

Surgery- II

Messay A.(**MD**)

BONE FRACTURE

Introduction.

- Definitions # .
- Mechanisms # .
- Classification # .
- Diagnosis # .
- Management of #
- Fracture healing.
- Common Specific #

Definition: A fracture is a structural breach in the normal continuity of bone.

Mechanism of injury

1- Tubular bone: - Direct **violence** to the bone
- Indirectly due to **twisting** or **angulation**

2- Cancellous bone: - may be fractured by **compression**

E.g. Clash fracture of vertebral body or by traction

E.g. Transverse fracture of the patella

FRACTURE DESCRIPTION

- At a minimum, a fracture should be identified using the following:
 - Name of the injured bone
 - Location of the injury
 - (eg, dorsal or volar; metaphysis, diaphysis, or epiphysis)
 - Orientation of the fracture (eg, transverse, oblique, spiral)
 - Condition of the overlying tissues (eg, open or closed fracture).
 - fracture angulation, comminution, and displacement.

Causes

- Fall
- Motor vehicle accident
- Homicidal (Quarrels)

Classification and description

- Open (Compound) or closed
- Complete Fractures or incomplete Fractures
- Transverse, Oblique or spiral
- Displaced or undisplaced
- Pathological (Underlying bone disease)

The most important clinical classification is:

- **Open** (compound) vs **Closed** fracture

❑ **Open** fractures are those in contact with the outside environment (ie, open to air)

- associated with higher rates of compartment syndrome, neurovascular injury
- It is an orthopedic emergencies requiring immediate **irrigation** and **debridement**
Tetanus prophylaxis.... Antibiotics: Broad spectrum
.....Delayed wound closure!
- this decreases the risk of **osteomyelitis** and other infectious complications



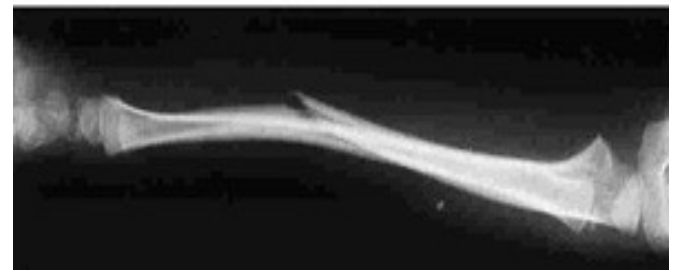
Closed Fracture



Open Fracture

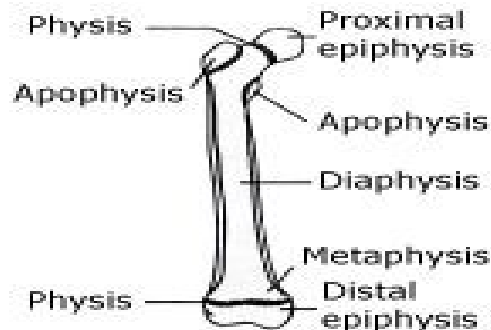


Complete Fracture



Incomplete Fracture

Location of the bone



Epiphyseal

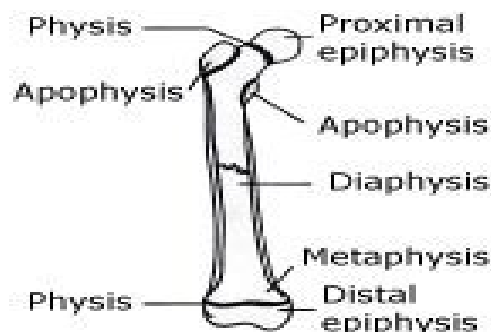
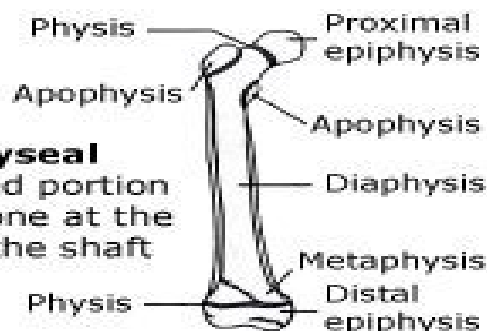
The end of the bone, forming part of the adjacent shaft

Metaphyseal

The flared portion of the bone at the ends of the shaft

Diaphyseal

The shaft of a long bone



Integrity of skin and soft-tissue envelope around fracture

Closed

The skin over and near the fracture is intact



Open

The skin over and near the fracture is lacerated or abraded by the injury



Amount of displacement



Nondisplaced

A fracture in which the fragments are in anatomic alignment



Displaced

A fracture in which the fragments are no longer in their usual alignment



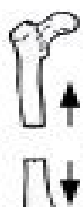
Angulated

A fracture in which the fragments are malaligned



Bayonetted

A fracture in which the distal fragment longitudinally overlaps the proximal fragment



Distracted

A fracture in which the distal fragment is separated from the proximal fragment by a gap

Orientation/extension of fracture line



Transverse

A fracture that is perpendicular to the shaft of the bone



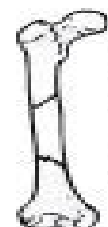
Comminuted

A fracture in which there is more than two fracture fragments



Oblique

An angulated fracture line



Segmental

A type of comminuted fracture in which a completely separate segment of bone is bordered by fracture lines



Spiral

A multiplanar and complex fracture line



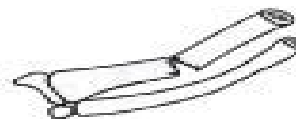
Intra-articular

The fracture line crosses the articular cartilage and enters the joint



Torus

An incomplete buckle fracture of one cortex, often seen in children



Greenstick

An incomplete fracture with angular deformity, seen in children



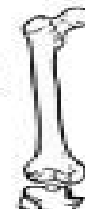
Impaction

A fracture that occurs when one bone hits or "impacts" an adjacent bone



Compression

A type of impaction fracture that occurs in the vertebrae, resulting in depression of the end plates



Depression

A type of impaction fracture that occurs in the knee when the femoral condyle strikes the softer tibial plateau



Stress (fatigue)

A fracture in normal bone that has been subjected to repeated or cyclical loads that in and of themselves are not sufficient to cause



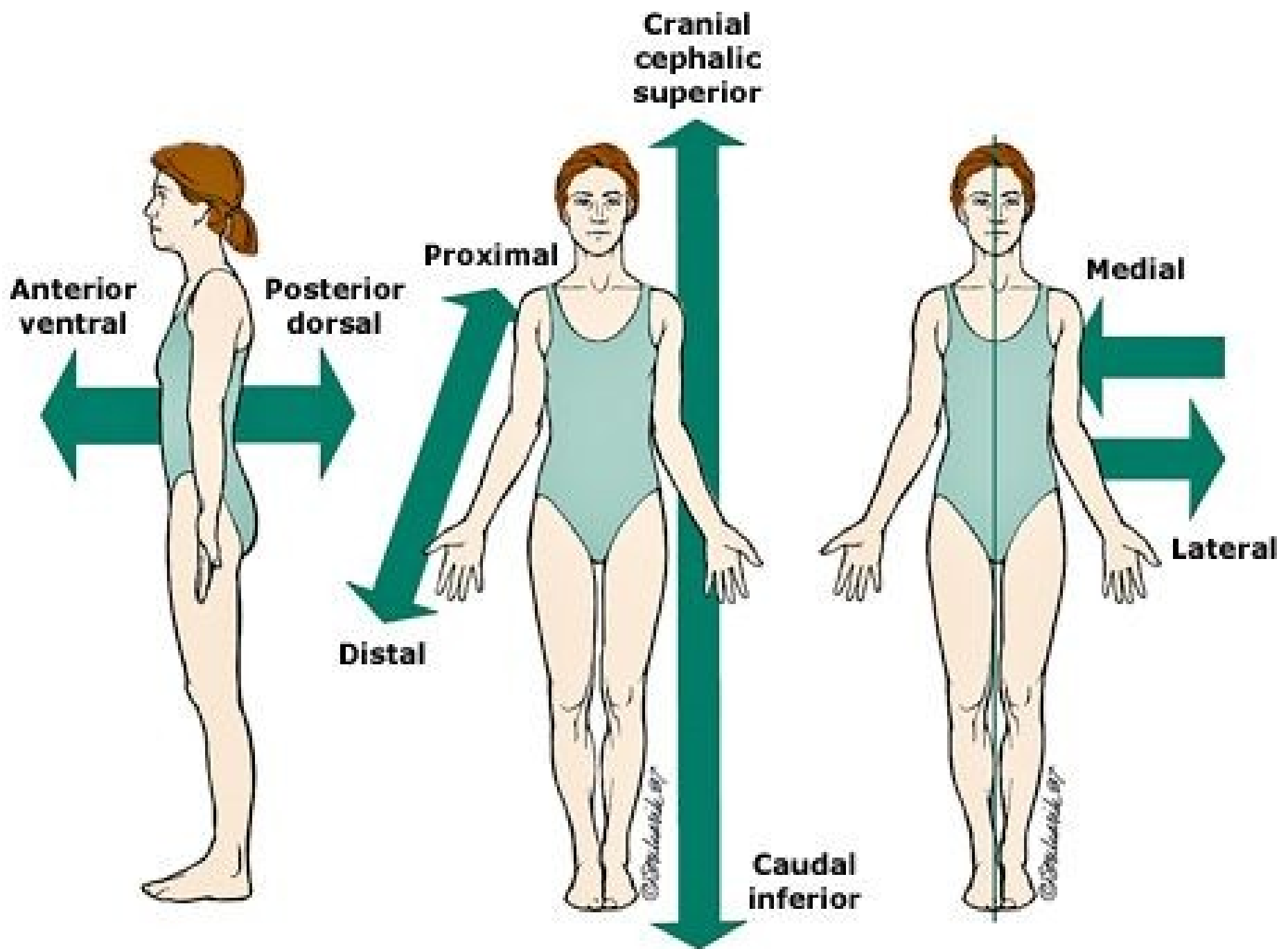
Stress (insufficiency)

A fracture in weakened bone that has been subjected to a load insufficient to fracture normal bone



Pathologic

A fracture through bone weakened by tumor, metabolic bone disease, or osteoporosis

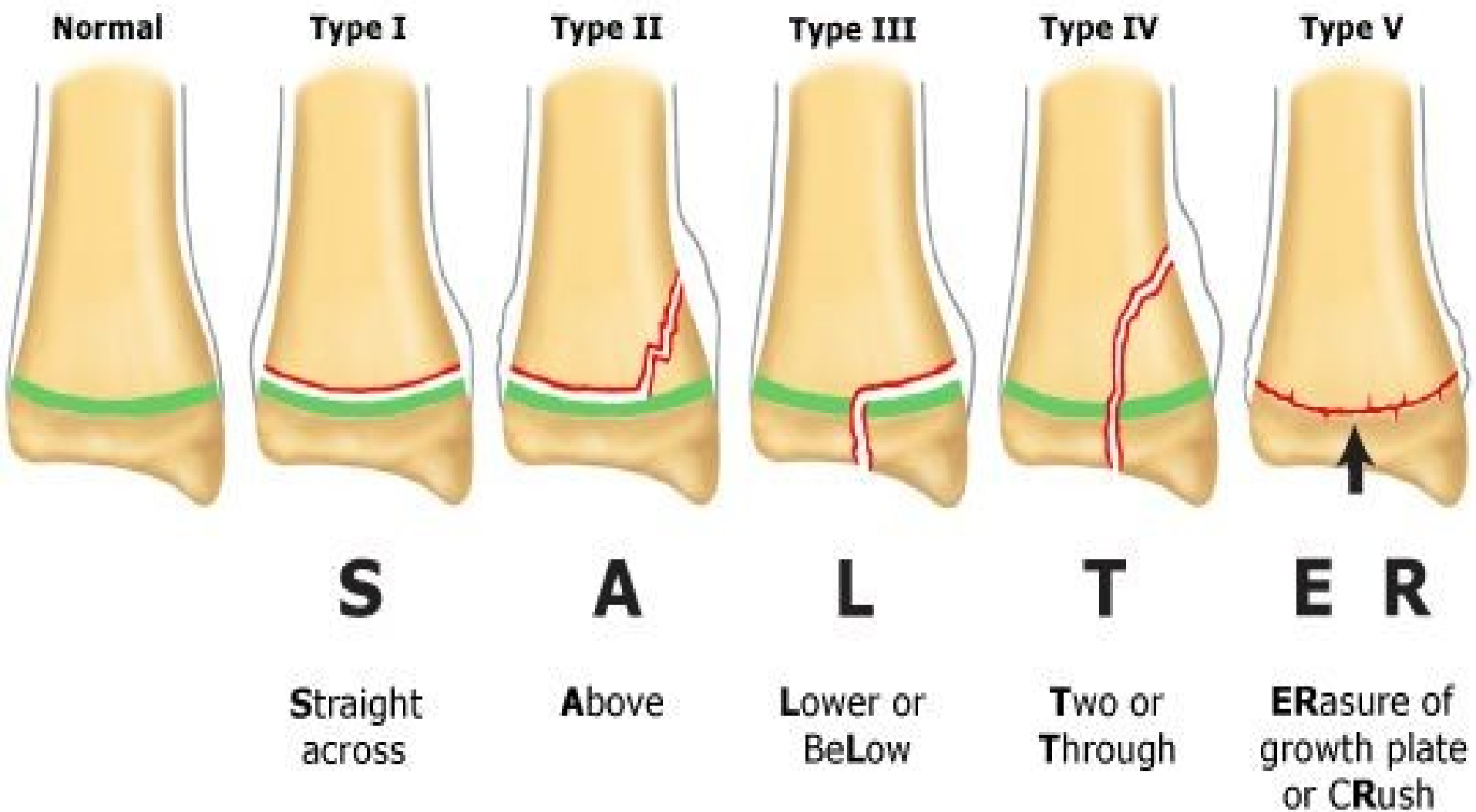


The Salter-Harris classification system

- easily applied and adequate for the majority of **physeal** fractures
- grades **physeal** fractures as types **I** through **V**.
- Complications of physeal injury include **growth arrest**, permanent **decreased range of motion**, and angular **deformity**
- These **physeal** injuries are more common during times of rapid growth, such as adolescence, and generally occur through the hypertrophic zone of the physis

SALTER Harris Fracture Pneumonics

- S ("Straight across") — Type **I** (low risk for growth plate injury)
- A ("Above") — Type **II**
- L ("Lower" or "BeLow") — Type **III**
- T ("Two" or "Through") — Type **IV**
- ER ("End") or ER ("ERasure of the growth plate") — Type **V** (high risk for growth plate injury)



FRACTURE DESCRIPTION IN CHILDREN

- Describing a fracture entails a thorough explanation of both the clinical scenario and the radiographic findings
- The clinical narrative should include
 - age,
 - gender,
 - mechanism of injury,
 - anatomic location,
 - soft tissue involvement (eg, open or closed), and
 - key physical examination findings,
 - especially neurovascular status.

- Fracture patterns in children
- ✓ periosteum of pediatric bone has significant osteogenic potential
- ✓ more metabolically active than the adult periosteum.
- ✓ This **active periosteum promotes callus formation, union of fractures, and remodeling** during the healing process
- ✓ **periosteum is also thicker and stronger** in children, which **limits fracture displacement, reduces**
periosteum - tissue around bones

Type of children fracture

- The qualities and function of the pediatric periosteum are responsible for some of the **unique fracture patterns** seen in children.
- **Examples of these fractures include :-**
 - **buckle,**
 - **greenstick, and**
 - **plastic deformation (or bowing).**
- Three fundamental forces cause these fractures:
 - **shear, tensile, and compressive.**
 - Bone is least able to withstand shear forces, followed by tension, then compression

Buckle (torus)

- Buckle fractures follow compression failure, often at the junction between the porous **metaphysis** and the denser **diaphysis**.
- ✓ **distal radius**, distal tibia, fibula, and femur.

Plastic deformation

- A plastic deformity (or **bowing fracture**) occurs when a longitudinal force exceeds the bone's ability to recoil to its normal position

Greenstick

- A greenstick fracture describes a bone that is bent with a **fracture line** that does not extend completely through the width of the bone

Diagnosis

Clinical: - History of trauma

- Pain, swelling, inability to use the injured body part
- **LOOK : Skin damage, deformity**
- **FEEL : Localized tenderness**, swelling and bruising
- **MOVE : Abnormal movement**(sure signs of fracture), **crepitus**

X-ray: A suspected fractured bone should be x-rayed.

- X-ray should be taken in at least two planes (**AP** and **lateral**)

Diagnosis

C- Description of X-ray :

1) Situation : side, site, localization

2) Pattern : line of fracture

3) Displacement :

a) Shift :

lateral,medial,anterior,posterior

b) Tilt : angulations

c) Twist : rotation , internal, external

d) Shortening: overriding,

impaction



SHIFT



TILT



TWIST



SHORTENING

Fig. 15 Displacement

Management #

***SAVE LIFE**

***SAVE LIMB**

***SAVE
FUNCTION**

Management

A) GENERAL TREATMENT

To SAVE LIFE,

- **ABC of life**
- **life threatening** injuries **Shock , Head, Chest, Abdomen**
- Systemic evaluation, associated **life threatening** injuries may be missed if evaluation of the patient is not systematic.
- Always assess the status of distal **circulation** and **neurological** function.
- Administer **anti pain** and **splint** all fractures before sending the patient for **x-ray** or **referring**.

Management.....

Local treatment of the fracture:-

To SAVE FUNCTION,

follow the principle
of Management

REDUCTION-> IMMOBILIZATION ->

**REHABILITATION & FUNCTIONAL
ACTIVITY**

I-Reduction

- Means bringing the fractured bone to normal or near normal anatomic position.

This is needed only for displaced fractures

- Age and function of the patient are important in considering the goals of reduction

- Reduction may be done in various ways:

1- Using **gravity** E.g. Humeral shaft fracture

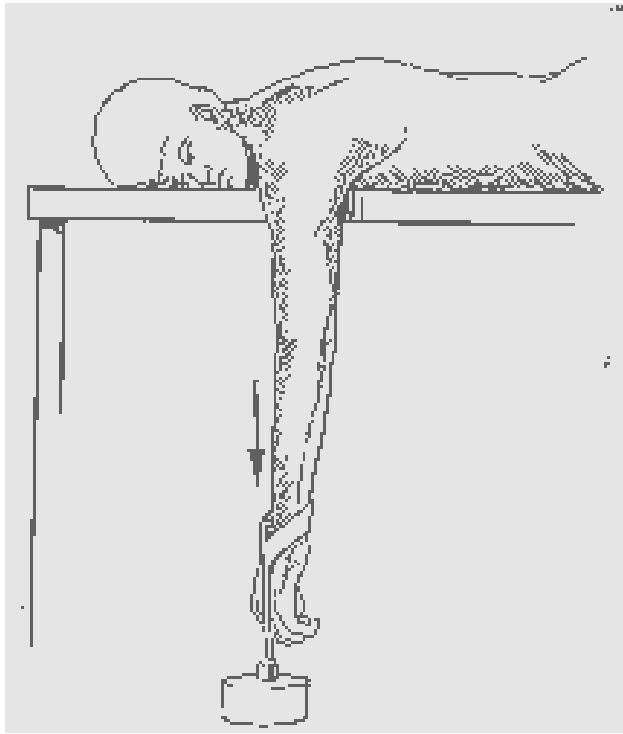
2- Closed reduction by:

A- Manipulation e.g. Colle's fracture

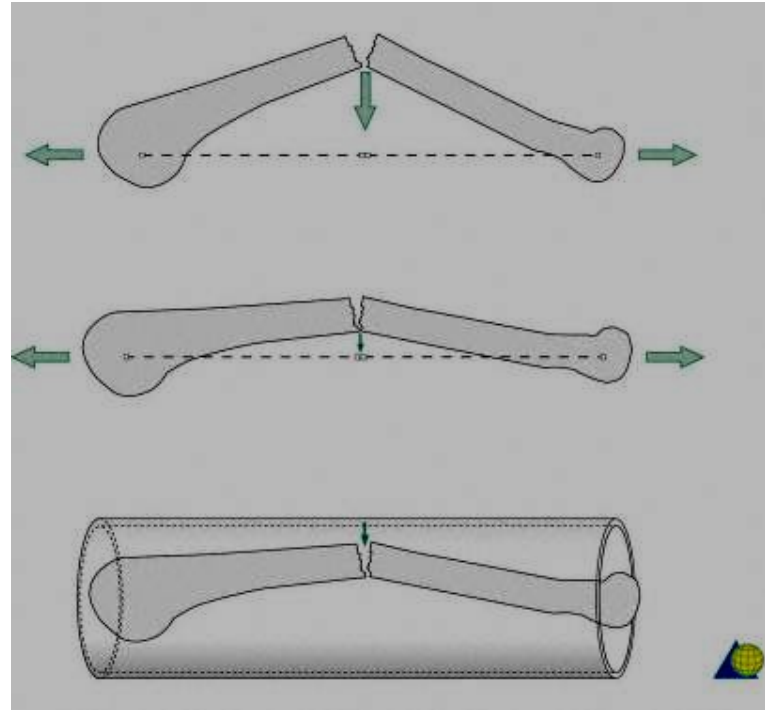
B- Traction e.g. Femoral shaft fracture

3- Open (Operative) reduction: Used when other methods are not possible, have failed or a perfect anatomic reduction is needed.

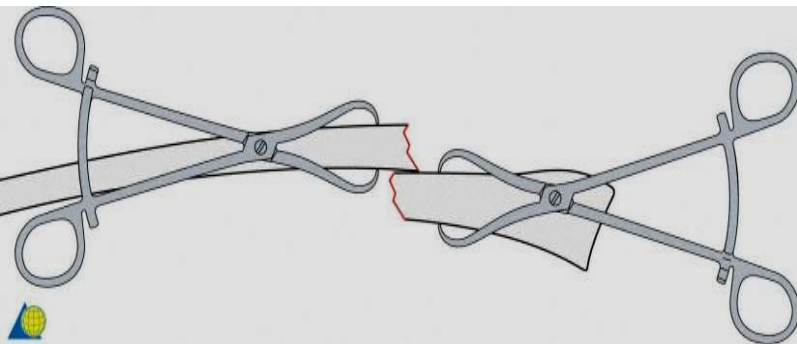
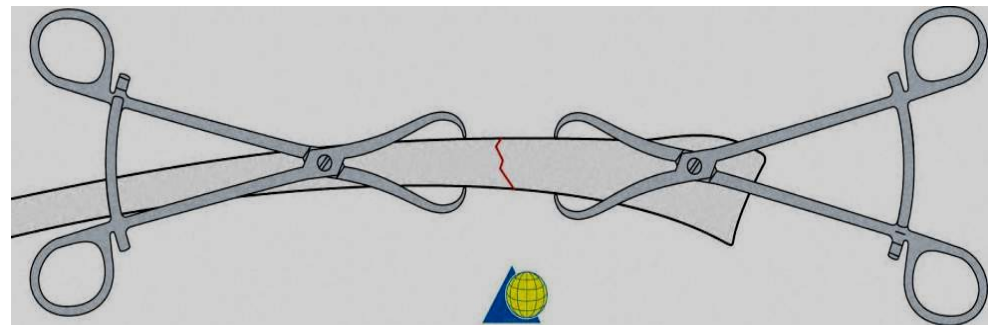
E.g. displaced intra articular fractures.



gravity



Closed Fracture Reduction



Open Fracture Reduction

II- Immobilization

The purpose of immobilization is to:

- prevent re displacement of a reduced fracture
- decrease movement at the site of fracture and prevent further soft tissue injury
- relieve pain

Methods

- **Plaster of Paris**
- **Traction**
- **Internal Fixation**
- **External Fixator**

Methods of Immobilization

1- Plaster of Paris (POP) cast

- Is the **safest** and **cheapest** method of immobilization
- Immobilization should always include the **two adjacent joints**
- Joints should be immobilized in a functional position

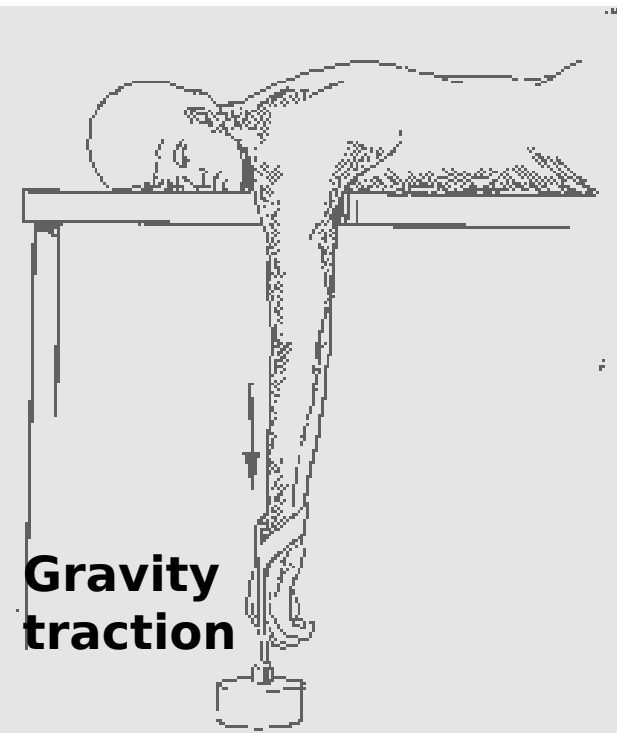
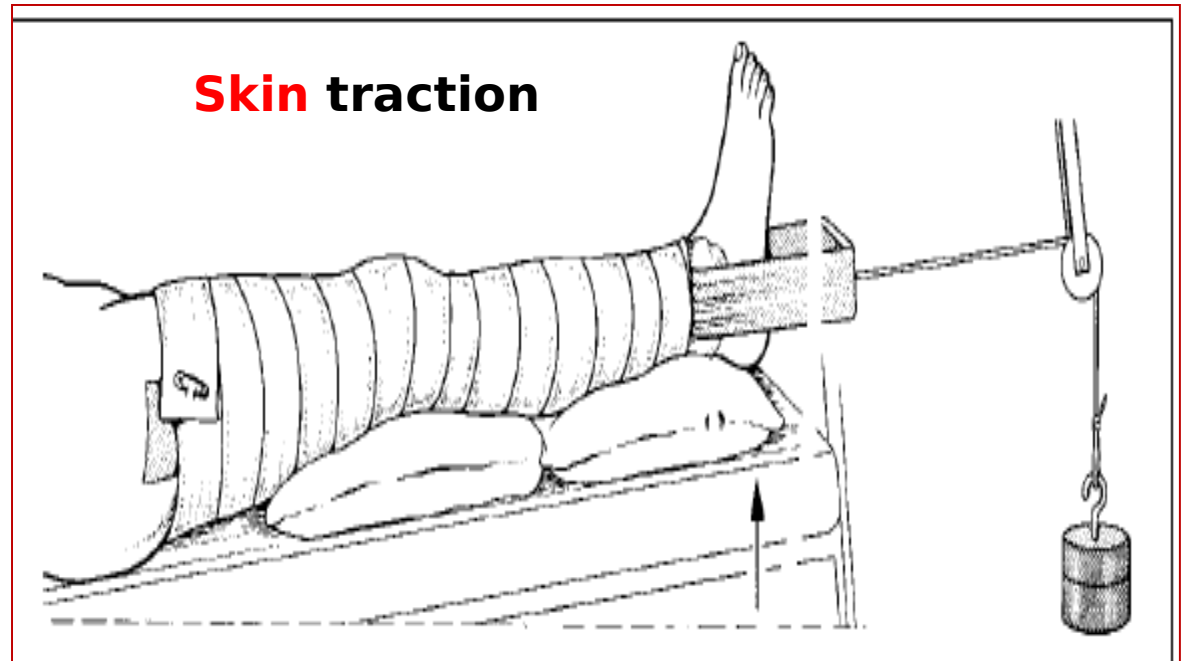
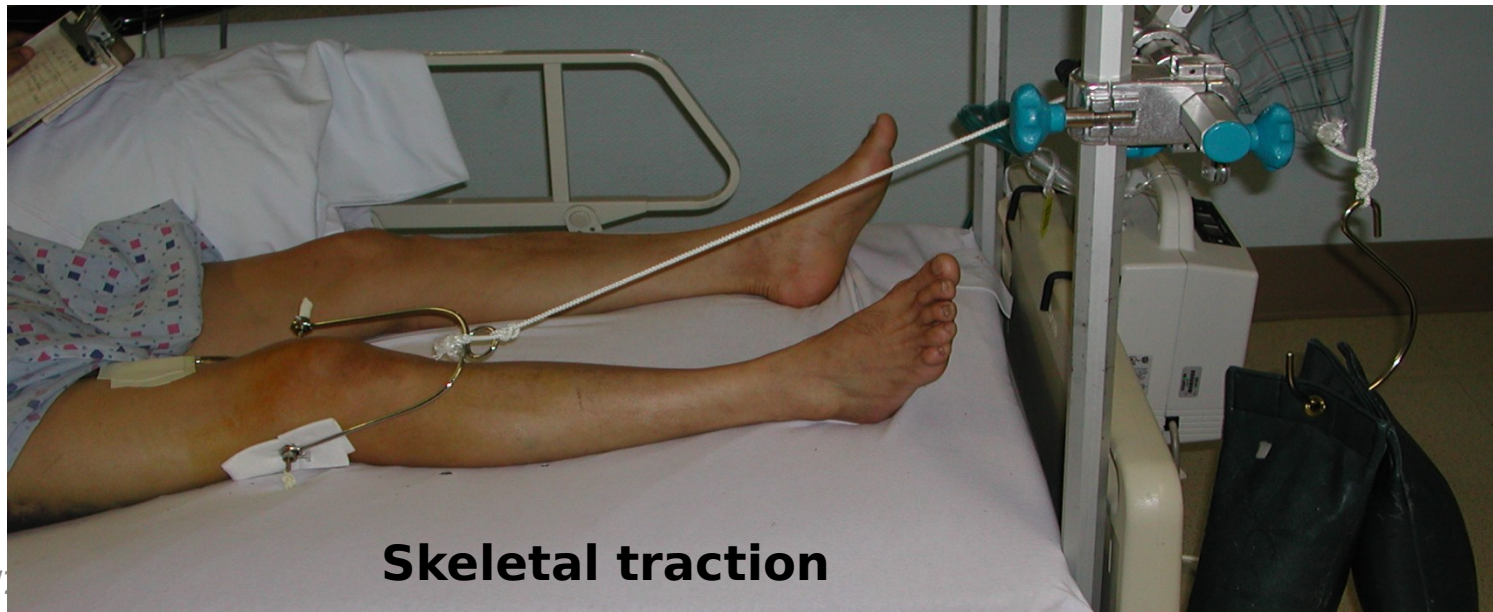


include
syndr



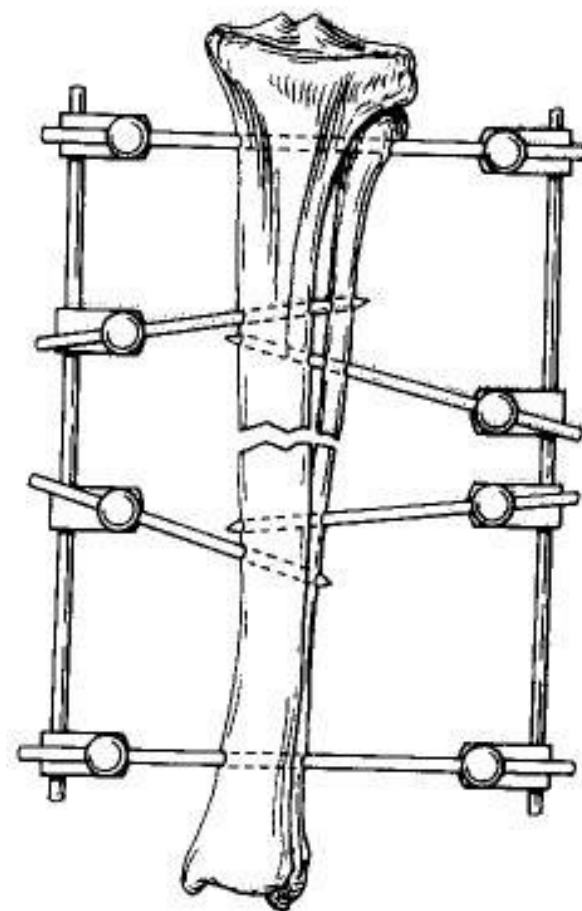
2- Traction

- A) Using **gravity**: e.g. U-slab for humeral shaft fracture
- B) **Skin** traction: A method of applying traction using bandage, usually used in children and temporarily in adults. The maximum weight that can be applied is 2kg.
- C) **Skeletal** traction: Traction applied via a pin inserted into the bone distal to the fracture.
E.g. Tibial pin traction for femoral fracture



3- External fixation

- This is a method of fixing the fracture by metal pins passed through the bone above and below the fracture and connected to a metal frame.
- It is mostly used in compound fractures as it combines good access for wound care with immobilization



12/03/2025

Dr.Messay A.(MD)

4- Internal fixation

- Internal fixation is a method of operative fixation of fractures by **plates, nails, screws, pins** and **wires**
- It's employed when operative reduction has been done for any of the reasons mentioned before.
- It's also indicated in poly traumatized patients
- **Infection** is the main complication and may result in chronic osteomyelitis
- It also needs expertise and orthopedic surgical facilities.

nailing



5. Splints

- Splint – splints are devices used to immobilize a particular part of the body.
- Types of splints:
 - 1. Wooden splints – commonly used
 - 2. Metallic splints
 - 3. Plaster splints
 - 5. Miscellaneous – newspapers, cardboard



Dr.Messay A.(MD)

III- Rehabilitation &Functional activity

- - Preserving muscle and joint function both during and after treatment is an
- essential component of fracture treatment for a good result.

Complications of Fractures

1. **Soft tissue Injuries..... VAN** injury

2. **Compartment syndrome** :- increased pressure within the enclosed **fascial compartments** of extremities, especially **forearm** and **leg**.....> Ischemia..... > Necrosis.

- tight bandages or circular POP casts on a freshly injured limb.
- Severe pain, especially with passive flexion of fingers is the earliest indicator.
- **Paresthesia, Paralysis, Pallor** or **Pulselessness** may develop later
- **Managent** -complete splitting of a tight bandage or circular POP cast **and/or**
- Fasciotomy is done if the above measures have failed.

3. Infection.....osteomyelitis

4. Bone healing abnormalities

- Delayed Union
- Non union
- Malunion
- Avascular necrosis

5. Joint complications..... > Joint stiffness,
osteoarthritis

6. Systemic complications.....> fat embolism
syndrome

Fracture healing

Phases of fracture healing:

- a. Inflammatory phase
- b. Reparative phases
- c. Remodeling phases

Fracture healing

Phases of fracture healing:

a. Inflammatory phase

- Started immediately after fracture
- Peak time : 48 hours
- Diminished : after a week
- Main event : **hematoma** formation and organization invasion of hematoma by neutrophils , basophils and macrophages

b. Reparative phases

- Activated within the first few days and persist for several months.
- Main event : the development of reparative **callus**
 - ✓ **callus** : a mass of fibrous tissue, cartilage, and bone that forms progressively woven bone and vessels during the healing of a bone fracture.
- Cell type **fibroblast** and **macrophages**

c. Remodeling phases

- It is a long process
- The initial calcification is re-modeled by **osteoclasts** and **osteoblasts**.
- Replacement of calcified cartilage and woven bone by **lamellar bone** the result is gradual modification of the fracture region nearly the same as before fracture

Variables that influence fracture healing

a. Injury variables:

- open fracture
- Severity of injury
- Intrarticular fracture
- Segmental fracture
- Soft tissue inter position
- Damage to blood supply

b. Patient variables

- Age
- Nutrition
- Systemic hormone
- **Nicotine** and other agent

c. Tissue variable

- Bone necrosis
- Bone disease
- Infection

d. Treatment variable

- Fracture stabilization
- Loading

Failure of fracture healing

- **Delayed union:** Healing progress in more than average time
- **Non union:** It is an arrest of healing process.
- **Malunion**
 - 1- Primary Neglected #
 2. Epiphyseal Growth plate... **Deformities**

Thank you