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Osteomyelitis

Compound fractures are particularly likely to lead to osteomyelitis. This is difficult to treat and may lead to non- union and shortening. Fractures may also become infected following operations for internal fixation.

Joint stiffness and pain

• Joint injuries — Stiffness may be a complication.

• Prolonged immobilisation — Particularly in plaster.

• Prolonged traction — Especially of the knee.

• Common sites — The shoulder and metacarpophalangeal joints, if immobilised for more than three weeks.

Miscellaneous bone and joint complications

• Instability — This is common in the knee and ankles, due to ligamentous injuries and wasting of muscles.

• Osteoarthritis — This is common in incompletely reduced fractures, particularly in the joints.

• Asymmetrical weight-bearing — This includes a varus or valgus deformity with secondary degenerative arthritis.

• Avascular necrosis — This may follow subcapital fractures of the hip, neck of the talus and neck of the scaphoid, with secondary osteoarthritis.

Neurological complications

Spinal cord

• Thoracic region — The spinal cord is often completely transected in the thoracic region following minor displacement, as it is a tight fit in the spinal canal.

• Cervical and lumbar — Cervical nerve roots and the cauda equina are more likely to be damaged than the cord.

• Thoraco-lumbar — In this region, both the spinal cord and nerve roots may be damaged.

Upper limb

• Brachial plexus injuries — These have a poor prognosis and often follow falls on the shoulder.

• Axillary nerve — This may follow fractures or dislocations of the shoulder.

• Radial nerve — Damage commonly follows fractures of the mid-shaft of the humerus and usually recovers.

• Ulnar nerve — Paralysis is often due to fractures of the medial epicondyle of the humerus.

• Median nerve — This may be injured in wrist fractures and lunate dislocations.

Shortening

• Lower limb — In fractures of the tibia and femur, this may cause a limp and secondary low back pain.

• Apparent shortening — This may also occur due to an adduction deformity of the hip, or fixed flexion of the knee.

Growth disturbances

• Epiphyseal injuries — Growth disturbances are common in children following trauma.

• Shortening or deformity — This may result from premature or asymmetrical fusion of the epiphyses. Fractures of long bones, such as the femur in children, may conversely lead to overgrowth of up to 2 cm in the affected leg.*Non-union can be (Weber-Cech classif.) hypertrophic, oligotrophic, atrophic. Treatment difficult-treat infection, improve nutrition, correct vit D defic., correct deformity, provide stability, ?bone graft, flaps, ?bone morphogenetic protein, U/S,EMG.

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General complications

Joints

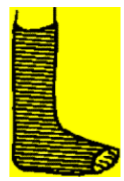
Old ligament injury

Incomplete reduction

Instability

Osteoarthritis

Prolonged immobilisation



Stiffness, pain, secondary osteoarthritis

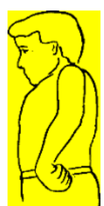
Plaster of Paris pressure areas

Nerve injuries

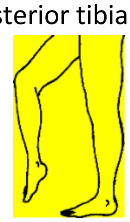
Spinal cord

Upper limb

Lower limb



- Sciatic
- Common peroneal and posterior tibial nerves



Brachial plexus axillary, radial, ulnar and median nerves

Lower limb

• Sciatic nerve — This is commonly damaged in posterior dislocations of the hip and in pelvic fractures.

• Common peroneal nerve — This is commonly injured in fractures of the neck of the fibula, and in knee dislocations.

Vascular complications

Upper limb

• Supracondylar fracture of the humerus, Age group 6-7 yrs. Very young may present as pseudoparalysis. Don’t confuse with elbow dislocation (rare in children). May damage the brachial artery.

• Compartment syndrome with ischaemia of the flexor muscles — This is due to oedema or to bleeding into the flexor compartment of the forearm following a supracondylar fracture. It is a surgical emergency, and all cases of displaced supracondylar fractures in a child, and fractures of the lower humerus in an adult, require admission to hospital.

Limitation of extension of the fingers, with pain, is the earliest clinical indication of ischaemia of the forearm flexor muscles. Urgent reduction of supracondylar fractures, and decompression of the flexor compartment if necessary, is required (see pages 243-245). Exploration of the brachial artery should be considered, plus repair or reconstruction, if necessary. Failure to treat this complication can lead to a Volkmann's ischaemic contracture, or even gangrene of the hand.

Lower limb

• Supracondylar fractures of the femur — These may cause damage to the popliteal vessels. The popliteal artery has a poor collateral blood supply and may lead to ischaemia of the calf muscles and gangrene of the toes, similar to the brachial artery causing ischaemia to the upper limb.

• Dislocation of the knee — Vascular injury present in 5-15% of dislocations. Selective arteriography along with physical exam (including ankle brachial index < 0.9) rather than immediate arteriogram is now the standard (2022).Intimal damage with thrombosis is common and may require a vein graft.

• Need emergency reduction(easy) and reconstruction of ligaments.

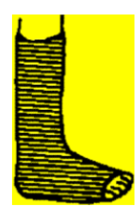
• Disruption of the pelvis — This is particularly liable to lead to massive retropelvic bleeding.

Vascular injuries

Supracondylar fracture humerus

• Supracondylar fracture femur

• Dislocation knee



Tight plaster

Other fractures of limb and trunk can cause compartment syndrome.

Other complications

Myositis ossificans — especially in dislocated hips and elbows

• Head and spinal injuries

• Chest injuries: lung, heart, major vessels, diaphragm

• Abdominal and pelvic injuries: including stomach, pancreas, intestine, liver, spleen, kidney and bladder

• Major vessels and other organs

• Other limb injuries

Miscellaneous complications

• Plaster of Paris — An unpadded or poorly fitting plaster may cause a vascular compromise and pressure sores.

• Local complications — These include traumatic ossification or myositis ossificans due to calcification, followed by ossification in a haematoma following a fracture, joint dislocation or periosteal damage. This is particularly common if there is associated neurological damage.

• General complications — These include respiratory obstruction in head, jaw and chest injuries. Other complications are shock, fat embolus, and the crush syndrome following abdominal, pelvic and limb injuries.

Details of the complications associated with head, chest, abdomen, spine and limb injuries and their treatment are discussed in the individual sections of this book.

Chapter 5

Upper limb injuries

Fingers injuries (minor)

Subungual haematoma

Treatment

• Pierce the nail — A sterile implement, such as the heated tip of a needle or a paper clip, may be used to release the blood collection. Tendon injuries and fractures should be excluded. No anaesthetic is necessary.

• Immobilisation — The finger may be strapped with an elastic adhesive bandage for one week ensuring that the fingertip is visible. The finger should be moved frequently. Sprained or bruised fingers may be strapped for support in a similar fashion.

Mallet finger

This occurs with a forced flexion injury of the terminal phalanx, typically when the fingertip is struck by a ball.

Diagnosis

There is either avulsion of a slip of bone at the insertion of the extensor tendon into the terminal phalanx, or rupture of the extensor tendon near its insertion.

Treatment

Splint the finger with the distal interphalangeal joint hyperextended for 4 weeks. Only 50% recover. There is only minimal disability from the residual 30° flexion deformity of the terminal phalanx.

Simple plastic mallet finger splints are available in different sizes (see page 287). It is important that splinting is not interrupted during immobilisation. Patients should be warned of the high failure rate of treatment.

Dislocated finger

Treatment

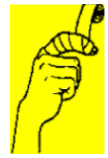
• Reduction — Reduce with smooth firm pull, with an elastic adhesive bandage on the fingers to improve grip. A digital nerve block without adrenaline can be used in adults, a general anaesthetic in children, and sometimes no anaesthetic in suitable patients.

• Immobilisation — The finger is immobilised for 1-3 weeks in slight flexion with a splint made of padded aluminium. It diminishes the stiffness and pain, which is common.

Finger injuries

Sprained and bruised fingers

Subungual haematoma

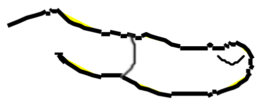


Elastic adhesive strapping

Mallet finger

Avulsion fracture

Extensor insertion rupture



Mallet finger splint

Dislocated fingers

Isolated dislocation

Aluminium splint for immobilisation

Fracture dislocation

Screw or Kirschner wire

• Energetic active exercises — These are used to regain movements. Support the joint with an elastic adhesive bandage to prevent swelling for 2-3 weeks after the splint is removed.

Fracture of the distal or middle phalanx

Treatment

• Reduction — Reduce only if there is significant displacement.

• Immobilisation — Immobilise for 1-3 weeks in slight flexion with a padded aluminium finger splint.

• Internal fixation — This will be required if there is joint involvement or residual angulation or rotation.

• Energetic active exercises — These are required after removal of the splint. The site should be supported with an elastic adhesive bandage for 2-3 weeks.

• Operative fixation — If a completely congruous surface or significant angulation cannot be obtained by closed manipulation, screws or Kirschner wire fixation is essential, particularly in young patients.

Fractures of the proximal phalanx

Treatment

• Reduction — Most fractures do not require manipulation. If this is necessary it is important always to correct malrotation as well as angulation.

• Internal fixation — Screw fixation or Kirschner wire insertion may be necessary if the fracture extends into the joint, and is angulated or rotated after reduction.

• Immobilisation — Immobilise for 2-3 weeks with the metacarpophalangeal joint well flexed and the interphalangeal joints slightly flexed. The finger should be supported by a padded aluminium splint extending into the palm and held with 2-3 layers of an elastic adhesive bandage.

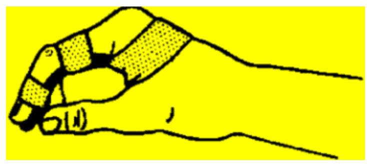
• Energetic exercises — These are necessary, irrespective of the fracture position, after removal of the splint. Elastic adhesive strapping may also be helpful to minimise oedema initially.

UPDATE, 2022. Biceps tendon rupture- may be of the upper tendon with a “pop-eye” appearance- surgery not required. But for the lower tendon, loss of supination power(easily missed),just about always re-attach to bicipital tuberosity.

Fracture of proximal phalanx

Not involving joint

Involving joint



- Padded aluminium finger splint held into palm
- Hold by elastic strapping
- Flexed metacarpophalangeal joints

Internal fixation with a plate, screws or Kirschner wire only if closed manipulation unsuccessful

Multiple fractures of the fingers

Treatment

• Reduction — Closed reduction is usually sufficient in most cases. Open reduction with Kirschner wire, or screw fixation, may occasionally be necessary.

• Immobilisation — A pad of wool is then placed in the palm, together with an elastic bandage, to hold the metacarpophalangeal joints well flexed and the interphalangeal joints near extension.

• Energetic active exercises — These should commence after

3 weeks, irrespective of the position of the fractures.

Compound fractures of the fingers

Treatment

• Reduction — Reduce if necessary and close the wound if clean.

• Immobilisation — Immobilise with a well padded aluminium splint, as for simple finger fractures.

• Energetic active exercises — These should be started following removal of the splint.

• Antibiotics and tetanus toxoid — These are usually required.

Stiff or extensively infected fingers

Treatment

• Preserve thumb — It is important always to preserve as much of the thumb as possible, irrespective of stiffness or infection. This may require later skin and bone grafting.

• Amputation — This may be indicated if a finger is stiff or badly infected. An amputated finger is preferable to a stiff and useless hand. Never amputate the thumb.

• Immobilisation — Injured hands should always be elevated and movements commenced as early as possible. Never immobilise for more than 3 weeks. Remember always to flex the metacarpophalangeal joints well.

• Internal fixation — Fixation with Kirschner wires, screws or small plates is occasionally indicated for severe fractures or dislocations of fingers where non-operative measures have failed, especially where the joint is involved.

Aluminium cock-up splint

A padded aluminium front splint with the wrist dorsiflexed about 30° is useful for many hand, wrist and lower forearm injuries, as either an emergency or definitive support.

Major finger injuries

Multiple fractures

Treatment: reduction and immobilisation flexed metacarpophalangeal joints

• Stiff or extensively infected thumb

• NEVER amputate • Debridement

• Antibiotics • Reconstruction

CHILD. NOT so good for- single digit, crushed/mangled, multi- system problems. Sequence - stablise bone/repair extensors/connect arterial/connect venous/nerve repair/skin close.

291 **Upper limb injuries**

Complications of finger injuries

Stiff fingers

This is a common complication following prolonged immobilisation, particularly in the elderly, and in those patients where the metacarpophalangeal joints have been immobilised in full extension.

Treatment-need specialised hand therapy or patient simply squeeze a soft tennis-type call over 20 types day.

• Prevention — Always immobilise fingers with the interphalangeal joints in slight flexion together with 90° of flexion at the metacarpophalangeal joints. Early mobilisation is important within three weeks.

Infection and osteomyelitis

These may complicate contaminated wounds and compound fractures.

• Prevention — Administration of prophylactic antibiotics is indicated.

• Treatment — Early surgical debridement should be carried out, and internal fixation considered for displacement.

Tendon damage

Tendons may rupture or be damaged by a penetrating injury.

• Extensor tendons — These may be sutured as a primary procedure.

• Flexor tendons — Divided flexor tendons should be carefully repaired followed by early movements to prevent adhesions in the flexor sheath between flexor profundus and flexor superficialis, In late cases a second stage tendon graft may be required if both flexor tendons are divided in the flexor sheath. In the case of division of the flexor superficialis alone, this may be excised so that the flexor profundus can act on its own without the danger of adhesion to the superficialis.

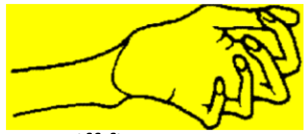
Nerve damage

All divided digital nerves, particularly those supplying the thumb and radial side of the forefinger and ulnar side of the little finger, should be sutured by microsurgical techniques at the time of the accident, particularly in young patients. This is because it will be very difficult to perform a repair as a secondary procedure.

UPDATE, 2022, Fingertip injuries are common and if well managed early avoids long term problems. Nail matrix may need to be repaired. Three types of amputations-transverse, dorsal, volar oblique.

Finger injuries

Complications



• Stiff fingers

• Stiff extended metacarpophalangeal joints

Infection and osteomyelitis

• Tendon division

• Digital nerve division

Fingertip injuries (ctd).Principles-Preserve length (esp. for thumb AND IN CHILDREN) as much as possible, early wound closure (you may need to shorten bone to close WITHOUT tension), simple flaps (such as V-Y for trans. amputations) are very effective. Involve the hand surgeons.

Metacarpal fractures*

Classification

• Fracture of metacarpal neck

• Fracture of the metacarpal shaft

• Bennett's fracture — fracture-dislocation of the base of first metacarpal. Fracture of the metacarpal neck

Treatment

• Reduction — This is necessary only if there is severe angulation, and is usually achieved by flexing the proximal phalanx to correct the anterior angulation of the metacarpal head. Up to 20°-30° of the anterior angulation is acceptable, with minimal or no appreciable residual disability.

• Immobilisation — 2-3 weeks with a padded aluminium front splint with the metacarpophalangeal joint flexed to a right angle if possible. The splint should be extended from distal phalanx to mid palm. An aluminium front splint made out of a 'T' splint can give useful support, particularly in fractures of the neck of the 5th metacarpal. A simple aluminium front splint or an elastic bandage may be sufficient for most fractures with minimal displacement.

• Energetic active exercises — These should follow the period of immobilisation.

Fracture of the metacarpal shaft

Treatment — most fractures

For all metacarpal fractures except for fractures of the first metacarpal and the necks of metacarpals 2-5.

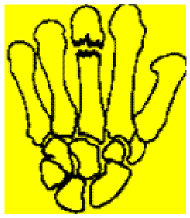
• Reduction — This is not usually necessary. Severe cases may require a Kirschner wire or a small plate with screws.

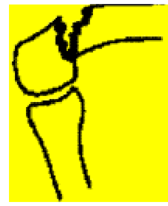
• Immobilisation — 2-3 weeks in an aluminium cock-up splint. An elastic bandage, however, is all that is required for most cases, as the other metacarpals act as a splint. A collar and cuff sling should be used for the first few days to diminish swelling. Occasionally a Colles' type plaster may be required.

• Energetic active exercises — This should follow after 2-3 weeks of immobilisation.*NB realignment of fingers and metacarpals-flexed digits ALL point towards scaphoid tubercle, NOT parallel down forearm.

Fractures of the metacarpals

Metacarpal neck





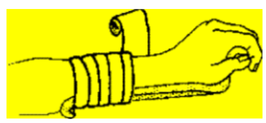
Reduction

Only in severe angulation

Flex proximal phalanx and push backwards

Padded aluminium front splint

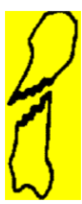
Treatment



• Cock-up splint or elastic adhesive bandage.

• Exception — 1st metacarpal and necks 2nd-5th metacarpals

Severely displaced metacarpal shafts



Kirschner wire or plate

Badly displaced fractures

• Internal fixation — These may require internal fixation with wire or small plates, especially if associated with other injuries.

It is important in all these cases to keep the metacarpophalangeal joints well flexed post-operatively.

• Immobilisation — This is not necessary for more than 3 weeks.

• Energetic active exercises — These are essential as soon as the fracture is stable.

Bennett's fracture

This is a fracture dislocation at the base of the first carpo- metacarpal joint. It is essential that this fracture be accurately reduced, as the mobility of the thumb is largely dependent on this joint, and osteoarthritis may result from an irregular carpo-metacarpal joint.

Diagnosis

There is tenderness, swelling and loss of movement of the first carpo-metacarpal joint.

• X-ray — This shows a fracture into the joint, with lateral and proximal displacement of the first metacarpal.

Treatment

• Reduction — This is achieved by traction on the thumb, with full adduction and pressure over the fracture site. Note that in the past abduction, rather than adduction, was advocated, but in many cases adduction produces a better reduction. Accurate reduction is essential.

• Immobilisation — 4 weeks in a complete 'scaphoid' type plaster extending to the interphalangeal joint, with the thumb fully adducted, and pressure over wool over the fracture itself. The site should be well padded.

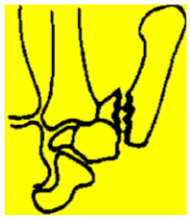
• Open reduction and internal fixation — This is necessary if manipulation fails to obtain a good reduction. The fracture is held by a Kirschner wire or screw until united.

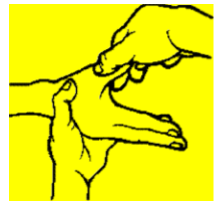
• Energetic active exercises — Essential after the plaster is removed. An elastic adhesive strapping of the joint for about a week is also beneficial.

Complications

Stiffness, pain and osteoarthritis may ensue if reduction has been incomplete, or if physiotherapy has not been carried out after the plaster is removed.

Bennett's fracture





Reduction

Immobilisation

Kirschner wire

Screw fixation

Scaphoid fractures*

Diagnosis

This is initially made by the finding of tenderness over the anatomical snuff box and not only by X-ray. 'Telescoping' the 2nd or 3rd metacarpals proximally may also cause pain over the scaphoid.

• X-rays — These must include an AP, lateral and 2 oblique views. X-rays sometimes shows nothing in the first 3 weeks. An ununited scaphoid is always very difficult to treat properly, and avascular changes in the proximal fragment can ruin a wrist joint. All fractures of the scaphoid must therefore be treated on suspicion. Do not, however, unnecessarily immobilise an old scaphoid fracture. Evidence of an old fracture may be a previous history of injury, sclerosis at the fracture site or cyst formation on X-ray.

Differential diagnosis

• Fracture of the radial styloid (Chauffeur's Fx) — This usually causes tenderness more proximally.

• De Quervain's tenosynovitis — Tenderness and pain are present over the radial styloid on extending the thumb against resistance. The tenderness is also more proximal than the scaphoid.

• Bennett’s fracture — The pain is more distal than the scaphoid and situated over the base of the metacarpal itself.

Treatment

Scaphoid fracture confirmed on X-ray

A ‘sprained wrist’ is uncommon and is often due to an undiagnosed scaphoid fracture.

• Immobilisation — A scaphoid plaster or skelecast left on for 8 weeks. The wrist is then re-examined and another X-ray taken.

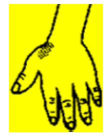
• Tenderness — If the anatomical snuff box is still tender after 8 weeks, or the X-ray does not show trabeculae across the fracture site, another scaphoid plaster or skelecast should be applied for a further 4 weeks before removal and another X-ray carried out.

• Internal fixation — All displaced fractures and all trans- scaphoid perilunar fracture dislocations should be treated by internal fixation with a Herbert compression screw or equivalent internal fixation.*Scaphoid Fxs are full of trouble, due to its retrograde blood supply and its disruption by the Fx.

Fracture of the scaphoid

Diagnosis

Tender anatomical snuff box.

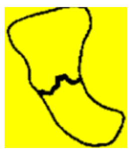


Pain over scaphoid

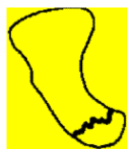
telescoping 2nd or 3rd

fingers proximally

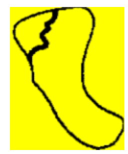
Types



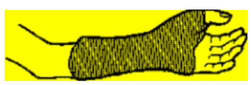
Waist



Proximal pole



Tuberosity



*Scaphoid nonunion advanced collapse (SNAC) wrist is where untreated chronic scaphoid nonunion leads to post-traumatic OA.

Non-union (*page 299).

• Elderly patient — If there is non-union after 3 months treatment in an elderly patient the position may be accepted, and the patient treated with a detachable scaphoid splint or the fracture should be internally fixed.

• Internal fixation — in most cases internal fixation with a compression screw with bone graft is necessary for old ununited fractures.

• Avascular scaphoid — Cases which have progressed to non-union with an avascular proximal fragment should be treated with screw fixation, plus bone graft, or with a prosthetic scaphoid replacement. A destroyed wrist may require arthrodesis, especially in a young patient.

Suspected scaphoid fracture

• X-ray negative — If there is pain in the anatomical snuff box, the wrist should be put into a scaphoid support or cock- up splint. This is removed at 3 weeks for further X-rays. If a fracture is seen it is treated as above.

• Bone scan — If there is doubt about a fracture, a nuclear bone scan, with technetium radioisotope, will help confirm the diagnosis.

Fracture of the scaphoid tuberosity

This has a good blood supply and usually heals well in 3 weeks in either a scaphoid or Colles' type plaster.

Complications

Non-union

This should be treated by screw fixation and bone grafting. It may be left untreated in an elderly asymptomatic patient.

Avascular necrosis

Avascular necrosis of the proximal fragment may destroy the wrist and lead to severe osteoarthritis.

• Prosthetic scaphoid — This may be used, but has only a place in elderly patients. Alternatively, the avascular fragment or the proximal row of carpal bones may be excised. Both procedures, however, are often unsatisfactory and may lead to a painful stiff wrist.

• Excision of the radial styloid — This is a fairly small procedure and has a place in some cases.

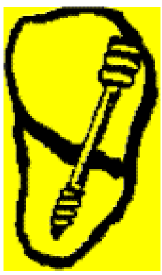
• Arthrodesis — Arthrodesis of the wrist is probably the best procedure in the case of a working labourer who requires a strong painless wrist and has avascular necrosis of the scaphoid and osteoarthritis.

Complications

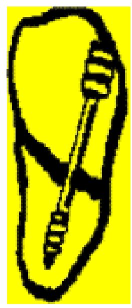
Fibrous union

Non-union

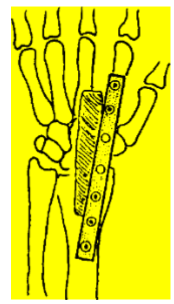
Avascular necrosis



Herbert compression screw fixation



Screw fixation and bone graft



Arthrodesis of wrist or excision proximal row carpus

Lunate dislocations

Dislocation of the lunate is a surgical emergency and the method of dislocation and management is illustrated. The lunate may be dislocated alone or associated with a scaphoid fracture, as in the trans-scaphoid perilunar fracture dislocation. Sometimes other carpal bones, such as the triquetral or the capitate, may also be fractured. In dislocation alone, the lunate may be displaced forward and the wrist may stay intact, or the lunate may be left in place, and the whole wrist and carpal bones displaced backwards. The most important complications, particularly with a forward dislocation of the lunate, is pressure of the lunate on the median nerve.

Diagnosis

• Clinical —The wrist is very swollen and painful, with limitation of movement. This is unlike a fracture of the scaphoid where tenderness and swelling may often be minimal.

• Median nerve — In median nerve compression there is numbness of the thumb and the radial two and half fingers, together with weakness of the thenar muscles.

• X-ray — Lateral X-ray views show the lunate either displaced forwards with the wrist intact, or the lunate in place and the whole wrist displaced backwards. In either case the lunate may appear anterior to the other carpal bones. On AP X-ray views a dislocated lunate will appear triangular rather than its usual quadrilateral shape. If in doubt, X-rays of the opposite wrist should be taken as a comparison.

Treatment

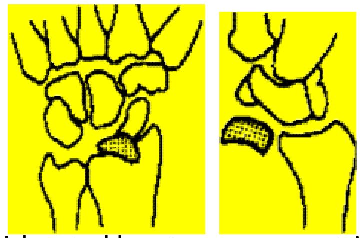
• Reduction — This is achieved by prolonged traction followed by dorsiflexion of the wrist to open up the carpus. Pressure is then applied by the thumb on the dislocated lunate, and the wrist is flexed fully.

• Open reduction — If closed reduction fails, open operation and replacement may be necessary. Avascular change is an important complication.

• Immobilisation — The wrist is held palmar flexed for 3 days with a padded backslab, followed by a complete Colles' type plaster with palmar flexion for 3 weeks. The arm should be kept elevated to reduce swelling. It is then held in a neutral position for a further 3 weeks.

Lunate dislocation (easily missed)

Normal wrist — lunate appears quadrilateral

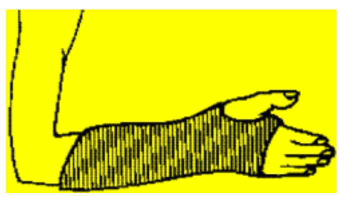


Dislocated lunate — appears triangular

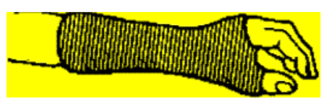
Initial immobilisation

Immobilisation in a backslab followed by a Colles' plaster

Further treatment After 3 weeks



Lunate dislocation — Colles' plaster in neutral position for further 3 weeks



Transcaphoid perilunar fracture- dislocations —initial internal fixation, otherwise a scaphoid plaster

Trans-scaphoid perilunar fracture dislocation

• Initial treatment —This is identical with the treatment of a dislocation of the lunate for the first 3 weeks, but only if accurate reduction is obtained. This is seldom possible, however, and internal fixation is usually indicated.

• Further treatment — The wrist is then straightened and put into a scaphoid type plaster for at least another 5 weeks.

• Internal fixation of the scaphoid — A Herbert compression screw and Kirschner wires are often necessary.

Complications of lunate dislocations

• Median nerve injury — This usually recovers after reduction of the dislocation.

• Electromyographic studies. These should be carried out if in doubt. Emergency surgical decompression of the nerve may be required.

• Avascular necrosis of the lunate — Excision of the lunate may be necessary, together with the proximal row of carpal bones, or alternatively, prosthetic replacement of the lunate.

• Pain, stiffness and osteoarthritis — Avascular necrosis of the lunate or the scaphoid may require arthrodesis of the wrist. A wrist support and physiotherapy should initially be tried before operation.

Fracture of the triquetrum*

Diagnosis

This is clinically an insignificant fracture. There is usually tenderness over the dorsum of the wrist in the midline and the fracture is often missed. A tiny chip fracture can be seen on the dorsum of the wrist on X-ray.

Treatment

Treatment is by a simple aluminium cock-up splint or by a Colles' type plaster for 3 weeks.

Other carpal fractures

Fractures of the capitate, trapezium and other carpal bones may become avascular and cause secondary osteoarthritis.

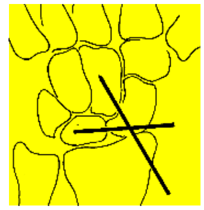
Hook of hamate Fx., from racquet sports, ignore or excise if painful.

Treatment

They seldom require reduction, and most can be treated with a Colles' type plaster for 6 weeks.

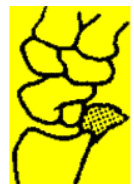
*In general problems of the wrist occur on the radial side, SELDOM the ulnar side.

Lunate dislocation with scaphoid fracture



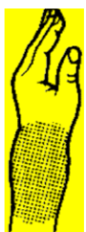
Open reduction and internal fixation Herbert screw and Kirschner wires

Complications



• Incomplete reduction

• Avascular necrosis of the lunate ± scaphoid



Stiff, painful wrist

Avascular necrosis with osteoarthritis

Colles' and lower radius

Cause

The 'dinner fork' deformity *in this fracture of the lower radius is caused by a fall on the outstretched hand. The following types of displacement are usual:

• Backward displacement

• Backward rotation

• Radial displacement.

In addition, the following may also occur:

• Impaction of the radius

• Fracture of the ulnar styloid

• Occasional other upper limb fractures.

Reduction

This is achieved by disimpacting the fracture well by prolonged traction followed by:

• Pushing forward

• Rotating forward

• Pushing towards the ulna.

It is difficult to over-reduce.

Hold reduced

• Backslab — A 15 cm backslab should be applied, extending from knuckles to upper forearm. This should be with full pronation of the forearm, ulnar deviation of the wrist and neutral flexion. Palmar flexion should only be used in difficult fractures and avoided if possible, because of metacarpophalangeal stiffness, especially in elderly patients.

Post reduction

• Initial — The arm should be well elevated in a sling for a few days and the patient encouraged to move the fingers.

• Completion of plaster — As soon as the swelling has subsided, (about 7 days) the plaster should be completed.

• Further immobilisation — Immobilisation is for 6 weeks. Energetic active exercises of the arm and shoulder should be encouraged within 3 days of the fracture.

Difficult and unstable fractures

• Above elbow plaster — In very unstable fractures hold fractures in full pronation in an above-elbow plaster.

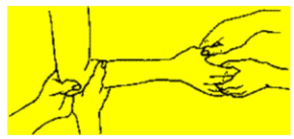
• Reduction in dorsiflexion — This has been advocated, with extension of the wrist to disimpact the fracture, before reduction in flexion. The danger of this method is damage to the median nerve and vessels which are stretched over the fractured lower radius. It is quite unnecessary in most cases,

Colles' fracture

AP X-ray view

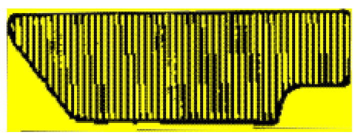
Lateral X-ray view

Reduction



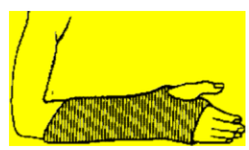
Disimpact by firm traction then…

Immobilisation



Backslab with 6–8 layers of 10 or 15 cm wide plaster bandage

Padded backslab and elastic bandage
initially for 1 week
plus sling



• Colles' plaster completed
• Early active movements of fingers and shoulder

provided there is adequate traction on the hand to disimpact the fracture.

•Associated shoulder stiffness — This is common in elderly patients, usually following immobilisation in a sling. It is sometimes due to an associated shoulder injury at the time of the original accident.

Smith's fracture

A Smith's fracture is a 'reversed' Colles' fracture and is often caused by a blow or fall on the dorsum of the wrist. Diagnosis

The characteristic deformity is due to palmar displacement and radial displacement of the lower radial fragment. There may often be an associated fracture of the ulnar styloid process.

Treatment

• Reduction — Disimpact the fracture with prolonged traction under anaesthetic. Rotate the disimpacted fracture dorsally and fully supinate the arm.

• Immobilisation — Immobilise in full supination in an above-elbow backslab until swelling has subsided, followed by a completed plaster cast for 6 weeks.

• Internal fixation —Internal fixation with a 'T' plate on the palmar surface of the radius, or Kirschner wires may be required.

Barton's fracture

A Barton's fracture is similar to a Smith's fracture, but extends into the wrist joint and is often comminuted.

Treatment

• Reduction — Similar to a Smith's fracture.

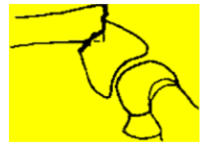
• Immobilisation — This usually requires an above elbow plaster in full supination.

• Internal fixation — This may be required with a 'T' plate, or Kirschner wires, if closed reduction does not achieve a good result.

*The dinner fork deformity although causes little loss of function is unsightly and not acceptable now so early ORIF with locking plates is a better option.

Smith's fracture

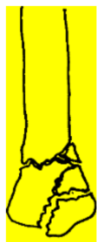
AP X-ray view



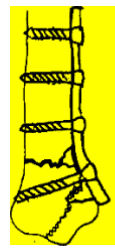
Lateral X-ray view

Above-elbow plaster in full supination

Barton's fracture



Comminuted lower radius into joint



'T' plate

Isolated fractures of lower radius and ulna

Minimal or no displacement

- Usually does not require plaster
- Aluminium splint or crepe bandage

Undisplaced fractures

- Immobilisation — Undisplaced fractures only require an aluminium cock-up splint for 1-2 weeks, followed by an elastic bandage.
- Early movements — These are necessary for both the wrist and shoulder.
- Isolated fractures — Fractures of the ulnar styloid are clinically insignificant and may require no treatment, or only a detachable aluminium splint or elastic bandage.

Complications of wrist fractures

Stiffness of the shoulder and elbow

Shoulder stiffness, particularly in elderly patients, is common following wrist fractures due to inadequate mobilisation, prolonged use of a sling, or an associated injury. All elderly patients should be shown shoulder and hand exercises starting on the day of injury.

Rupture of the extensor pollicis longus

The tendon may rupture due to friction over an incompletely reduced fracture. Transfer of the tendon of extensor indicis may be necessary.

Stiffness of the fingers

Stiffness of the fingers, common in elderly patients, is due to lack of exercise and prolonged immobilisation. Stiffness of the metacarpophalangeal joints may occur if the wrist is splinted in flexion. This should be avoided.

Mal-union and radial shortening

The lower ulna may need to be excised or shortened.

Sudeck's osteodystrophy

Pain, swelling, stiffness and osteoporosis of the wrist and hand, due to an autonomic reflex, may require a sympathetic nerve block. It may lead to severe disability and residual stiffness and pain. Now called chronic regional pain syndrome.

Osteoarthritis

Incomplete reduction of Colles', Smith's, or particularly Barton's, fractures may result in osteoarthritis. Arthrodesis of the wrist may be necessary in a manual labourer, or a wrist support for other patients, plus physiotherapy.

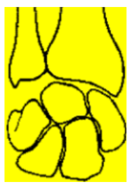
Complications of fractures of the distal of radius and ulna

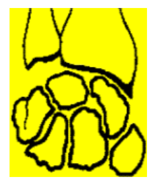
Stiffness of shoulder

Ruptured extensor pollicis longus

Stiffness of fingers and wrist

Malunion with subluxation of the radio-ulnar joint





Sudeck's atrophy (Now called Complex Regional Pain Syndrome)   OA of wrist

Radius and ulnar shaft

Diagnosis

It is important always to X-ray the whole shaft of both radius and ulna and to include both the wrist and the elbow. Avoid the trap of missing a dislocated head of radius with an isolated fracture of the ulna (Monteggia fracture), or a dislocated distal radio-ulnar joint, DRUJ, with an isolated fracture of the radius (Galeazzi fracture).Seen with TFCC tear (triangular fibrocartilage complex).

Treatment

• Closed reduction — Reduction with appropriate analgesia or anaesthesia may be attempted.

• Immobilisation — In cases requiring manipulation, if there is much swelling, a well padded backs lab should be applied initially with elevation until the swelling has subsided. This is followed by a well padded complete above-elbow plaster, with the elbow in 110° and immobilisation for approximately 12 weeks.

• Proximal shaft fractures — These often require immobilisation in supination.

• Distal shaft fractures — These are usually immobilised in full pronation.

• Mid-shaft fractures — These require immobilisation in mid rotation in most cases.

• Internal fixation — This is required with most fractures in adults, with plates, because of the difficulty of obtaining a satisfactory closed reduction.

Monteggia fracture-dislocation

• Displacement — This is a fracture of the upper ulna, and in addition the head of the radius is usually dislocated anteriorly/sometimes posteriorly.

• Closed reduction — After reduction, an above-elbow plaster for 8-12 weeks in full supination is required.

• Open reduction — This is usually necessary with a plate on the ulna to stabilise the fracture and reduce the dislocation.

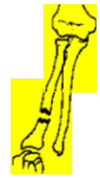
• Late dislocation — Missed dislocations may require excision, or replacement of the radial head with a prosthetic implant.

• Children — Excision of the radial head should never be carried out in children, as a valgus deformity with a late ulnar nerve palsy may result. In children, if closed reduction of the radial head fails, Kirschner wire fixation may be necessary after open reduction.

Fractures of the shaft of the radius and ulna*

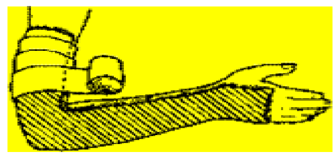
Fractured shafts of radius and ulna

Monteggia fracture dislocation



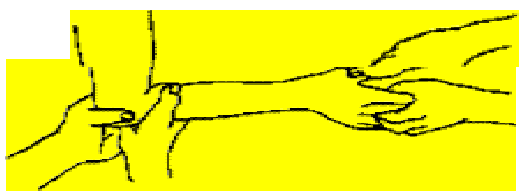
Galeazzi fracture dislocation

Emergency treatment



Padded backslab and elevation for oedema before manipulation

Reduction



Immobilisation

Mid 1/3 fracture: neutral position

Fx, from defensive position when being struck with a police baton.

Galeazzi fracture-dislocation

This is more common than a Monteggia fracture-dislocation. It usually results from a fall on the hand. The characteristic finding is a fracture of the distal radial shaft together with dislocation of the distal radio-ulnar joint. Accurate reduction is essential. Open reduction and internal fixation is usually required, with plating of the radius.

In late untreated cases, excision or shortening of the lower ulna may be necessary.

Complications

Non-union

Non-union is particularly common in the distal third of the ulna where the blood supply is relatively poor. It may also occur if the bone ends are not in contact.

• Treatment — This is usually by a compression plate or intramedullary nail, together with bone grafting from the iliac crest.

Mal-union

Mal-union is particularly important, especially if there is more than 10° angulation, as this will limit supination and pronation of the forearm. Internal fixation is usually necessary.

Cross union

In cross union an osteotomy of the radius may be necessary to restore rotation to a functional position.

Missed Monteggia and Galeazzi fractures

In isolated fractures of the upper ulna or lower radius, dislocation of the radial head or the distal radio-ulnar joint, respectively, can cause marked disability in elbow or wrist movement. Excision of the head of the radius* or the lower end of the ulna may be necessary. Excision of the head of the radius must never be carried out in the growing child.

Other complications

• Stiffness — Stiffness of the elbow and wrist, with limitation of rotation of the forearm, may be due to prolonged immobilisation, lack of physiotherapy or untreated complications.

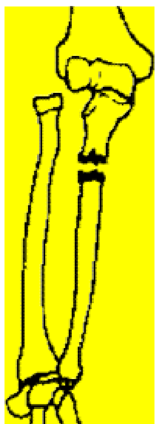
• Pressure sores — These may result from a badly applied plaster of Paris splint.

*Prosthetic replacement of the radial head in adults works well.

Open reduction radius and ulna

Plate both the radius and ulna

Monteggia fracture-dislocation*



Monteggia fracture- dislocation

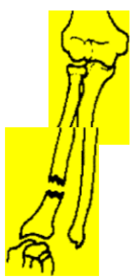
• Plate ulna and reduce radial head.

• Excise radial head or insert prosthesis in late cases.

• Never excise radial head in children

• Manipulation alone plus above-elbow plaster if possible

Galeazzi fracture-dislocation*



Galeazzi fracture - dislocation

• Plate radius and reduce dislocation
• In late cases excise or shorten lower ulna
• Manipulation initially and plaster

• Volkmann's ischaemic contracture — This may be the result of oedema due to muscle ischaemia, or to bleeding into the flexor compartment of the forearm, with ischaemic death of the flexor muscles.

Sudeck's atrophy — This is due to an autonomic sympathetic reflex. It causes severe burning pain and hyperaesthesia in the fingers and osteoporosis of the bones of the wrist together with stiffness of the hand. It sometimes may be helped by a sympathetic nerve block. *NB-Non anatomic reduction of ulna +

interposition annular lig. causes failure of radial head reduction. Posterior radial head dislocation (Bado type II) or radial head Fxs (Monteggia equivalent) have higher complications, e.g., PIN.

Elbow injuries

Classification

Radial head

- Undisplaced fracture
- Displaced segmental fracture
- Comminuted fractures
- Dislocated radial head.

Olecranon

- Undisplaced fracture
- Displaced fracture
- Comminuted fracture.

Elbow subluxation and dislocation

- Radial head subluxation — ‘pulled elbow’ — children
- Dislocation without fracture
- Dislocation with fracture of coronoid process
- Dislocation with fractures of lower humerus.

Fractures of the radial head

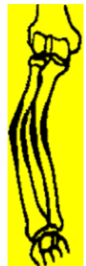
A fracture of the head of the radius may be caused by a fall on the outstretched hand. It can sometimes be missed, even when the patient complains of pain in the elbow.

Treatment

- Minimal crack or displacement — A collar and cuff sling or crepe bandage for 2 weeks all required.

Fracture of the shaft of the radius and ulna

Complications

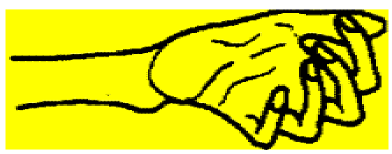


Both bone forearm Fxs need ORIF, restore radial bow, re fracture with R/O plate < 12-18 mths, synostosis from single-incision ORIF (need to excise asap, radiate, indocid).

*Galeazzi Fxs = Fx radius + distal RU jnt., ORIF radius and intra-op. assess distal RU jnt, if cannot be reduced then interposed ECU (dorsal approach to remove).

Untreated or missed Monteggia fracture

Untreated or missed Galeazzi fracture



Volkmann's ischaemic contracture Sudek's atrophy

• Severe comminution, or significant displacement* — A rough area may result which can erode the cartilage of the distal humerus. The head of the radius should be excised with care so as not to damage the posterior interosseous nerve(PIN). It can sometimes be replaced by a prosthesis.

Occasionally there is a place for internal fixation with a small compression screw in younger patients. In older patients, the head of the radius should be excised.

• Children — Dislocations and fractures should be reduced by manipulation and open reduction if necessary, followed by immobilisation in an above-elbow plaster for 3 weeks. The head of the radius in a child should never be excised, or a severe valgus deformity may occur during growth. This may in turn cause a late ulnar nerve palsy due to stretching of the ulnar nerve over the lower humerus.

Complications

The complications of a fracture of the radial head include:

• Osteoarthritis and stiffness — This is common, especially when the coronoid process is involved.

• Associated fractures — Associated fractures of the wrist, elbow and shoulder sometimes also occur.

• Valgus deformity — This may be associated with a fracture of the lower humerus or a fracture in a child.* ORIF for comminuted radial head Fxs with < 3 pieces, otherwise metallic radial head replacement. PIN is at risk, so pronate arm to avoid.

Olecranon fractures

Fractures of the olecranon are usually due to a fall on the point of the elbow.

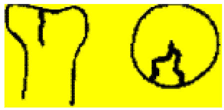
Treatment

• Undisplaced fractures — An above-elbow plaster, for about 6 weeks is the only treatment necessary in these cases.

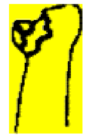
• Displaced fracture — Where there is separation of the olecranon, tension band wiring with two Kirschner wires and a figure-of-eight wire is usually necessary. Plates for oblique Fxs extending to coronoid process.

• Comminuted fracture — In severely comminuted fractures, excision of the fragments may be necessary and the triceps advancement/reattachment. In elderly patients, early movements without operation may occasionally be indicated.

Fractures of the radial head



Minimal crack

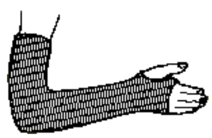


Comminution

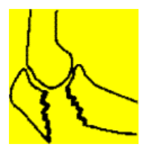
- Collar & cuff/ sling for minor crack
- ORIF, prosthetic replacement or excision for comminution

Olecranon fractures

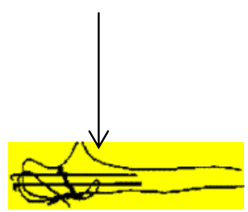
Undisplaced crack

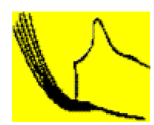


Above elbow plaster for 3-6 weeks



Displacement with clean break

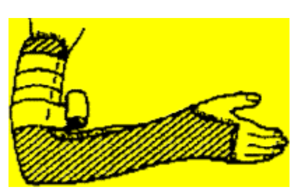


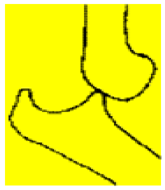


Kirschner wires and tension banding

Elbow dislocation

Treatment





Dislocation of the elbow

Reduce and above elbow plaster back-slab or collar and cuff

Complications

The complications are illustrated and include:

- Osteoarthritis
- Joint stiffness
- Weakness of extension — After excision of the olecranon.
- Established non-union — This may occur if there is a gap between the fracture ends. Internal fixation and bone grafting may be necessary.

Elbow subluxation or dislocation Radial head subluxation —

pulled elbow (nursemaid's elbow).

• Cause — This occurs in young children, often due to a sudden jerk on the forearm, such as when a child is lifted up by one hand. The head of the radius subluxes out of the annular ligament.

• Treatment — It can be reduced by supinating the forearm sharply with flexion and your thumb over radial head.. No anaesthetic is usually required.

Recent dislocations

• Reduction — This can usually be achieved by traction. Occasionally, open reduction is necessary.

• Immobilisation — The joint should be held reduced in a padded backslab or a simple collar and cuff sling for 3 weeks.

• Vascular and neurological complications — These should be looked for before reduction is attempted.

• NB easy to reduce but may be unstable due to incompetence of the med. collat lig. (may need reconstruction).

Long-standing dislocations

• Treatment — Open operation is required in most cases.

• Young patients — In manual labourers or young active patients, arthrodesis of the elbow may be necessary.

Arthroscopy can be useful(LBs, debridement).

• Elderly patients — Arthroplasty of the elbow joint is usually only indicated in the elderly (or severe RA and OA, chronic instability, complex distal humeral Fxs in the elderly).

Complications of elbow dislocation

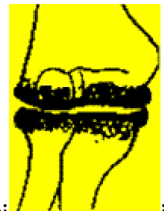
• Traumatic ossification — This requires further immobilisation and possible late excision of ectopic bone, followed by low dose radiotherapy within 3 days of operation.

• Associated fractures — These should be treated.

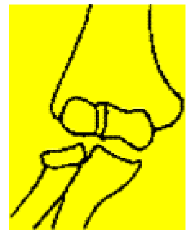
• Vascular and neurological damage — These are surgical emergencies and should be urgently treated.

Complications

Fracture head of radius



Osteoarthritis and joint stiffness



Cubitus valgus

Associated fracture of coronoid process

Fracture olecranon

Osteoarthritis and joint stiffness

Weakness of extension

Non-union

Dislocation of elbow*

Traumatic ossification

Vascular and neurological damage

*NB The Terrible Triad-elbow=complex dislocation/lat. collateral. lig. injury, radial head Fx., coronoid Fx. UNSTABLE. Needs ORIF, ligament repairs.

Fractures of the humerus, shoulder and scapula

Distal humerus (most need ORIF)

- Epicondylar
- Condylar
- Supracondylar — see pages 243-246

Shaft (adults- most need ORIF)

- Transverse
- Oblique
- Comminuted

Proximal humerus

- Humeral neck fracture — unimpacted — impacted
- Tuberosity fractures
- Fracture dislocation Shoulder dislocation
- Anterior
- Inferior
- Posterior.

Shoulder fracture/dislocation

Rotator cuff injuries

- Acute tendinitis
- Partial rupture
- Complete rupture.

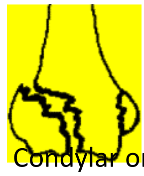
Scapular fractures

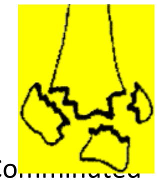
Fractures of the humerus

Distal humerus

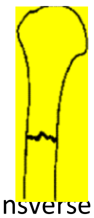
Just about all need ORIF


Supracondylar


Condylar or


Comminuted

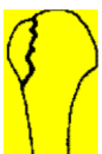
Shaft


Transverse

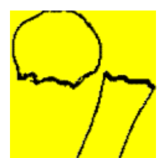

Oblique


Pathological

Proximal humerus


Tuberosity


Impacted


Displaced

Fractures of the humerus

Condylar fractures

The capitellum or the trochlea may fracture following falls on the outstretched hand.

Treatment*

• No displacement — Treatment is with an above-elbow plaster for about 3 weeks if there is minimal or no displacement.

• Displaced/ comminuted fracture — ORIF with plates, locking plates in the elderly, will be necessary. In severely comminuted fractures with many fragments, early movements will help mold bone fragments which are too comminuted to replace.

Complications

• Stiff elbow — This may be due to a bony block or myositis ossificans (traumatic ossification).

• Osteoarthritis — This is common if reduction of the fracture is incomplete.

• Valgus or varus deformity — This is due to incomplete reduction, or growth disturbances in a child.

• Vascular or neurological deficits — These include damage to the brachial vessels with flexor muscle ischaemia and

Volkmann's ischaemic contracture. Damage to the radial, median and ulnar nerves may occur. Late ulnar nerve palsy may be due to a valgus deformity.

Medial epicondylar fractures

These are more common than those of the lateral condyle in children.

Treatment

• Undisplaced fractures — These only require an above-elbow plaster for 3 weeks.

• Minimally displaced epicondylar fractures — These may require internal fixation.

• Displaced epicondylar fragment — If this is displaced into the joint, the fracture should be manipulated into full supination, extension and abduction of the elbow. This may result in the flexor origin pulling the fragment out of the joint.

*UPDATE (2022) distal humeral Fxs of columns, need ORIF, via posterior approach with two plates applied to either column. Total elbow replacement where severe comminution and > 65 yrs age.

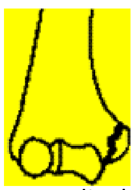
Lateral condyle

Fractures lateral condyle: internal fixation

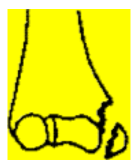
Trochlea or capitellum

Internal fixation with screws or plates

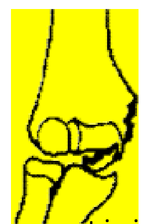
Medial epicondylar fractures



Undisplaced

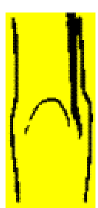


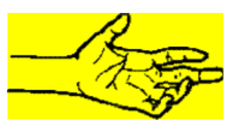
Minimally displaced

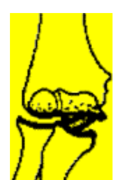


Fragment in joint — internal fixation

Complications







Osteoarthritis due to unreduced epicondylar fragment

nerve damage

• Open reduction and internal fixation — This may be necessary if the bony fragment remains displaced.

Complications

• Displacement of the medial epicondylar fragment — This may lead to non-union or osteoarthritis.

• Damage to the ulnar nerve — This may occur due to the fracture itself, scar tissue or valgus deformity.

Supracondylar fractures

These fractures occur most commonly in children between the ages of 6-9 years. These fractures may lead to vascular and neurological complications, and their management is discussed in detail on pages 243-246.

Comminuted fractures of the elbow

Cause

These may follow a severe fall, or a ‘side swipe’ when a car driver’s elbow is protruding outside the car window.

Treatment

The fracture is initially supported in a padded backslab, with the arm elevated. Open operation with screws, wire fixation or plates should be used if possible.

Examination

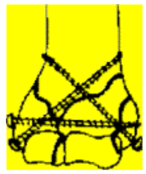
Both neurological and vascular injuries should be excluded. There may also be a compound fracture.

Complications

These include:

- Vascular damage — This may lead to Volkmann’s ischaemic contracture of the forearm muscles and possible gangrene of the fingers and hand.
- Neurological damage — This includes damage to the radial, median and ulnar nerves.
- Osteoarthritis, stiffness and elbow deformity — These are similar to condylar fractures.
- Infection — Osteomyelitis may follow an open fracture.
- Other injuries — These are treated as necessary.

Comminuted fractures of the elbow



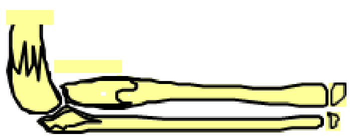
Comminuted elbow fracture

Internal

Padded crepe bandage following manipulation

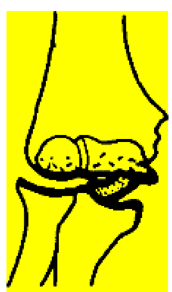
Complications

Vascular or neurological damage



Osteomyelitis

Osteoarthritis



Humerus fractures

Causes of humeral shaft fractures include:

• Fall on the outstretched hand

• Direct trauma

• Metastatic deposits — Carcinoma, especially from the breast, commonly involves the shaft of the humerus and may lead to a pathological fracture.

Treatment

• Collar and cuff sling — This is used for the emergency treatment of humeral shaft fractures. It will allow the weight of the arm to distract the fragments and improve alignment.

(Note that it is not a triangular sling which would support the elbow and shorten the humerus).

• Functional humeral brace (where < 20 degrees ant. angulation, < 30 valgus/varus with sling but NOT when brachial plexus injury palsy. (see page 329).

• Immobilisation — When the swelling has subsided, the bandage should be removed and a plaster applied.

Alternatively, a plaster of Paris slab alone is used for about 3 weeks, followed by a lightweight plastic splint. This extends into the upper forearm, as illustrated. This is a more comfortable alternative for the patient.

• Union — This usually takes 8-12 weeks.

• Unstable fractures* — Very unstable fractures should be internally fixed with a nail or plate.

• Delayed and non-union — In delayed union or difficult fractures, a simple shoulder abduction splint with the arm held with circular strips of fibreglass can be initially tried. Internal fixation with a compression plate or a Huckstep titanium locking nail plus bone graft is, however, the treatment of choice.

It is essential in these cases that the radial nerve, which is often involved in the callus surrounding the fracture, be carefully isolated before the fracture is stabilised.

• Pathological fractures —In pathological fractures resulting from metastatic deposits, a Rush or other type of nail should be inserted 'blind' from the tuberosity, under image intensifier control, without opening the fracture site. This is then followed by radiotherapy, plus chemotherapy or hormones if indicated.

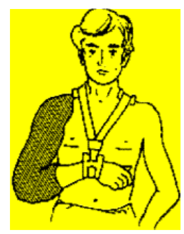
*ORIF for open Fxs, floating elbow, pathological Fx, where brachial plexus injury.

Fractures of the humerus First aid treatment

- Proximal and distal
- Shaft fractures humerus
- Triangular sling
- Collar and cuff sling

Humeral shaft fractures Treatment

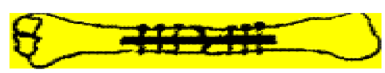
Plaster U slab and collar and cuff
Better to use functional brace.



Plastic support

Malunion or non-union

ORIF



or IM Huckstep locking nail + bone graft

Fractures of the humeral tuberosity

Treatment

• Undisplaced fractures — An undisplaced fracture should be managed with a sling for 1-3 weeks, together with early physiotherapy and active movements.

• Displaced fractures — Moderately and severely displaced fractures can be managed by holding the arm in an abduction frame for 3 weeks, followed by a triangular sling.

• Operative fixation —The alternative and better treatment for severe displacement is open reduction and internal fixation with a screw .

Complications of humeral fractures

The main complications are damage to the axillary (circumflex) and radial nerves and non-union. Other complications include stiffness of the shoulder and elbow.

• Radial nerve palsy — This is a particularly common complication of humeral shaft fractures. Upto 92% recover by 3 to 4mths.completely without operative intervention.

• Conservative management — It may be managed conservatively with a simple cock-up splint. A 'lively' splint to keep the fingers extended is indicated where recovery does not occur within 2 or 3 weeks.

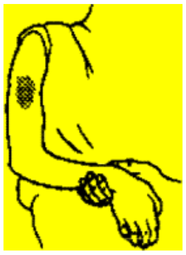
• Investigations — Electromyographic (EMG) studies should be performed if no recovery is evident in 3 weeks. In cases which do not recover, or if there is clinical and EMG evidence of damage or pressure by bony callus on the nerve, operative exploration should be undertaken.

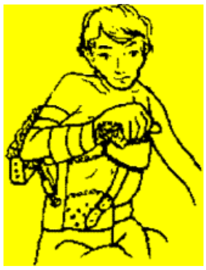
• Operation* — Operation should be delayed for at least 3 months, in view of the relatively good prognosis in most cases of radial nerve palsy resulting from a closed injury. If radial nerve repair is necessary, this should be performed by microsurgical techniques where possible.

• Further treatment — In all cases the wrist should be supported with a cock-up splint. The fingers should be stretched daily to prevent flexion contractures. A 'lively' splint can be used to keep the fingers extended, but is often not tolerated by the patient.* Explore when open Fx.(more likely to be transected, ORIF at same time),? When 2nd nerve palsy after MUA or with spiral/oblique Fx distal 1/3(so called Holstein-Lewis Fx).

Humeral shaft fractures Complications

Axillary nerve palsy

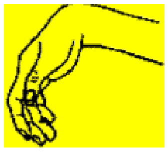


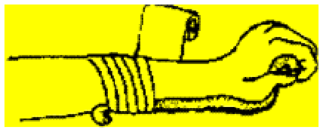


- Sensory loss over insertion of deltoid
- Paralysis of deltoid

Vascular or Radial nerve palsy neurological compromise.

Also see pages 166-168





- Cock-up or lively splint
- Daily stretching

Humeral neck fractures

Clinical findings

- Impacted fractures — In these cases the patient can actively lift the arm from the side of the body. Gentle examination may show the shaft and the head in continuity.
- Unimpacted fractures — The arm cannot be lifted at all.
- X-rays — Clinical evaluation should always be confirmed by X-ray.

Treatment

• Impacted fractures — These should be supported by a triangular sling for 3 weeks. Physiotherapy with active assisted exercises should be commenced after 3 days. There is usually no indication to disimpact the fracture to obtain a better position unless there is considerable angulation.

• Unimpacted fractures — In a young or middle aged patient,

a manipulation under general anaesthesia, with impaction of the two ends, should be attempted. This is followed by support of the arm in a sling for 3 weeks. Internal fixation, however, with a 'T' plate followed sometimes with an abduction splint, is the procedure of choice to obtain early movements.

• Displaced fractures — In younger patients, if closed reduction fails, open reduction is always required.

• Elderly patients — In elderly patients the arm should be mobilised as early as possible and supported in a sling. In these patients it is seldom necessary to disimpact an impacted fracture of the neck of the humerus. A moderate degree of angulation is acceptable in these patients.

Complications

• Shoulder stiffness — A shoulder should never be immobilised by the side for more than 3 weeks. Early active shoulder exercises are essential, especially in the elderly.

• Injury to the axillary nerve — Always test for diminished sensation over the deltoid insertion before manipulation. Early exercises and an abduction frame may be necessary for associated deltoid paralysis.

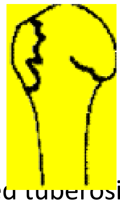
• Associated dislocation of the shoulder — Operative reduction and internal fixation is a safer alternative to manipulation.

• Treatment — An axillary nerve palsy should be treated in

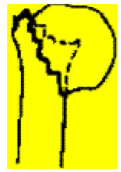
a shoulder abduction splint. There is also occasionally a place for systemic steroid administration in major nerve injuries, as this diminishes the oedema of the nerve associated with the injury.

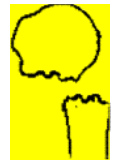
Proximal humeral fractures

Classification (*Neer also)



Fractured tuberosity





Treatment

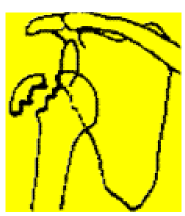
Impacted fracture:

- Triangular sling for 3 weeks
- Occasional internal fixation

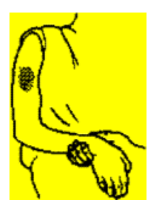
Treatment of complicated fractures

Displaced fracture of the humeral neck with dislocation

Plate and screws and reduction of dislocation



Fracture dislocation of the humerus — internal fixation



Deltoid palsy — abduction splint

Dislocation of the shoulder

Anterior dislocation

Examination

In an anterior dislocation there is flattening of the normal deltoid fullness, with the acromion now being the most prominent lateral point. There is an abnormal fullness in the subcoracoid region. Swelling and pain, however, may be minimal in a recurrent or long-standing dislocation. The arm is also held slightly abducted and movements will be limited, especially adduction and external rotation. Do axillary XR.

Complications

Examine for axillary nerve palsy, associated fracture, brachial plexus injury and vascular damage, before reduction. X-ray before reduction except for a known recurrent dislocation.

Reduction

Analgesia

This requires adequate analgesia and relaxation in most cases. Intravenous pethidine and a diazepam will usually achieve this.

Recurrent dislocation

This can be usually reduced immediately without anaesthetic.

Relaxation method

The patient lies prone on the couch with arms hanging over the edge. This may spontaneously reduce a dislocation with minimal assistance and is usually the best method.

Köcher method

This method involves traction with external rotation, followed by gentle adduction and internal rotation (see page 337).

Hippocratic method

Gentle arm traction and abduction is applied while a counter sling is applied in opposite direction to provide counter pressure in the axilla. This is commonly used on the football field for patients with a history of recurrent dislocation. It should not be used in other patients.

Other methods

• Good relaxant anaesthesia — The shoulder may sometimes be lifted back into its socket without difficulty.

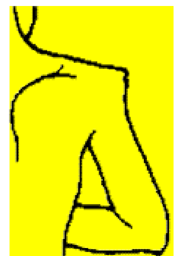
Dislocated shoulder*

Anterior

Inferior with fracture (luxatio erecta)

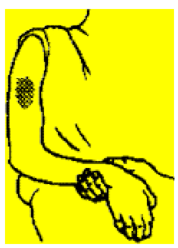
Posterior, easily missed.

Anterior view



Posterior view

Acute complications



Axillary nerve palsy

Associated fracture

*KNOW- TUBS: traumatic, unidirectional, Bankart lesion (ant. labral tear), requires surgical repair. AMBRI: atraumatic, multidirectional, often bilateral, rehab. is main treatment, inferior capsular shift indicated when non-op fails.

• Padded broad sling — This is around the upper arm, with an assistant pulling laterally. The patient is on a firm mattress with a sandbag under the scapula. The Huck step method for difficult dislocations (which may have been unreduced for several days) uses pressure, with the point of the elbow of the surgeon over the head of the humerus, and pushing downwards and laterally towards the firm operating table to reduce the dislocation.

• Open reduction — This is used when the above methods fail. Always operate rather than cause a brachial plexus injury by over-enthusiastic manipulation in difficult cases.

• Young patients — There is a place for early arthroscopic stapling in view of the very high incidence of recurrent dislocations, especially in young patients.

Post reduction

• X-ray — This should always be repeated following reduction of the dislocation, and may show a fracture of the tuberosity of the humerus, which was not initially evident.

• Young patients — Post-operative immobilisation of the arm may diminish the high incidence of recurrent dislocation. In first time dislocations a wool pad should be placed in the axilla and the arm immobilised for 3 weeks in a collar and cuff sling. The alternative in young patients is early arthroscopic stapling to prevent the high incidence of recurrent dislocation in these patients.

• Middle-aged patients — A sling for about 1 week.

• Elderly patients — A sling for 3 days plus physiotherapy.

Associated fracture

This will often necessitate internal fixation of the tuberosity, or neck of the humerus, if manipulation does not achieve a good reduction, especially in young patients.

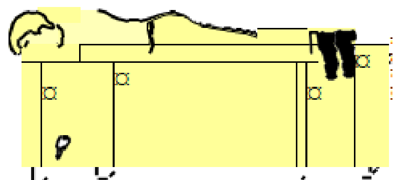
Recurrent dislocation

The arm in a sling for 3 days followed by normal use. Operative stabilisation by arthroscopic op, or surgery as below for recurrent dislocation maybe required.*Further-Ant. Shl. disloc.-surgery where recurrence or rotator cuff tear. High recurrence in young patients (with labral tear), rotator cuff tear in >45 yrs. Multidirectional as per AMBRI. Posterior- associated with seizures, electric shocks. Key feature is LACK of ext. rotation/fixed posterior dislocation. Luxatio erecta presents with arm abducted 110-160 degrees. Surgery is-inf. capsular shift, SLAP repair, labral repair, close rotator interval, osteotomy.

Dislocated shoulder

Treatment

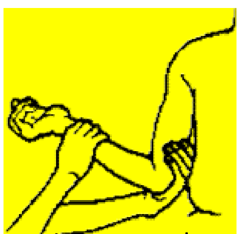
Relaxation method



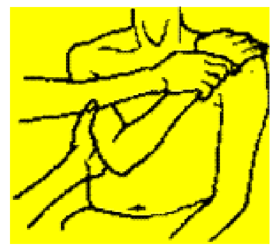
• Arm hanging over couch

• Relaxation with intravenous pethidine and Valium

Köcher method(may cause Fx)



Traction with external rotation



Hippocratic method

Counter sling in axilla + traction —

Only for recurrent dislocation

Dislocated shoulder

Post reduction: Collar and cuff for 1-3 weeks for first dislocation

• Arthroscopic stapling in young patients

• *Know Neer Classif. For prox Hum Fxs, I to IV as guide to treatment.

Failed closed reduction and old dislocations

• Young patients — In recent dislocations open reduction should always be carried out.

• Elderly patients — Long-standing unreduced dislocations in the elderly are sometimes managed conservatively with shoulder exercises. A better alternative is arthrodesis, or replacement with a prosthetic shoulder.

Posterior dislocation

Posterior dislocation of the shoulder is often missed. The shoulder not only has marked limitation of all movements, but is usually held internally rotated and slightly abducted.

Diagnosis

• X-rays — These will show a more globular head than normal (the 'light bulb sign'). The normal glenohumeral joint line is also obliterated on X-ray with the globular head of the humerus usually displaced slightly medial and posterior to the glenoid cavity. Lateral X-ray of the shoulder will confirm a posterior dislocation.

Complications

• Recurrent dislocation — This is the main complication, especially in young patients.

• Treatment — Stabilisation of the posterior capsule with a Huckstep locking titanium staple and screw is a relatively simple and effective method of treatment of recurrent posterior dislocation of the shoulder, compared to other procedures.

Early complications

These include injury to the axillary (circumflex) nerve, an associated fracture of the neck of the humerus and injury to the brachial plexus.

Axillary nerve lesion

• Diagnosis — Injury to the axillary nerve is diagnosed by examining for diminished sensation over the insertion of the deltoid before the dislocated shoulder is manipulated.

• Treatment — This should be treated with an abduction splint after reduction of a dislocated shoulder. Parenteral hydrocortisone may be indicated. Most patients recover satisfactorily. Forcible manipulation can result in damage to the brachial plexus, and to the subclavian vessels.

Fracture-dislocation shoulder

Fracture greater tuberosity

or

Fracture-dislocation

Open reduction and Rush nail (use 2 or more).

or

Open reduction and 'T' plate

Fracture of the humeral neck

An associated fracture of the neck of the humerus may be missed if the shoulder is not X-rayed before manipulation.

Fracture-dislocation

A fracture-dislocation will require careful manipulation with full anaesthetic relaxation. Open reduction and fracture fixation is safer and preferable.

Brachial plexus lesion

Injury to the brachial plexus usually follows too forceful manipulation or is due to the primary injury. Treatment is an abduction splint and hydrocortisone. Exploration of the brachial plexus and repair is seldom successful.

Late complications

These include recurrent dislocation, stiffness of the shoulder and axillary nerve injury.

Recurrent dislocation of the shoulder

• Young patients — Operative treatment should be carried out on those who have experienced more than one dislocation. Various procedures have been described:

• Putti-Platt operation — This entails ‘reefing’ of the capsule. It limits external rotation of the shoulder and has a limited application. Superseded by capsular shift, coracoid transfer (Latarjet) or combination thereof.

• Bankart operation — Re-attachment of labrum and inferior glenohumeral ligament to anterior glenoid +/-capsular shift. GOLD standard now.

• Huckstep titanium staple and screw — A smaller operation where the capsule is firmly attached to the scapula with a staple/screw. It is no longer used.

• Arthroscopic anchors — This is now being used by those with the necessary operative expertise.

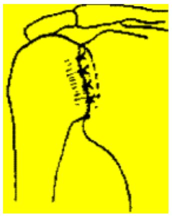
• Other procedures for revisions — These include bone blocks attached to the front of the glenoid, transfer of the coracoid process to the front of the scapula just medial to the glenoid and glenoid osteotomy .

Elderly patients

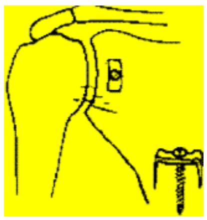
Conservative management only is indicated in elderly patients with a minimal disability. Early movements are essential, even after reduction of an initial dislocation.

Recurrent dislocation

Treatment

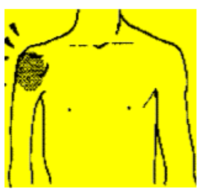


Putti-Platt operation: Capsule and subscapularis overlapped— Limits external rotation of the shoulder. See page 341.



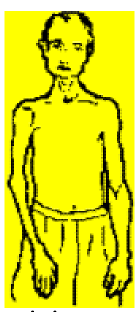
Huckstep staple and screw or arthroscopic stapling , seldom now used.

Complications

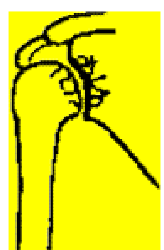


Stiffness and pain

Axillary nerve palsy:
- Deltoid paralysis
- Sensory deficit



Brachial plexus injury, secondary to manipulation



Gleno-humeral osteoarthritis

Rotator cuff injuries

Anatomy

The rotator cuff is made up of subscapularis, supraspinatus, infraspinatus and teres minor. These muscles stabilise the humeral head in the glenoid during arm abduction. They also act as abductors, plus internal and external rotators.

Lesions

• Degenerative — e.g., calcification in the supraspinatus .

• Traumatic — This is more common if degeneration is already present. Traumatic lesions may be subdivided into: acute tendinitis partial rupture complete rupture.

Acute tendinitis

• Cause — Calcification in the tendon is often due to minor trauma, and precipitates an inflammatory reaction.

• Clinical findings — Pain is intense and the patient is unable to move the arm, or abduct the shoulder, due to impingement of the rotator cuff on the under surface of the acromion.

• Injection — Occasionally, local injection of corticosteroids and local anaesthetic is indicated.

• Operation — Arthroscopic or small incision open operation with grasping forceps and bony anchors, surgery is a lot more successful last 20 yrs. Is first choice for treatment when MRI reveals significant tear with dysfunction. It is mow recommended to do early repair of full-thickness acute tears.

Partial rupture of the rotator cuff

• Cause — This may occur when attempting to lift a heavy object, especially if the rotator cuff is degenerated.

• Clinical findings — The patient is often unable to abduct the arm because of pain. In severe cases, an injection of local anaesthetic into the rotator cuff will eliminate the pain and allow abduction in partial but not complete rupture.

• Treatment — Treatment is either conservative with a sling, or if possible operative repair, especially in young patients.

Complete tears of the rotator cuff

• Clinical findings — Complete tears of the rotator cuff result in an inability to initiate shoulder abduction. Check MRI.

Injection of the supraspinatus tendon with local anaesthetic to eliminate the pain will differentiate a complete from an incomplete .

Rotator cuff injuries

Classification

Acute tendinitis

Partial tear

Complete tear

Diagnosis

- Inability to initiate abduct
- X-ray for possible calcification

↓

Inject local anaesthetic

↓ ↓

Partial rupture — can now lift arm → ……………..

Rotator cuff arthropathy(OA) may develop when a full thickness tear is not repaired, then requiring a reverse shoulder replacement.

- Sling and physiotherapy
- May need arthroscopy/open repair, esp when complete.

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345 **Upper limb injuries**

Clavicular injuries

Fractures of the clavicle

Causes

• The fracture — A fracture may occur after a fall onto the outstretched hand, and is most common at the junction of the medial two-thirds and the lateral one-third of the clavicle.

Treatment

• Triangular sling — In most cases, the optimum treatment is a triangular sling only. This is worn under the clothing for 3 days, followed by a triangular sling worn over the clothes for 2-3 weeks.

• Figure-of-eight bandage — A well-padded figure-of-eight bandage, together with a triangular sling for 3 weeks, is occasionally indicated when there is considerable overlap of bone ends. This has the disadvantage of loosening and requiring frequent tightening and is NOT usually necessary.

Complications

• Non-union — Non-union is uncommon and in young patients is treated with a plate or nail plus bone graft.

• Shortening — This is common, but is a very minimal disability.

• Callus formation — Callus formation and a bony lump at the fracture site is common and rarely necessitates trimming.

• Lung damage — Injury to the apex of the lung is a rare, but important complication.

• Neurovascular damage — Damage to the subclavian vein and the brachial plexus or supraclavicular nerves is rare, but the possibility must always be considered.

Fractures of the clavicle

Common site at the junction of medial 2/3 and lateral 1/3

Triangular sling —

- Under clothes for 3 days
- Over the clothes for 3 weeks
- Optimum treatment

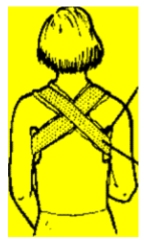
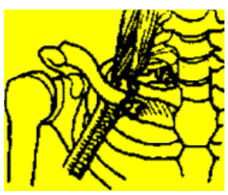


Figure-of-eight-bandage — only occasionally for severe bone overlaps. NOT usually necessary



Soft tissue injuries e.g., lung apex, vessels and nerves — rare

Clavicular deformity — surgical 'trimming' rarely necessary

Non-union — plate or locking nail, ++ bone graft

Sternoclavicular injuries, SC.

Classification

These may be divided into:

- Sprains
- Subluxations
- Dislocations*.

Image with CT.

Treatment

• Sprain — This requires no treatment.

• Subluxation and dislocations — Subluxations and dislocations usually only require a pad of wool over the joint held with firm strapping, together with a triangular sling for 1 –3 weeks. I

• Operative reconstruction with a fascial sling held in place with a Kirschner wire has been attempted in the past(BUT wires may migrate). This operation often fails and is not indicated in most cases.

• Untreated dislocations — An untreated sternoclavicular dislocation produces little functional disability, although it's cosmetically unsightly.

• Complications — A posterior dislocation may cause pressure on the vessels at the base of the neck in 30% cases. This will require urgent reduction and stabilisation with Kirschner wires and ligamentous reconstruction. Thoracic surgeon on stand-by.

*Usually anterior, can be unstable although asymptomatic.

NB-medial clavicular epiphysis is the last to close (at 25 yrs) so in young patients, SC dislocation is often a Salter-Harris type I or II Fx.

Sternoclavicular injuries

Strain

Subluxation

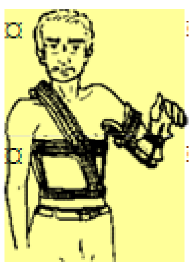
Dislocation

Subluxation

Sling for all types of dislocation

Subluxation or dislocation — firm strapping and sling for 3 weeks

Dislocation



Abduction splints occasionally

Operation — only if impinging on vital structures, and for occasional cosmesis

Acromioclavicular joint injuries, AC.

• Cause — These are caused by a fall on the point of the shoulder, such as in a fall from a bicycle or a fall in football. Both the acromioclavicular, as well as the coracoclavicular ligaments, should be examined.

• X-ray — An AP X-ray view of both acromioclavicular joints should be compared if in doubt as to the diagnosis.

Sprain-Type I

• Clinical findings — There is often tenderness and slight swelling over the joint but no displacement.

Subluxation-Type II

The weak acromioclavicular ligament is ruptured, but the strong coracoclavicular, CC + acromioclavicular-OK.

• Clinical findings — These include tenderness and swelling over the joint and an increase in the normal 'step' between the lateral end of the clavicle and the acromion. This is reduced easily by pressing up on the elbow.

• Investigation — X-rays show subluxation of the acromioclavicular joint. There is however, no increase in the gap between the coracoid process and clavicle.

• Treatment — A triangular sling for 1–3 weeks for

Types I and II.

Dislocation-Types III, IV (clav. button holed thru' trapezius),V (trapezius + deltoid detached), VI clav. dislocated inferior to coracoid).

This is due to rupture of AC and CC ligaments.

• Clinical findings — These include pain and swelling. There is a step between clavicle and acromion with a gap between the coracoid process and clavicle. The dislocation is easily reducible by upward pressure on the point of the elbow.

• Treatment — Most Type III only require a triangular sling supporting the elbow for 3 weeks, followed by shoulder exercises. Types IV-VI need surgery.

• Operative treatment — A Kirschner wire or screw fixation across the acromioclavicular joint, or a screw from clavicle to coracoid process, can be used with fascial repair for reinforcement. This is only occasionally indicated in athletes and young women requiring a cosmetic result. Strapping from the elbow to the shoulder is seldom tolerated.? Weaver-Dunn op. for heavy labourers in Type III.

Complications

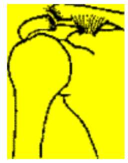
Few complications occur, other than those of poor appearance.

The outer end of the clavicle occasionally requires later excision for cosmesis.

Acromioclavicular injuries

Classification

Strain



Subluxation

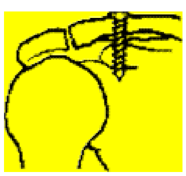
Conservative treatment

Strains, subluxations, and most dislocations treatment — sling

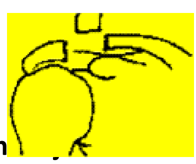
Dislocations — no indication for strapping

Operative treatment

Reduction and insertion of Kirschner wire



Coracoclavicular screw + reconstruction of coracoclavicular ligaments



Excision of the outer end of the clavicle in late cases only

Brachial plexus injuries*

Brachial plexus lesions may be secondary to birth trauma or due to trauma later in life.

Erb's palsy

Cause

This results from damage to the nerve roots C5 and C6 on one side.

Clinical findings

Paresis or paralysis of the deltoid and biceps muscles and the external shoulder rotators. As a result, the arm is held internally rotated and with elbow extended, producing the characteristic 'waiter's tip' position.

Treatment

The shoulder should be splinted in abduction with the elbow in 90° of flexion. The prognosis is good.

Klumpke's palsy

Cause

This results from damage to the lower cervical nerve roots (C7 to T1).

Clinical findings

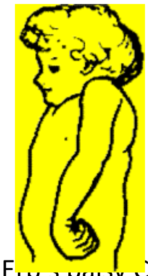
This produces a flexed elbow with a wrist drop and a weak hand, secondary to paresis or paralysis of the triceps muscle group and the small muscles of the hand.

Treatment

Klumpke's palsy is managed with an above-elbow back slab with the elbow extended and wrist dorsi flexed. The prognosis is usually good.* Medical students get very anxious about brachial plexus injuries, understandably so as the anatomy is complicated and it is hard to unravel the basis of the injury based upon your exam. So, look at pictures of the plexus and go over it many times. Pre-ganglionic (nerve root avulsions) have the worse prognosis Horner's sign (sympathetic chain) ptosis, miosis, anhidrosis; Winged scapula from serratus ant.(long thoracic); weak rhomboids (dorsal scapula); motor deficits with intact sensory fnt. (cell bodies in dorsal root ganglia).

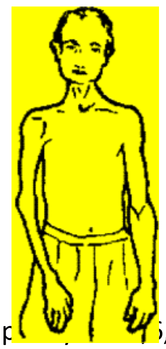
Brachial plexus injuries

Birth injuries



Erb's palsy C5

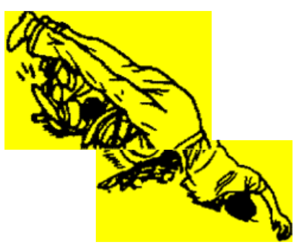
Klumpke's palsy C7,8,T1



Complete palsy C5,6,7,8,T1

Adult trauma

Causes



Fall onto the shoulder

Brachial plexus tears — usually complete

Partial brachial plexus lesion

Cause

In children and adults, the most common causes of brachial plexus injuries are falls onto the point of the shoulder following bicycle or motorcycle accidents.

Clinical findings

These show a weakened or flail arm, together with diminished sensation and sweating in the affected limb, due to autonomic involvement.

Investigations

• Radiographic — These include X-rays and CT scans of the cervical spine and occasionally a myelogram or MRI scan. Tears of the nerve roots from the cervical cord may occur in high lesions.

• Electromyelogram — This should be delayed for at least three weeks after the injury to allow for settling of the spinal shock.

• Histamine test — Subcuticular injection of histamine into the flexor surface of the forearm is considered positive if it causes a local weal and an erythematous flare. A positive test is an indication of pre-axonal high root damage and indicates a poor prognosis. A negative histamine test is indicative of post-axonal damage and offers a better prognosis.

Treatment*

Initially the brachial plexus should be held relaxed in a splint, with approximately 60° of shoulder abduction. Steroids may reduce local nerve root oedema. Early operative exploration and repair of a low or post-axonal lesion is occasionally indicated. This is difficult and the prognosis is poor.

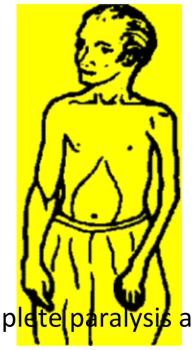
Further management

Partial lesions which do not recover with conservative management, such as physiotherapy, may also require operative intervention. This usually involves tendon transfers and, occasionally, wrist arthrodesis, plus supports and splinting of the elbow, wrist and fingers.

*Update (2022), stab wounds may do better after early surgery whereas gunshot not so well.

Brachial plexus injuries

Diagnosis



Partial or complete paralysis and sensory loss

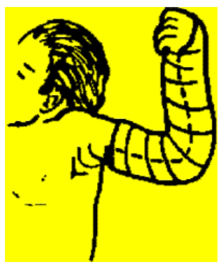
Treatment

Complete paralysis or

Erb's palsy: C5,6,

• Abduction splint

• Occasional exploration



Klumpke's palsy: C7,8,T1, Above-elbow splint with elbow straight and wrist dorsiflexed

Complete paralysis: C5-T1, Splints or amputation plus shoulder arthrodesis and prosthesis

Complete brachial plexus lesion

Cause

This is a complete lesion of the nerve roots from C5 to T1. It is usually due to a fall on the shoulder, classically from a motorcycle or a bicycle, but also following sporting injuries.

Clinical findings

A flail and wasted arm develops, held in extension and internal rotation, with complete sensory, motor and autonomic involvement. In children, this will lead to shortening of the arm and hand. There may also be a Horner's syndrome with enophthalmos, a constricted pupil and lack of sweating of the face on the side of the lesion, due to autonomic involvement.

Treatment

• Splinting — Splinting the elbow and hand is best carried out with a detachable, lightweight, padded plastic support for elbow and wrist. The complete lack of sensation and flaccid paralysis often make this arm an encumbrance, despite splinting. In addition, phantom pain is common in the arm, as are pressure sores due to the pressure of the splint on a completely anaesthetic arm.

• Amputation — An above-elbow amputation, with arthrodesis of the shoulder in about 50° of abduction, 30° internal rotation and 30° forward flexion, followed by fitting an artificial arm, may be necessary. This is indicated only if the trapezius, rhomboids and other muscles have adequate power to abduct the scapula actively with at least power 4.

Scapular fractures

These may involve the glenoid cavity, the neck of the scapula, the acromion, or the body of the scapula.

Treatment

Treatment is usually a triangular sling for 3 weeks, together with early active assisted shoulder exercises and physiotherapy. Manipulation or operative intervention are rarely necessary.

Chapter 6

*UPDATE, 2022. Incomplete cervical spinal cord syndromes (all some sparing distal function-

Central cord: most common, elderly patients where spondylotic spine, motor/sensory loss is > in upper limbs vs lower limbs. In 50% independent ambulation returns and most of young patients.

Anterior cord syndrome: worst prognosis re ambulation, greater motor loss in legs than arms.

Brown-Sequard syndrome: ipsilateral motor weakness on side of in jury, contralateral loss of pain/temperature. Best prognosis.

Posterior cord syndrome: most uncommon, loss of proprioception/vibration/deep pressure from injury to posterior column.

Autonomic dysreflexia, can be subtle but it is important. It is uncontrolled sympathetic nervous output where cord injury above T6.

Have hypertension/dilated pupils/headache/pallor/reflex tachycardia.

Need urinary catheter, faecal disimpaction, anti-hypertensives, and ?atropine.

Causation and transport

Spinal fractures causing paralysis often result from a flexion and rotation strain in the cervical and thoraco-lumbar regions and flexion injuries in the thoracic region.

Important causes particularly of cervical injuries include diving and surfing accidents, rugby football, and motor vehicle accidents.

Pathological fractures due to osteoporosis are common in elderly females, and seldom cause paraplegia. Secondary deposits in the spine from primary carcinoma elsewhere may cause paraplegia or quadriplegia and require urgent decompression.

Cervical fractures

These are commonly associated with head injuries and are often missed in unconscious patients. It is important to note also that fractures may occur at more than one level. All patients with a head injury should therefore be treated as having a possible spinal injury. The prognosis can be much improved in incomplete lesions by adequate initial emergency splinting with a cervical collar and care with transport.

• Forced flexion — This, associated with rotation, may cause a dislocation or fracture dislocation of the vertebral body or one or both cervical facets or the odontoid peg.

• Hyperextension injury (‘whiplash’ injury) — This is common in rear car collisions if the occupants do not have head restraints or if these restraints are too low.

• Cervical fractures and dislocations — These may not always cause spinal cord damage, due to the wide cervical spinal canal. Nerve root pressure, however, is common.

Thoracic fractures

• Flexion and flexion-rotation injuries — These are associated with thoraco-lumbar fracture dislocations.

• Paralysis with complete cord transection — This is common, due to the tight fit of the spinal cord in the relatively small spinal canal in the thoracic region.

• Operation — This is seldom required for complete paraplegia, as spinal cord damage is usually irreversible.

Lumbar fractures

• Flexion-rotation injury — This may cause a fracture dislocation with both spinal cord and nerve root damage in the thoraco-lumbar region.

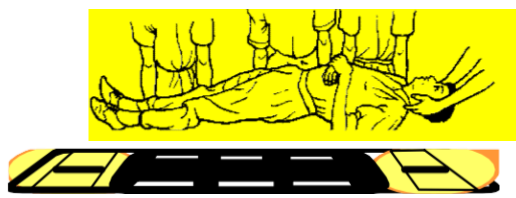
Emergency transport

Cervical spine fractures

• Stabilise the neck with sandbags and a stiff neck collar

• Watch for respiratory distress

Thoracic and lumbar spine fractures



Conscious patient

• Placed flat on a Jordan frame or Russell extraction device

Unconscious patient —
• Roll into the recovery position
• Maintain spinal column in straight alignment
• Cervical collar
• Airway kept clear
• Other injuries managed

• Paralysis — Combined upper and lower motor neurone paralysis in the thoraco-lumbar region is often incomplete and some recovery is possible.

• Fractures in the lumbar region — These may affect the conus medullaris or cauda equina. Some recovery is possible in cauda equina lesions.

• Prolapsed intervertebral disc — This may occur with or without a fracture, particularly in the lower lumbar region. Central protrusion of the disc may cause a cauda equina lesion, with perineal numbness and bladder paralysis and require emergency decompression.

• 'Burst' fracture — Urgent decompression of bone fragments may be necessary if these cause pressure on the cauda equina. • Calcaneus — Associated fractures are common.

• Autonomic damage — This will cause perineal numbness, inability to micturate and require emergency decompression. • Neurological deterioration in the clinical signs — It is essential that all incomplete lesions be kept under careful observation as urgent spinal decompression may be required.

Injuries associated with spinal fractures

Calcaneal fractures

A fall from a height may also fracture the lumbar spine. A lateral X-ray of the lumbar spine is essential in all calcaneal fractures, even when there is no tenderness due to the legal implications of a missed associated lumbar vertebral fracture.

Pelvic fractures

A fall from a height, or a motor vehicle accident may cause both pelvic and spinal fractures.

Other injuries

Stable or unstable spinal injuries may be associated with both soft tissue and bony damage. Fractures may also occur at multiple levels.

Multiple head, trunk, and limb injuries, together with cerebral and visceral injuries and hypovolaemic shock may necessitate urgent cardiopulmonary resuscitation before transport. This may also include intravenous fluid, a gastric tube and a urinary catheter.

Emergency transport

Cervical spine fractures

The neck should be stabilised with a hard neck collar or, failing this, with a towel. In addition, supporting sandbags should be used as illustrated.

Cervical spine injuries

Fractures and dislocations

Examination

Examine bladder and bowel function, and assess the adequacy of respiratory efforts

Power and reflexes

1 2	S — Ankle Jerk
3 4	L — Knee Jerk
5 6	C — Biceps Jerk
7 8	C — Triceps Jerk

Thoracic and lumbar spine fractures

The patient should be lifted without flexing the spine and transported on a Jordan frame or 'scoop stretcher' lying supine with restraining straps if necessary. A spinal board or Russell extractor device (RED) should be also used if possible (see page 63).

Unconscious patients may require to be rolled on their side, as shown. In the case of transport where no stretcher is available, it is safer to carry the patient prone with the spine extended rather than flexed.

Stable cervical spine injuries*

Minor fractures

Treatment

Isolated fractures of the transverse or spinous processes only require a few days' bed rest, on a mattress with fracture boards, followed by mobilisation of the patient in a neck collar.

Subluxations and stable fractures of the cervical vertebrae

Examination

Hyperextension injuries due to ‘whiplash injury’ usually cause severe pain on extension of the neck. There are seldom any neurological signs except when there is instability of the vertebrae. A full neurological examination is essential.

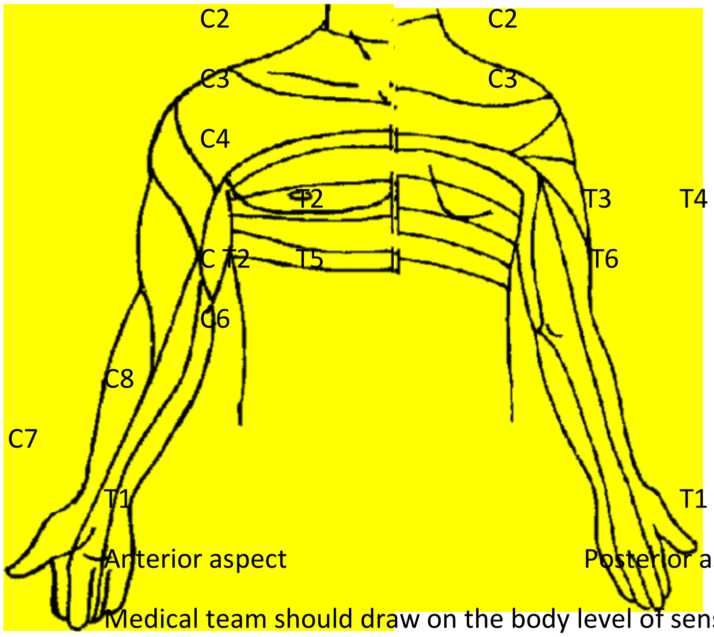
Investigation

• X-ray — These may not show any bony injury. A soft tissue radiograph may, however, show a haematoma under the anterior longitudinal ligament, confirmed on a CT scan.

X-rays in stable fractures and subluxations will show only minimal forward displacement with no overriding of the articular facets. Screening is also essential to confirm the stability of the cervical spine.

Fractures of the cervical region, although showing wedging of the vertebrae, will not usually show rotation. Oblique X-rays of the cervical spine and a CT scan, and sometimes an MRI, may be necessary if there is any doubt, or if there are neurological signs.*Patients with spine pain, +/-trauma, need to clear for occult Fx. If missed for cervical Fxs have high risk for neurology.

Dermatomes — upper limbs and chest



Medical team should draw on the body level of sensory loss

This should be regularly checked

UPDATE, 2022. Bilateral facet jnt dislocations(jumped facets), C3-7,where >50% translation, higher chance spinal cord injury. Role of MRI before/after closed reduction is not clear.

Treatment

• Glisson's sling — This sling consists of a 2–3 kg weight over the head of the bed.

• Skeletal skull traction — Skull traction of 4-10 kg may be necessary for displacement.

• Plastic or foam collar — After 3 weeks, a neck support collar is recommended for a further 2-3 months. This is made of foam rubber for night use and padded plastic during the day.

• Halo-vest support — This consists of a 'halo' with pins through the outer table of the skull attached to a vest of plaster or plastic. It gives better support than a detachable collar for unstable fractures and dislocations but is not necessary for stable fractures

Unstable cervical spine

Examination

Neck

This is usually painful, tender and has a limited range of movement.

Nerve root damage

This alone may occur in incomplete lesions. If only 1 or 2 cervical nerves are involved one side is often worse than the other. There is usually both motor and sensory loss in the root distribution.

• X-ray — This will usually show a dislocation. Oblique X- rays of the cervical spine, a CT scan and sometimes an MRI scan are essential. This will show locked or fractured cervical facets causing possible pressure on the cord or cervical nerve roots.

Cord damage

This may involve the legs and bladder as well as the arms. Respiration may be affected with paralysis of the intercostal muscles and diaphragm.

• Prognosis — There is considerable difference in prognosis between incomplete and complete lesions.

Incomplete spinal cord lesion

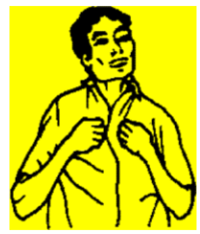
There is usually some movement or sensation, however slight, below the level of division. Recovery can occur and can be almost complete.

Cervical spine injuries

Motor examination with complete spinal cord transection

C5 — complete flaccid quadriplegia

C6 level lesion —
• C5 root irritation
• Abduction, flexion and supination of the upper upper limbs



C7 level lesion —
• C6 level root irritation
• Abduction and pronation of the limbs

C8 and T1 level — Paralysis of the small muscles of the hand

Complete spinal cord lesion

• Movement and sensation — There is no true active (as opposed to reflex) movement or sensation at or below the level of the lesion 3 days after the injury. The findings on examination with complete cord transection are illustrated at the individual levels of transection. The bladder is paralysed with initially a flaccid paralysis which after 2-3 weeks will become 'spastic' with automatic reflex emptying.

• Anal reflex — Early return of the anal reflex in less than 3 days, without any sensation or voluntary motor power at or below the level of the lesion, is suggestive of a complete transection of the cord. The prognosis is poor.

Immediate management

Emergency transport

Transport the patient flat, the with head well supported with sandbags plus a hard neck collar or towel.

Lesion itself

• Cervical traction — This should initially be with a padded Glisson's sling and approximately 3 kg of traction with a well padded sandbag on either side of the head. The patient should be flat on a mattress, supported by fracture boards, and be turned very carefully every 2 hours to prevent bed sores.

• Skull traction — This may be necessary with 10-15 kg where there is dislocation or displacement.

• Open reduction — This may be required with internal fixation.

Progressive lesion

If deterioration occurs, an urgent myelogram, CT or MRI scan followed by operative exploration is indicated.

Unstable fractures

Fractures which are still unstable 8 weeks after injury should be stabilised by operation.

Nerve damage alone

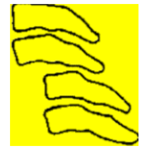
Traction for 3-6 weeks. The patient is then mobilised in a suitable neck support.

Complete lesion with no recovery

The traction is decreased in 3-6 weeks, and the patient gradually mobilised with a cervical collar. A halo jacket brace is an alternative if a better support is required. Late spinal cord recovery is rare, but some further nerve root recovery may sometimes occur.

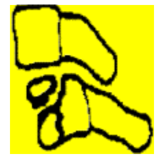
Unstable cervical fractures

Atlanto-axial fracture dislocation



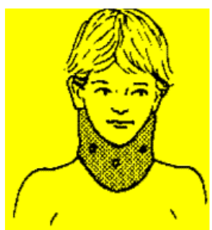
Dislocation: facets may be locked

Crush fracture



Fracture dislocation

Initial treatment



Collar for cervical injuries

• Glisson's sling with 2–3 kg of traction

• Fracture boards under a well padded mattress

• Elevate the head

Management of incomplete lesions

• Closed reduction — An attempt should be made to reduce the fracture with a skull caliper and traction of up to 10-15 kg. This method is essential where there is dislocation of one or both spinal facets, or where traction with a Glisson's sling has failed to correct displacement.

• Open reduction — In cases where this fails, or where re- displacement occurs after reduction, open reduction and wiring of the laminae may be indicated. In unstable dislocations, bone grafting of the spine may be indicated Immediate open reduction may achieve a better long-term result.

Further management

• Neck support — A plastic collar or halo vest is required for at least 3 months from the time of the injury in all but complete lesions.

• Late treatment — The quadriplegic patient with a complete lesion and no recovery is discussed under rehabilitation (see page 378).

• Rehabilitation — This must be planned immediately following an injury, as considerable psychological and social problems result from permanent paralysis. A team effort is required involving orthopaedic, general surgical, plastic, urological and neurosurgeons, physicians, nurses, physiotherapists, occupational therapists, social workers and orthotists, as well as specialists in the rehabilitation and re- training of the disabled.

Complications

Prevention and treatment of urinary retention, bed sores, contractures and respiratory complications such as hypostatic pneumonia are required and are discussed below.

Unstable fractures

Treatment

Unstable fractures are often best managed with either a halo jacket for at least 3 months or by an internal fixation with wire plus additional bone grafting. Early stabilisation of cervical fractures and dislocations will enable early mobilisation of the patient, and prevention of the complications associated with spinal cord and nerve root involvement.

UPDATE, 2022. C1 ring Fxs are stable/unstable depending upon integrity transverse lig. Where combined lat. mass displacement > 6.9mm and/or ADI, atlanto- dens interval,> 3.5mm, then trans. lig is disrupted and need spinal fusion.

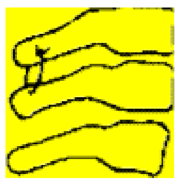
Cervical spine injuries

Treatment

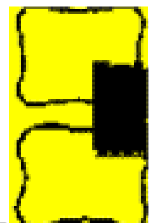
or

Unstable fractures: skull calipers for 6 weeks with 7–15 kg of traction

Halo jacket support



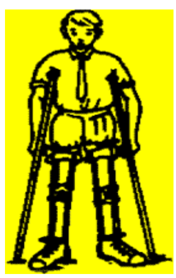
Wiring



Bone grafting

Open reduction if necessary

Further treatment



Patients with complete spinal cord lesions will require a padded wheelchair

angulation. Axial distraction- higher risk cord damage.

Odontoid Fx-Tip(stable), waist need ORIF when displaced >5mm, through body, stable, rigid orthosis.

Thoracic and lumbar spine

Examination

Examine the back for tenderness, kyphos and a gap in the interspinous and supraspinous ligaments.

Upper and mid thoracic spine

Unstable fractures of the upper and mid-thoracic spine usually cause a complete lesion of the spinal cord with an upper motor neurone type of spastic paralysis.

Lower thoracic and upper lumbar spine

Unstable fractures of the lower thoracic and upper lumbar spine may involve both the nerve roots and the spinal cord. This is because the lower thoracic nerve roots take a very oblique course in this region. Some recovery of the nerve roots is possible and operative stabilisation of these fractures may be indicated as a result.

Mid and lower lumbar spine

Unstable fractures of the mid and lower lumbar spine may involve the cauda equina with bladder paralysis and are often incomplete. Some recovery can occur. The paralysis is the lower motor neurone type, and the prognosis is much better than with spinal cord damage at a higher level.

Stable injuries of the thoracic and lumbar spine

Examination and investigation

• Neurological signs — Signs of cord compression are not usually present in a stable fracture. Nerve roots however, may be damaged by both bone and disc especially in the lumbar region.

• Supraspinous and interspinous ligaments — These are intact.

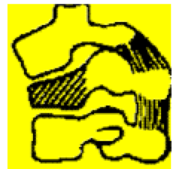
• X-ray — This does not show any appreciable forward displacement of one vertebra on the next. Compression of the vertebral body, a burst fracture or a chip fracture are usually the only abnormalities. In the lumbar region the transverse processes may be fractured.

Treatment

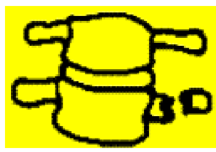
• Bed rest — The patient should be nursed on a mattress with fracture boards for a few days.

Stable spinal fractures

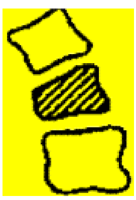
Thoracic lumbar and sacrum



Undisplaced fracture with intact supra and interspinous ligaments



Fracture of the transverse or spinous processes



Wedge fracture

Fractures of the sacrum or coccyx

‘Burst’ fracture of lumbar vertebrae

Emergency assessment

- Roll the patient onto the side
- Palpate for tender areas and gaps between spinous processes
- Never sit the patient up or flex the spine

- Back extension exercises — These should be started immediately, plus radiant heat locally.
- Back support — This is usually required when the patient is mobilised out of bed.

a. Taylor brace — Supports both the thoracic and lumbar spine.

b. Lumbo-sacral brace — Supports the lumbar spine. This should be used for 3 months, or longer when the patient is mobile. The patient can be up and walking in the support but must not lift weights.

• Back exercises — These are essential as is graded physiotherapy. The best exercise for patients with a stable spinal injury is swimming.

Spinal injuries without radiological signs Certain spinal injuries may produce neurological signs in the absence of any radiological abnormalities.

• Spinal subluxation or dislocation — These may reduce spontaneously prior to X-rays being taken.

• Flexion or extension injuries — These with minor subluxations and prolapsed discs or ligaments may also produce spinal cord damage and neurological abnormalities without any evidence of a fracture or dislocation on plain X- ray films.

Unstable spinal fractures

Immediate management

Transport flat on back if possible, on a stretcher; otherwise face down with spine extended.

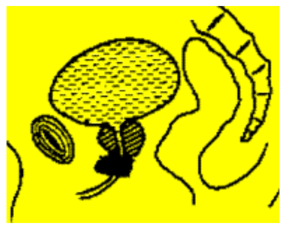
• Initial treatment — The patient should be nursed on a soft mattress supported by fracture boards. Two-hourly turning and back exercises are essential. Most patients should be treated conservatively without operation.

• Thoracic — In the thoracic region patients usually have a complete transection of the cord with complete paraplegia due to the relatively ‘tight fit’ of the thoracic cord. These patients are often best treated by 2-hourly turning and lifting on a soft mattress on fracture boards to prevent bed sores and to facilitate care of bladder and bowel, and prevention of joint contractures. Occasionally internal stabilisation of the spine will enable earlier mobilisation, and ease the problem of nursing. •Thoraco-lumbar region — Occasionally, there is an indication for stabilisation of the fracture with spinal Harrington rods or CD instrumentation for incomplete

Stable spinal fractures Clinical examination

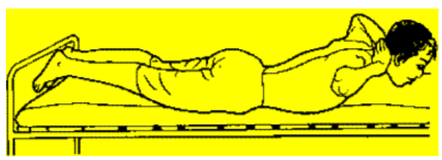
Tone, power and sensation are unaffected

Reflexes are unchanged

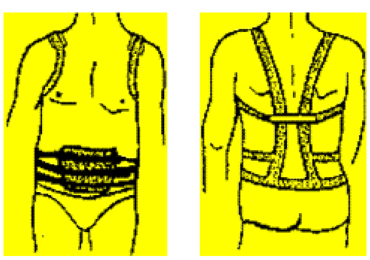


Bladder function not affected

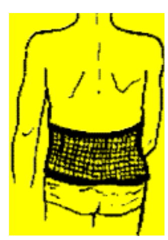
Treatment



- 3 days to 3 weeks in hospital
- Fracture boards for support
- Back exercises excluding flexion



Taylor brace thoracic spine



Lumbar spinal support

lesions in the thoracolumbar region. Operative stabilisation may make for ease of nursing and earlier mobilisation.

• Cauda equina lesions — These should be explored as an emergency if pressure by an intervertebral disc or bone is suspected. MRI or myelography may be valuable. Perineal numbness and paralysis of the anus and bladder make this an emergency, and decompression should be carried out without delay.

Progressive lesions

All progressive lesions should be urgently explored. There may be a place for systemic cortisone administration.

• Lumbar — In the lumbar region early stabilisation will enable early mobilisation, but operation is usually not indicated unless there is pressure on the cauda equina by bone or disc.

Further management — unstable spinal injuries

Mobilisation

The patient should be mobilised in 8 – 12 weeks with the help of calipers, crutches and a wheelchair.

Rehabilitation

This is essential and should be commenced immediately after admission to hospital.

Nursing

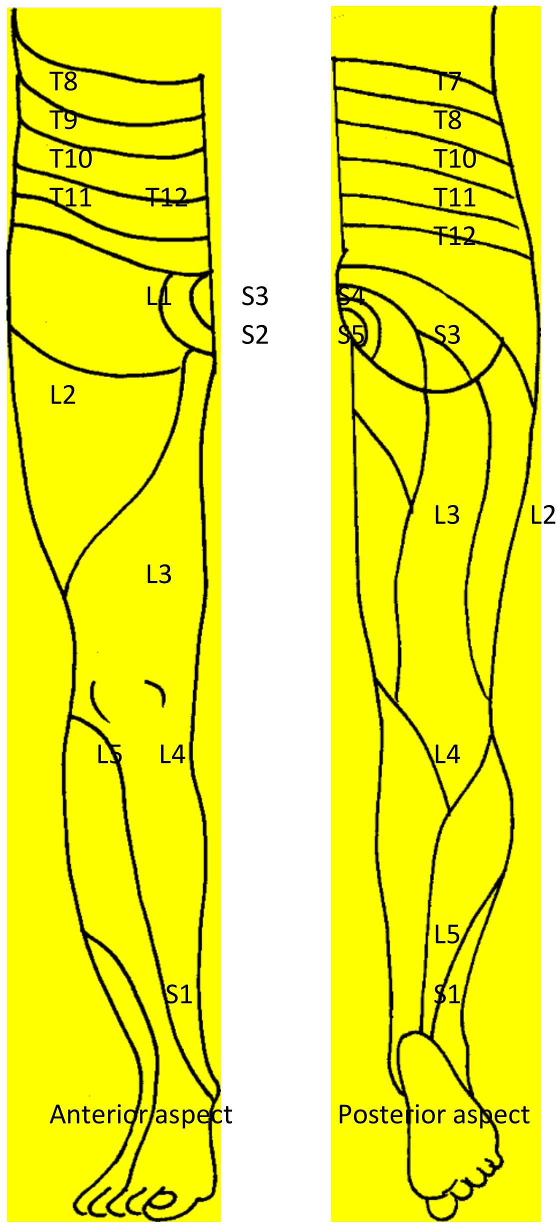
• Bed sores — The use of a hydrostatic flotation bed for patients with paraplegia may prevent the occurrence of bed sores and often allow bed sores to heal. Water bed treatment is indicated in hospitals where lack of nursing staff prevents 2-hourly turning of the patient.

• Bladder and bowel — Care of the bladder and prevention of urinary infection is discussed below.

Walking

Most patients with good power in the arms can walk with the aid of crutches and above-knee calipers. A high or mid- thoracic lesion may necessitate a tripod gait with both legs swung forward simultaneously as the body is supported by calipers plus 2 crutches placed firmly on the ground. Both crutches are then moved forward, with the legs this time acting as the fixed pivotal unit. It is essential that every effort be made to encourage the patient to walk.

Dermatomes —trunk and lower limbs



• Flexion contractures — These are common in the hip, knee and ankle and should be prevented or treated by physiotherapy where possible. Failing this, subcutaneous fasciotomy to correct the contractures is preferable to open operation.

Complications of unstable

spinal fractures

The complications of unstable fractures of the spine are much more important than the fracture itself. There are 3 main complications.

Urological

• Spinal shock* — In the early stages of spinal shock, there is retention of urine. Intermittent catheterisation under full sterile precautions may be necessary. Occasionally an indwelling catheter of polythene tubing or a plastic Foley catheter may be required.

• Indwelling catheter —This should be used only if anti- cholinergic drugs are unsuccessful.

• Suprapubic catheter — A fine suprapubic silastic catheter now has a long term role for quadriplegics, and for some elderly paraplegics.

• Removal of catheter — Any indwelling catheter should be removed at about 10 days and attempts made to obtain reflex emptying. This may, however, take a week or two longer to achieve and is usually much easier to achieve if no catheter has been inserted.

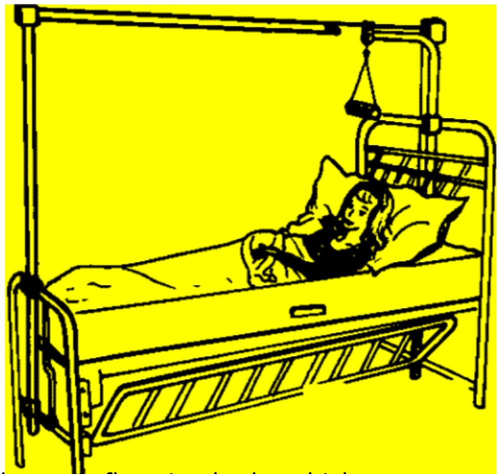
• CISC — Clean intermittent self-catheterisation may be a preferred option for some patients with adequate hand function.

• Atonic bladder — An atonic bladder results from a lower motor neurone type lesion and is only partially emptied by suprapubic pressure.

• Reflex bladder — A reflex bladder results from an upper motor neurone lesion. Complete emptying is achieved by a spinal reflex often achieved by stimulating the inner side of the thigh or lower abdomen.

• Prophylactic antibiotics — A soluble sulphonamide, or other suitable antibiotic should be prescribed prophylactically for at least one month to prevent urinary tract infection. Antibiotics may also be indicated for other infections.

Paraplegic nursing*



- Hydrostatic flotation bed or thick mattress on fracture boards
- 2 hourly turning
- Good skin care and urinary tract
- Physiotherapy to prevent contractures
- Prophylaxis for deep vein thrombosis
- Psychological counselling and rehabilitation

*Polytrauma has a devastating impact on ADLs/quality of life. Women- more affected; higher rates of PTSD; and take more sick leave (Miller et al, Review of Orthopaedics, 8th ed, page 733).

UPDATE, 2022. *Spinal Shock. Usually involves 24- 72hrs period of paralysis, hypotonia and areflexia (flaccid paralysis).Return of the bulbocavernosus reflex(anal sphincter contraction after squeezing of the glans penis or tugging on the Foley catheter)signifies the end of spinal shock. Phases are-phase 1, areflexic/hyporeflexic,24-48 hrs; phase 2,initial reflex return, next 1 or 2 days, return of some reflexes. Phase 3, initial hyperreflexia, 1-4 wks. Phase 4, final hyperreflexia, spasticity.

• Bladder or renal calculi — These may be the result of urinary retention and infection associated with recumbency. These usually occur in infected alkaline urine, are made of calcium ammonium phosphate and are radio opaque. They are fairly soft and when they take on the shape of the renal calyces they are called stag horn calculi.

• Treatment — This may involve calculus removal either by open operation or lithotripsy. Endoscopic transurethral resection of the urethral sphincter may also be indicated to improve urinary flow.

• Complications — Management of the complications commonly associated with renal calculi, such as hydronephrosis and urinary tract infections, may be necessary.

Decubitus ulcers

These require first class nursing to prevent their occurrence.

- Mattress — The patient should be nursed on a hydrostatic floatation bed or one of a variety of pneumatic mattresses if possible. The alternative is a very soft, thick mattress on fracture boards.

- Turning — The patient should be turned and lifted every 2 hours from one side to the other and the back rubbed with spirit and kept dry.

- Flotation bed — This should be used where available. This reduces the necessity for frequent turning. Large bed sores may require rotation skin flaps and skin grafting.

- Osteomyelitis — This may occur under the bed sores and require sequestrectomy and debridement, together with antibiotic treatment before a skin graft is embarked upon.

Contractures

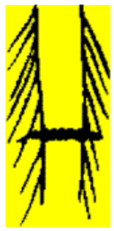
- Prevention — All paralysed limbs should be moved at least once a day through their full range of normal movement. Once contractures have developed, they can be very difficult, if not impossible, to treat.

- Physiotherapy — This is important, as well as gentle skin traction.

- Operations — These include adductor tenotomy to correct adductor spasm and contracture, and fasciotomy and open biceps tenotomy to correct hip and knee contractures. Subcutaneous elongation of the tendo Achillis to correct equinus deformity may also be necessary.

Major thoracic and lumbar*

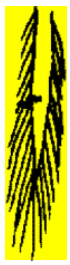
Thoracic fractures



Complete cord division

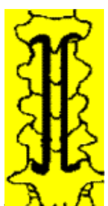
- Poor prognosis
- Conservative management

Thoraco-lumbar fracture dislocation



Nerve root damage and lower cord damage

- Possible partial recovery
- Operative stabilisation



Treatment

- Incomplete spinal cord division
- Occasional stabilisation with rods or C.D. instrumentation

*UPDATE, 2022.Thoracic/lumbar injuries-Denis classifn., (ant col., middle col., post col., ? 4th col in thoracic sp. of sternum and rib cage).Types of Fx- compression/burst/fx-distraction(Chance)/Fx-dislocations (unstable often needs surgery). Indications for surgery not clear unless unstable.

Rehabilitation

The rehabilitation of patients with paraplegia and quadriplegia is essential. Over 80% of paralysed patients in economically rich countries can be found employment of some kind.

The social rehabilitation of these patients is also essential. This includes aids to help with transport such as wheelchairs and walking frames, ramps for access to accommodation and aids for eating and toilet.

Finally, social integration into the community is essential to the further rehabilitation of the paralysed patient.

Sports injuries in the spinal injured

Injuries to spinal cord injured athletes, as with injuries to the general population, are generally specific to the sport, the level of fitness, intensity of competition, preparation, and predominant muscles and joints used.

Joint injuries

• Shoulder — This is the major joint used in most spinally injured athletes. Common injuries include tendinitis and rupture of the rotator cuff, muscle strain, and osteoarthritis of the shoulder and acromioclavicular joints.

• Elbow — This is less commonly injured than the shoulder, although tears of the extensor and flexor origins ('tennis' and 'golfer's' elbow) can be a problem with throwing sports, and wheelchair tennis.

• Wrist — Injuries to this region are more common with quadriplegic track athletes due to the wrist roll wheelchair pushing style used.

Cause

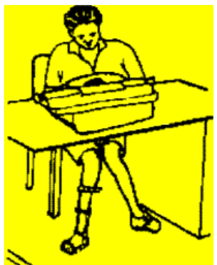
The primary causes are repetitive strain and over use of the joint and muscles, inadequate warm up and cool down, and inadequate pre and post exercise stretching. These causes are not isolated to spinally injured athletes, but are common complaints with all athletes, and all body regions.

Treatment

• Prevention — This includes adequate muscular preparation and strengthening prior to training and competition.

Social rehabilitation

- Ramps for home wheel chair access
- Home modifications to kitchen, bathroom and living areas for paraplegic and quadriplegic patients
- Training for future employment



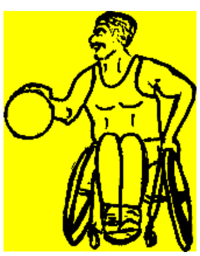
Clerical work

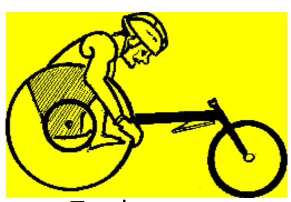
Sewing machine factory in

Light industry and electronics

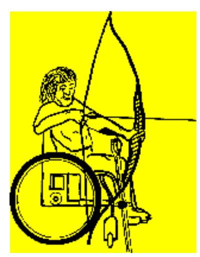
Computer operator

Wheelchair sports





Track



UPDATE, 2022. Gunshot wounds to spine. Usually stable. Surgery when progressive neuro decline and fragment in canal (esp L1. and below).Note also abdo trauma. SCIWORA (spinal cord injury in children with normal XRs).This was pre MRI. Pseudosubluxation cervical spine in children. At C2/3 and C3/4.

Syringomyelia(syrinx) is a collection of fluid, CSF, within the spinal cord.

Stingers/Burners are a neuropraxia of the upper brachial plexus seen in sport. Exclude a ruptured disc.

Transient quadriplegia seen after an axial loading (athlete's head driven into ground),exclude cervical canal stenosis, disc rupture. May need to stop all contact sports.

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Chapter 7

Pelvic fractures*

*UPDATE (2022). Pelvic ring Fx commonly classified as per Young-Burgess system (injury mechanism and so easier to understand)viz. Lateral Compression(LC), involve sacrum, post. iliac wing, contralateral AP compression; Ant. Post compression(APC), have symphysis diastasis; Vertical Shear,(VS), from fall, complete disruption of SI jnt., Combinations thereof. All may also involve-urethra/bladder/spleen/liver/bowel/pelvic vessels/brain/lungs/GI. Other classifn. is Tile.

FOLLOW A TREATMENT PROTOCOL

May cause death- control emergency(85% is venous), volume resus., use pelvic binder/tape feet together, angiographic embolization, pelvic packing, Ext. Fix. Symphysis diastasis, SD, > 2.5cm then ORIF; Anterior Injuries- ORIF, or Ext. Fix., newest technique is ant. subcutaneous internal fixateur; for Posterior injuries-percutaneous iliosacral screw ORIF, plate across ant SI jnts., post. transiliac sacral bars/plates; Vertically Unstable-ant. ring ORIF + percut.SI screw, spinal-pelvic fixation. Complications- severe haemorrhage/neurologic injury/GU and GI problems/DVT/Bone healing problems/infection/ heterotrophic bone/Death.

Classification and causes

Classification

Minor fractures of the pelvic ring

Major fractures of the pelvic ring

• Anterior-posterior force fractures

• Vertical force fractures

• Diastasis of the pelvis

• Combined displacement.

Acetabular fractures

Common causes

The forces responsible may be divided into 3 main types:

• Antero-posterior force — This may occur when a pedestrian is struck head-on by a car or in any crush injury in which an antero-posterior compression force is applied to the pelvis. This may result in pubic rami fractures and damage to the bladder and urethra.

• Vertical force — Often results from a fall from a height. The pubic rami may be fractured and the hemipelvis may be displaced superiorly. These are unstable fractures which may potentially damage pelvic viscera, and produce neurovascular complications including stretching of the sciatic nerve.

• Book fractures — The pelvis is opened out and may be associated with a diastasis of the sacroiliac joint and a retropelvic massive haemorrhage.

• Combined displacement — This may be caused by a variety of forces including lateral compression.

Minor pelvic fractures

Types of fracture

These are fractures in which the 'pelvic ring' is still stable. They may vary from an isolated chip off the rim of the pelvis to a single crack through the pelvic ring and fractures of the pubic ramus with minimal displacement.

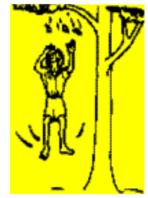
Investigations

•'Springing the pelvis' — There is minimal or no pain on 'springing' the pelvis.

Pelvic fractures

Common causes

- Antero-posterior force
- Bladder damage

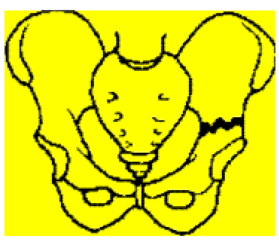


- Vertical force

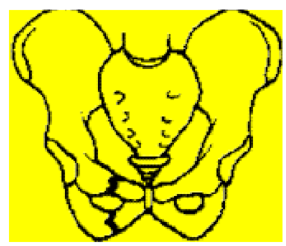
Sciatic nerve damage

- Diastasis of the pelvis
- Massive haemorrhage

Minor Fractures



Single fracture of pelvic wing



Pubic rami fracture

Examination

Assess the stability of the pelvic ring by gently 'springing' the pelvis

- Complications — As the pelvic ring is intact there should be no damage to the major intrapelvic structures such as the bladder, urethra, sciatic nerves and major blood vessels.

- X-ray — This will show a fracture which has not disturbed the stability of the pelvic ring.

Treatment

A pelvic fracture may be much more extensive than can be seen on X-ray, as the sacroiliac joint may have been damaged.

• Admission — The patient should be admitted to hospital and nursed on a soft mattress, which is in turn placed on fracture boards.

• Mobilisation — The patient can often be mobilised and discharged (with or without crutches) from 1 to 3 weeks after admission and often earlier, provided the sacroiliac joints are not damaged.

• Exercises — Leg exercises and early walking should be encouraged.

• Deep vein thrombosis — Prophylactic anticoagulants (subcutaneous low molecular weight heparin) are indicated if the patient is confined to bed.

Major pelvic fractures

Types of fracture

These are fractures in which there is disruption of the pelvic ring in more than one place, resulting in displacement of part of the pelvis. They can be classified into 3 main groups according to their cause, as listed above — anterior-posterior, vertical force and diastasis force.

• Combined fractures — In severe injuries all 3 types of fractures can be combined. This may lead to diastasis of the pelvis and disruption of the sacroiliac joints, with severe bleeding and upward displacement of the pelvis, with damage to the sciatic nerve. The bladder and urethra may be injured by backward displacement of the pubic rami.

• Fractures of the acetabulum — These are discussed separately under 'Dislocation of the hip' (see page 402).

Complications

Complications are often more important than the displacement itself and must be looked for.

• Hypovolaemic shock — This results from considerable retropelvic bleeding. (see page 397).

• Bladder and urethral injuries.

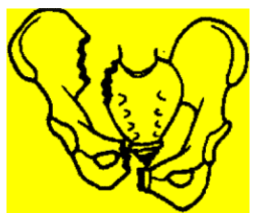
• Sciatic nerve damage.

Major pelvic fractures

Classification and complications

Anterior-posterior force: pubic rami are displaced posteriorly

Bladder and urethral damage



Vertical force: hemipelvis is shifted superiorly

Sciatic nerve damage

Diastasis or ‘book’ fracture: pelvis is opened out, at the pubic symphysis

Retropelvic haemorrhage

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Anterior-posterior force fractures

These occur in crush types of injury. All 4 pubic rami may be fractured and displaced posteriorly. The pelvic ring is usually stable.

Investigation

The important complication of this fracture is damage to the bladder and urethra (see below).

• Rectal examination — This must be never omitted. This is particularly important if there is any possibility of damage to the urinary tract. In the case of rupture of the membranous urethra, apart from urethral bleeding and inability to micturate, a rectal examination will show a gap anteriorly due to the prostate being displaced upwards with the bladder in males.

Treatment

• Nursing — The patient should lie on a soft mattress supported by fracture boards. The actual fracture hardly ever requires reduction, even if displaced.

• Mobilisation — This can commence within 3-6 weeks and often earlier with the support of crutches or a walking frame. In elderly patients without complications, the patient can often be mobilised within a few days.

• Complications — The management of urethral and bladder injuries is discussed below.

Vertical force fracture

Cause

These may be due to a fall from a height onto the feet, resulting in one half of the pelvis being displaced superiorly.

Minor displacement

• Treatment — The patient is nursed lying flat on a soft mattress supported by fracture boards. Skin traction of approximately 5 kg is applied to the relevant leg, as illustrated.

Severe displacement

• Traction — A Steinmann's pin should be inserted into the

tibial tuberosity or lower femur. Traction of approximately 10-12 kg is applied, gradually reducing to 7 kg over 2-3 weeks. This is maintained for a total of 3-6 weeks.

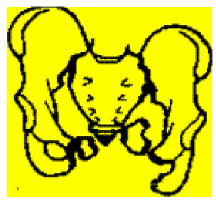
• Mobilisation — The patient can be mobilised on crutches, but no weight-bearing should be allowed on the affected side for 3 months from the time of the original injury.

Major pelvic fractures

Anterior-posterior force

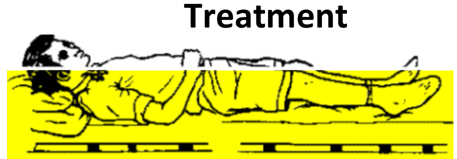
Minimal or no displacement of pubic rami

Moderate displacement of pubic rami



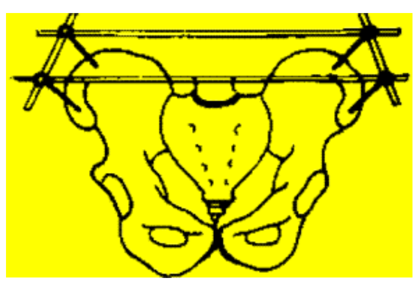
Fractured pubis with disruption

Treatment



Pubic fracture alone

- 1-3 weeks of bed rest on a well- supported mattress
- Early mobilisation



External fixateur is ideal treatment for severe disruption

- External fixateur — In severe displacement of the pelvis this may be required for 2-3 months.

• Internal fixation — This may be necessary with plates and screws in some cases after initial stabilisation with external fixateurs.

Complications

Sciatic nerve damage:

• Neurapraxia — This is common.

• Axonotmesis — This is common.

• Neurotmesis — This is rare.

• Other complications — Shock due to blood loss, leg shortening and low back pain.

'Book' fractures.

The whole pelvis opens out like a book. The diastasis is usually, but not always, at the symphysis pubis.

Treatment

• Nursing — A soft mattress supported by fracture boards with the patient lying on the side. The effect of this is usually to 'shut the book' (i.e., reduce the fracture).

• Conservative treatment — Elevating the whole pelvis in a very wide large padded canvas sling or in a plaster spica.

• Severe displacement — Closed manipulation of the fracture followed by an external fixateur and a plate if necessary.

• External fixateur — Pins in each ilium.

• Internal fixation — A plate across the symphysis pubis after initial external fixateur.

Complications

• Bleeding — This is due to disruption of the posterior iliac vessels. Early reduction of the fracture is important with an external fixateur if possible. Urgent resuscitation may be necessary, including massive blood transfusion.

• Other complications — Bladder and urethral damage, sciatic nerve injury, intestinal damage and other fractures.

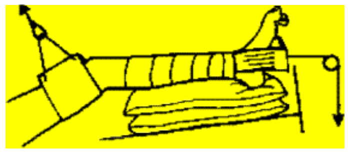
• Chronic low backache — This is due to opening out of the sacroiliac joint and is common.

Multiple pelvic fractures

The various fractures of the pelvis are often combined. This is particularly so in cases where there is a high velocity impact injury. All the various complications described above can be present.

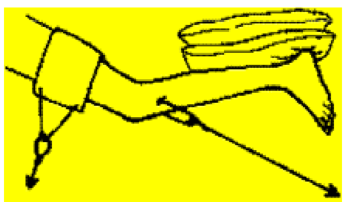
Pelvic fractures — treatment Vertical force

Minimal displacement



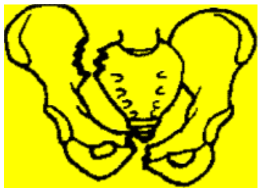
- Russell traction for 3-6 weeks
- Elderly patients — mobilise early

Moderate displacement



- Steinmann's pin for 3-6 weeks followed by mobilisation with crutches
- Crutches: non-weight- bearing, on the affected leg for a total of 2 months from the time of the trauma

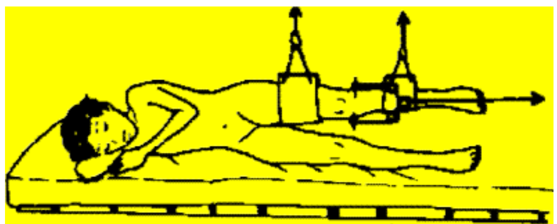
Major pelvic fractures Vertical force



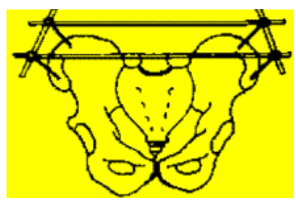
Moderate or severe vertical displacement

Vertical displacement associated with central dislocation of the hip

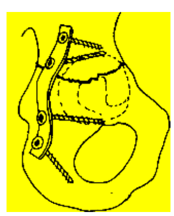
Severe upward displacement with diastasis



Conservative management



External fixateur is ideal treatment for severe disruption

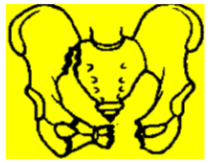


Disruption of the pelvis

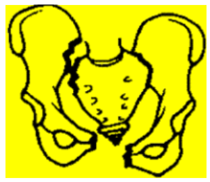
- External fixateur followed by ORIF if required
- Treatment of complications

Major pelvic fractures 'Book' fractures

Symphysis pubis is opened out



Symphysis pubis is separated with appreciable sacroiliac disruption



Severe ‘book‘ fracture associated with displacement and ,disruption of the pelvis

Complications of pelvic fractures

Urological complications — common

See hospital emergency section — page 114

- Intraperitoneal rupture of the bladder
- Extraperitoneal rupture of the bladder
- Rupture of the membranous urethra
- Rupture of the penile urethra.

Neurological complications

- Sciatic nerve lesion
- Lumbosacral plexus damage.

Vascular complications

- Major vessel damage
- Massive haemorrhage from retropelvic vessels.

Intestinal complications

- Paralytic ileus — common
- Small intestinal damage — uncommon
- Large intestine and rectal damage — uncommon.

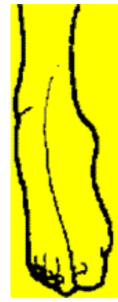
Other complications

- Damage to liver, spleen and pancreas
- Damage to the heart, lungs and great vessels
- Damage to the spinal cord, brain and limbs.

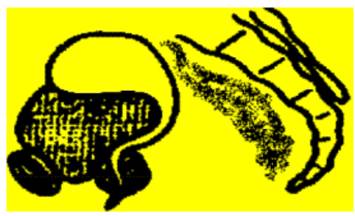
Pelvic fractures

Complications - 1

Rupture of the bladder or urethra (See page 114)



Foot drop due to sciatic nerve lesion



• Pelvic haematoma, involving colon and rectum.

• Massive retropelvic haemorrhage

Urological complications

The bladder and urethral complications of a pelvic fracture are often more important than the fracture itself. They must be looked for carefully, because if left untreated they are potentially fatal.

Clinical assessment

Bleeding from the urethra should be looked for and the patient asked whether he or she has passed urine since the accident.

A careful abdominal examination, including rectal examination, must never be omitted. Displacement of the prostate and bladder superiorly occurs in ruptures of the membranous urethra.

Investigations

A cystogram and an intravenous pyelogram should be performed if there is any doubt about urinary tract damage.

A urethrogram may also be indicated. This is discussed further under emergency hospital care — see page 114.

Bladder or urethral damage

If a partial or complete rupture of the bladder is suspected, a soft catheter should be passed with full sterile precautions.

A urethrogram or cystogram is often of assistance, as is an intravenous pyelogram.

Intraperitoneal rupture of the bladder

This often occurs when a full bladder is traumatised. The bladder should be repaired in 2 layers and an indwelling urethral catheter inserted. Prophylactic antibiotics should be prescribed.

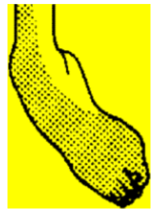
In severe bleeding or damage, leave in a suprapubic catheter or fine plastic tube as well for 2-3 days to help with bladder irrigation. The urethral catheter is removed after 2 weeks.

Extraperitoneal rupture of the bladder

This is relatively common. Repair is often not possible. A suprapubic drain should always be inserted plus a suprapubic catheter or suction drain. A urethral catheter will be required for 2-3 weeks. Prophylactic antibiotics are also essential.

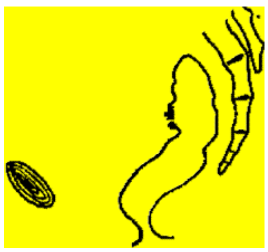
Pelvic fractures

Complications - 2

• Sciatic nerve — foot drop and sensory disturbance

• Massive blood loss — retropelvic vessel damage



Damage to colon and rectum is uncommon

Back pain: common

395

Rupture of the membranous urethra

The importance of a routine rectal examination in all fractures of the pelvis is stressed. Passage of a urethral catheter should be done under full sterile precautions preferably in theatre.

Treatment

1. Open the bladder and pass a metal sound into the prostatic urethra, to insert a Foley catheter.

2. Inflate the 30 ml balloon in the tip of the catheter with sterile water.

3. The prostate is drawn down to the pelvic floor and the Foley catheter left in place.

4. Prophylactic antibiotics should be prescribed.

5. The Foley catheter is left for 2-3 weeks.

Complications

The main late complication of urethral damage is a urethral stricture. This may require regular dilatations and sometimes surgery to reconstruct the urethra.

If a rupture of the membranous urethra has been missed for several days, severe scar tissue may necessitate ureteric transplant into the intestine.

Emergency laparotomy

This is important, with repair and drainage of the bladder and urethra (see page 116).

Neurological complications

Sciatic nerve lesions

• Vertical force fracture — Muscles below the knee are weak or completely paralysed with a foot drop and sensory loss. Exploration of the nerve is only necessary if pressure on the nerve is being caused by a posterior acetabular fracture.

Lumbo-sacral plexus

These may involve the lumbo-sacral plexus or individual nerves.

• Prognosis for recovery — This depends on the type of neurological damage.

• Neurapraxia and axonotmesis — These are relatively common and usually partially or completely recover.

• Neurotmesis — This is uncommon and does not recover. It occurs where there is significant superior displacement of the hemipelvis.

• Sacral fractures — These may damage nerves within the sacral foramina.

• Displacement of the sacroiliac joint — The nerves may be stretched and damaged.

Vascular damage

Major vessel

• Common iliac artery — This is occasionally damaged by bone fragments or completely divided.

• Treatment — This involves repairing the vessel or replacement with a synthetic or vein graft.

Massive haemorrhage

• Retropelvic arteries — These may produce a massive pelvic haematoma, especially in pelvic diastasis. Urgent resuscitation and blood transfusion plus reduction of the fracture with external fixateurs is urgently required. Vascular embolisation under radiological control may also be useful.(see page 119)

Treatment

• MAST suit — This should be the initial emergency treatment prior to reduction of the fracture dislocation.

• Reduction of the fracture — An external fixateur, plus massive blood transfusion is essential with resuscitation of the patient often before laparotomy and repair of intestinal injury or vascular exploration. Two intravenous cannulae of least 14-16 gauge should be inserted.

Intestinal complications

• Paralytic ileus — This is common.

• Small intestine, colon and rectum — These are uncommon as displaced fractures of the sacrum are relatively rare.

• Rectal examination — This should be routinely carried out, to assess anal sphincter tone, bleeding into the rectum and prostatic upward displacement in rupture of the membranous urethra.

Osteoarthritis

• Acetabular fractures — These may result in secondary osteoarthritis of the hip joint usually due to damage to the articular surface. Disruption of the blood supply to the femoral head associated with fracture of the head or neck of femur is less common.

• Chronic back pain — This is common, especially when one or both sacroiliac joints have been disrupted.

Chapter 8

Lower limb injuries*

*UPDATE (2022), Acetabular Fxs. Hard to assess on XRs, use CT. Use Letournel classif. Think- post wall/column, ant wall/column, transverse, combination thereof. Aim is to restore joint congruity and get hip stability. ORIF(risk DVT/PE + heterotopic ossif.) for younger patients to avoid OA but difficult; acute hip replacement for older. Very frail + osteoporotic-brief period of traction.

Hip dislocations

Posterior dislocation

Diagnosis

• Clinical diagnosis — This is confirmed by the finding of an extremely painful hip held in flexion, adduction and internal rotation. This is the only traumatic condition which will give an internally rotated and adducted hip on clinical examination and this clinical picture is absolutely diagnostic.

• Sciatic nerve palsy — This must be looked for at the initial examination and the nerve may be injured either by the dislocated head of the femur, or by a fracture of the posterior rim of the acetabulum.

• X-ray — Only an AP X-ray is necessary. This shows not only an adducted but also an internally rotated hip. The internal rotation is diagnosed by the lesser trochanter which is normally situated posteromedially, either disappearing from view, or being less prominent on the AP X-ray.

Treatment

• Reduction — This is required urgently due to the risk of devascularisation of the femoral head and pressure on the sciatic nerve. It is achieved with a good relaxant anaesthetic. The knee is flexed to a right angle and the hip externally rotated and lifted back into the acetabulum. If not successful the patient should be placed on a mattress on the floor to obtain added leverage. Can be difficult.

• Operative replacement — This, combined if necessary with screw or plate fixation of the rim of the acetabulum, should be carried out if closed reduction is unsuccessful, or if there is a large displaced posterior segment of the acetabulum. The sciatic nerve should be carefully protected if this is done.

• Immobilisation — Following reduction the affected limb should be supported in modified Russell traction for 3 to 6 weeks, and kept off weight bearing on crutches for 3 months from the time of dislocation. This is because of the risk of avascular necrosis of the femoral head. Fx. NB-30% rate labral tear.

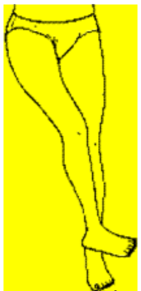
Anterior dislocation

This is much less common than posterior dislocation. Diagnosis

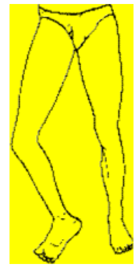
The hip is abducted, externally rotated and flexed. This is the only traumatic condition which produces an externally rotated and abducted hip and is diagnostic. The head of the

Dislocation of the hip*

Examination



Posterior dislocation: Adducted, internally rotated and flexed



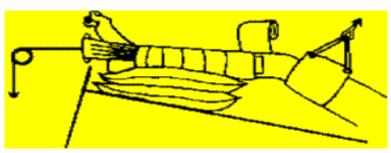
Anterior dislocation: abducted , externally rotated and flexed

Reduction

Posterior dislocation: externally rotate and abduct with traction

Anterior dislocation: internally rotate and adduct with traction

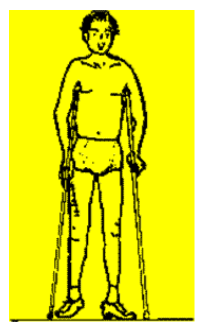
Post reduction



Modified Russell traction for 3-6 weeks

*Femoral head Fxs - restore congruity, remove LBs.

Most need ORIF.



Young patients Non-weight-bearing for 3 months femur may be felt in the groin, or may be in the obturator fossa.

• Differential diagnosis — It should be compared with the internally rotated, adducted hip in posterior dislocation, and the adducted externally rotated hip in all other conditions including fractures of the hip, osteoarthritis and infections.

• X-ray — This shows a dislocated, abducted, externally rotated hip. The external rotation on an AP X-ray is shown by a more prominent lesser trochanter. (NB: It is less prominent in the internal rotation of a posterior dislocation).

• Complications — The femoral vessels or femoral nerve may be damaged and there may be an associated fracture of the acetabulum or pelvis. These complications should be looked for.

Treatment

Treatment is the same as for posterior dislocation, except that the manipulation is performed in the opposite direction. Occasionally an open reduction is required.

Central dislocation

Diagnosis

• Clinical — Pain is present, with limitation of both active and passive movements, with a flexed, adducted and externally rotated hip. A fracture of the floor of the acetabulum may be associated with true shortening. Apparent shortening will also be present and is due to the adducted hip. Often elderly osteoporotic bone.

• X-ray — There may be only a minimal crack, or considerable displacement medially of the acetabular floor.

• CT scan — A CT scan is indicated if operative reduction and internal fixation with plates of the floor of the acetabulum is planned. A CT scan will also help diagnose loose bone fragments in the acetabulum.

Slight degrees of displacement

Treatment

• Skin traction — Longitudinal traction with 4 kg weight plus

a sling under the thigh with upward traction of about 3 kg weight (modified Russell traction — see page 403).

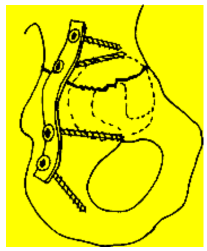
• Mobilisation — At the end of 3 weeks, the patient can be mobilised on crutches, non or partial weight-bearing.

• Elderly patients — In these patients, with a minor degree of displacement, the fracture should be ignored and the patient mobilised weight-bearing and out of bed within a few days.

Central dislocation hip

Severe cases

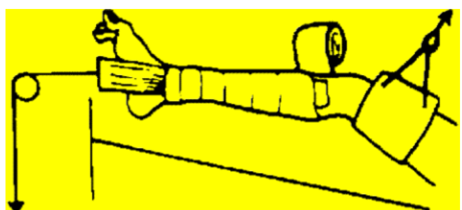
Fractured acetabulum — May be associated with other fractures of the pelvis



Disruption of the pelvis and acetabulum will require internal fixation with plates and screws

Mild and moderate cases

3 kg



4-5 kg

• Modified Russell traction for 1-6 weeks then non-weight-bearing on the affected limb with crutches for 6 weeks

• Occasional internal fixation

Severe displacement

Treatment

• Steinmann's pin — This should be inserted deep to the tibial tuberosity, or a threaded pin with an eyelet should be inserted into the greater trochanter for lateral traction.

• Traction — 10-12 kg of traction is applied, progressively reduced at the end of 3 weeks.

• Operative reduction — In moderate or severe displacement, internal reduction and stabilisation with a plate on the inner side of the acetabulum is the treatment of choice, especially in young patients. A CT scan should be carried out, before internal fixation, to locate the displacement and any loose fragments of bone in the acetabulum. A later total hip replacement may be required if osteoarthritis supervenes.

• Mobilisation — The patient should be mobilised with crutches and non-weight-bearing for at least 3 months.

Complications

• Early recurrent dislocation — This is common if there is a large fracture of the posterior acetabulum. It is important that this be reduced with screws or a plate.

• Sciatic nerve damage — This seldom requires operative treatment unless a fracture of the acetabulum is causing ongoing compression. In these cases, operative neurolysis is required, together with internal fixation of the acetabular fracture. It is important that this complication should be looked for before reduction of the dislocation.

• Avascular necrosis of the femoral head (up to 15%) — This may progress to osteoarthritis. Technetium bone scanning is a useful investigation for making the diagnosis of avascular necrosis of the femoral head in the early stages.

• Traumatic ossification — This is also known as myositis ossificans. The hip should be rested by immobilisation in a hip spica in the early stages. If this is severe the bone may require excision once it has consolidated (after a few months) followed by low dose radiotherapy within 3 days of operation. Indocid may also be of limited value in some cases.

• Osteoarthritis — Complications of a central dislocation of the hip include stiffness and pain in the hip, and referred pain down to the knee. This may be due to myositis ossificans, avascular necrosis of the femoral head, or osteoarthritis due to a damaged acetabulum or a retained fragment of bone in the acetabulum.

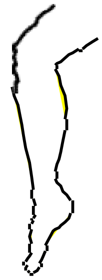
• Fracture head of femur — An associated fracture of the

femoral head may require internal fixation.

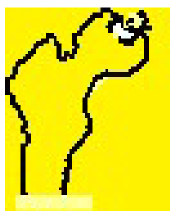
Dislocation of the hip

Complications

Early recurrent dislocation: especially with posterior acetabular fractures



Sciatic nerve damage: paralysed foot with sensory loss



Fracture head of femur

Avascular necrosis of the head of femur: anterior or posterior dislocations

Myositis ossificans

Osteoarthritis: all types of dislocations

Hip fractures*, NOF (Neck of Femur)

Classification

• Minor fractures

• Cervical fractures(Garden-I or II= stable, III or IV unstable) • Trochanteric and subtrochanteric fractures.

Minor fractures

These include isolated fractures of the greater and lesser trochanters alone. These fractures do not extend through the line of weight-bearing of the femur.

Treatment

Bed rest for a few days, followed by early mobilisation with crutches, partial weight-bearing, for up to 3 weeks. Physiotherapy is important to assist with mobilisation.

Complications from these minor hip fractures are uncommon.

Cervical fractures

Diagnosis

Fractures may occasionally be impacted in abduction. In these cases, the true diagnosis is sometimes missed, as the patient can still actively move the leg. Except for impacted fractures, the diagnosis is made with the clinical findings of pain, inability to lift the leg unaided, and marked external rotation (60°) and adduction. Both AP and lateral X-ray views should be taken to confirm the diagnosis, especially if there is no displacement, or the fracture is impacted.

If there is any doubt as to the diagnosis, a radioisotope bone scan should be carried out.

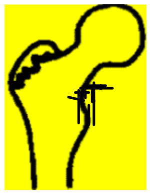
Treatment

These fractures are best treated by reduction and insertion of compression screws, sliding screw plates or blade plates under image intensifier control. Operative treatment is indicated in most cases because patients tend to be over 60 years of age, and early mobility out of bed, together with weight-bearing, is important. In displaced subcapital fractures, especially in elderly patients, a hemi or total hip replacement should be considered, as early full weight-bearing is again important.

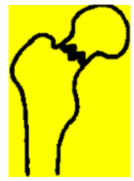
In addition, the risk of either avascular necrosis of the femoral head, or non-union, is high.

Hip fractures

Classification



Isolated lesser or greater trochanter

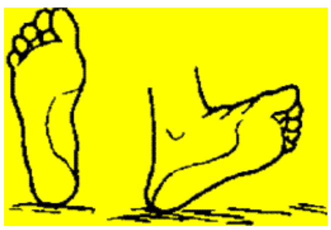


Cervical

Trochanteric

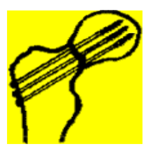
Cervical fractures

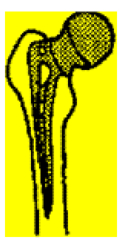
Diagnosis

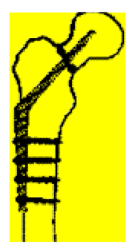


- Pain, shortening, inability to lift the leg
- External rotation of the foot to 60°
- Exception: impacted fracture

Treatment*







Cervical and subcapital fractures: cannulated compression screws. (Garden III and IV)

*Preoperative cognitive function and mobility determine functional outcome.

Trochanteric fractures

Clinical findings

• Site — These occur through the trochanters and are often comminuted.

• Clinical examination — The hip is usually externally rotated more than in cervical fractures — up to 90°.

• Blood loss — Considerable blood loss may occur, with lateral swelling over the upper thigh.

• Non-union is uncommon.

Treatment

• Sliding hip screw and plate/device — This should be inserted within 12 hours if possible. This is a larger operation than insertion of a compression screw alone and requires an image intensifier. Added bone graft may be necessary in severely comminuted fractures.

• Short or long IM nails for standard and reverse oblique Fx and for subtrochanteric Fxs.

• Modified Russell traction — This is an alternative treatment for patients in developing countries. 4.5 kg (10 lb) of skin traction is applied to the affected leg and 3 kg (7 lb) of traction to a sling under the thigh for 8–12 weeks. In elderly patients, however, there are many disadvantages of keeping a patient in bed for 2-3 months. This method is only used where the facilities are not available for internal fixation.

Complications

All hip fractures

• General complications — The complications of prolonged bed rest in elderly patients include bronchopneumonia, deep venous thrombosis and pulmonary thrombo-embolus, urinary retention, decubitus ulcers, joint contractures and mental confusion.

Cervical fractures

• Non-union — Non-union, or avascular necrosis of the femoral head occur in about one third of all cases.

• Subcapital fractures — In displaced fractures avascular necrosis may occur in over 50% due to the poor blood supply.

• Treatment — A hemi-arthroplasty is indicated in displaced fractures in elderly patients. Alternatively, a total hip replacement may be used in fit elderly patients.

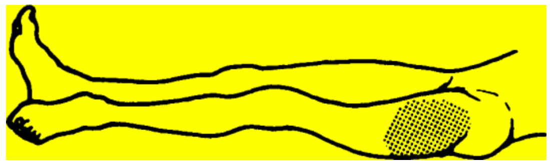
• Osteoarthritis — Osteoarthritis is common in displaced fractures.

Major trochanteric fractures of the femur

Diagnosis

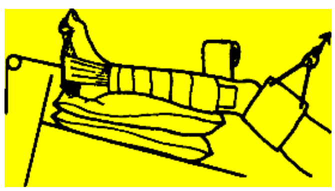
• X- ray appearance

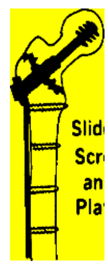
• Usually comminuted



Haematoma Hip externally rotated to 90° with adduction and shortening

Treatment





Bone graft for comminution Optimum treatment

• Sliding screw plate

• Early weight bearing

• IM nails-best

• Other complications — Penetration of the acetabulum or femoral head by a blade plate, or fracture of the nail or plate, may also occur.

Non-union

• Elderly patients — In established non-union, in an elderly patient, no treatment, a trochanteric osteotomy or a total hip replacement may be indicated.

• Young patients — In younger patients intertrochanteric osteotomy is indicated, sometimes associated with a vascularised fibular bone graft up the neck of the femur.

Avascular necrosis

• 'Unfit' elderly patient — A symptomatic unfit patient should be treated with a hemi-prosthesis, or a Girdlestone excision arthroplasty.

• ‘Fit’ elderly patient — If the patient is fit, a total hip replacement should be carried out.

• Young patients — In young patients a vascularised fibular bone graft of the neck of the femur may be indicated.

Trochanteric fractures

• Non-union — This is rare in trochanteric fractures as the fracture has a good blood supply.

• Varus and external rotation — This may occur and require a trochanteric osteotomy as both mal-union and coxa vara may cause shortening.

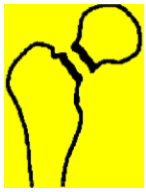
Subtrochanteric fractures (unstable)

In sub-trochanteric fractures, unlike trochanteric fractures, non-union is fairly common. Compression of the fracture with a blade plat but best with long locked IM nail and maybe with bone grafting, is the treatment of choice. A bone growth stimulator may also be indicated in cases where other methods have failed.

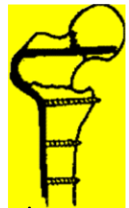
Osteoarthritis

• Elderly patients — In established osteoarthritis a total hip replacement may be indicated.

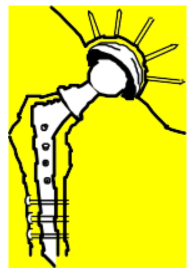
• Young patients — An intertrochanteric osteotomy may be required initially to correct the deformity. A later total hip replacement may be required.



Non-union

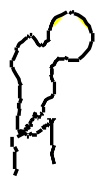


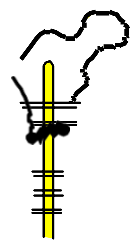
Intertrochanteric osteotomy



Avascular necrosis: hemiarthoplasty or total hip replacement

Coxa vara deformity with apparent shortening: common





Huckstep locking nail with bone graft, long IM locked nail is now used.

Femoral shaft fractures*

Emergency treatment

Splint

Use a well padded Thomas splint with skin traction or tie the 2 legs together, including the foot, as illustrated. Open wounds should be treated by a pressure bandage. Elevate the legs for transport.

Blood loss

1-2 litres or more blood loss may occur, even in closed fractures.

Associated injuries

Fractures and dislocations of both the hip and knee may be associated and must be included in the X-rays. Other injuries to the head and neck, trunk, spine and other limbs should always be looked for, especially neurological and vascular complications.

Conservative management of femoral

shaft fractures

Indications

Conservative management is normally only indicated in severely infected compound fractures, or where the facilities are not available for internal fixation in closed fractures.

Children should also be treated by non-operative measures if possible (see page 248).

• Operative fixation — Most fractures require internal fixation with a locking nail. This is particularly indicated in a patient with multiple injuries.

• Emergency treatment — Skin traction with 4 kg in a Thomas splint, as illustrated, with padded straps or bandages.

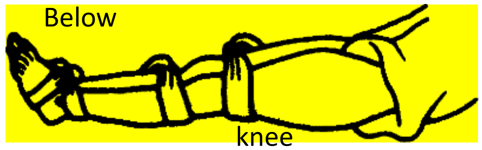
• Definitive treatment — A Steinmann or Denham pin is inserted deep to the tibial tuberosity, with 6-7 kg longitudinal traction. A Pearson's knee piece (as illustrated) is attached to the Thomas splint.

One cord is attached to the upper end of the Thomas splint with approximately 3 kg of traction directed slightly proximally.

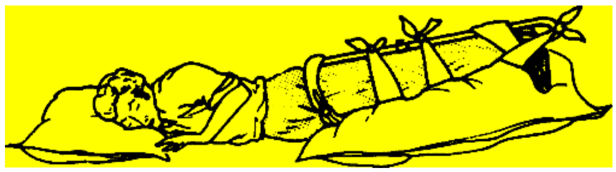
One cord is attached to the lower end of the Thomas splint parallel with the upper cord. There should be just enough weight (3-4 kg) to balance the leg in mid air.

Femoral shaft fractures

Emergency management

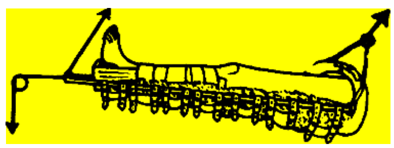


Immobilisation: bandage the legs and feet together or use a Thomas splint

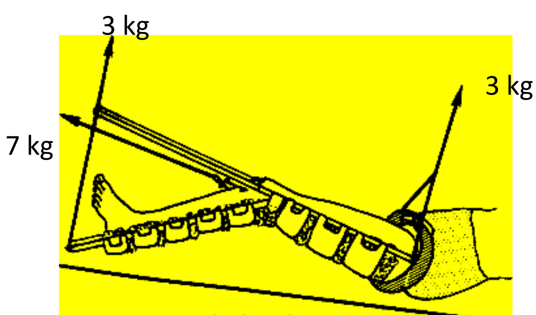


Transport: Thomas splint if possible, with the leg elevated and under traction

Initial treatment in hospital

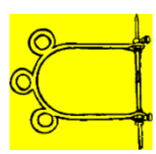


- Treat hypovolaemia and other injuries
- Skin traction using a Thomas splint



Skeletal traction

Thomas splint with Pearson's knee piece



Huckstep Böhler stirrup

Anaesthetic

• Intravenous pethidine and local anaesthetic — This should be used to reduce the fracture and to insert the tibial pin for traction. A femoral plus sciatic nerve block is also a very useful initial and post-operative method to minimise pain.

X-rays

These should be carried out only after any resuscitation of the patient including blood transfusion. They must include both the knee and the hip.

• Repeat X-rays — These may be required at 3 days, 1 week, 3 weeks, 6 weeks, 9 weeks, 3 months, and finally at 6 months.

Clinical measurement

Measurement of the limb length will also allow adequate adjustments to be made to the traction weight and help minimise X-rays.

Mobilisation of the knee

At about 4 weeks, the knee can be mobilised with a separate cord attached to the Pearson's knee piece. The alternative is traction alone with the Thomas splint removed. The lower half of the mattress is removed in the special bed, and the knee mobilised with the leg dangling below the upper half of the mattress.

Clinical union

At about 8 weeks the patient can be mobilised further and the traction reduced. As soon as the X-ray appearance of the fracture site is satisfactory, the Steinmann's pin is removed.

A cast brace, which is a well fitting plaster cast for fractures of the middle or lower one third of the femur, is an alternative and will allow graded weight-bearing on crutches. Otherwise, the patient may be mobilised with gradually increasing weight-bearing.

Physiotherapy

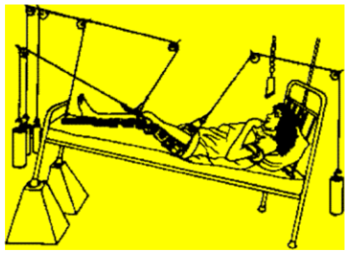
• Quadriceps exercises — These should be started immediately after splinting, and knee movements commenced in a constant passive motion (CPM) machine once union has commenced.

• Mobilisation

Mobilisation with crutches and full weight-bearing can be started at about 3 months when solid union has taken place.*Gerhard Kuntscher,1900-1972,was a German surgeon who introduced intramedullary nailing of femoral and tibial shaft fractures and used in WW2.

Femoral shaft fractures

Conservative treatment shaft

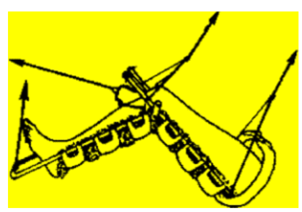


Knee movements: 3-4 weeks after initial injury

Fractures proximal 1/3rd

- Leg abduction and flexion.
- Intramedullary locking nail is best

Supracondylar fractures



- Knee flexed to 90°
- Screw plate or locking nail is best

Difficult femoral shaft fractures

Proximal third of femur Position

The upper femoral fragment is abducted and flexed by the hip muscles.

Conservative treatment

The leg should be fully abducted to compensate for this displacement.

'Closed' operative treatment Internal fixation with a locking intramedullary nail is the optimum method of treatment.

Supracondylar fractures

The lower fragment may be rotated backwards by the gastrocnemius. Do CT.

Conservative treatment

The knee piece of the Thomas splint must be flexed to a right angle to relax the gastrocnemius, with a pad of wool placed behind the lower fragment of the fractured femur. Alternatively, a cylinder plaster with the knee well flexed, may be used.

Operative treatment Plate fixation for most Fxs. (Huckstep locking nail is one option for complicated adult Fxs.).

Distal condylar fractures

Diagnosis

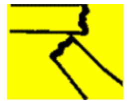
A fracture of one condyle or a 'T' shaped fracture of the distal femur can cause considerable bleeding into the knee joint. A plain X-ray may also show fat in the knee joint, and aspiration of the knee may reveal a large haemarthrosis with fat globules.

Treatment

• Undisplaced fractures — Patients with minimal or no displacement can be treated by aspiration of the blood under full sterile precautions, plus a pressure bandage with wool padding and a Thomas splint, for a few days. This is then followed by the application of a complete

Femoral shaft fractures

Treatment of non-alignment

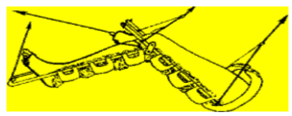




• Malalignment: manipulate under anaesthesia

• Shortening: increase traction

MOST CASES REQUIRE INTERNAL FIXATION

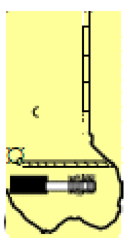
Fractured femur plus tibia (floating knee)



Thomas splint plus a below knee plaster, incorporating a Steinmann's pin

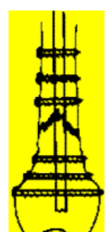
Locking femoral and tibial nails best

Supracondylar fractures



Screw plate

or



Huckstep locking nail

cylinder plaster, or by a fibreglass support and early quadriceps exercises. Operative fixation with screw stabilisation is best as this will allow for early knee movements.

• Displaced fracture —Use (?locked)plates and option of retrograde IM nail (easy).Accurate reduction and stable fixation is important.

• Severely comminuted fractures — Operative fixation should be attempted. If this is not possible, aspiration of the haemarthrosis and application of a backslab for a few days should be followed by modified Russell traction and early movements. A Constant Passive Motion (CPM) machine is the best method of achieving this.

Cast bracing in femoral fractures

• Middle and lower third fractures — If these fractures are treated conservatively, patients may often be mobilised weight-bearing between 4-6 weeks after the initial injury. This is achieved by fitting a well molded support from the upper thigh to the toes with a knee hinge to prevent the last 20° of extension. This allows mobility of the knee while still preventing the rotation forces of the tibia being transmitted to the femoral shaft.

Multiple injuries

A locking intramedullary nail is essential so that patients may be mobilised out of bed as soon as possible. It will prevent prolonged and difficult nursing care, particularly in elderly patients.

Difficult fractures

Locking nail

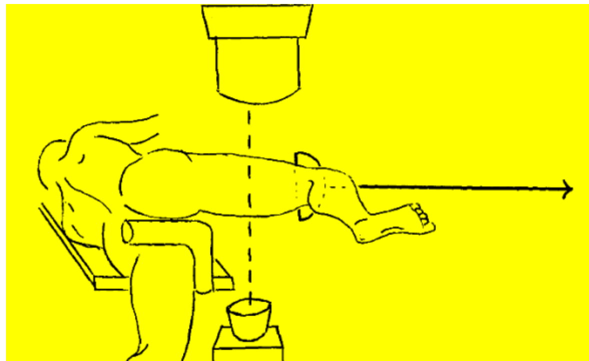
A Huckstep intramedullary compression nail or other locking nail is indicated in difficult fractures.

Contaminated compound fractures

External fixation with pins and an external fixateur is indicated initially. This is usually followed by internal fixation with an intramedullary locking nail, or plate plus bone grafting, when the infection has resolved. There is also a place for an unreamed intramedullary nail as a primary procedure.

Locking femoral nail

Image intensifier



Skeletal

(this is a most useful image showing theatre/OR set-up for femoral IME nail on side; or can be in supine position)

- 'Closed' intramedullary locking nail and screws inserted under image intensifier control
- Fracture site not opened

Locking nails

Indications

These require more skill than unlocked nails. They allow for greater stability and earlier mobilisation of patients with femoral shaft fractures. Apart from the Huckstep nail, image intensifier control will be needed for their insertion.

• Oblique and comminuted fractures — Closed locking nails inserted under image intensifier control, and locked with screws above and below the undisturbed fracture site, are the optimum method of stabilising these fractures.

• Pathological fractures — These are mainly due to secondary deposits and Paget's disease.

• Mentally confused and demented patients — These patients need stable internal fixation.

• Severe multiple injuries — The prognosis is improved if patients are mobilised within 2 or 3 days of the accident.

• Interposition of soft tissue between the fractured bone ends.

• Delayed-union and non-union.

• Fractures where there is associated vascular or neurological damage. These may also require vascular or neurological repair.

Contraindications of locking nail

• Grade 3, severely contaminated compound fractures — In these fractures there is a risk of infection. Even in these cases, however, internal fixation can sometimes be carried out, after extensive debridement of dead tissue, provided the wound is left open for delayed closure and intravenous antibiotics are given. Some of these cases are best treated initially either with external fixateurs or with plates.

• Severely comminuted fractures involving the joints — These patients need other types of internal fixation.

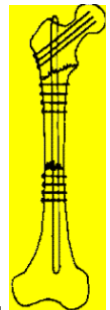
Huckstep titanium alloy locking

compression nail

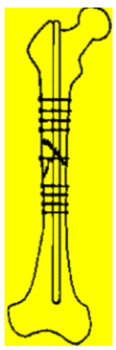
This nail was designed by the author in 1967 for difficult femoral shaft fractures or combined fractures of the neck and shaft of the femur, and was the first compression locking nail in the world. It is usually a 12.5 mm diameter titanium alloy nail for the femur. It is available in different lengths and diameters and can be cut to shorter lengths if required. It has an advantage over standard nails in that only one diameter need be used for the femur, even when the medullary cavity is wide. Comminuted fractures and fractures of the proximal and distal thirds of the femur can also be stabilised. The nail

Huckstep locking titanium compression nail*

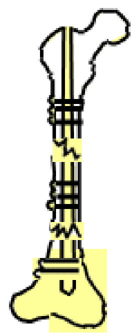
Jig system for insertion of drill holes without control



Combined trochanteric and shaft fractures, or X-ray double fractures of femoral shaft



Comminuted fractures



Rigid strong fixation with compression or elongation; also fixation of supracondylar fractures

• Inert strong titanium nail with either 4 oblique holes or all transverse holes.

• Immediate postoperative weight -bearing

is locked in place with 3 or 4 titanium screws inserted above and below the fracture site. A special jig (illustrated) allows the screw holes to be located without the need for X-ray control, in most cases, and early weight-bearing is possible.

Established non-union

A compressor is attached over the greater trochanter. Bone grafts should always be added.

Double fractures

The nail can also be used in double fractures of the neck and shaft of the femur with oblique screws up the femoral neck.

Advantages

This nail has many advantages over the standard nail.

• Compression — A fracture can be held compressed and rigid and is indicated in delayed and non-union.

• Whole length of femur — Fractures of the proximal and distal ends of the femur can be stabilised.

• Comminuted fractures — Comminuted fractures can be held to length and individual fragments locked to the nail with screws.

• Lengthening — The femur can be lengthened over the nail in cases of femoral shortening.

• Pathological fractures — These fractures may be held and strengthened with methyl methacrylate cement. Titanium spacers can be used for bone defects.

• Oblique fractures — The Huckstep circlip or cirband with lugs to minimise periosteal compression can also be used for difficult oblique fractures of the femur.

• Compound and infected fractures — The inert titanium nail can be used in open and infected fractures.

• Strength — The nail is stronger than the average femur, enabling most patients to be full weight-bearing postoperatively.

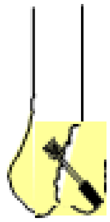
• X-rays or special operating tables — These are not necessary in most cases, except for the insertion of screws up the neck of the femur or for closed nailing.

• Modulus of elasticity — Titanium alloy is half that of chrome cobalt and stainless steel. The nail also seldom requires removal, even in younger patients. 'Stress shielding' is also rare.

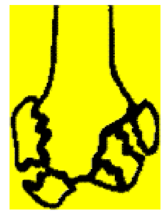
• Inertness — Titanium aluminium vanadium alloy is completely inert. This is unlike other metal alloys, such as stainless steel and chrome cobalt, which may give chrome cobalt or nickel sensitivity reactions.

Femoral condylar fractures

Long lag screws

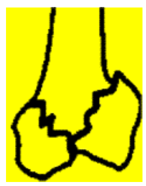


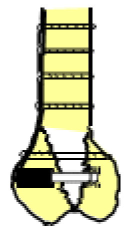
Internal fixation



best followed by CPM machine

'T' fractures

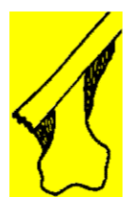




Screw or plate fixation

Complications of femoral fractures - 1

Associated dislocation of the hip



Genu valgum

Genu varum

Complications of femoral fractures

Early complications

Vascular complications

• Hypovolaemic shock — Blood loss may be up to 1-2 litres with closed femoral fractures. All patients should have a large intravenous cannula inserted on admission and their blood pressure stabilised with crystalloid or colloid infusion, until blood is available for transfusion.

• Blood vessel damage — The femoral artery may be damaged by a shaft fracture, requiring urgent surgery. Either end to end suturing, or a reversed vein graft will be necessary.

• Compartment syndrome — These results from increased pressure in a fascial compartment and is due to both bleeding and oedema. Treatment is immediate decompression by fasciotomy, or else ischaemic death of muscles may occur, with all the severe local and general complications of crushed muscles (see page 182).

Neurological complications

Neuropraxia and axonotmesis are usually the result of closed fractures, whereas compound fractures may produce a neurotmesis (see page168).

Infection

Infection is more common with compound fractures.

• Osteomyelitis — This usually results either from a compound fracture, or from an operation on a closed fracture. Treatment includes long-term intravenous antibiotics. Compound fractures require extensive debridement. Intramedullary nails, if already present, should not be removed until union has occurred.

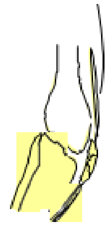
• Tetanus — These results from proliferation of clostridium tetani in contaminated, devitalised tissue. It produces a neurotoxin which leads to involuntary muscle contractions. Prophylactic tetanic toxoid (TIG) is essential in patients without prior protection (see compound fractures - page 150).

• Gas gangrene — These results from proliferation of clostridial bacteria (usually Clostridium welchii) in contaminated, dead, anaerobic tissue. The treatment involves extensive debridement, intravenous antibiotics with high doses of penicillin and other antibiotics, blood transfusion, if indicated, and

hyperbaric oxygen. The wound must always

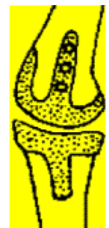
Complications of femoral fractures - 2

Knee ligamentous injuries



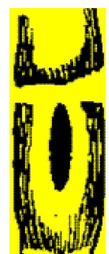
Associated patella fractures

Osteoarthritis

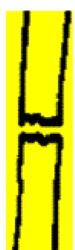


Total knee replacement

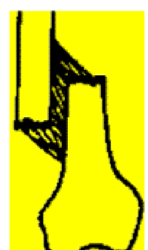
Comminuted fractures: post traumatic syndrome



Compound fracture: infected IM nails



- Non-union
- Over distraction
- Muscle interposition
- Infection



Shortening: inadequate traction or reduction be left open after debridement and closed when the infection has resolved.

Post traumatic syndrome (fat embolism)

This is common following closed femoral fractures, especially after extensive reaming. It is characterised by dyspnoea, pyrexia, tachycardia and petechiae. Treatment is symptomatic, with oxygen administered by intubation if necessary, plus intravenous steroids and correction of anaemia by blood transfusion (see page 186).

Late complications

Complications of prolonged immobilisation

• Bronchopneumonia — This can be minimised with regular chest physiotherapy, mobilisation of the patient and prophylactic antibiotics.

• Deep vein thrombosis and pulmonary thrombo-embolism — These again are minimised with the application of a TED stocking to both legs and prophylactic administration of subcutaneous low molecular weight heparin.

• Urinary retention and infection — Established infection should be treated with appropriate antibiotics.

• Decubitus ulcers — Nursing on a padded mattress with sheepskin cover and regular turning will minimise these. A hydrostatic flotation bed may be indicated.

• Delirium — Minimise immobilisation time if possible, and return the patient to a familiar environment. Internal fixation and mobilisation of the patient out of bed, on the day after operative fixation, is particularly indicated for elderly patients, and for all patients if possible.

• Contractures and joint stiffness — Early mobilisation, physiotherapy and active exercises will minimise these complications. They may be associated with ligamentous or bony damage to the knee. A constant passive motion (CPM) machine should be used for all patients with stiff knees.

Delayed union and non-union

Femoral fractures in normal bone without infection should unite within approximately 3 months, and will unite faster in young patients than in the elderly.

• Delayed union — Causes include poor blood supply, infection, inadequate immobilisation and excessive traction. Internal fixation and bone grafting is the treatment of choice.

Mal-union

This results from poor reduction and immobilisation. Treatment is by osteotomy, internal fixation and bone grafting.

Limb length inequality

• Children — Femoral fractures in children may lead to overgrowth of 1-2 cm in the affected leg, whereas epiphyseal damage or bony overlap can produce shortening.

• Adults — Shortening is common, especially in comminuted fractures treated conservatively by inadequate traction.

Articular complications

• Stiffness, pain and swelling — These are common complications following femoral fractures, and are due to immobilisation and traction on the knee joint, or bone and ligamentous injury at the time of femoral fracture.

• Osteoarthritis — This may be due to damage to the articular surface of the knee, directly as occurs following a fracture which extends into a joint, or indirectly by alteration to joint mechanics as a result of mal-union. It may be caused by a residual genu varum or valgum.

Myositis ossificans

Is within the muscle fibres, also called a traumatic ossification. After hip and elbow fractures, fractures associated with paralysis.

Early mobilisation of patients

Intramedullary fixation of fractures of the femur with locking nails is being used to an increasing extent. It allows early mobilisation, and enables the patient to return to work sooner. It must only be carried out by skilled surgeons in operating theatres with high standards of sterility. Closed intramedullary nailing with the nail inserted at the greater trochanter, under image intensifier control, can also be carried out. This requires skeletal traction during the operation, together with a surgeon who is experienced with this technique. The fracture site itself is not opened.

In summary, the treatment of suitable cases with open or closed intramedullary locking nails has many advantages over conservative management and should be used if possible.*Working out future limb length discrepancy- females mature at 14 yrs, males 16 yrs, allow for future growth, prox. femur 1/8th inch/yr, distal femur 3/8th inch/yr and prox. tibia ¼ inch/yr.

Knee — ligamentous and meniscus injuries

Collateral and cruciate ligaments

Sprain

• Diagnosis — There is usually no effusion, or only a minimal amount, into the knee. There is often localised tenderness over the ligament and pain on abducting or adducting the knee but no instability.

• Treatment — Cold packs should be applied, (not in direct contact with the skin). A padded elastic bandage should be applied, and quadriceps exercises undertaken.

• Local injection — Injection of 25 mg of hydrocortisone acetate plus local anaesthetic into the ligament may be necessary if pain persists for more than 6 weeks. There is a slight danger of ligamentous rupture, however, with cortisone injections. This should never be injected into the knee itself.

Partial rupture

• Diagnosis — There is usually an effusion or haemarthrosis into the knee, with tenderness and swelling over the affected ligament, and pain on knee abduction and adduction.

• Ligamentous laxity may be demonstrated when the knee is abducted and adducted, plus limited laxity while flexed at about 30°, but the knee will not completely open out.

The joint may be stressed with the aid of X-ray views, under anaesthetic if necessary, but will only open out slightly.

• Treatment — Blood should be aspirated under local anaesthetic with full sterile precautions. A well padded pressure bandage should be applied if there is a marked effusion. The patient may be mobilised with the support of crutches. A cylinder plaster, plastic cast or detachable splint should be applied for 3 weeks. Quadriceps exercises should be commenced from the day of injury.

Complete rupture

• Diagnosis — A haemarthrosis is always present, with tenderness, swelling and laxity of the injured collateral ligament. The anterior or posterior cruciate ligaments may be ruptured or lax. The Lachman's and anterior or posterior draw signs may also be positive. The medial meniscus is often also torn, as it is attached to the medial collateral ligament. Associated fractures may occur, usually diagnosed by the

Ligamentous injuries

Strain

- Pain on abduction of the knee
- Local tenderness

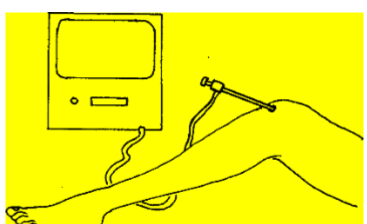
Partial rupture

- Haemarthrosis
- Partial instability
- Aspirate

Complete rupture

- Joint instability
- Immediate haemarthrosis
- Aspirate

Treatment



Arthroscopic or open repair for all complete ruptures

presence of fat globules in the aspirated blood, and confirmed on X-ray.

• Treatment — The patient should be admitted to hospital and the blood within the joint aspirated. (This is usually still possible up to 10 days following the initial injury.) A well padded elastic pressure bandage should be applied, and the leg supported in a Thomas splint for 3 days. This is followed by the application of a cylinder plaster cast for 6 weeks and isometric quadriceps exercises undertaken from the time of the initial injury.

• Operative repair — Repair of the collateral knee ligaments is often indicated, especially in young patients. It can also be done arthroscopically. Cruciate ligament repair, especially of the anterior cruciate ligament, should also be considered in athletes involved in running sports.

Meniscus injuries

Causes

• Medial meniscus — This is torn in about two-thirds of cases of trauma involving meniscal injury, because of its firmer attachment to the tibial plateau and its attachment to the medial ligament. It may be associated with tears of the medial ligament. Meniscal injuries usually occur when a twisting force is applied to a weight-bearing knee.

• Degenerative menisci — In these cases any type of strain may cause a tear.

• 'Bucket handle' tear — This may result in displacement of the medial part of the meniscus between the femoral condyles and cause 'locking' of the knee.

Diagnosis

• History — The diagnosis of a meniscal tear may also be made on the history of recurrent locking of the knee and inability to extend the knee joint fully.

• Examination — On examination there is often tenderness overlying the antero-medial or antero-lateral joint lines. There may be pain on adducting the knee in the case of medial meniscus tears and abducting the knee in lateral meniscus tears. With medial or lateral ligament injuries the reverse is true.

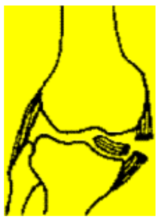
• Synovial effusion — In a meniscus tear this may take several hours to form.

• Haemarthrosis — Conversely, a haemarthrosis following a rupture of a major ligament, or a fracture extending into the knee joint forms almost immediately.

Meniscal injuries of the knee

‘Bucket handle’ tear of the medial meniscus

Anterior or posterior ‘tags’



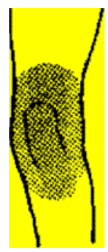
• Meniscal tears associated with medial collateral ligament rupture

• Anterior cruciate ligament may also rupture

Cause

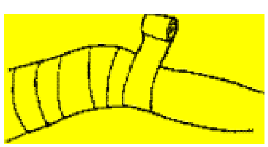
• Twisting force to a weight-bearing knee

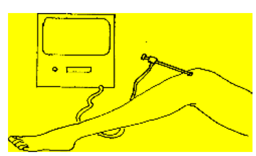
Diagnosis



• Synovial effusion
• Often locked in 20° flexion
• Stable ligaments
• Tender anterior joint lines

Treatment





Arthroscopic meniscectomy or repair: in young patients or for recurrent locking

• McMurray’s test — This involves rotating the knee in varying degrees of flexion, while abduction and adduction forces are applied to the knee. The patient may complain of pain and the examiner should palpate for, and listen for, a ‘click’. This is due to the torn meniscus 'catching' between the tibial plateau and femoral condyle.

• Locking of the knee — This usually occurs in about 10°-20° of flexion. The knee can be flexed, but not fully extended. There may be a ‘spongy’ feeling as the examiner attempts to extend the knee. A large effusion into the knee may also prevent full extension, making the diagnosis more difficult.

• Arthroscopy — Arthroscopy, and possibly an arthrogram, may be indicated to confirm the diagnosis, look for other injuries and repair or excise the ruptured meniscus.

Treatment

• Conservative management — If immediate operative management is not possible, the knee should be unlocked under general anaesthetic if necessary. This should be followed by support in a cylinder plaster in about 20° flexion for 3 weeks, if this is the first episode of locking.

• Operative management of meniscal injuries — This is the treatment of choice in young patients with a locked knee, where early mobilisation is desirable, such as in a professional footballer. In these patients, immediate partial meniscectomy or repair of a peripheral tear by arthroscopy is indicated. In other patients, if the knee locks again or gives significant symptoms, arthroscopic meniscectomy should be carried out, as late osteoarthritis may otherwise occur.

• Physiotherapy — All knee injuries require energetic quadriceps exercises immediately after the injury. An elastic support should be worn if a cylinder support is not used. In the case of associated anterior cruciate ligament tears, hamstring exercises are also indicated.

Extensor mechanism of the knee

Tears of the quadriceps tendon

These are more common in the older/elderly, and occur near the upper border of the patella. Have other medical problems (renal, diabetes, thyroid, steroid use, intra articular injections).

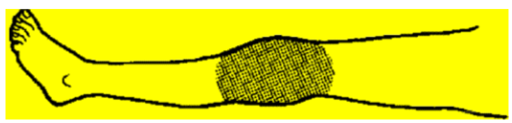
• Complete rupture — Operative repair (osseous drill holes or suture anchors) is indicated.

Knee injuries

Damage to extensor mechanism

Extensor rupture	Patella fractures	Ligamentum patellae rupture
		
Elderly	Middle age	Young patients (Usually have other medical problems; easily missed. Do direct repair with a nonabsorbable and locking (Krackow) stitch through patellar drill holes.

Diagnosis



• Inability to extend leg against gravity

• Haemarthrosis often present

• Partial rupture — Aspiration of a haemarthrosis should be carried out, followed by a knee support or plaster for 3-6 weeks.

Disruption of the patella

• Cause — This commonly occurs in middle age, with the patella being pulled in two by sudden forceful flexion applied across the extensor mechanism of the knee.

• Treatment — Tension band wiring should be performed for a clean break and whenever a repair is possible in comminuted fractures. Excision of the patella and reconstruction of the extensor mechanism are indicated in other cases of severe comminution.

Ligamentum patellae strain or rupture

• Cause — A strain is common in adolescents and young adults, and is often caused by over use in athletes. It may also cause osteochondritis of the lower pole of the patella (Sinding Larsen's disease).

• Treatment — Physiotherapy and cold packs are required for strains. Ruptures require early operative repair.

Osgood-Schlatter's disease

• Cause — This is a traction apophysitis at the insertion of the ligamentum patellae into the tibial tuberosity and is most often seen in adolescent boys.

• Treatment — This requires reorganisation of sporting activities, plus a protective detachable splint only in severe cases. The prognosis is good.

Patellar dislocation

Diagnosis

The patella may dislocate laterally when it is small, high- riding, or if the lateral femoral condyle is less developed. It is particularly common in adolescent girls with a valgus deformity of the knees.

The patient complains of severe anterior knee pain, with the knee in about 20° of fixed flexion, and inability to flex or extend the joint. There may be a history of previous episodes.

Treatment

A short general anaesthetic, or even intravenous valium and pethidine, will enable the dislocation to be reduced. The knee should be rested in a splint for about 3-6 weeks in first time dislocation.

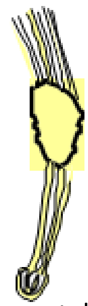
Extensor injuries

Extensor strain

Sinding Larsen's disease

Lower border

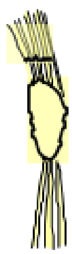
Osgood -Schlatter's disease



Ligamentum patellae insertion

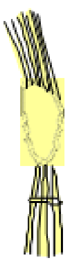
Conservative management

Repair of extensor rupture



Extensor muscles

Tension band wiring patella



Ligamentum patellae

• Recurrent dislocations — These may require operative intervention and transposition of the ligamentum patellae medially and distally.

Patellar fractures

Minor undisplaced fracture

• Cause — This is most often due to direct trauma.

• Diagnosis — There is no displacement and a secondary haemarthrosis with fat globules is almost always present.

• Treatment — This involves aspiration of the haemarthrosis and application of a firm elastic bandage over wool padding for 3 days. A cylinder plaster is then applied for 3-6 weeks, plus static quadriceps exercises.

Single transverse fracture

• Cause — Usually caused by a sudden flexion knee strain, usually in middle-aged patients.

• Diagnosis — The patient is unable to extend the leg against gravity with swelling and often a palpable gap in the patella, plus a haemarthrosis with fat globules.

• Treatment — Internal fixation with tension band wires is indicated, as illustrated, with a detachable knee splint.

Bipartite patella

This is a congenital abnormality, usually in the upper outer quadrant. It may be bilateral.

• Diagnosis — Examination usually reveals no localised tenderness. The abnormality may also be present on the contralateral side, which should be X-rayed if in doubt. X- ray also shows a well defined 'fracture' edge, unlike that of a recent fracture.

Comminuted fractures

• Causes — These are most often caused by direct trauma.

• Diagnosis Much swelling, tenderness, haemarthrosis.

• Treatment — ORIF if possible.(tension band wire). Otherwise, a partial patellectomy, followed by immobilisation with a plaster cast for 6 weeks, is indicated, followed by quadriceps exercises. Rehab is slow.

• Patellofemoral OA — This may occur if reduction is not accurate.

Complications of patellar fractures

Stiffness and pain may occur, then late onset OA , especially if ORIF not complete. An extensor 'lag', with weakness of extension, is common after patellectomy.

Fractures of the patella

Treatment

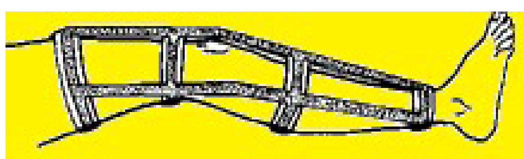
Direct trauma

Sudden 'pull' on quadriceps

Minimal displacement:
- Aspirate blood
- Splint

Most displaced fractures

Tension band wiring



Knee support in 10° of flexion if necessary

- Mobilise gently
- Quadriceps exercise early

4369 **Lower limb injuries**

Miscellaneous knee injuries

Loose bodies within the knee joint

• Causes — Osteochondritis, osteoarthritis and previous trauma are common causes.

• Osteochondritis dissecans — A loose body, or damaged area of cartilage, usually originates from, or is situated at the lateral side of the medial condyle. It is common in adolescent boys and probably caused by an injury.

• Fabella — This is a sesamoid bone in the tendon of the lateral head of gastrocnemius, and is occasionally mistakenly thought to be a loose and calcified body within the knee joint.

• Synovial fringes — These may be 'nipped' and cause episodes of pain and swelling.

• Articular cartilage — Damaged fragments may be present in the knee.

• Cartilagenous loose bodies — These may 'grow' in the synovial fluid and cause episodes of 'locking', 'giving way', 'clicking', pain and effusion in the knee.

• Treatment — Loose bodies should be excised by arthroscopic resection, or by open operation.

Knee dislocation

This is a surgical emergency. Always admit the patient to hospital and treat immediately.

Diagnosis

• Clinical examination — This will reveal a deformed and swollen knee. Examination for distal pulses, warmth, colour, sensation and paralysis should be carried out, as well as evidence of a compartment syndrome.

• Urgent investigation — After initial X-ray, Doppler ultrasound and angiography will usually be required to exclude vascular damage.

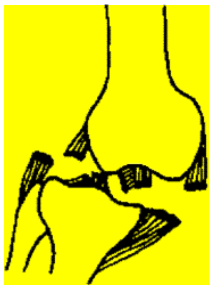
Treatment

Reduce dislocation as early as possible and aspirate the haemarthrosis before an angiogram is carried out. X-ray without a stress view may also appear normal due to the dislocation being spontaneously reduced.

A completed padded cylinder cast should be applied for 6 weeks with the knee in 30° of flexion. This follows reduction and ligamentous repair, or internal fixation of associated fractures.

Dislocation of the knee

Investigations



• Doppler ultrasound

• X-ray stress views

• Selective arteriography, examine, with brachial index < 0.9

Treatment

Urgently reduce dislocation

• Repair popliteal vessels or vein graft
• Repair ligaments
• Microvascular repair of nerves
• Internally stabilise associated fractures
• Splint in 30° flexion post-operatively

Complications

• Vascular or neurological damage — This is common and should be examined for both before and after reduction.

• Damage to the popliteal vessels — This will require urgent exploration and repair.

• Neurological damage — This may also require repair.

• Collateral and cruciate ligaments — Operative repair after the vascular repair which is the first urgent priority.

• Bony damage — Fractures may require internal fixation.

Tibial plateaux fractures

Clinical examination

This should exclude possible associated injury of the medial collateral ligament and lateral popliteal nerve.

Radiological examination

In the case of depression of the lateral plateau of the tibia, a CT scan, or an oblique X-ray of the upper tibia may be required.

Minimally displaced fracture

• General management — A haemarthrosis should be aspirated followed by a firm padded elastic bandage for 3 weeks. A cylinder plaster cast may be necessary. The patient should be non-weight bearing or partial weight bearing on crutches for a total of 2-3 months.

• Management in the elderly — There is risk of knee stiffness. It is often more important to ignore the fracture and encourage the patient to commence early weight-bearing and mobilisation with a knee support and quadriceps exercises.

Displaced tibial plateau

• Operative fixation — A buttress plate with bone graft packing under the tibial plateau is indicated in young patients with moderate or severe crush injuries followed by CPM machine and quadriceps exercises to regain knee movements.50% have meniscus tears; lateral > than medial.

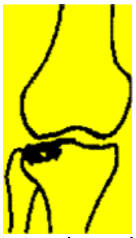
Comminuted fractures

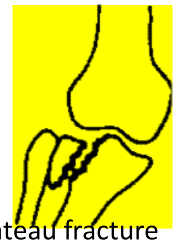
• Treatment — ORIF with locked plate and calcium phosphate cement. A CPM machine will also help to achieve knee mobility post-operatively.

• Complications — These include pain, stiffness and early recurrent effusion. Later, a valgus or varus deformity with osteoarthritis of the knee may occur and require osteotomy or a total knee replacement.

Knee injuries

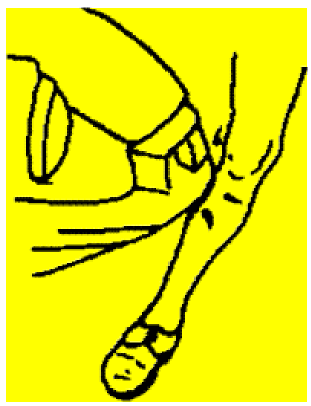
Tibial plateau fractures





Minimal crush   Severe crush Isolated tibial   plateau fracture

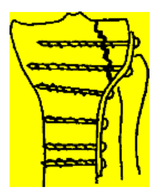
Cause



Bumper bar impact

Treatment

Operative



Conservative

• Aspirate blood

• Apply a padded elastic bandage

Buttress locked plate with bone graft. Restore articular alignment and best results when mechanical axis maintained.

Complications of knee injuries

Quadriceps wasting

Wasting occurs within 3 days in all knee injuries.

• Treatment — Quadriceps exercises, isometric or isotonic, must be started not later than the day after any knee injury.

Knee stiffness

• Treatment — Knee exercises should be started as soon as possible and continued until the knee is fully mobile.

• CPM machine — A constant passive motion machine is an excellent method of achieving early knee movements following injuries or operations.

• Haemarthroses — These, unless minimal, should always be aspirated under full sterile precautions.

Late osteoarthritis

• Causes — This is common if the articular surfaces are left irregular. It also occurs if the knee is left with a varus or valgus deformity, or if loose bodies are present.

• Conservative treatment — This involves short wave diathermy and quadriceps exercises.

• Operative treatment — A total knee replacement, arthrodesis or osteotomy may be necessary in cases of severe pain and stiffness.

Miscellaneous complications

• 'Locking', 'clicking' and 'giving way' — These may be caused by loose bodies or meniscal injuries.

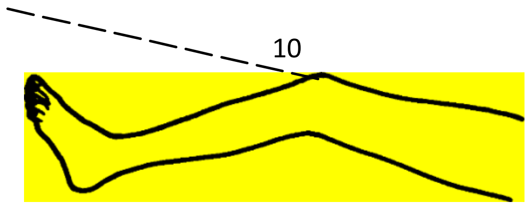
• Unstable knees — These are due to weak quadriceps muscles and ligamentous laxity. Intensive physiotherapy is essential. Knee supports may also be necessary as well as ligamentous reconstruction by arthroscopic or open procedures.

• Vascular damage — This may be secondary to knee dislocations or severe fractures. The popliteal artery has a poor anastomosis around the knee joint, and urgent exploration and repair is essential for vascular damage.

• Nerve damage — Microsurgical techniques for nerve repair should be delayed for at least 3 weeks in all severe and open knee injuries. This will allow musculoskeletal injuries and oedema to settle. It will also localise the extent of fibrosis in the nerve following damage. This is discussed in more detail under nerve injuries (see page 168).

Knee injuries

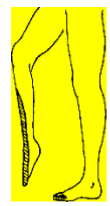
Complications



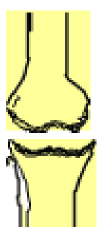
• Extensor lag of the knee following patellectomy

• Quadriceps wasting

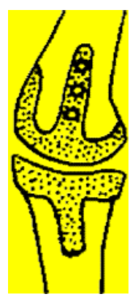
Popliteal artery damage: repair urgently



Nerve damage
• Microsurgical repair
• Tendon transfer
• Caliper



Osteoarthritis



Tibial and fibular shaft fractures

Classification

Fractures may be transverse, oblique, comminuted or compound, and involve one or both bones. A compound/open fracture of the tibia is a surgical emergency, and must be adequately debrided early, and always within 6 hours of occurrence.

Conservative treatment

• Closed fractures of the tibia or fibula — These should be treated conservatively if possible, by manipulation if necessary, and an above-knee cast, with the leg elevated and the knee in approximately 10°-20° of flexion.

• Significant oedema present — The tibia should be supported in an above-knee padded plaster backslab for 1-2 days and kept elevated to allow the oedema to settle before reduction.

• Unstable oblique fractures — These can be held to length with a Steinmann pin in the lower tibia or calcaneum with a plaster backslab and traction of 4-5 kg, if internal fixation is not possible.

• Brace — A knee hinged brace will allow mobility of the knee once early union of the fracture has occurred.

• Elderly — In elderly patients, early mobility of the knee is important. A padded cast brace molded well to the tibial flare below the knee may allow this if operation is not indicated.

Operative treatment

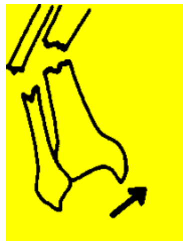
• Open reduction and internal fixation with a locking nail, plate or external fixateur should be carried out in the case of failed closed reductions and unstable fractures. A Huckstep grooved titanium compression plate will minimise periosteal vascular compression.

• Compound/open fractures* — These require extensive secondary closure, plus debridement and prophylactic tetanus toxoid and intravenous antibiotics. Fixation can be obtained with external fixateurs with 2-3 pins above and below the fracture site. In clean open fractures intramedullary fixation with a locking nail is usually the best method.*Apply the Gustilo and Anderson Classification for open Fxs as a very useful guide to treatment. Reamed IM nail is the best; …(see page 445)

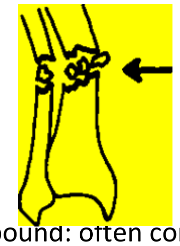
Tibial and fibular shaft fractures

Initial treatment

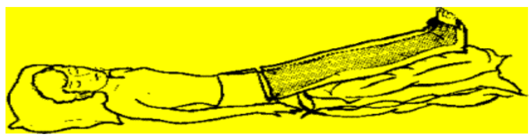
Oblique: twisting force



Transverse: lateral force

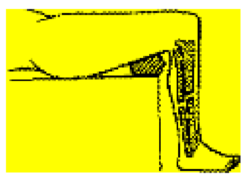


Compound: often comminuted



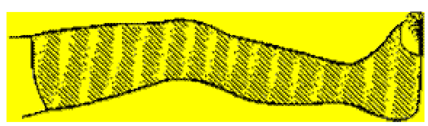
A pneumatic splint or padded backslab plus elevation Closed

reduction



• Pad under the lower thigh
• Knee flexed

*(ctd) Early amputation maybe necessary in IIIC tibial Fxs where- posterior tibial nerve injury, warm ischaemia > 6 rs., severe foot injury same limb.



• Complete above-knee padded plaster
• Knee 10° flexion
• Elevate leg
• Split plaster if necessary.
• Long leg cast for 4-6 weeks then functional brace (or patellar tendon weight bearing cast, PTB, for 4-6 weeks.

• Compound fractures with vascular or neurological complications — These need internal fixation or an external fixateur before repair to the nerve or vessels.

Tibial fractures involving the ankle

The ankle must always be examined in all fractures of the tibia and fibula. Management is the same as that of an ankle fracture and this is discussed under plafond fractures of the lower tibia (see page 460).

Fracture of the fibula alone

This may be associated with an ankle fracture or dislocation. Shortening of the fibula may lead to later osteoarthritis of the ankle. The common peroneal nerve may also be damaged in upper fibular fractures and lead to a foot drop.

Early complications

• Pressure sores — These may occur under poorly applied plaster of Paris.

• Neurovascular damage — This is particularly common in compound fractures and often requires repair.

• Compartment syndrome — Bleeding and oedema in the fascial compartments may occur, especially in unconscious patients (see page 182).

Late complications

• Angulation — This can often be corrected by wedging the complete padded plaster.

• Lateral overlap — This is less important than angulation and may not need correction.

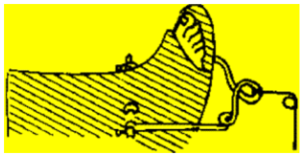
• Non-union — Non-union of the tibia is common at the junction of the proximal 2/3 and distal 1/3 due to the poor blood supply at this site. Infection and incomplete immobilisation of the fracture site are other causes.

• Treatment — In established non-union compression fixation should be either with a compression plate, locking nail or with external fixateurs and bone graft. Good results can also be obtained with electrical stimulation with an implanted battery, an external pulsating magnetic field, or an external battery and implanted cathode leads. These all give 20 microamps of negative current to the ununited fracture site, and will result in bony union in 80%-85% of patients with ununited fractures.

• Osteomyelitis — This is common following contaminated compound fractures. External fixateurs and sequestrectomy may be necessary, plus appropriate intravenous antibiotics.

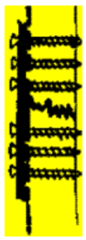
Tibial and fibular shaft fractures

Other methods of treatment



• Oblique fractures with shortening

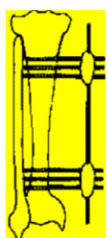
• Traction via Steinmann's pin where operation is not indicated



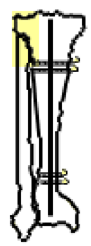
• ORIF with plate and screws

• Intramedullary locking nail

Compound/open fractures



• External fixateur
• Secondary wound closure
• Intravenous antibiotics

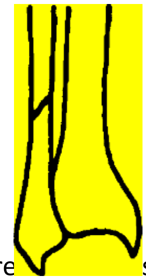


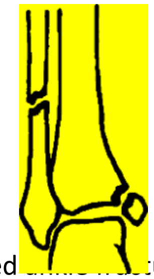
• Unreamed locking nail
• Secondary wound closure

• Knee and ankle stiffness — This may be due to prolonged immobilisation in plaster or to associated ligamentous or bony injury at the time of fracture. It requires physiotherapy with exercises and supports if necessary.

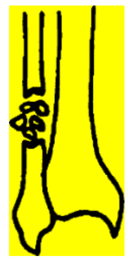
• Osteoarthritis of the knee and ankle — This may follow associated fractures into these joints or be due to malunion and angulation, with asymmetrical weight-bearing.

Fibular fractures





Stre s Associated ure



Common peroneal paralysis with upper 1/3rd fracture

Tibial and fibular fractures

Complications

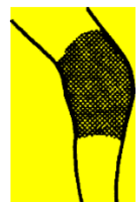
Pressure sores: poorly applied plasters

Neurovascular damage

Shortening: oblique and comminuted fractures

Non-union: poor blood supply or infection

Mal-union: osteoarthritis of the ankle



Stiffness and oedema

Ankle injuries Classification

Soft tissue injuries

• Ankle sprains

• Ruptured medial and lateral ligaments

• Rupture interosseous tibiofibular ligament.

Bony injuries

First degree — one malleolus fractured

• Adduction injury

• Abduction injury

• External rotation injury.

Second degree — two malleoli fractured

• Adduction injury

• Abduction injury

• External rotation injury.

Third degree — two malleoli plus dislocation The margins of the tibia are fractured and the tibiofibular and medial ligaments ruptured.

• Adduction injury

• Abduction injury

• External rotation injury.

Less common ankle fractures

• Vertical force

• Transverse force

• Compound fracture.

Weber classification

• Type A — Adduction

• Type B — External rotation

• Type C — Abduction.

Mechanism of ankle injuries

Deforming force

Adduction

The ankle is adducted and the medial malleolus is fractured. The lateral collateral ligament of the ankle may also be ruptured.

Abduction

The ankle is abducted with a transverse fracture of the lateral

malleolus or fibula. The fracture may also be in the mid or proximal fibula. The medial collateral ligament, interosseous tibiofibular ligament and medial malleolus may also be damaged.

External rotation

This is similar to an abduction fracture and often combined with it. Again, the fracture may be in the mid or proximal one third of the fibula. As with the abduction fracture the interosseous tibiofibular ligament may be ruptured, and the medial malleolus may be fractured.

Clinical diagnosis

It is essential to examine the ankle for stability, and especially evidence of rupture of the inferior tibiofibular ligaments, and for a high fracture of the fibula. The ligament is particularly liable to disruption in fractures of the fibula at or above the ankle joint.

X-ray is essential if in doubt. Clinically there is swelling over the medial and lateral malleoli, as well as local tenderness.

Ligamentous ankle injuries

Ankle sprains

Causes

Ankle sprains and partial ruptures of the lateral ligament are very common, particularly in athletes. They usually result from inversion of the foot while weight bearing.

Examination

• Look — There is usually swelling and often bruising.

• Feel — Tenderness over the lateral ligament.

• Move — Active movement is restricted. Passive movement and inversion are painful and may be excessive in complete ligamentous ruptures.

The talus, calcaneus and base of the 5th metatarsal should also be specifically examined.

• 5th metatarsal base — This may be avulsed by the pull of the peroneus brevis tendon at its insertion.

• Shaft of the fibula — This may also be fractured in external rotation or abduction fractures of the ankle.

• Oblique X-ray views — These are essential if diastasis of the ankle between the tibia and fibula is likely.

• Fractured talus — The neck of the talus may be fractured, and lead to avascular necrosis of the body of the talus.

• Fractured calcaneus — The calcaneus must always be examined for an associated fracture.

Investigations

• X-rays — The standard X-ray appearance may be normal. Stress X-ray views in ruptures of the lateral ligament or the lower tibiofibular ligaments however, may show diastasis of the ankle joint. X-ray may also show an associated fracture of the talus, calcaneus, or base of the 5th metatarsal.

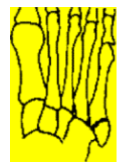
Ligamentous ankle injuries

Associated injuries

Ankle instability

Subluxation of peroneal tendons

Rupture of the inferior tibiofibular ligament with diastasis



Fracture of the base of the 5th metatarsal

Fracture at the neck of the talus

Fracture of the calcaneus

Treatment

• Rest — Rest followed by active exercises.

• Ice — Cold pack to the affected area, for a maximum of 15 minutes at each application. This will reduce localised swelling, provide symptomatic relief, and aid recovery. The pack should be wrapped in a towel and not applied directly to the skin.

• Compression — An elastic bandage over plaster wool should be applied for support.

• Elevation — The affected limb should be elevated to minimise oedema.

• Movement — The patient should be encouraged to move the ankle up and down frequently. When associated with a compression bandage or a pneumatic ankle support, this will help to diminish oedema.

• Ankle support — Once most of the oedema has settled, an elastic or pneumatic ankle support, worn only when the patient is walking, will help diminish the final oedema and give confidence to the patient.

In severe ligamentous injuries the pneumatic ankle support or lace-up boots, extending above the ankle, will give additional support.

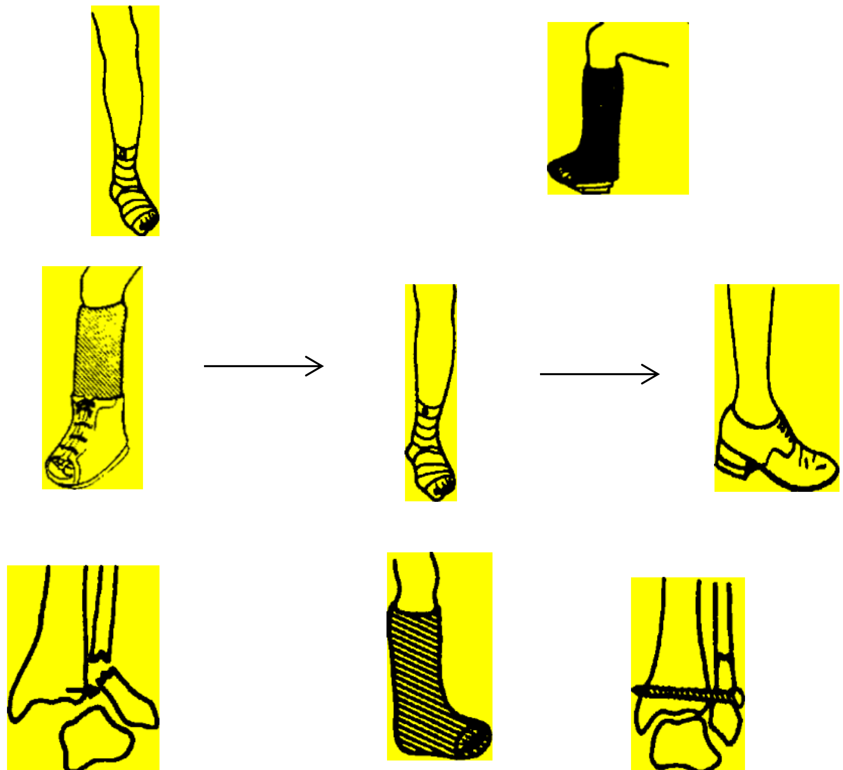
Rupture of the tibiofibular ligament

• Cause — The tibiofibular ligament may rupture and the ankle may be displaced laterally.

• Treatment — Internal fixation with a screw or plate to hold the lateral malleolus is indicated. A screw, if used between the fibula and tibia, should be removed as soon as stability has been obtained in 6 weeks, and before unsupported full weight-bearing takes place.

Ligamentous ankle injuries

Treatment



Abduction or external rotation

- Manipulation or screw
- Plate fibula if indicated

First degree ankle fractures

Conservative treatment

• Undisplaced fractures — These do not require operative fixation if undisplaced or stable and only need a well padded elastic bandage and crutches. Gradually increased weight- bearing can then be started in many cases with a walking plaster or plastic splint for 3-6 weeks.

• Complete tears of the lateral and medial ligaments — Immobilisation may have to be continued for 6 weeks.

UPDATE, 2022. Tears of the lateral ligament complex are common (grade I= sprain, II = partial tear, III= complete tear).Usually it is the ATFL ligament (ant. talo fibular lig.).The anterior draw test checks the ATFL, the varus talar tilt test in dorsi-flexion checks the CFL (calcaneo-fib. lig.).Non-operative treatment for about 12 mths, otherwise where instability persists then modified Brostrom procedure or Evan's procedure(used peroneal tendon).

• Tear of interosseous tibiofibular ligament — This may occur with fractures of the fibula at, or above, the tibiofibular syndesmosis, or with a rupture of the ligament alone. In these cases, always consider that there may also be a fracture of the fibula as well, in its middle or upper third. This injury usually requires internal fixation with plating of the fibula and a screw between the tibia and fibula.

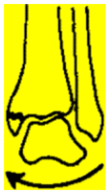
Operative treatment

• Medial malleolus — Fractures with any displacement at all, or rotation, will require accurate reduction and internal fixation with one or two screws to achieve a perfect ankle mortice. This is essential, as late osteoarthritis of the ankle joint will result from an irregular articular surface.

• Lateral malleolus or ankle instability — This may require internal fixation with a small plate and sometimes a screw, in addition, between the tibia and fibula. This is especially important if the fibula is displaced superiorly or laterally, with an associated rupture of the interosseous tibiofibular ligament. This injury should be suspected if the fracture occurs at, or above, the tibiofibular syndesmosis.

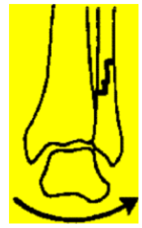
Ankle fractures

First degree — single malleolus

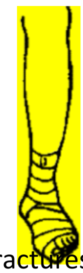


Adduction

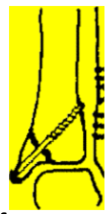
Abduction



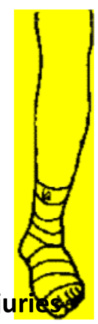
External rotation



Undisplaced fractures: elastic bandage, crutches and early weight-bearing



Displaced fractures of the medial malleolus: internal fixation



Later management: elastic bandage plus foot and ankle exercises

Second degree ankle fractures

Diagnosis

Fractures of both medial and lateral malleoli are present, with minimal displacement. Fractures may be transverse or oblique, depending on whether the force was in adduction, abduction or external rotation.

Treatment

• Reduction — Reduction may be necessary, with or without internal fixation.

• Manipulation — This should be attempted initially, except in cases where there is displacement of the medial malleolus in the ankle mortice. In such instances accurate internal screw fixation of the medial malleolus is essential.

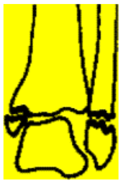
• Immobilisation — After reduction, a below-knee, non- weight bearing plaster will be necessary for 3-6 weeks, followed by weight bearing.

• Severe fractures — The immobilisation time may be 9-12 weeks.

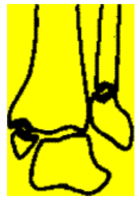
• Internal fixation — Screw fixation of the medial malleolus followed by plate, screw or Rush nail fixation of the lateral malleolus or fibula is essential, for lower tibiofibular ligament rupture and diastasis. It is also essential where a perfect reduction cannot be obtained by manipulation.

Ankle fractures

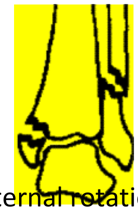
Second degree — two malleoli



Adduction



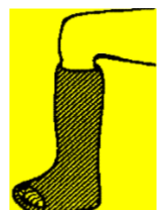
Abduction



External rotation

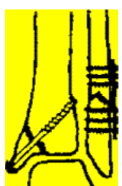
Conservative

Manipulation

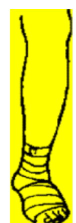


Below knee plaster

Operative



- Internal fixation
- Plate and screw



Post-operative splint or bandage

Third degree ankle fracture dislocation

Diagnosis

There is usually a dislocation of the ankle joint combined with a fracture of both the medial and lateral malleoli with diastasis of the ankle and sometimes the lower tibiofibular syndesmosis. There may also be an associated fracture of the distal tibial articular surface.

Treatment

• Admission to hospital — This is essential, with reduction of the fracture and internal stabilisation of the interosseous tibiofibular ligament.

• Reduction — Manipulate the ankle in severe cases where operative reduction is delayed, to improve the position temporarily and prevent skin necrosis.

• Oedema — If this is severe a below-knee padded backslab with a well padded elastic bandage is utilised. The leg is elevated for 3 – 4 days before operative fixation is undertaken.

• Neurovascular damage — If present an immediate reduction must be carried out. An associated compartment syndrome in the lower leg may require an urgent compartmental fasciotomy (see page 182).

• Compound fractures — These often still require internal fixation after adequate debridement and delayed wound closure. Intravenous antibiotics and tetanus prophylaxis are essential.

• Immobilisation — Post-operatively, a non-weight-bearing plaster or plastic support should be applied for 6 weeks in osteoporotic patients, or where further protection of the internal stabilisation is required.

Uncommon ankle fractures

Vertical force (Plafond fracture)

• Treatment — Open reduction, usually with a plate, is indicated for a fractured fibula, plus external fixateur and screws, and Kirschner wires for severe displacement of the lower tibia. An accurate reduction of the lower tibial articular surface is important; otherwise, osteoarthritis is inevitable.

• Associated injuries — Crush fractures of the calcaneus or lumbar spine may be associated.

Transverse force fracture

• Treatment — Both malleoli should be internally fixed to obtain a concentric anatomical congruous ankle mortice.

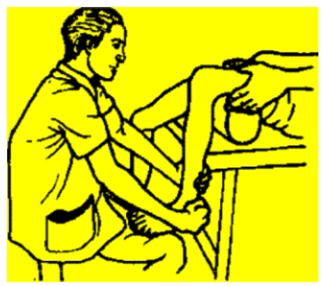
Ankle fractures

Third degree — fracture dislocation

Adduction

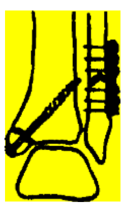
Abduction

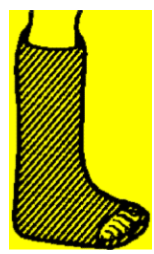
External rotation



Manipulation for displacement plus backslab if ORIF delayed

ORIF in most cases





Post-operative support in osteoporotic patients

Compound fractures of the ankle

• Treatment — A compound fracture of the ankle is treated in exactly the same way as a simple fracture, often with internal fixation. The patient must be admitted to hospital and the leg elevated. The fracture must be reduced and adequate debridement of the wound carried out, as an emergency, within 6 hours of injury.

• Uncontaminated fractures — In clean compound fractures internal fixation should be attempted. In all cases the wound should be drained or delayed primary closure carried out. Intravenous antibiotic therapy is essential, plus tetanus toxoid and/or tetanus immunoglobulin (see page 152).

• Contaminated fractures — In the case of dirty wounds, delayed primary closure is always required. Internal fixation may still be indicated. Appropriate parenteral antibiotics should be continued for at least 3 weeks post-operatively and the leg kept elevated. Further treatment includes protection of the ankle by a well-padded brace, plus an elastic bandage and elevation to prevent oedema.

Complications

Non-union

This is uncommon except for the medial malleolus. This must be treated by internal fixation. An electrical bone growth stimulator, or bone grafting, should be used in addition.

Incomplete reduction and mal-union

This is common and may lead to severe osteoarthritis.

• X-rays — It is important that fractures should be X-rayed regularly post-operatively. Correction of a displacement by manipulation or operation must be carried out early if necessary.

• Severe osteoarthritis — An arthrodesis of the ankle in young patients, or replacement arthroplasty or arthrodesis in older patients may be indicated after failure of physiotherapy, but only for severe disability. An ankle arthroplasty in an active young patient is rarely satisfactory and often fails.

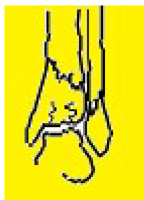
Stiffness and pain

• Cause — These may be due to inadequate ankle exercises after removal of the plaster. They may also be due to inadequate reduction and secondary osteoarthritis. Treatment should initially be by intensive physiotherapy, plus an ankle support.

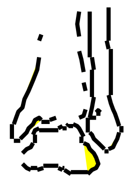
Uncommon ankle fractures

Vertical force

Often caused by a fall onto the feet



Crush lower tibia & fibula



- Plate fibula
- External fixation ± wires and screws for tibia

Transverse force

Lateral force

Internal fixation: tibia and fibula

Oedema

• Cause — This is usually due to inadequate elevation and lack of ankle exercises. It may also be due to a deep vein thrombosis, especially in elderly patients.

• Treatment — Treatment should be by elevation, wool and elasticated bandage, ankle support or elastic stocking plus adequate physiotherapy, with active exercises.

• Oedema due to infection — Infection in a compound fracture will require intravenous antibiotics.

• Deep vein thrombosis — Deep vein thrombosis will need anticoagulant therapy. Prophylactic anticoagulant therapy, with subcutaneous low molecular weight heparin, is also essential. This should be started pre-operatively in all patients undergoing internal fixation.

Instability

• Cause — This is usually due to inadequate physiotherapy after removal of the plaster. Occasionally it may be due to rupture of the lateral ligament or the tibiofibular syndesmosis.

• Treatment — Instability is best treated by adequate physiotherapy, with active exercises, together with an elastic support. Raising the outer side of the sole of the shoe by 5 mm may be necessary to diminish the likelihood of ankle inversion.

A pneumatic ankle support to prevent inversion, or alternatively lace-up boots, may be necessary to support an unstable ankle.

Operative reconstruction of the lateral ligament is occasionally indicated especially in the young athletic patient.

Other complications

• Subluxing peroneal tendons — This may be associated with fracture of the lateral malleolus. These tendons may need to be operatively stabilised.

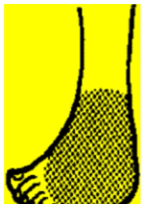
• Pressure sores - These may require skin grafting.

• Tendo Achillis — Instability and weakness of plantar flexion may follow associated Achilles tendon injury.

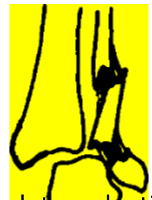
• Pressure areas and sores — These may be the result of a tight, poorly padded or poorly fitting plaster cast. These may require skin grafting.

Ankle injuries

Complications



Pain, stiffness & swelling



Incomplete reduction with mal-union

Non-union

Late onset OA

Ankle instability

Subluxation of peroneal tendons

Tendo Achillis injuries

Cause

These injuries often result from unaccustomed sport in middle aged people

Strain or partial rupture

Treatment

A supporting bandage is recommended, together with a shoe with an elevated heel. A plaster of Paris or plastic cast, with the foot in an equinus position may be required, followed by physiotherapy after 3-6 weeks.

Complete rupture

Diagnosis

Complete rupture of the Tendo Achillis causes a palpable gap with weakness of plantar flexion of the ankle. The long flexors of the toes and plantaris, however, are able to plantarflex the foot. The patient will, however, not be able to rise up on the toes on the affected side.

• Simmonds test — This is performed by squeezing the calf on the affected side. The foot will not plantarflex, as it will normally do on the unaffected opposite side.

• Operative repair — This is the treatment of choice, followed by a plaster in full plantar flexion for 6 weeks.

• Conservative management — The foot is fully plantar flexed for 6 weeks in a plaster or plastic cast. This does not provide as good a result as operative repair.

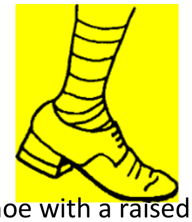
• Physiotherapy — This will be necessary to regain ankle dorsiflexion following the removal of the plaster.

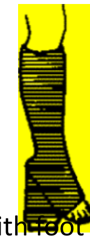
Associated injuries

These include ankle fractures, diastasis of the distal tibiofibular joint, an avulsion fracture of the base of the 5th metatarsal at the insertion of peroneus brevis (due to an inversion force), calcaneal fractures and fractures of the neck of the talus.

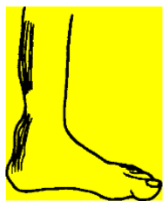
Injuries to Tendo Achillis

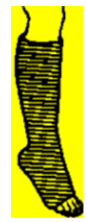
Strain — treatment


Shoe with a raised heel


Plaster cast with foot plantar flexed

Complete rupture






Weakness of plantar flexion


Pressure sores

• Ischaemic contracture due to tight plaster

Talus fractures

• Minor fractures — These do not involve the neck of the talus, and are mainly small chip fractures of the sides or back of the talus.

• Major fractures — These cause a complete fracture through the neck of the talus, with or without displacement. The blood supply to the talus, as with the scaphoid and the head of the femur, comes mainly from the capsule and distal bone. As a result, the blood supply to the body of the talus may be compromised by fractures through the neck of the talus. These fractures are, therefore, surgical emergencies. They may also be missed if only the ankle joint is X-rayed.

• Bone scanning — This is very useful in diagnosing whether the blood supply has been cut off, and if the body of the talus is still viable.

Treatment

• Minor chip fractures — These only require an elastic bandage and crutches, or a walking plaster or plastic splint, for 3-6 weeks.

• Undisplaced neck fractures —A below-knee non-weight bearing plaster for 2-3 months is the usual treatment. It is important that weight-bearing is not started too soon.

• Displaced neck fractures — Open reduction is necessary, with internal fixation with one or two compression screws followed by non-weight-bearing for at least 3 months.

Complications

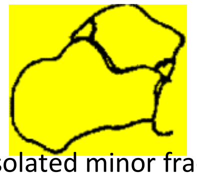
These include avascular necrosis of the body of the talus, non- union and late osteoarthritis of the subtaloid and ankle joints.

• Clinical examination — There will usually be pain, limitation of movement and oedema.

• X-ray — This may or may not show displacement of the neck of the talus. Avascular necrosis will, after a few weeks, show as increased sclerosis and later as fragmentation and flattening of the body of the talus.

• Bone scan — It is important to carry out a nuclear scan in all cases where avascular necrosis is a possibility. This should be repeated before the patient is allowed to bear weight on the leg.

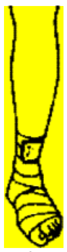
Fracture of the talus



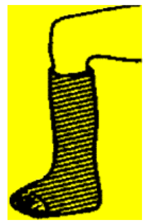
Isolated minor fractures

Neck without displacement

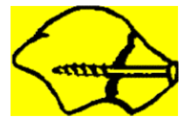
Neck with displacement



Elastic supportive bandage or walking plaster



- Plaster or plastic splint
- Non weight- bearing

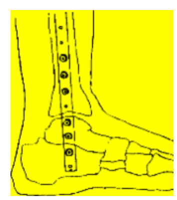


- ORIF
- Non weight - bearing for 3 months

Complications

Osteoarthritis

Avascular necrosis



Pantalar arthrodesis

• Avascular necrosis — If avascular necrosis occurs the patient must not bear weight on the affected side. In a case where the body of the talus is completely avascular, however, this may have to be excised and the distal tibia arthrodesed to the calcaneus. This procedure is a pantalar arthrodesis and is best done with a Huckstep locking titanium compression nail.

• Non-union — Non-union may require a compression screw, perhaps with the addition of an electrical bone growth stimulator or bone grafting.

• Osteoarthritis — In late osteoarthritis due to an avascular body of talus, a pantalar arthrodesis (arthrodesis of the tibia to the calcaneum), may be necessary if pain and swelling is severe. The alternative is a detachable ankle splint, or an ankle or subtaloid arthrodesis for localised osteoarthritis without severe avascular changes.

Calcaneal fractures

Almost all calcaneal fractures result fall from a height.

Minor fractures

• Treatment — Those not involving the subtaloid joint usually heal well within 3 weeks with minimal treatment. These fractures usually only require the support of a well padded elastic bandage for 3 days and mobilisation on crutches, followed by exercises at home. Occasionally a below- knee walking plaster or plastic wrap will be required for 3 weeks.

Major fractures

These usually involve the subtaloid joint and may or may not be displaced.

• Avulsion fractures — Avulsion fractures may also occur where the tendo calcaneus has 'pulled off' part of the calcaneus. The latter case is best treated by internal fixation with one or two screws to secure the fracture back into place.

• Crush fractures — In crush fractures involving the subtaloid joint, operative intervention is seldom indicated. The patient is usually treated initially with a well padded firm elastic bandage, together with crutches for mobilisation. The limb should be kept elevated, and for this reason admission to hospital for a few days may be necessary.

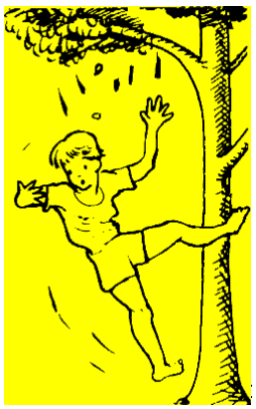
• Operative treatment* — This should only be carried out by surgeons with special expertise in ORIF, when the initial oedema has settled after 2 or 3 weeks, esp in two or three-part fractures involving the subtaloid joint.

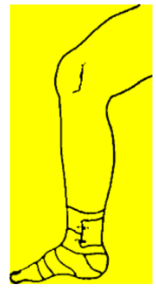
Fractures of the calcaneum

Not involving the joint

Subtaloid joint without displacement

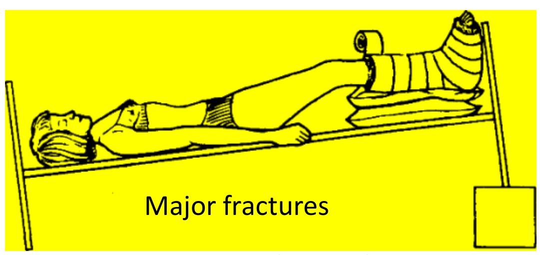
Subtaloid joint with displacement





• Minor fractures not involving subtaloid joint

• Below-knee walking plaster for 3 weeks or a supportive bandage and elevation



Major fractures

• Admit to hospital
• Elevate leg
• Elastic bandage over wool

results of internal fixation are slightly better than conservative management in young patients.

• Physiotherapy — If there is significant oedema the patient should be admitted to hospital for a few days. Exercises for the toes, foot and ankle should be commenced as soon as possible, especially inversion and eversion movements, as the subtaloid joint becomes stiff very quickly.

• Weight-bearing — The patient should be non-weight- bearing for at least 6 weeks and sometimes 2 or 3 months, as weight-bearing at an earlier stage will crush the calcaneus further and lead to osteoarthritis and pain. There may be a place for application of a below the knee plaster to give extra support for 3-6 weeks after the swelling has subsided.

• Subtaloid arthrodesis — In some cases with severe crushing there may be a place for early subtaloid arthrodesis. This may be necessary, in any case, at a later stage for stiffness and pain and for severe subtaloid osteoarthritis. If not performed in the acute stages, this is best delayed for at least 1-2 years following the injury, as symptoms may be well controlled with physiotherapy and an adequate ankle support.

Relative lengthening of Tendo calcaneus

• Cause — This may be due to crushing of the calcaneum with upward displacement of its insertion resulting in relative lengthening of the Tendo Achillis.

• Disability —This is a real disability for those who frequently climb ladders, such as window cleaners and builders. Ironically ladder users are most prone to calcaneal fractures in the first instance.

Osteoarthritis of the subtaloid joint

• Diagnosis — This may follow severe fractures of the calcaneum and lead to severe pain, limitation of inversion and eversion and osteoarthritis. As a result, the patient is often unable to walk on uneven ground. The patient may also suffer from severe spasm of the peroneal muscles at night.

• Treatment — Initially physiotherapy and short wave diathermy and an ankle support should be given. In severe disability arthrodesis of the subtaloid joint may be necessary. In very severe crush fractures, there may be a place for immediate subtaloid arthrodesis.*ORIF of calcaneal fractures is like operating on egg shells.

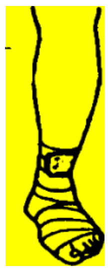
Other tarsal fractures

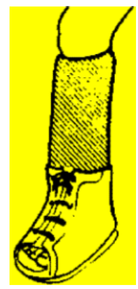
Minor tarsal fractures


Cuboid


Navicular

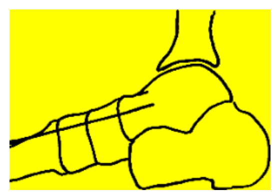

Cuneiforms


Elastic bandage


Below-knee walking POP splint

Major tarsal fractures

- Manipulation
- Below-knee plaster for 6 weeks
- Occasional internal fixation


Kirschner wire fixation for mid-tarsal dislocation

Associated Injuries

Spinal fractures

Fractures of the lumbar spine are commonly associated with fractures of the calcaneum. It is therefore essential that, in all patients with calcaneal fractures, a minimum of a lateral X- ray of the lumbar spine should be carried out. This is especially so in insurance cases, even though the patient may not complain of back pain. This is also because there are often legal complications in accidents. The patient may later consider either the hospital or the doctor negligent for having missed a fracture of the spine. Later, also, it will be difficult to prove that this did not occur at the time of injury, as minor wedge fractures of the lumbar spine, with minimal symptoms, are common.

• Back exercises — These should be started if there is a fracture without neurological complications. A back support should be given when the patient is mobilised.

• Neurological complications — These are uncommon in stable lumbar crush fractures, unless bone fragments from a burst fracture compress the cauda equina.

Minor fractures of the tarsal bones

These include minimally displaced fractures of the back and sides of the talus and minimally displaced or undisplaced fractures of the navicular, cuboid, and cuneiform bones. They also include minor fractures of the calcaneum.

Cause

They are usually caused by twisting strains or falls from a height onto the foot. Occasionally they may result from crush injuries or a weight dropping onto the foot. These are often combined with fractures of the tarsal and metatarsal bones, and as a result the extra diagnosis is sometimes missed.

Treatment

These usually heal well with little residual disability. A firm elastic bandage for 3 weeks is usually sufficient. Graduated weight-bearing is possible. Occasionally a padded walking plaster or plastic splint for 3 weeks may be necessary.

Complications

Pain, stiffness and osteoarthritis of the joints involved may occasionally occur and necessitate physiotherapy.

Compound fractures will require debridement and antibiotics.

Tarsal fracture-dislocations

Causes

A tarsal fracture dislocation can involve dislocation of the talus on the navicular, navicular on the cuneiforms or the cuneiforms on the metatarsals. It also frequently occurs in association with a fracture of the metatarsals, cuneiforms and navicular. It is a surgical emergency as the circulation to the forefoot is often impaired. The patient must be admitted to hospital.

Diagnosis

Swelling and deformity with severe pain are present. The circulation of the foot is often impaired. The peripheral circulation of the foot must be carefully examined. This includes pallor, coldness, loss of sensation and paralysis.

Treatment

The fracture is usually very unstable. Best results are obtained by fixation with Kirschner wires after reduction, (see page 473) followed by elevation of the foot to reduce oedema. The wires are usually removed after about 6 weeks and physiotherapy started to mobilise the foot.

If the circulation is not rapidly restored, a fasciotomy in the foot may be urgently required.

Complications

Both the dorsalis pedis and tibialis posterior arteries may be compressed, with ischaemia of the forefoot and toes. If there is vascular compromise, the foot will usually appear pale when compared with the contralateral side. The patient will complain of pain and paraesthesia. Untreated residual ischaemia, death of intrinsic muscles and diminished sensation will follow and may sometimes lead to a claw foot and even gangrene, which may necessitate amputation of the toes.

UPDATE, 2022. Lisfranc Fx (Tarsometatarsal Fx/dislocation). Easily missed. Base of 2nd MT. Do wg.t bearing XRs or CT. Check for Fleck sign on XR, small fragment to lateral side of 2nd MT. If ignored may lead to flat foot, needs ORIF.

Metatarsal, MT, fractures

Base of the 5th metatarsal

Cause

This is due to an inversion strain on the ankle. The peroneus brevis tendon produces an avulsion fracture of the base of the 5th MT at the insertion of the tendon.

Diagnosis

May be missed. It is frequently associated with a rupture of the lateral ligament of the ankle. The base of the 5th MT should always be palpated for tenderness in all ankle fractures and lateral collateral ligament injuries.

Treatment

Well-padded elastic bandage, crutches for 3 days followed by full weight bearing. Alternatively, a below-knee-weight bearing plastic support or plaster for 3 weeks.

March fracture

Causes

A stress fracture of the neck of the 2nd or 3rd MTs due to unaccustomed walking or running.

Diagnosis

• Clinically — Usually tenderness over the dorsum of the relevant MT. X-ray views, especially of poor quality, may not show the fracture immediately after the incident. The diagnosis may only be confirmed 2 to 3 weeks later, on further radiological examination, by the presence of marked callus over the fracture site.

Treatment

Treatment- support of the fracture site with a well padded elastic bandage or a complete plastic wrap. The patient should remain partial weight-bearing on crutches for 3 weeks.

Compound metatarsal fractures

Treatment

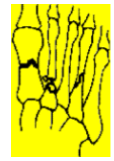
Debridement and occasionally by ORIF with Kirschner wires. Contaminated fractures require delayed wound closure.*5th MT Fxs-avulsion type; metaph/diaphysis, Jones Fx*;diaphysis- all slow to heal and may need ORIF.

Metatarsal fractures

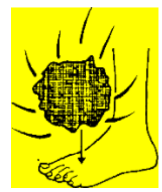
Base of 5th metatarsal

2nd or 3rd metatarsals

• Treat on suspicion



Miscellaneous fractures



• Inward twist of foot
• Peroneus brevis pulls off its insertion

Jones Fx*., named after Sir Robert Jones, (1857- 1933), a great surgeon; it is said that when he operated time stood still

Miscellaneous metatarsal fractures

Treatment

These are usually minor, and in most cases only need the support of a well padded elastic bandage and gradually increasing weight-bearing with crutches. Occasionally a weight-bearing plaster or plastic splint may be applied for 3 weeks.

Toe fractures

Fractures can be divided into the great toe, isolated fractures of other toes and multiple fractures of other toes. Any of these fractures may also be closed or open. There is often considerable swelling and pain. There may also be a history of a heavy weight falling on to the toe, or of stubbing the toe against a chair or table leg. A compound fracture may be due to a gardening accident such as with a rotary mower, especially if the patient was barefoot or wearing open toe sandals.

The great toe

A major fracture of the big toe may be very painful and require strapping and a below-knee walking plaster or a plastic wrap. Adequate strapping, together with a good, firm soled shoe or boot, however, is usually adequate in most cases. Occasionally internal fixation of a displaced fracture with a screw or Kirschner wire may be required.

• Compound fracture — This usually results from a crushing injury. It may require debridement and intravenous antibiotics.

Multiple fractures of the toes

These can be treated by strapping or occasionally with a below-knee walking plaster or plastic wrap for 3 weeks.

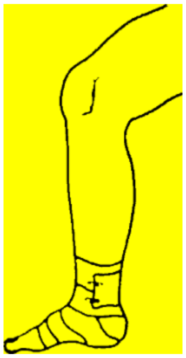
Isolated toe fractures

A single fracture seldom requires reduction. It is best treated with strapping either by itself, or to the adjoining toe for 3 weeks. These fractures are very painful. The patient should wear a firm soled boot or large shoe for 3-4 weeks.

• Osteomyelitis — This may require intravenous antibiotics, drainage and sequestrectomy. Amputation of the smaller toes may be necessary for chronic infection. This should be avoided for the great toe, as it is important for balance and walking.

Metatarsal fractures

Treatment



- Elastic bandage and crutches
- Occasional walking plaster or internal fixation

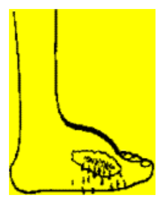
Further treatment

- Firm soled shoe or boot
- Foot and ankle exercises

Complications

Localised tenderness

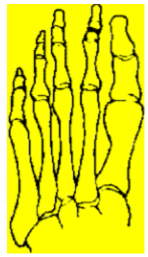
Pain, swelling and stiffness

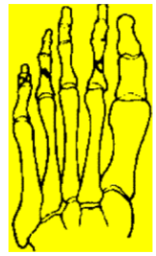


Compound fracture and osteomyelitis

Fractures of the toes

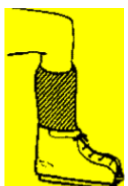

Great toe


Single fracture 2nd-5th toes

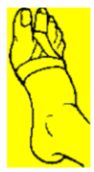

Multiple fractures 2nd-5th toes

Treatment

Great toe


Below-knee walking plaster for 3 weeks

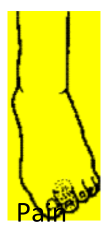
Single toe

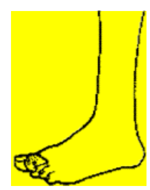



Strapping

Complications


Osteomyelitis


Pain


oedema

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Deformity and pressure where footwear 'rubs'

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Chapter 9

Post-operative care

Post-operative treatment of injuries

Upper limb

• Elevation of the limb either by a 'roller towel' or on pillows for at least 3 days post-operatively. Outpatients should have the arm elevated in a sling. The patient should move the fingers, elbow and shoulder as much as possible.

• Check the fingers regularly for appearance, warmth, movement, ability to straighten the fingers, swelling and sensation, disturbing the patient if necessary. The plaster should be checked for pressure.

• If the circulation is in doubt, the plaster should be split or loosened immediately. In supracondylar fractures the elbow should be extended and the patient treated as an emergency (see pages 243 and 324).

Lower limb

• Elevation of the limb in major cases, either by bed blocks, or pillows, for at least 1 - 3 days post-operatively. The patient should move the toes frequently.

• In acute cases, plasters should be either well padded and split, or a padded plaster slab and bandage used instead of a complete plaster.

• On the evening of operation, it is important to check swelling, colour, warmth, sensation and movement of toes, disturbing the patient if necessary. Plaster should be trimmed if rough areas are causing pressure.

• If there is any doubt as to the circulation the plaster should be split and loosened down to the skin for its whole length and opened out.

Post-operative care

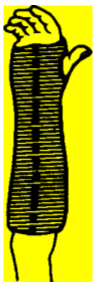
Observation of circulation and patient

Fingers and toes general Careful Chest

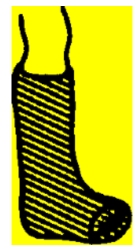
Appearance, warmth and pulses Movement and sensation

Swelling and plaster pressure

Split POP (if in doubt)



- Split whole length down to skin itself
- Open out well
- Increase elevation
- Encourage movements of fingers and toes



After splitting plaster, put wool in gap and crepe bandage

Instructions for patients in plaster

If your arm is in plaster

- Move your shoulder and fingers several times every hour during the day.
- Keep the plaster dry and away from water.
- Carry the arm in a sling during the first 3 days if your hand or fingers are at all swollen.

If your leg is in plaster

- Do not bear weight on it unless the plaster has a foot piece or you have been given an over boot.
- Move the toes several times every hour during the day.
- Raise your foot on a chair when sitting, especially during the first week.

If your fingers or toes become swollen or cannot be felt properly, go to the nearest hospital, or inform your own doctor immediately.

Instructions after the plaster has been removed

If your arm was injured

- Move your fingers, wrist, elbow and shoulder several times every hour during the day.
- Use your arm and hand more and more each day.

If your leg was injured

• Move your toes, ankle, knee and hip as much as possible each day.

• If your foot swells, raise it on a chair while sitting and wear a crepe bandage, elastic support or stocking.

• Walk more and more each day.

If your fingers or toes become swollen or cannot be felt properly, go to the nearest hospital, or inform your own doctor immediately.

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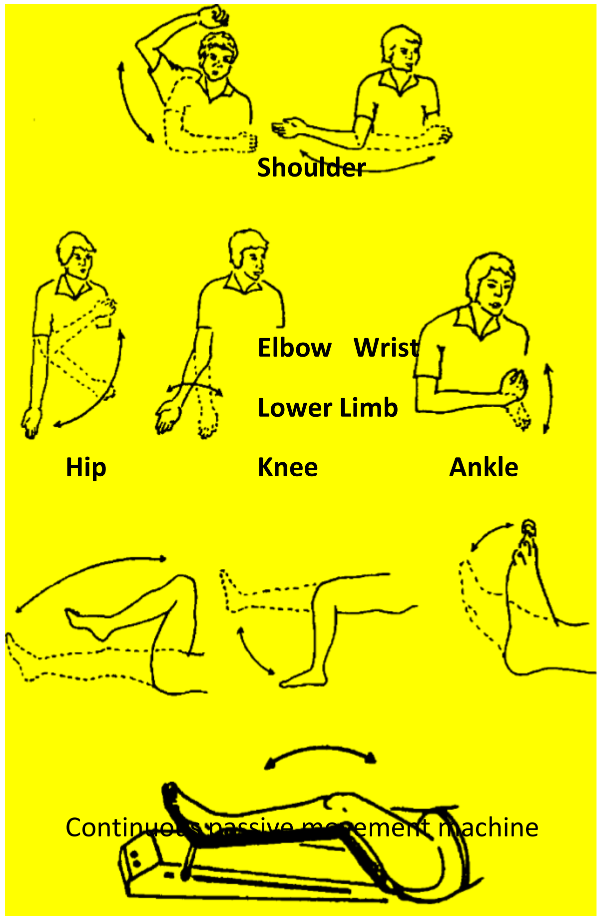
Exercises Upper limb



Physiotherapy

Physiotherapy can be divided into three main categories:

Thermal and cryotherapy

Radiant or superficial heat is suitable for patients who are unfit to travel to a physiotherapy department or who have an implanted prosthesis. Sometimes ice packs are used if there is considerable bruising immediately after injury.

Deep heat, such as short wave diathermy or ultrasound, can be used in cases where there is NO implanted prosthesis or plates, nails or screws.

Massage

Massage in its various forms is soothing to the patient but has a limited place.

Exercises

Exercises may be active or passive.

• Active exercises — These are where the patient exercises the joint, and are by far the most valuable. They increase the power of muscles and actively move the joints, often increasing both the range of joint movement and joint lubrication.

• Passive exercises — These are where the physiotherapist moves the joints. They may be necessary where the limb is paralysed, or where the patient is reluctant to move the limb. They have a place, but are of much less value than active exercises. They are useful, however, in preventing contractures across joints, particularly in the shoulder, hand and knee.

• CPM machine — In addition to passive exercises performed by the physiotherapist, continuous passive motion (CPM) machines are now in use. These machines are powered by an electric motor and are used mainly on the lower limb and occasionally on the upper limb. Limbs are moved through a variable range of movements at a predetermined speed. The machines are invaluable for patients recovering from severe knee or hip operations (and occasionally the upper limb), and help prevent the joints from becoming stiff post-operatively. It has also been shown that constant movement by these machines markedly improves the nutrition of the joint cartilage and often accelerates the recovery of joint mobility.

Transcutaneous electrical nerve

stimulation (TENS)

In chronic pain, particularly low back pain and sciatica, transcutaneous nerve stimulation with a battery powered machine worn by the patient may relieve pain. A small pad, placed over the site of maximum tenderness on the skin, can electrically stimulate the underlying cutaneous nerves in differing amplitudes and duration.

Bed supports

These include special cushions to support a patient’s back, supports and cushions under the sacrum and under the heels, to prevent pressure sores in bed. Pillows can also be used under the legs to elevate the feet or to keep the knee flexed after a hip operation. Sheepskin covers under pressure areas such as the lower back, hips, and heels can also help prevent pressure sores.

Boots and innersoles

In the case of a short leg, a contracted knee or an equinus ankle, a raise on a boot, either on the heel alone, or on both the sole and the heel, may be necessary.

Many other supports are in common use, including innersoles in shoes to support ‘fallen arches and soft plastic inserts to relieve pressure areas on the sole of the foot, particularly the heel (plantar fasciitis) and forefoot (anterior metatarsalgia).

Walking aids

A variety of crutches is available. Some allow the patient to bear weight mainly on the shoulders and hands. In addition, there are short elbow crutches and walking frames.

Walking sticks vary from those with a broad base and 4 prongs, called quadrapods, to single walking sticks which are used in the opposite hand to the affected leg.

Wheelchairs and motorised vehicles

Various types of wheelchairs are available, from chairs where the patient is self propelled, to electric or petrol driven wheelchairs which allow patients to drive on the road. Special adaptations to cars including hand controls will allow disabled patients to drive cars, even if both legs are completely paralysed.

Other supports

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These are discussed on pages 262-265 (orthopaedic splints).

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Rehabilitation

• Physiotherapy — Adequate early physiotherapy will minimise late stiffness of joints and weakness of muscles, in nearly all injuries, and early rehabilitation is important in all severe trauma.

All patients with fractures and dislocations must be shown early movements of the relevant joints of the upper and lower limbs or back as illustrated.

• Post-operative — After removal of plaster , a crepe bandage and wool for a few days, with energetic active exercises, either at home or in a physiotherapy department, is essential. The injured limb should also be elevated to prevent oedema. Swimming is particularly valuable for mobilising joints and strengthening muscles. Walking on soft sand in bare feet is good for foot, ankle and knee joint injuries, while cycling on a static machine or actual bicycle is indicated for hip, knee, ankle and back injuries.

• Amputations and paralysis — The long-term management of patients with amputations, residual paralysis, or residual deformities, requires a team approach with surgeons, physicians, social workers, or physiotherapists, occupational therapists, orthotists or prosthetists, rehabilitation doctors and others, as already discussed earlier in this book under 'Spinal injuries' (see page 378).

• Daily living and employment — The final aim should be to rehabilitate the patient, not only to the activities of daily living, but also wherever possible to return to some employment. This may mean retraining and adjustments to the place of work and to the home, such as ramps, supporting rails and low benches, together with adjustments and attachments to machines.

It should also be a legal requirement for all large companies to recruit a minimum of possibly 3% of its workforce from those with a significant disability. The needs of paraplegic and other severely disabled workers also include ramps in public buildings, special lavatories with easy access, and supporting rails geared to the needs of the physically disabled.

Rehabilitation

Daily living

- Combs and sponges with handles
- Towels with loops
- Bath with seat
- Lavatory rails

Washing and toilet

Nelson knife (combined knife &d fork)

Rubber handle on spoon

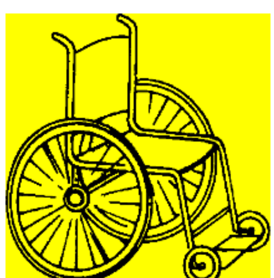
Eating

- Ground floor accommodation
- Ramps and suitable doors
- Low basins and stoves

Housing

Transport

Wheel chairs



Ordinary and motorised

Cars

- Special hand controls
- Automatic gears
- Space for wheelchair

Public transport

- Improved access
- Improved accommodation

Industry

- Low benches
- Adjusted controls for machines
- Safety guards if necessary
- Ramps for wheel chairs
- Suitable canteens
- Wider bathroom doors

Adjustment to premises if necessary

491 **Post-operative care**

The future

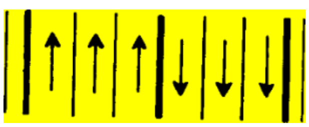
Safe vehicles

- Compulsory seat belts plus air bags
- Child safety seats and capsules
- Safer passenger compartment
- Head restraints all seats
- Stronger seat backs
- Secured luggage

Roll-over bars for all cars. Traction control. Adaptive headlights

Safe:

- Steering
- Tyres
- Brakes
- Daytime running lights
- Anti-lock brakes
- Electronic stability control
- Safe coaches and heavy vehicles



Separate paths for cyclists

- Surface roads non-skid
- All roads reflectors or lighted
- Speed, alcohol and drug infringement penalties strictly enforced
- Helicopter and police highway patrols increased

Safe people

- Ban alcohol and drugs certain
- Random breath testing
- Heavier penalties
- Fatigue
- Driving skills
- Medical fitness
- First aid training
- Wear Fitbit self monitor.

Safe pedestrians

Education More underpasses and footbridges More cycleways Helmet for all cyclists and motor cyclists

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The future Public education

Safe travel

- Air
- Sea
- Land

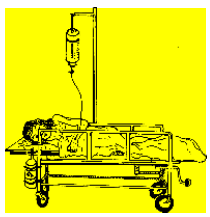
Safe homes

- Safe electricity
- Safe kitchens
- Safe bathrooms
- Non-skid floors

Safe work

Safe factories and offices

Hospitals



General hospitals: improved accident and intensive care departments

Regionalisation of accident services

Trauma and resuscitation training

- Surgeons
- Doctors
- Medical students
- Nurses
- Ambulance officers
- Police
- Fire officers

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495 **Post-operative care**

Emergency equipment and procedures

Emergency equipment for vehicles

First aid kit for general use

Reflective pack

Torch plus 2 batteries + light stick

Waterproof cape (pocket size)

Space blanket

Labels (3 red plus 3 green disaster or tie-on luggage labels) Marking pen — waterproof

Scissors — all purpose heavy duty

Whistle

Hand cleaner — small tube

Bandages — triangular — 6

Plaster wool — 15 cm roll

Cling bandages — 10 cm and 15 cm — 3

Combines (9 x 29 cm) and (15 x 20 cm) — 3

Adhesive dressings — miscellaneous sizes

Elastic adhesive bandage — 2.5 cm roll

Airways (disposable) Nos 2 and 3

Collapsible face masks (optional)

Cervical collar — Plastazote or inflatable

Anaesthetic cream

First aid manual

Extra for doctors, nurses and paramedics

Stethoscope — lightweight paediatric

Sphygmomanometer — lightweight

Syringes (10 ml) + needles + alcohol wipes + blood bottles (for samples)

Dwell cath needle (12 g — for emergency

cricothyroidotomy) Long leg pneumatic splint + 2

malleable splints for arms Entonox (nitrous oxide +

oxygen) inhaler (optional)

Spinal board (lightweight) — (optional)

Plastic bowl + paper tissues

Velcro tourniquet

Mini-suction pump and catheter (optional)

Auto inflatable bag and mask for artificial ventilation + adult and children's face masks

Needles (14 g) through Heimlich valve, or through surgical glove — for tension pneumothorax

Sterile gloves — 2 pairs

Laryngoscope + cuffed endotracheal tubes + connections + lubricant (optional)

Oro-nasal tube + syringe

Urethral catheter + lignocaine jelly(optional)

Hacksaw — small (15 cm) for emergency amputations (including 2 sterile blades, 4 artery forceps, 1 scalpel + 2 blades,

1 pair scissors, plus suture material dressings + alcohol wipes) Defibrillator + ECG + pads + electrode jelly (optional)

Intravenous giving sets x 2

Drugs

Haemaccel — 500 ml x 2

Lignocaine — 2% — 2 ml x 10

Adrenaline injection — 1 in 10,000 — 0.1 mg/ml — 10 ml x 2 Dexamethasone — 4 mg/ml x 5

Naloxone — 400 µg x 5

Atropine sulphate — 600 µg x 2

Morphine sulphate — 10 mg x 2 (dilute in 10 ml saline for i.v. administration)

Aminophylline injection— 25 mg/ml —10 ml x 2

Salbutamol sulphate — 5 mg/ml — 10 ml

Sodium chloride — 0.9% — 10 ml x 5

Sodium bicarbonate — 8.4% — 50 ml x 2

Calcium chloride — 10% — 10 ml x 2

Frusemide — 10 mg/ml — 2 ml x 5 (optional)

Flumazenil — 0.1 mg/ml — 5 ml x 2 (optional)

Verapamil HCl — 2.5 mg/ml — 2 ml x 5 (optional)

Anaesthetic drugs — (optional)

Sodium versenate — 2 ml (dilute in 100 ml water for alkali eye injuries)

Antibiotics — (optional)

Tetanus toxoid and TIG — (optional)

General car equipment

Four-way indicator flasher

Flashing torch (red with white non-flashing beam)

Reflective number plates

Reflective danger triangles — 2

Fire extinguisher

Seat belts, head restraints and airbags

Map

Car tools — jack, screwdriver, pliers, adjustable spanner, tyre levers, hammer and plastic insulating tape

Container of water — 2 litres minimum + small towels

Penknife — multi-purpose with scissors

Emergency procedures

The following summary of emergency procedures is given only as a guide for those who cannot obtain more skilled assistance in an emergency.

Oropharyngeal airway

• Procedure — Clear the airway and lift the jaw forward. Insert the correct size airway (one that extends from teeth to the angle of the jaw) with the concavity of the airway facing the palate. Rotate the airway 180° at the back of the tongue. Lift chin and apply a face mask such that the concavity now lies on the tongue.

• Children — In young children depress the tongue with a spatula, and insert the airway, the correct way down under direct vision, i.e., no rotation required.

Nasopharyngeal airway

• Indications — This should only be used when there is no nasal obstruction or suspected fracture of the base of the skull.

• Procedure — Lubricate the airway or use tap water, and pass the airway gently with a slight twisting action for its full length. Apply a face mask and oxygen.

Bag and mask resuscitator

• Procedure — Apply the correct size mask to the patient's face, with the oxygen flow at approximately 15 litres per minute. Use only if trained in the procedure. Ventilate 12 times a minute (every 5 seconds). Do not over ventilate. Observe and auscultate for the adequacy of ventilation using parameters such as equality of chest movements and air entry. Always consider the possibility of an associated tension pneumothorax.

Adult orotracheal intubation

• Indications — See Accident site — emergency management (see page 76).

Needle cricothyroidotomy

• Indications — This is indicated in an emergency if the doctor cannot intubate.

• Procedure — A 12- or 14- gauge cannula about 5 cm long connected to a 10 or 20 ml syringe. Palpate the cricothyroid membrane anteriorly between the cricoid and thyroid cartilages and stabilise the trachea.

Puncture the skin in the midline and direct the needle caudally at 45° aspirating as it is advanced carefully. Withdraw the trochar when air is aspirated, and advance the cannula sheath fully over the trochar and remove the latter. Attach the cannula sheath if possible to an oxygen supply under pressure at 2 to 4 litres per minute.

Note — Use only as a temporary emergency measure as adequate oxygenation can usually only be maintained for about 30-60 minutes as CO_2 elimination may be limited.

Open cricothyroidotomy

• Indications — This is indicated in patients over the age of 12 where the patient cannot be intubated. In younger children, a needle cricothyroidotomy is preferable as an emergency procedure.

• Procedure — The cricothyroid membrane is palpated between the cricoid and thyroid cartilages (see page 76) and local anaesthetic injected in the conscious patient. A transverse skin incision is made and continued through the lower half of the cricothyroid membrane.

Do not damage the cricoid or thyroid cartilages. Open up the incision with artery forceps and insert a cuffed tracheostomy or endotracheal tube distally into the trachea. Inflate the cuff and ventilate the patient with oxygen after securing the tube. Check by auscultation and chest X-ray for the adequacy of tube placement and air entry on both sides.

Intravenous cannulation

• Indications — These are given on page 18. In all severe cases at least two l4- or 16- gauge intravenous lines should be inserted.

• Technique — Wear gloves and apply a venous tourniquet. Clean skin with an alcohol wipe and allow to dry. Use a local anaesthetic if possible. Insert a 14- or 16- gauge cannula. Remove the trochar after blood is aspirated and send for haematological and biochemical investigations if necessary. Advance the cannula into the vein and remove the trochar. Attach the cannula to the drip.

In severe trauma or hypovolaemic shock at least 2 veins should be cannulated.

The best veins for closed cannulation are the veins over the radial side of the forearm or the basilic at the elbow. Other veins used in an emergency include the femoral at the groin and the internal jugular and subclavian.

Venous cutdown

• Technique — The saphenous vein at the ankle, or alternatively the basilic at the elbow, 2.5 cm (1 in) lateral to the medial epicondyle, are the veins usually used.

• Saphenous vein — The skin 2.5 cm (1 inch) anterior and proximal to the medial malleolus is cleaned and draped and anaesthetised with 1% or 2% lignocaine. The skin is incised with a small blade and the vein mobilised carefully for about 2.5 cm (1 inch). A suture is tied as distal as possible and left uncut for traction. A small transverse incision is made carefully in the anterior surface of the vein and a large plastic cannula inserted for at least 3 cm up the vein. The skin is closed and the cannula secured to the skin and attached to the drip.

Femoral venepuncture

• Technique — After cleaning and draping the skin the vein is identified immediately medial to the femoral artery. The skin is infiltrated with 1% or 2% lignocaine. A cannula through a needle attached to a 5 or 10 ml syringe with 2 ml of saline is then inserted towards the patient's head in the femoral vein. The vein should again be located during insertion of the needle by using a finger palpating the femoral artery as a landmark. The needle is advanced until free blood appears in the syringe. The cannula is advanced and the needle is removed. The catheter is then attached to the intravenous drip.

Subclavian and internal jugular

venepuncture

These procedures should be left to a skilled operator, and are not usually the first portal of access for the hypovolaemic shocked patient for fluid replacement (see page 91).

Intraosseous transfusion

• Indications — Although this is usually only recommended for children under the age of 6, older children or even adults can benefit in an emergency if other venous infusion sites are inaccessible. It should be ceased as soon as other sites for infusion become available.

• Procedure — The knee should be slightly flexed over a pillow with the patient supine. The subcutaneous surface of the tibia is punctured about 2.5 cm (1 inch) below and medial to the tibial tubercle after cleaning and anaesthetising the skin. The special intraosseous needle with stylet is inserted distally at about 30° to the skin by a twisting motion into the medullary

cavity. The stylet is removed and a 5 or 10 ml syringe with about 5 ml of saline attached and the saline injected into the bone marrow. It should flow easily. The needle is then attached to the intravenous infusion.

Needle thoracocentesis

• Indications — As an emergency for a tension pneumothorax. There is a 10% risk of lung damage. Definitive drainage should by blunt insertion of a drain, in the 5th intercostal space (nipple level) in the mid axillary line.

• Procedure — Infiltrate the 2nd intercostal space in the mid clavicular line with local anaesthetic and sterilise the skin only if time allows. If there is no hypotension or suspected spinal injury the patient should be sitting up. A cannula approximately 5-8 cm long over a needle and attached to a 20 ml syringe is inserted into the pleura, aiming just superior to the insertion point. Air is aspirated to relieve the immediate distress, and the sheath attached to a Heimlich valve, or put through the finger of a glove to form a one-way valve (see page 93-97). In an emergency use any large bore needle and aspirate air. As soon as possible insert a chest drain in the 5th intercostal space in the mid axillary line (see below).

Open thoracocentesis

• Indications — This is a much safer procedure than by using a cannula. It is illustrated on page 95, with insertion of a gloved finger through an open wound. It should be used for both a tension pneumothorax and haemothorax. It is sometimes indicated as a prophylactic measure when intubation and positive pressure ventilation is used in patients with a risk of a pneumothorax.

• Procedure — The site should be in the 5th intercostal space (nipple line) in the mid axillary line. It is important to anaesthetise the skin, and particularly the pleura and muscles, with at least 30-40 ml of 0.5% or 1% lignocaine and allow this anaesthetic time to work. A 3 cm incision is made in the line of the 5th intercostal space and the subcutaneous tissues are opened with tissue forceps.

The pleura is carefully penetrated with the forceps and replaced immediately after penetration with a gloved finger (see page 95). The finger is used to separate any adhesions around the insertion site. Forceps clamped to the end of the thoracotomy tube are then used to insert the intercostal tube for about 3-6 cm in a caudal direction.

A Seldinger technique is also available with a 20-gauge needle, guide wire, dilator and 7 FG catheter.

The tube is sutured in place and the wound closed with interrupted sutures (not purse string), and a vaseline gauze dressing applied. An underwater drain, with low suction if necessary, is used, and a post-insertion chest X-ray taken. Check that the tube does not become kinked or blocked, and that the drainage bottle is never lifted above the level of the chest without first being clamped.

Pericardiocentesis

• Indications and assessment — Pericardial tamponade may produce muffled heart sounds, increased pericardial dullness on percussion, elevated jugular venous pressure and diminished pulse pressure (see page 100).

Assess the patient for mediastinal shift and also apply ECG leads if time allows.

• Procedure — Anaesthetise the puncture site with 1% lignocaine. A 16- or 18- gauge cannula over a needle is attached to a 3-way stopcock. The skin is punctured about 1 cm below the left xiphichondral junction, and at 45° to the skin. The needle and catheter are slowly advanced, aiming for the tip of the left scapula. As soon as the needle tip enters the blood filled pericardium the cannula sheath should be advanced over the needle before the needle is removed. The pericardium is then aspirated. The catheter is strapped in place and the stopcock is closed.

ECG changes such as ST segment elevation or frequent ventricular ectopic beats as the needle is advanced indicate irritation of the myocardium, and the catheter should be withdrawn slightly. This may also occur as the haemopericardium is aspirated, and the heart comes in contact with the catheter which can then be slightly withdrawn.

Repeated aspirations of the pericardium may be necessary. A clotted haemopericardium may occasionally require open operation.

Diagnostic peritoneal lavage

• Indications — These are discussed on page 108. Do not waste time performing this if there is an open wound, or if a CT scan or ultrasound indicate the need for an urgent laparotomy. In children CT scan or ultrasound is indicated instead of peritoneal lavage.

Laparotomy may be needed for injuries to the diaphragm or for retroperitoneal injuries when peritoneal lavage is negative. If in doubt a laparotomy should always be carried out. This is discussed in detail on page 108 under abdominal injuries. Always insert a gastric tube and urinary catheter.

Chapter 11

Reference material

Reference books

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Adams J C Standard Orthopaedic Operations. Churchill Livingstone

Apley A Solomon L Apley's System of Orthopaedics and Fractures. Butterworth

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Dandy D Essentials of Orthopaedics & Trauma. Churchill Livingstone

Evans T R et al ABC of Resuscitation. British Medical Journal

Huckstep R L A Simple Guide to Orthopaedics. Churchill Livingstone

Huckstep R L Sherry E Colour Guide — Picture Tests — Orthopaedics and Trauma. Churchill Livingstone

McLatchie G Lennox M E Soft Tissues — Trauma and Sports Injuries. Butterworth

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Sivananthan S Sherry E Warnke PH, Miller M D Mercer’s Textbook of Orthopaedics and Trauma. 10th Ed. CRC Press

Sherry E et al. Trauma, Oxford University Press.

Teddy P Head Injuries — Pocket Picture Guide. Gower

Watson N Hand Injuries & Infections — Picture Guide. Gower

Wedel D J Orthopaedic Anaesthesia. Churchill Livingstone

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Haematology

Reference intervals

The following reference intervals are intended as a guide only. Results should be assessed using the reference intervals provided by the laboratory that performs the testing. If there is any doubt the results should be discussed with the particular laboratory involved.

Red and white cell counts

Haemoglobin (Hb)

— adult male 13.0-18.0 g/dl

— adult female 11.5-16.5 g/dl

Red cell count (RCC)

— adult male 4.6-6.5x10l2/L

— adult female 3.8-5.8x10l2/L

Mean cell volume (MCV) 80-100 fL

White cell count (WCC) 4.0-11.0x109/L

Leucocyte differential count

— neutrophils 2.0-7.5x109/L

— lymphocytes 1.5 -4.0x109/L

— monocytes 0.2 -0.8x109/L

— eosinophils 0.04 -0.4x109/L

— basophils <0.1 x109/L

Platelet count 150-400x109/L

Erythrocyte sedimentation rate (ESR)

— male <50 years 1-7mm/hr >50 years 2-10mm/hr

— female <50 years 3-9mm/hr >50 years 5-15mm/hr

Coagulation levels

Activated partial thromboplastin time (APTT) 25-35 seconds

Prothrombin time (PT) 13-17 seconds

International normalised ratio — INR — (therapeutic range for oral anticoagulants) 2.0-4.5

Fibrinogen 1.5-4.0 g/L

Bleeding time (in vivo test) < 9 minutes

Clinical Chemistry

Electrolytes, urea and creatinine (EUC's)

Sodium	135-145 mmol/L
Potassium (serum)	3.8-4.9 mmol/L
Chloride	95-110 mmol/L
Bicarbonate (total CO_2)	24-32 mmol/L
Calcium (total)	2.10-2.55 mmol/L
Phosphate	0.70-1.50 mmol/L
Magnesium	0.8-1.0 mmol/L
Copper	13-22 µmol/L
Zinc	12-20 µmol/L
Urea	3.0-8.0 mmol/L
Creatinine	0.05-0.12 mmol/L

Liver function tests (LFT’s)

Bilirubin (total) 2-20 µmol/L

Alkaline phosphatase (ALP) 25-100 U/L

Gamma glutamyl transpeptidase(GGT)

— males <50U/L

— females <30U/L

Aspartate transaminase — AST(SGOT) 10-45 U/L

Alanine transaminase — ALT (SGPT) 5-40 U/L

Total protein 62-80 g/L Albumin 35-47 g/L

Arterial blood gases (ABG’s)

pH	7.36-7.44
PaO2	74-108 mmHg
PaC02	34-46 mmHg
Bicarbonate (HCO3)	18-25 mmol/L
Base excess	-2 — +2
Oxygen saturation	95-100%

Miscellaneous

Glucose — Fasting 3.0-6.0 mmol/L — Random 3.0-8.0 mmol/L

Urates — Males 0.20-0.45 mmol/L — Females 0.15-0.40 mmol/L Amylase 70-400 UL

Notes

Major insights into Trauma Care, from Dr Annette Holian, Pres. Aust. Orthopaedic Association, 2022,probably the most experienced trauma surgeon in Australia(AOA Bulletin,43,2,2022,pages 6-7) summarized the essence of modern trauma care as being- Getting the right patient to the right place in the shortest possible time.

She states this was the major advance in trauma care, NOT, improved surgical techniques.

Further from her major experience in the Middle East, she adds that she learnt: prevent heat loss, trauma triage for multiple casualties being done by the most experienced trauma surgeon, limiting hand-over, with the whole surgical team being present at the patient’s arrival, the hands-off ED supervisor of trauma primary assessment resuscitation, the anaesthetist caring for the airway and delaying intubation until massive transfusion was underway in the awake patient, limiting time in the ED, always moving the patient forward in the system and not returning to

ED after CT, the hands-off supervision of the surgical symphony in theatre by the most experienced senior surgeon and surgeons operating concurrently.