

- **Hairline fracture:** Fracture may be complete or incomplete, no displacement, difficult to detect radiologically, repeated weekly X-rays and oblique view may reveal the fracture clearly, healing is rapid, and require mostly conservative treatment except fracture of scaphoid and fracture neck of femur.  
**MOI:** Mostly minimal violence.
- **Single fracture:** The bone is fractured at one level.  
**MOI:** Mostly direct violence.
- **Double fracture:** The affected bone is fractured at two different levels, difficult to reduce and fix the fragments, ORIF may further impair doubtful blood supply to central segment, and delayed/non-union common.  
**MOI:** Direct violence and fall from height.
- **Comminuted fracture:** The bone is broken into more than two fragments. Greater comminution indicates severe violence, marked damage to the adjoining muscles, tendons, nerves, vessels and skin. Comminuted fractures are mostly unstable and usually complicated ones.  
**Types:** Minor comminution at fracture site without any displacement; major comminution at the fracture site with a large “butterfly” type fragment.
- **Impacted fracture:** In this type of fracture, one fragment is driven into the other fragment. Usually seen at junction of cortical and cancellous bones, i.e. end of the shaft or impaction of one cancellous fragment.  
**Example:** Fractures of vertebral bodies (flexion injuries); fractures of calcaneus (fall from height)
- **Complicated fracture (syn. complex fracture):** Fracture associated with neighbouring structures, i.e. neurovascular, visceral injuries.  
**Example:** Fracture shaft of humerus with radial nerve injury.
- **Pathological fracture:** Fracture occurs in an abnormal or diseased bone. A little force may be sufficient to break the affected brittle, eroded, osteoporotic, and cystic bone.
- **Avulsion fracture:** Fracture occurs due to sudden, violent muscular contraction.  
**Example:**
  - Fracture patella (upper pole), due to violent contraction of quadriceps.
  - Fracture tibial tuberosity, due to contraction of patellar tendon.
  - Fracture base of fifth metatarsal, due to contraction of peroneus bravis.
  - Fracture lesser trochanter, due to contraction of iliopsoas.
- **Intra-articular fracture:** Fracture involving a joint, causing irregularity of joint surface, leading to complication of stiffness of joint and finally to development of secondary osteoarthritis.
- **Fracture-dislocation:** Joint dislocation, along with fracture of one of the bony components of the joint.  
**Example:**
  - Fracture dislocation of shoulder joint.
  - Monteggia fracture-dislocation.

## DIAGNOSIS OF FRACTURE

**Symptoms:** 1. Pain, 2. Swelling, 3. Difficulty/inability to move part, 4. Bruising.

**Signs:** 1. Deformity, 2. Shortening, 3. Local tenderness, 4. Bone surface irregularity, 5. Crepitus, 6. Un-natural mobility, 7. Loss of function, 8. Wound, 9. Shock.

**Deformity:** Usually characteristic of a fracture, but a bone may be broken without any deformity; the deformity means separation of bony fragments from each other due to extensive tearing of the soft tissues, fascia, intermuscular septa, etc.

- *Types:* Displacement, angulation, and axial rotation
- *Displacement:* It is defined as shifting of distal fragment relative to proximal fragment. Displacement may be anterior/posterior/medial/lateral. It may be partial or complete (no bony contact of fragments) and may lead to shortening, malunion, or non-union due to interposition of soft tissues between fractured fragments.
- *Angulation:* It may be anterior/posterior/medial/lateral, depending upon point of angle or position (tilt) of distal fragment. Angulation should never be neglected, as deformity is regarded as sign of poor treatment. It may also interfere with normal functioning especially in upper limb, affecting pronation/supination.
- *Axial rotation:* In this deformity, one fragment rotates on its long axis, relative to other fragments. It may or may not be associated with displacement or angulation. It may be detected radiologically, from the position of interlocking fragments, and from the differences in the relative diameters of the fragments.

**Shortening:** If present, is an important sign of fracture. Occurs due to overriding of fragments.

**Local tenderness:** In impacted fractures, local bony tenderness is the most important clinical sign while loss of function is the most important symptom.

**Bone surface irregularity:** In form of a gap, elevation, or a bend, if present, is a definite sign of a fracture.

**Crepitus:** While palpating or testing unnatural mobility, a crepitus or grating sensation may be felt or heard. It is also a definite sign of a fracture. It may also be positive in a hematoma, gas gangrene, surgical emphysema, and osteoarthritis.

**Un-natural mobility:** It is elicited by moving one fragment against the other. If present, is a definite sign of a fracture, but to be elicited with great care to avoid occurrence of complications. It is absent in impacted fracture and greenstick fracture.

**Loss of function:** There may be complete loss of function in a fracture case. Impacted fracture may present great difficulty in clinical diagnosis. X-ray is of great help in such cases.

**Wound:** If present may contain broken fragments, foreign body, blood clots, etc. There may be oozing of blood from the wound.

**Shock:** If present, is a life-threatening emergency, and to be managed on priority basis. It is oligemic due to hemorrhage and vasoconstriction (to maintain peripheral vascular resistance).

- *Signs of shock:*
  - Unconscious
  - Air gasping or breathless
  - Pale, cyanotic
  - Hypotension.

## INVESTIGATIONS

- **X-ray examination:** It is the main investigation for confirming the clinical diagnosis of a fracture. X-rays of the affected bone taken, mostly in two planes (views),

- To confine massage and physiotherapy (poor substitute) to early period of rehabilitation, because of local trauma, or necessity of using fixed splints, active exercise not feasible.

### Factors Affecting Healing of Fracture

- **Definition:** Following factors may affect healing in a patient with a fracture or dislocation (Table 1.1).
- **Factors:**
  - **Age:** Younger the patient, better are chances of early union of fracture. In children, union of fracture is faster, which slows down as the age advances. Also power of remodelling of fracture is stronger in epiphyseal fusion is imminent; remodelling also poor in case of axial rotation.
  - **Type of bone:**

*Cancellous (spongy) bone:* Healing in the fractured cancellous bone is comparatively earlier than in the fractured cortical bone, and the weight-bearing usually permitted:

    - In fractures of os calcaneus usually after 6/52,
    - In fractures vertebral bodies allowed after 6–8/52
    - In fractures tibial plateau allowed after 6–8/52
    - In fracture pelvis bed rest advised for 6/52
    - In Colles fracture plaster discarded after 6–8/52

*Cortical (compact) bone:* Endosteal callus may be well established in a couple of months (appx. 10–15/52 to unite), while an abundant external bridging callus may permit an early recovery, e.g.

    - In fractures humeral shaft, union occurs usually in 10/52
    - In fractures tibial shaft, union occurs usually in 12–16/52
    - In fractures metacarpals, metatarsals, phalanges (substantial callus externally bridging) firm, union occurs in 4–6/52.
- **Distraction of bone ends,** due to:
  - Interposition of soft tissues between bone ends: Usually fasciae or ligaments seems to be a more effective barrier to growth of external callus across a fracture than muscle's interposition (e.g. fractures of patella, olecranon, and medial malleolus), resulting in impaired apposition of fractured surfaces, may cause delayed union, or even non-union.

Table 1.1: Factor affecting healing of fracture

Factor	Healing	
	Early	Late/slow/delay/non-union
Age	Younger	Adult/old
Type of bone	Cancellous	Cortical
Distraction of bone ends	—	Delayed/non-union
Unnatural mobility	—	Delayed/non-union
Infection	—	Delayed/non-union
Impaired blood supply	—	Delayed/non-union
Quality of bone	Clavicle	Tibia
Pathological fracture	—	Malignant tumors (delayed)
Intra-articular fracture	—	Delayed

(Source: Kapoor's Accident and Emergency)

# Fractures



## GENERAL PRINCIPLES

### Pathogenesis of Fractures

- Definitions
- Etiology (Mode of Injury)
- Patterns
- Level
- Deformity
- Types: Simple and Compound
- Healing
- Epiphyseal Injuries

### Diagnosis of Fracture

#### Investigations

#### Management of Polytrauma

#### Management of Fracture

- First Aid Treatment
- Local Treatment

#### Reduction of Fracture

- Closed Reduction
- Open Reduction

#### Fixation (Immobilization) of Fracture

- External Fixation
- Internal Fixation
- Implants

## Rehabilitation

### Factors Affecting Healing of Fracture

#### Complications of Fracture

- General Complications
- Local Complications

## PRINCIPLES OF FRACTURE TREATMENT IN CHILDREN

### REGIONAL FRACTURES

#### Upper Limb

- Shoulder Girdle
- Humerus
- Elbow
- Forearm Bones: Radius and Ulna
- Wrist
- Hand

#### Lower Limb

- Pelvis
- Hip and Femoral Neck
- Femur
- Knee
- Leg bones: Tibia and Fibula
- Ankle
- Foot

## GENERAL PRINCIPLES

### PATHOGENESIS OF FRACTURE

#### Definition

Fracture is defined as break in the continuity of alignment of a bone, that includes all types of disruptions, i.e. hairline or microscopic to grossly comminuted fractures.

#### Mode of Injury (MOI)

**Direct violence:** Fracture occurring at the site of impact, i.e. being hit by a falling or moving object.

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