

Principles of fracture management

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Fracture

A ***fracture*** is a break in the continuity of bone



Dislocation

- Complete disruption of a joint such that there is no contact between the articular surfaces of the bones making up the joint



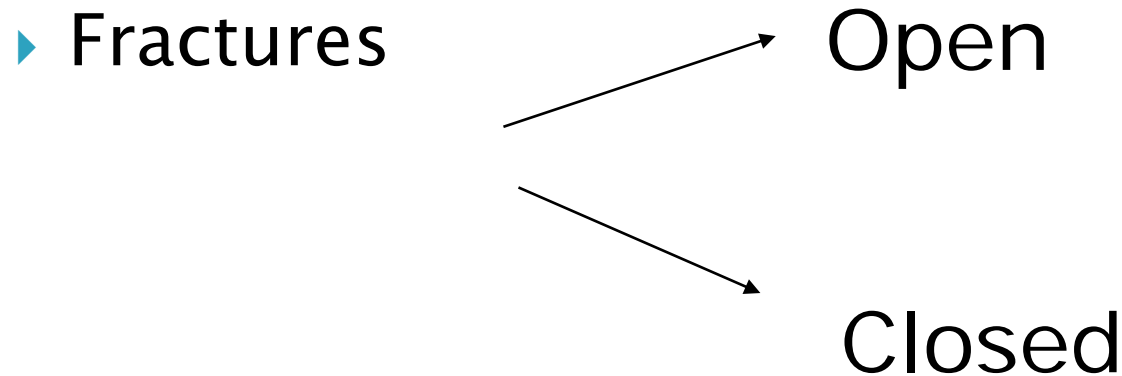
Subluxation

- (*sub=partial, luxation=dislocation*) is an incomplete disruption with the bones still retaining partial contact.



Classification

- ▶ Fractures can be classified on the bases of whether the skin (or epithelium) over it is intact or not



Open Fractures

- ▶ There is a wound in continuity with the fracture or its hematoma.
- ▶ The potential exists for organism to enter the fracture site from outside.

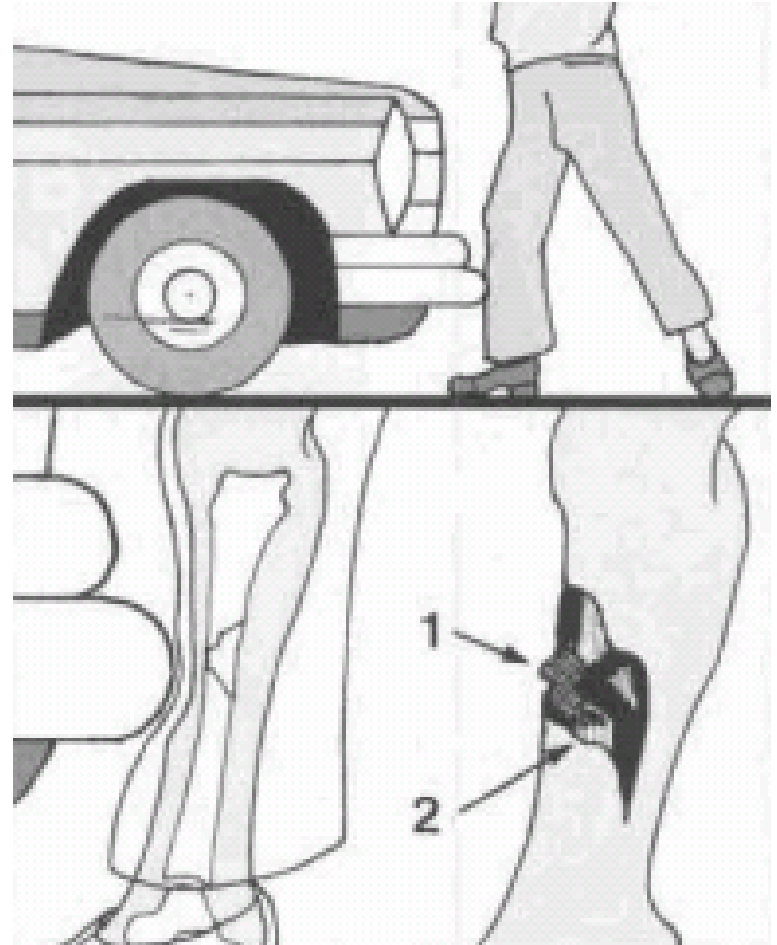


Note:

- Wound on the posterior aspect of the leg.
- Note also the deformity, the unquestionable sign of a fracture

Types of open fractures

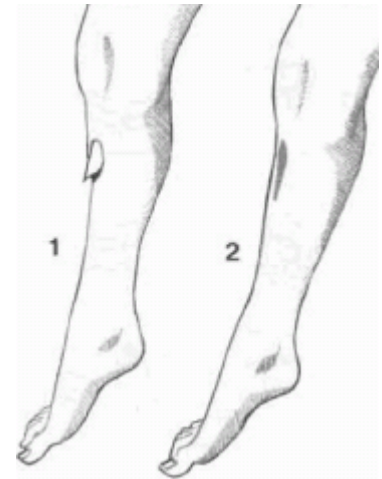
Open from without



Types of open fractures

Open from within

- Sharp end of bone pierces the skin.
- Soft tissue damage is minimal, and contamination is usually not severe

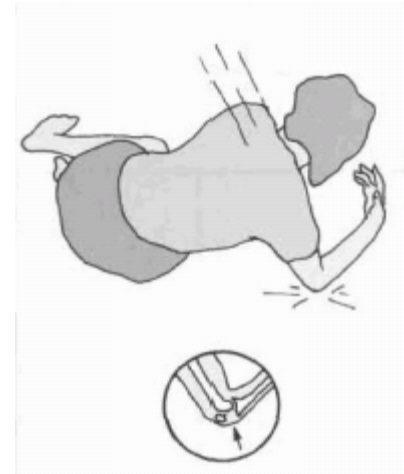


Closed fractures

- ▶ The skin over the fracture is intact.

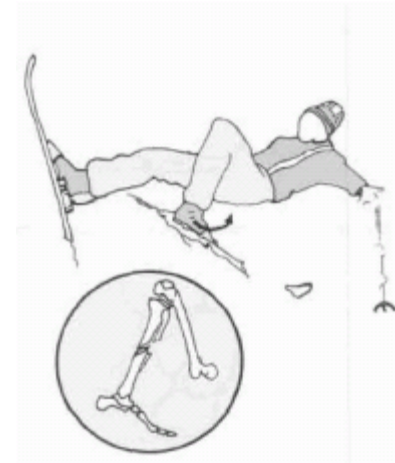
Causes of fractures

Direct violence



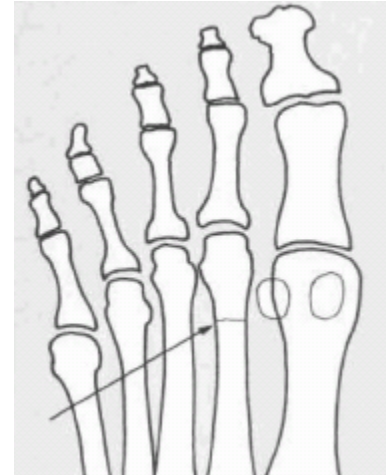
Causes of fractures

Indirect Violence



Causes of fractures

Fatigue or Stress fracture



Causes of fractures

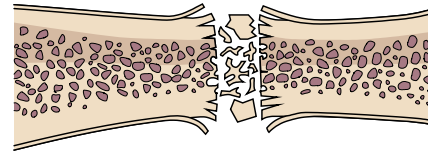
Pathological fractures



Healing of fractures

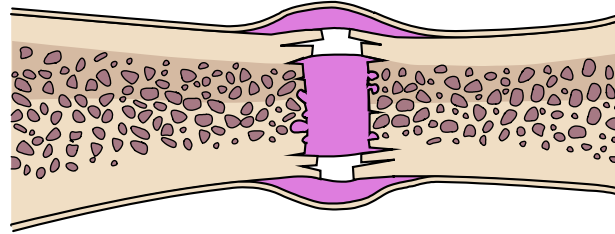
For convenience, fracture healing is divided into the following stages:

- ▶ Haematoma Formation
- ▶ Demolition

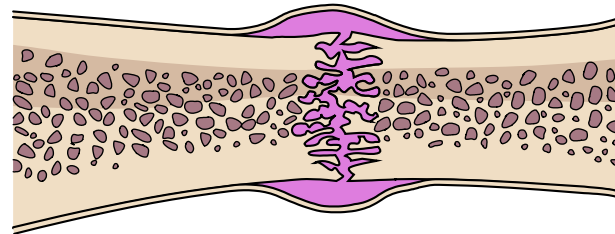


Healing of fracture (contd)

- ▶ Callus Formation

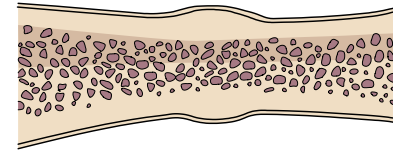


- ▶ Woven Bone Formation



Healing of fracture (contd)

- ▶ Remodelling

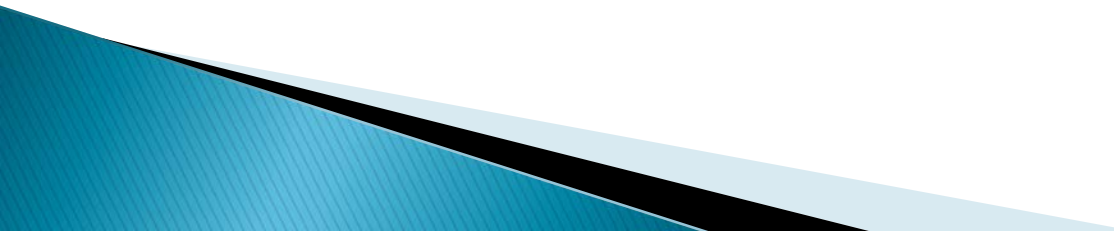


Factors affecting Bone Union

- ▶ General factors:
 - Malnutrition
 - Immunodeficiency states
 - Systemic diseases e.g. diabetes
- ▶ Local Factors
 - Poor Immobilization
 - Infection
 - Poor blood supply
 - Foreign bodies
 - Soft tissue damage
 - Part/type of the bone (cancellous versus cortical)

Duration of fracture healing

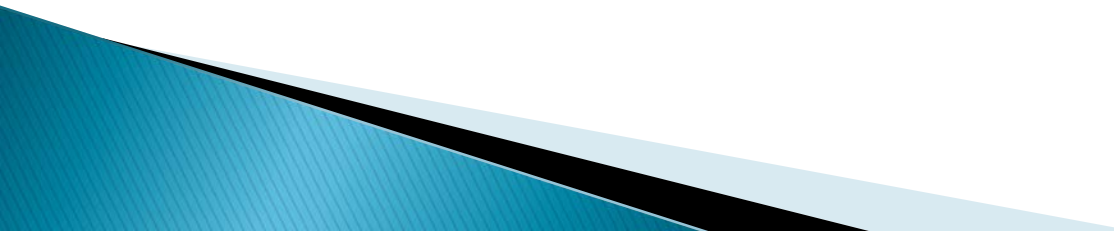
Rules of thumb:

1. Fractures of the lower limb takes twice as long to heal as fractures of the upper limb
 2. Fractures in adults take twice as long to unite as fractures in children
- 

Duration of fracture healing

	Upper Limb	Lower Limb
Children	3-4 weeks	6-8 weeks
Adults	6-8 weeks	12-16 weeks

Principle of managing fractures

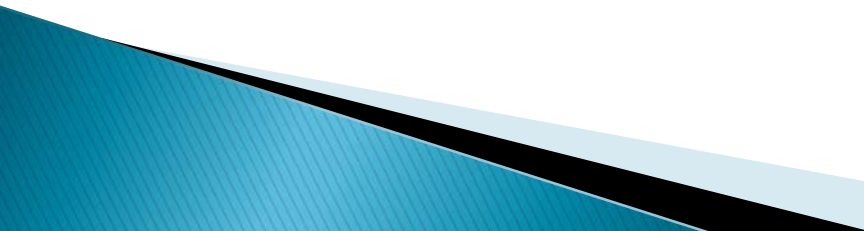
1. Diagnosis
 2. Reduction
 3. Immobilization
 4. Rehabilitation
- 

Diagnosis: History

- ▶ Mechanism of injury
 - ▶ Duration
 - ▶ Site of injury
 - ▶ Symptoms
 - ▶ Associated injuries
 - ▶ Past medical history
 - ▶ Last meal
 - ▶ Current medications
- 

Diagnosis: Examination

1. General examination

- ▶ Evidence of shock
 - ▶ Associated injury e.g. to head, chest etc.
 - ▶ Systemic diseases that may cause pathological fractures e.g. Cushing's syndrome
- 

Diagnosis: Examination

2. Local Examination: look, feel & move

Look

- Swelling
- Wounds (Describe and estimate the size, depth and shape. Note tissues exposed)
- Deformity (The most specific sign of fracture)

Deformities



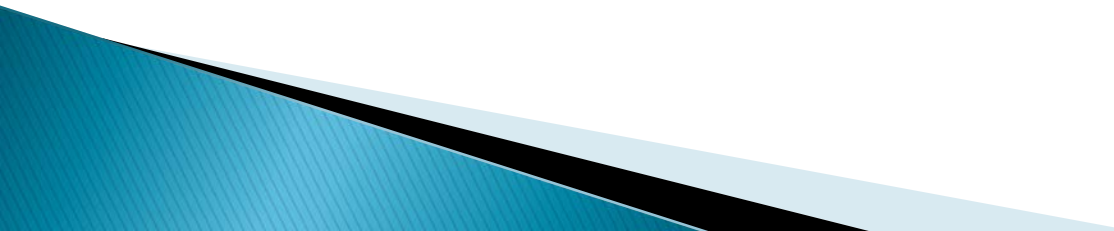
Deformity of the leg following a fracture



Elbow deformity following dislocation

Diagnosis: Examination

Feel

- Tenderness
 - Distal pulses
 - Test for sensations
- 

Diagnosis: Examination

Move (Potentially painful. Be Gentle!)

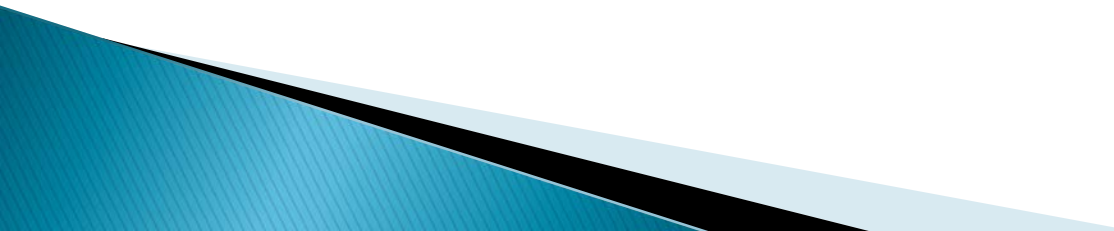
- Abnormal movement
- Range of movement in distal & proximal joints
- DON'T deliberately check for crepitus: It is painful!

Diagnosis: X-Ray

Plain X-rays

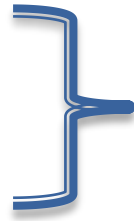
- ▶ The most important diagnostic test.
- ▶ The following rules must be observed (*rule of 2*)
 - i. At least **2** views at right angle to each other.
 - ii. The **2** adjacent joints must be included.
 - iii. \pm **2** limbs in some cases.
 - iv. \pm **2** times in some cases.

Guide to Reading fracture X-rays

- ▶ Site on bone
 - ▶ Fracture Line
 - ▶ Displacement
 - ▶ Angulation
 - ▶ Other incidental findings
- 

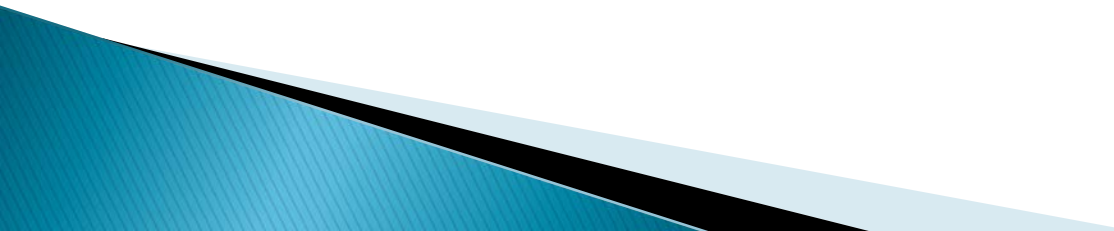
Reading X-rays: Site on bone

- ▶ Epiphysis
- ▶ Metaphysis
- ▶ Diaphysis
 - Upper third
 - Middle third
 - Distal third



These two are usually named
Eg trochanter, head, etc

Reading X-ray: Fracture lines

- Transverse
 - Oblique
 - Spiral
 - Segmental
 - Comminuted.
 - Green stick
- 

Examples of fracture lines



Transverse



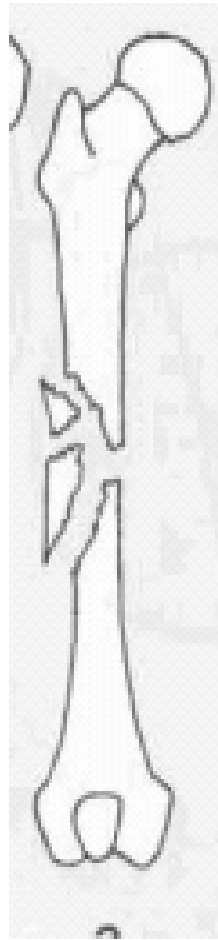
Spiral



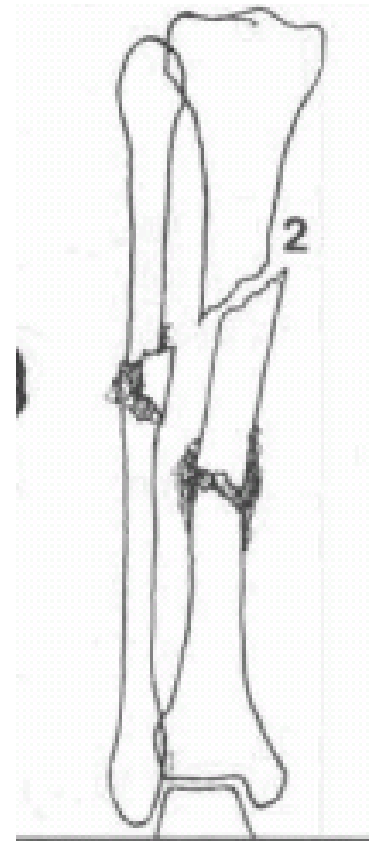
Oblique

Examples of fracture lines

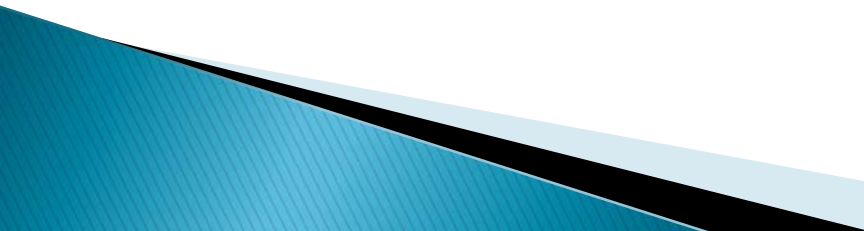
Comminuted



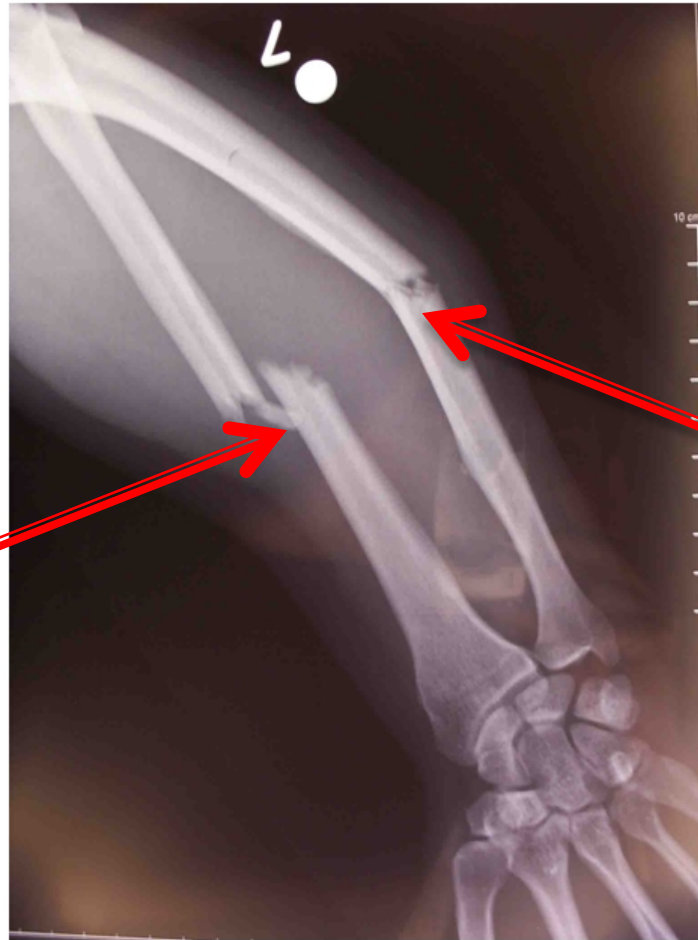
Segmental



Reading x-rays: Displacement

- Angular (Angulation)
(Medial, lateral, anterior, posterior)
 - Rotational
(Medial or Lateral. This usually is a clinical diagnosis)
 - Shift (displacement)
(Medial, lateral, anterior, posterior)
 - Impaction
 - Distraction
- 

Examples of displacements



Medial Displacement

Medial Angulation

Examples of displacements



- ▶ Oblique
- ▶ Overlapping
- ▶ Angulated
- ▶ Completely displaced (Laterally)
- ▶ Midshaft fracture of the humerus

Fractures in Children

(A) Shaft fractures

FRACTURES IN CHILDREN



Complete



Greenstick



Buckle



Pipe

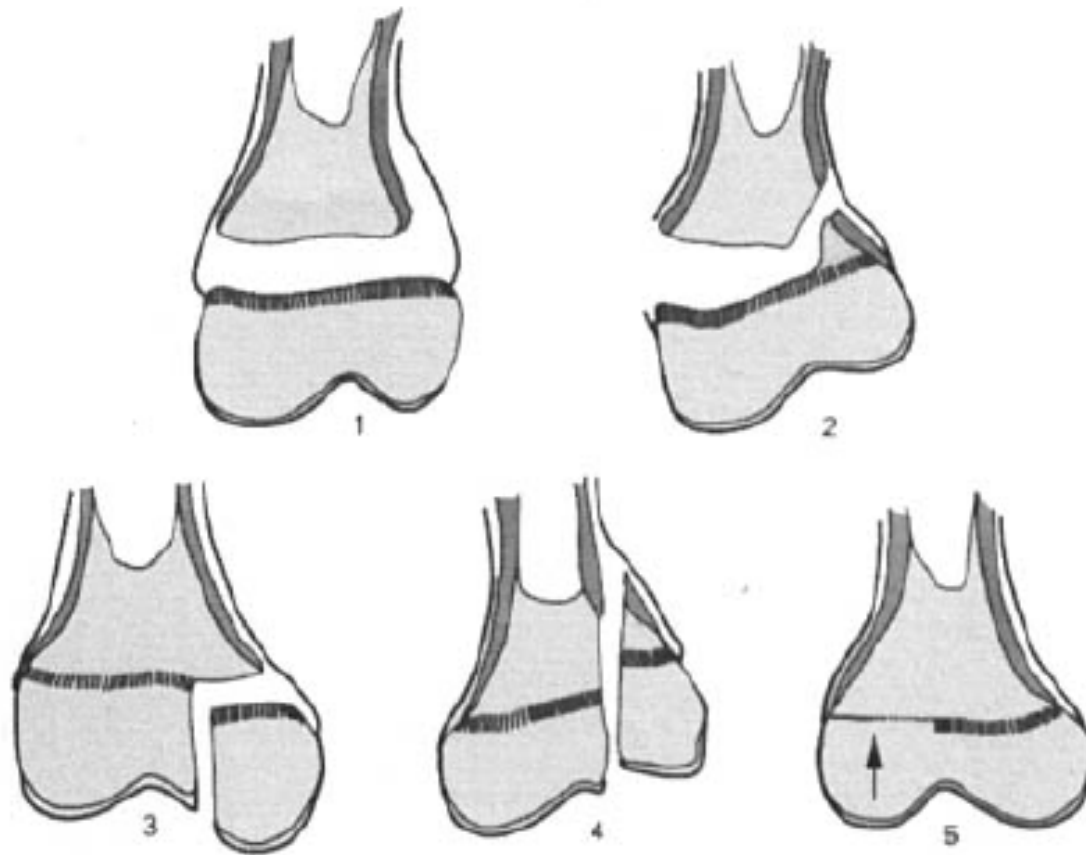


Bow



Fractures in Children

(A) Epiphyseal plate fractures



**Classify by using
Salter-Harris
classification**

Final Diagnosis

This is based on a combination of clinical and investigative findings

1. Is it open or is it close?

- This is a clinical decision

2. Site (X-ray)

- Which bone?
- Site on bone
- Fracture line
- Fracture displacement

3. Underline disease? (Combination of the two)

Pathological fracture

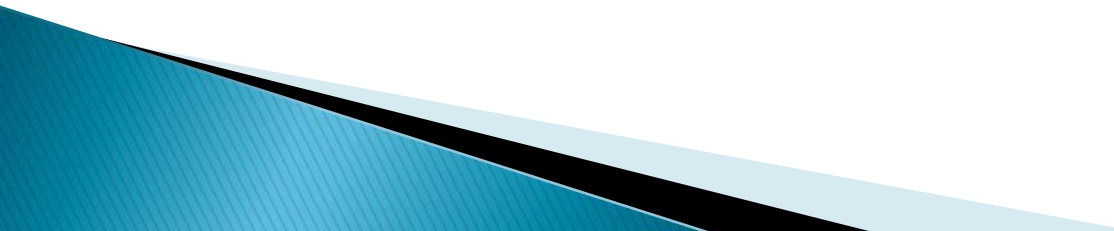


- ▶ Osteoporosis
- ▶ Comminuted fractures of the surgical neck of the humerus
- ▶ Some impaction

General management

- ▶ First aid
- ▶ Transport
- ▶ Shock and haemorrhage
- ▶ Pain
- ▶ Associated injuries
- ▶ Prophylaxis against tetanus when indicated.
- ▶ Antibiotics when indicated.

Reduction

- ▶ This is the restoration of the (displaced) fractured bone to its normal anatomical alignment.
 - ▶ Not necessary when fractures are undisplaced (e.g. greenstick, stress fractures)
 - ▶ Inaccurate reductions lead to mal-union
- 

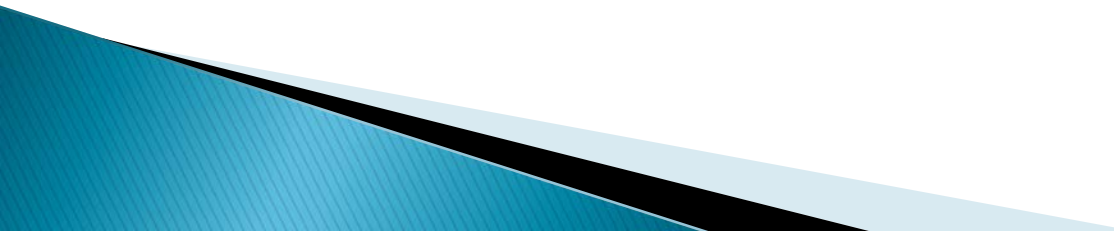
Reduction: Methods

- ▶ Gravity
- ▶ Closed reduction or Manipulation under anaesthesia (MUA)
- ▶ Open reduction

Closed reduction

- ▶ The ideal method of reduction
- ▶ Must be done under anaesthesia
 - General
 - Regional
 - Sedation and analgesia
 - Haematoma block occasionally

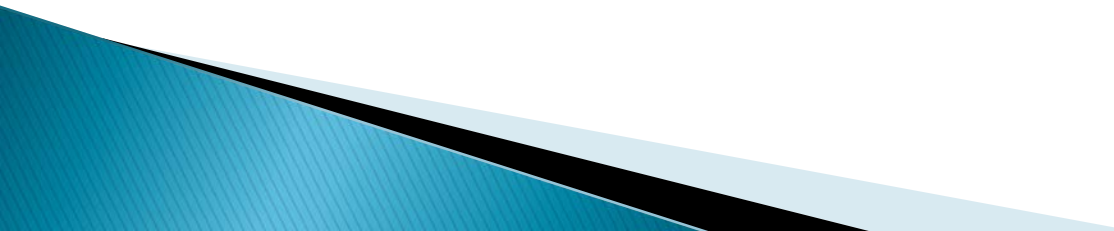
Close reduction

- ▶ Based on the principle of reversing the (direction of) the force that caused the fracture
 - ▶ X-ray film must be at hand
 - ▶ Most entails dis-impacting the fracture fragments by manual traction, followed by manipulation
- 

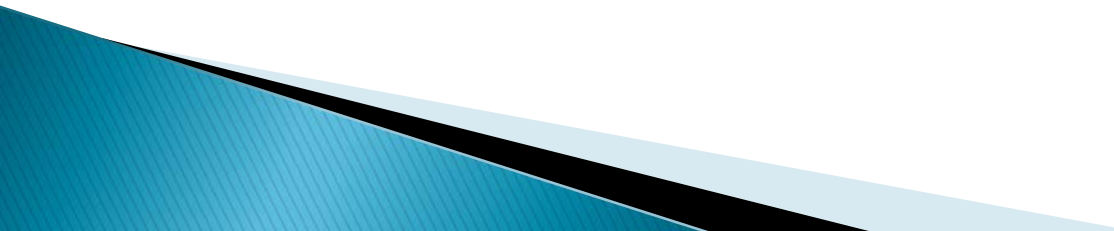
Open reduction

- ▶ A surgical operation in which the fracture site is exposed in order to reduce the fracture. Usually done in conjunction with Internal fixation (Hence the acronym: ORIF)
- ▶ Have specific indications

Open reduction: Indications

- ▶ Close reduction is impossible
 1. Small fragment, cannot be manipulated
 2. Loose fragment in the joint
 3. Certain forearm fractures–dislocations
 - ▶ Close reduction is inaccurate
 1. Displaced articular fractures
 2. Displaced fractures of both forearm bones
 - ▶ Internal fixation is indicated
- 

Immobilization (Fixation)

- ▶ Methods by which reductions are held in place.
 - ▶ An essential step to fracture union
 - ▶ Inadequate immobilizations lead to non-union
 - ▶ Also referred to as splinting or fixation.
- 

Immobilizations

▶ External

- Casts
- External fixators
- Traction
- Strapping (useful in the upper limb)
- Cast-braces

▶ Internal

- Screws
- Plates and screws
- Nails
- Wires and Pins

Casts

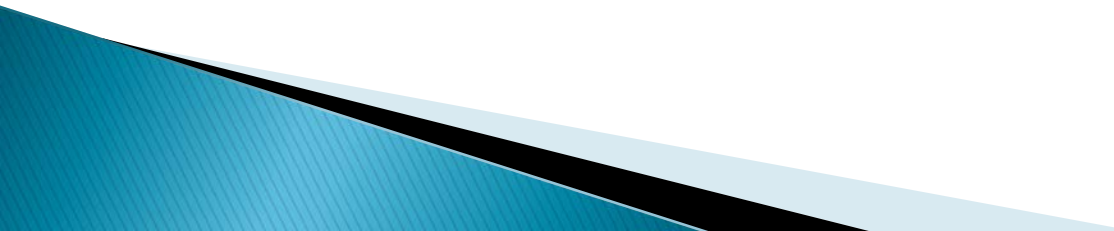
- ▶ Types
 - i. POP
 - ii. Fibre-glass casts
- ▶ Application mode
 - i. Complete Casts
 - ii. Back Slabs

Casts



BACK SLAB

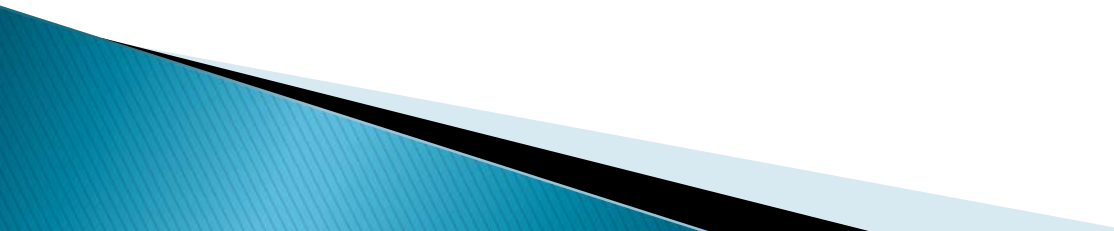
General rules of cast application

- ▶ Always protect the underline skin by padding the cast. (velban, Sofban, stockinet)
 - ▶ For adequate immobilization, the joint above and the joint below the fractured bone should be included in the cast (Except in some cases)
 - ▶ Never apply a complete cast on a freshly fractured limb
- 

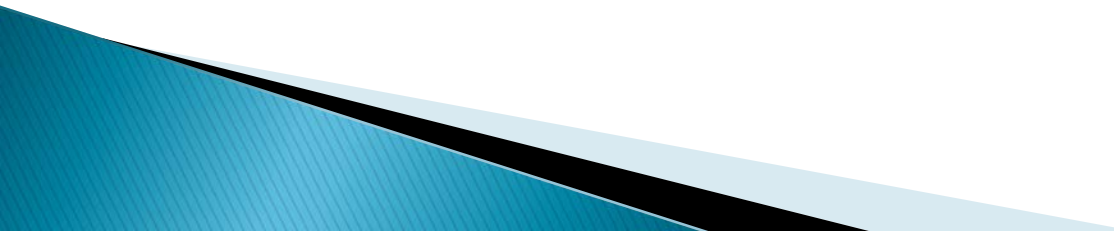
POP Advantages

- ▶ It is cheap.
- ▶ It is easily available and
- ▶ It is safe and easily applied.

POP: Disadvantages

- ▶ It is heavy
 - ▶ It is easily spoiled by water.
 - ▶ It is relatively radio-opaque.
 - ▶ Wounds are not easily accessible in casts.
 - ▶ Joint stiffness is common
 - ▶ Impaired blood flow may lead to ischaemia and Volkmann ischaemic contracture
- 

Fibre Glass casts

- ▶ More rigid than POP
 - ▶ Lighter
 - ▶ Comes in different colours
 - ▶ Water resistant
 - ▶ More difficult to apply than POP
 - ▶ More Expensive too
- 

Traction

- ▶ Pulling force is applied to the skeleton
- ▶ counterbalanced by a counter-traction



Tractions

Question

- ▶ How much weight to use for femoral traction?

Answer

- ▶ 10% of the patient's body weight
- 

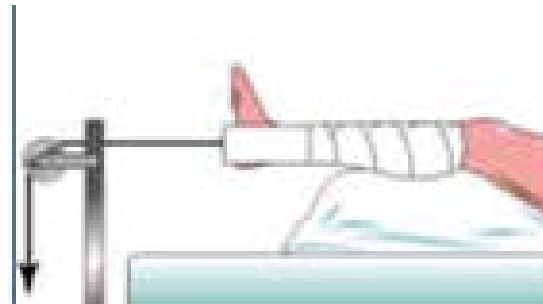
Traction

Types of tractions

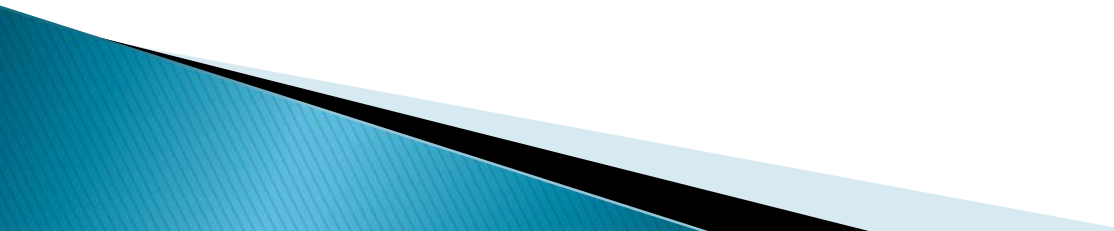
- ▶ Skin Traction
- ▶ Skeletal Traction

Skin tractions

- ▶ Adhesive or non-adhesive tape applied to the leg or the forearm with weight attached.
- ▶ Cannot take more than 5Kg; therefore
 - Can be used for definitive immobilization in children BUT
 - Can only be used for temporary immobilization in adults

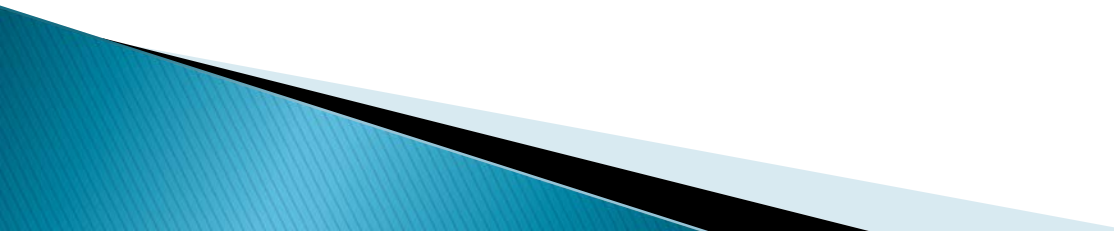


Skeletal tractions

- ▶ A pin or wire is passed through the skeleton distal to the fracture and weights are attached to this to provide traction
 - ▶ Can support much more weight than skin traction
 - ▶ Commonest site of insertion is the upper tibia for femoral fractures
- 

Tractions

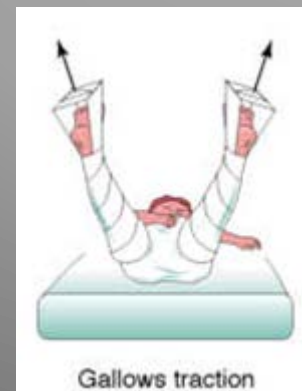
Mode of Application

- ▶ Fixed traction
 - ▶ Balanced or sliding traction
 - ▶ Combined traction
 - ▶ Gallows Traction
- 

Example of Traction types

Gallow's Traction

- ▶ Used in Children < 2yrs
- ▶ Can be taken home
- ▶ For femoral fractures



Example of Traction types

- ▶ Balanced Traction
- ▶ With foot of bed elevated, Patient's weight provides counter-traction

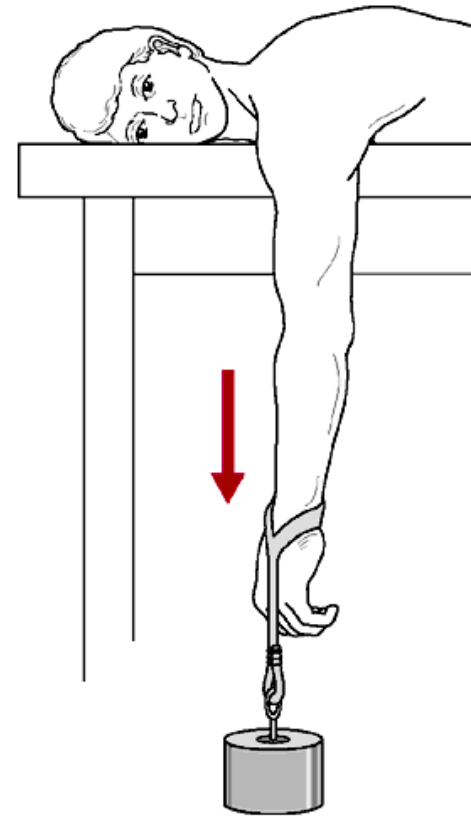


Traction


Counter-traction

Examples of tractions

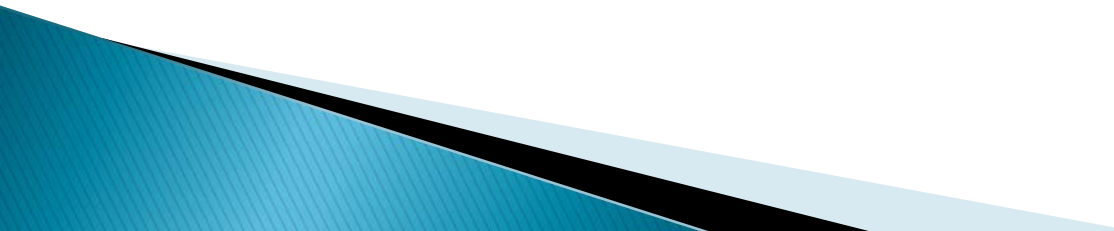
- ▶ Fixed traction



Complications of tractions

- Pin site infection (Skeletal traction)
 - Distraction leads to non-union or delayed union (Too much weight)
 - Insufficient traction: Overlapping fragments. Leads to malunion
 - Reaction to skin traction kit (Zinc oxide)
 - Common peroneal nerve injury especially in the elderly
- 

External Fixation

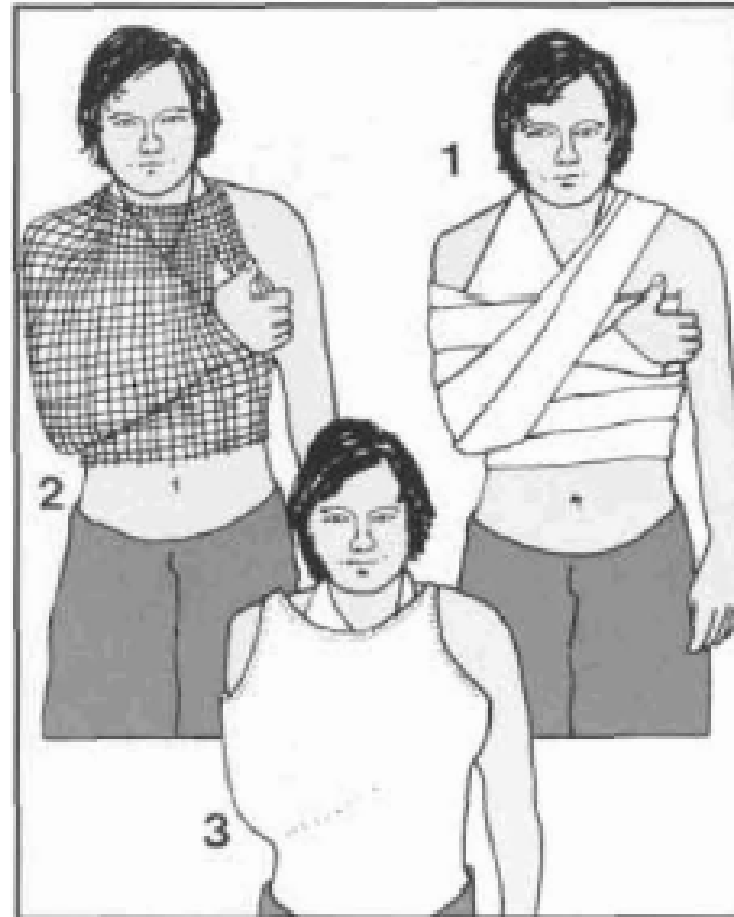
- ▶ Bone fragments are held in alignment with pins inserted percutaneously
 - ▶ The pins are then held in proper relation to one another by a rigid external frame.
 - ▶ Major indication is open fractures with large wounds
- 

External fixation



Strappings

- ▶ Very useful in the upper limb




Cast-Braces

- ▶ Useful for managing humeral fractures



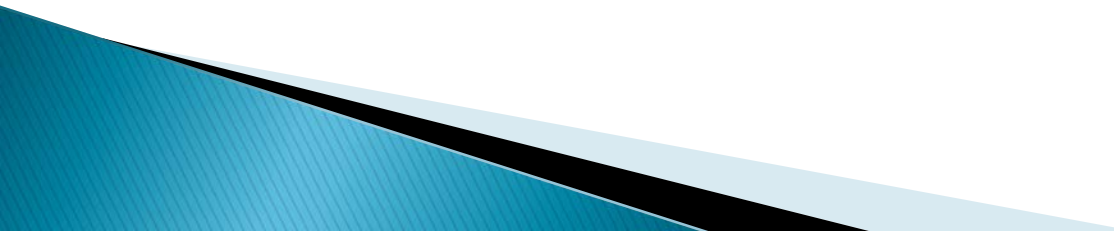
Internal fixation: Indications

- i. Difficult fractures
 - ii. Pathological fractures secondary to tumours: to facilitate patient's early mobilisation
 - iii. Multiple fractures especially in one limb
 - iv. Nursing difficulties e.g. quadriplegics or paraplegics and those with multiple injuries.
 - v. In cases where prolonged hospitalisation is undesirable e.g. elderly patients.
- 

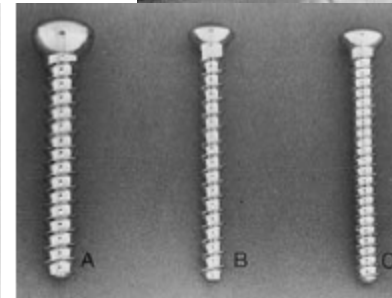
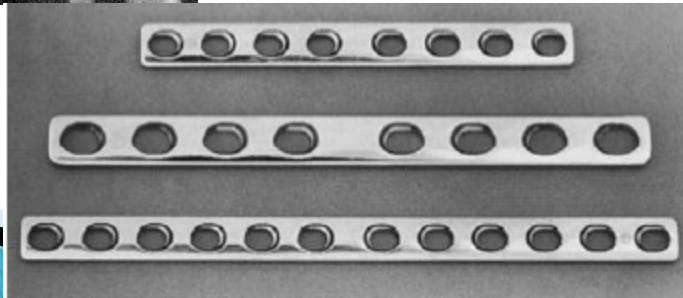
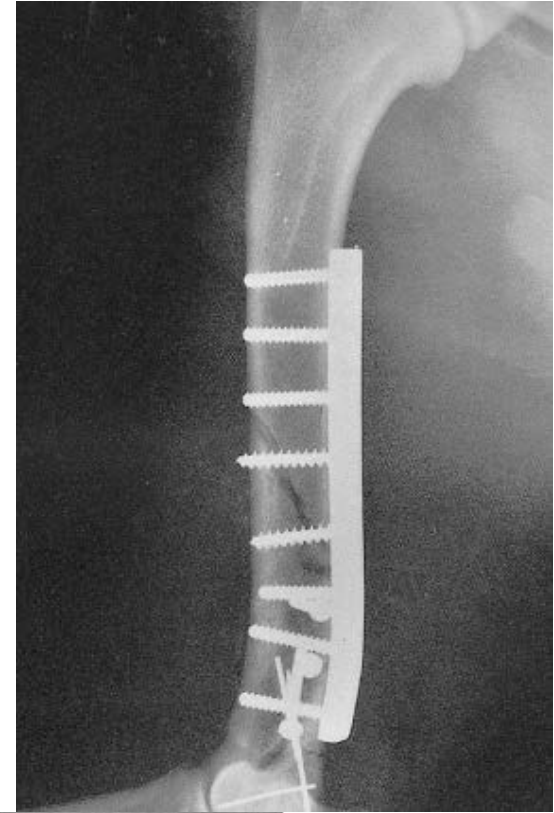
Examples of difficult fractures

- i. Those prone to non-union e.g. femoral neck fractures
- ii. Those prone to malunion e.g. ankle and wrist fractures
- iii. Those prone to distraction e.g. patella and olecranal fractures.

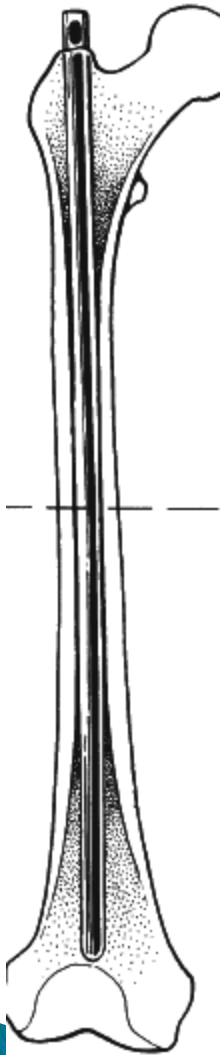
Type of Internal splints

- Plates and screws.
 - Intramedullary nails e.g. Kuntscher nails.
 - Wires e.g. Kirchner wires.
 - Screws alone
- 

Plates and Screws



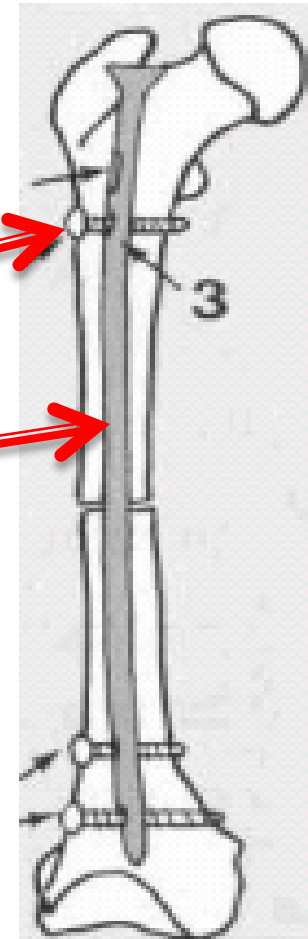
Intramedullary Nail



**Kuntscher nail
(Non Locking**

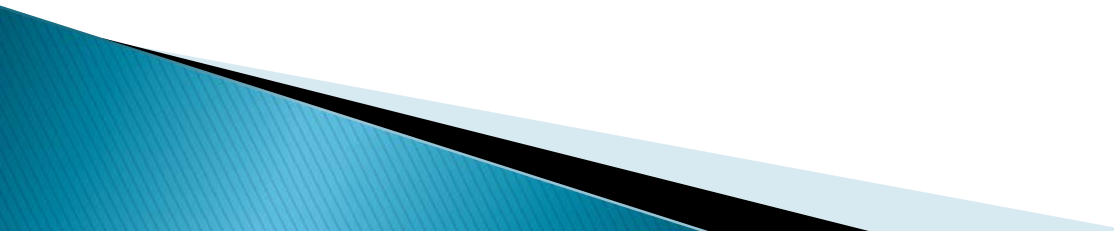
Interlocking
screw

Nail



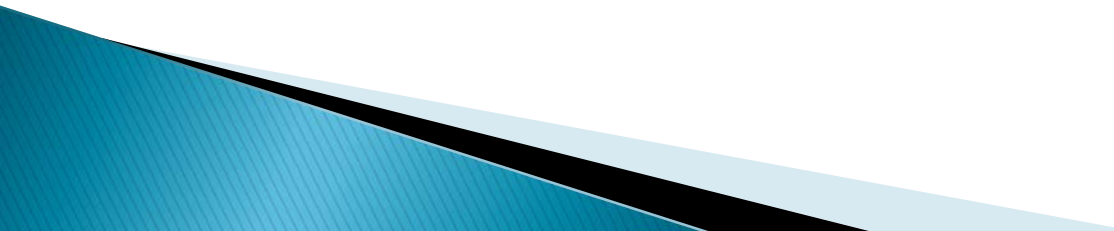
Locked Intramedullary Nail

Complications of internal fixations

- Infections: the most feared complication!
 - Implant failure.
 - Refracture after implant removal.
 - Implant migration.
- 

Open fracture treatment

Main worry is INFECTION!

- ▶ Tetanus immunoprophylaxis
 - ▶ Debridement
 - ▶ ± Immediate Closure
 - ▶ ± Daily dressing
 - ▶ ± POP + windows
 - ▶ ± External fixation
 - ▶ ± ORIF
- 

Signs of Union



- ▶ Absent movement and pain at fracture site
- ▶ Palpable callus
- ▶ Can raise limb up
- ▶ Good Callus formation on x-ray
- ▶ Fracture line has disappeared on X-ray

Complications

General complications

- ▶ Shock and haemorrhage
- ▶ Tetanus
- ▶ Fat embolism
- ▶ Pulmonary embolism

Skin

- Fracture blisters
- Plaster sores
- Bed sores
- Reaction to skin traction

Complications

Muscles

- Muscle atrophy
- Muscle weakness
- Muscle tear

Tendons

- Avulsion
- Rupture (usually late)
- Tendonitis

Complications

Nerves

- Neuropraxia
- Axonotmesis
- Neurotmesis
- Nerve entrapment syndrome. Usually delayed

Vascular

- Direct injury to vessels
- Compression of vessels
- Vascular spasm
- Compartmental syndrome
- Volkmann ischemic contractures

Complications

Bone

- Avascular necrosis
- Non-union
- Malunion
- Delayed union
- Growth disturbances in the skeletally immature.
- Osteomyelitis

Joints.

- Stiffness
- Recurrent dislocations
- Osteoarthritis
- Haemarthrosis.

Complications

Miscellaneous

- Myositis ossificans
- Sudeck's atrophy

Non-union and malunion

Non-Union



MalUnion



Thank you

