



# PRINCIPLES OF FRACTURES (ADULTS)

**KHALID BAKARMAN, MD, SBO**  
**PEDIATRIC AND TRAUMA ORTHOPAEDICS**  
**SURGEON ASSOCIATE PROFESSOR**

ACKNOWLEDGMENT DR. S. AL-DOSSARY

# OBJECTIVES

---

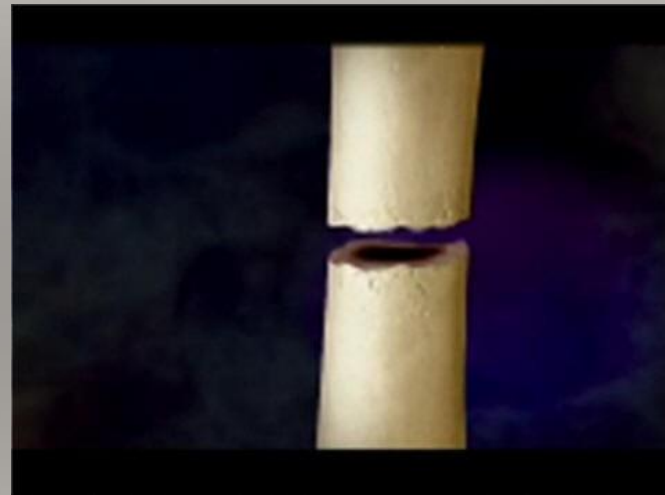
- Introduction.
- Basic science of fracture healing.
- Principles of evaluating patients with fractures.
- Principles of management.
- Common fractures in adults

# INTRODUCTION

---

- Fracture means literally broken bone.
- This can be described in different ways:
  - Extent
  - Location
  - Morphology
  - Mechanism
  - Associated soft tissue injuries

- 
- **Extent:**
    - **Complete:** fracture extends  $360^\circ$  of bone circumference (all around)



---

- **Extent:**

- Complete: fracture extends  $360^\circ$  of bone circumference (all around).
- Incomplete: seen almost only in children:
  - **Greensick**



---

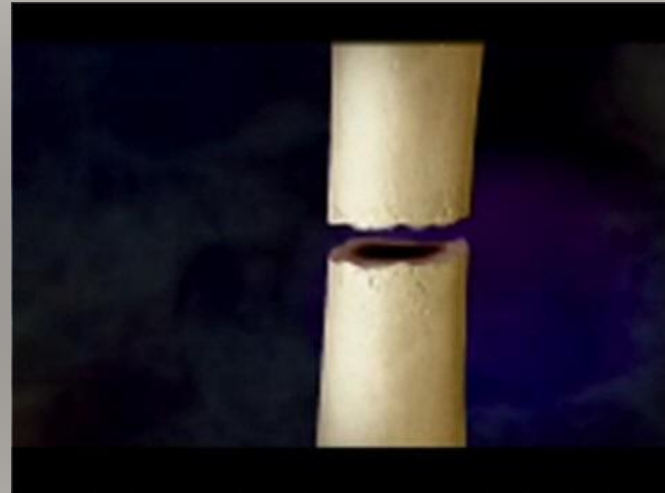
- **Extent:**

- Complete: fracture extends 360° of bone circumference (all around).
- Incomplete: seen almost only in children:
  - Greensick
  - **Buckle fracture**



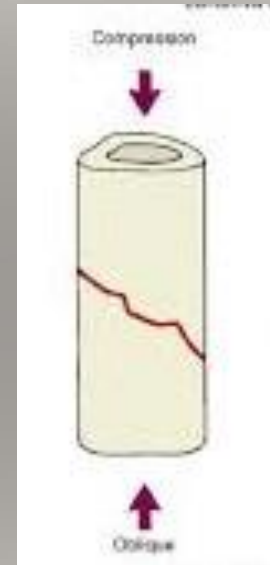
- 
- Location:
    - Name of bone
    - Side
    - Diaphysis, metaphysis or epiphysis
    - Long bones (diaphysis): divide them in thirds (proximal, middle or distal third)
    - Metaphysis: intra-articular v.s extra-articular

- 
- Morphology:
    - Transverse: loading mode resulting in fracture is tension

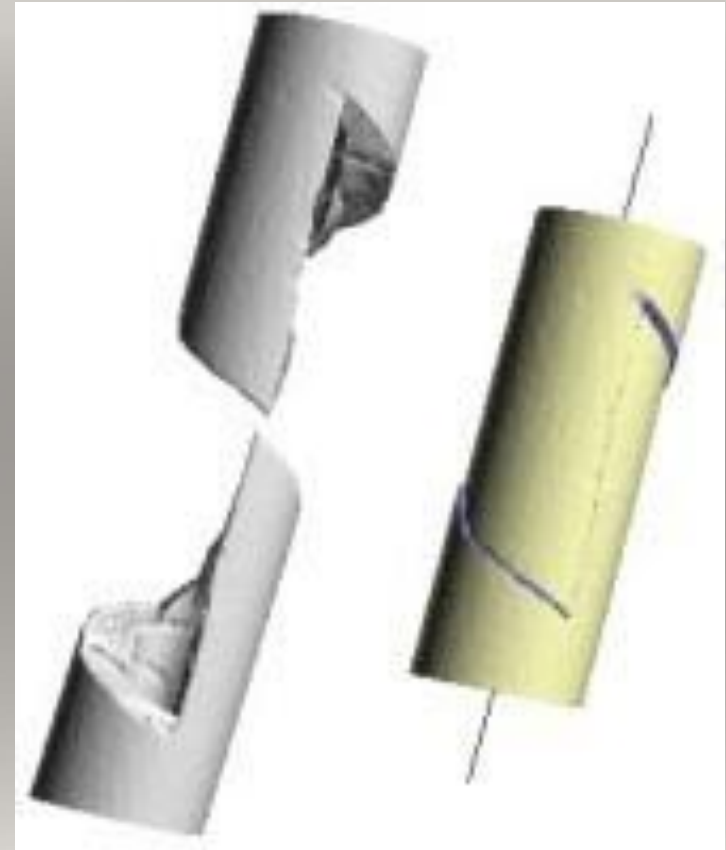




- 
- Morphology:
    - Oblique: loading mode is compression.



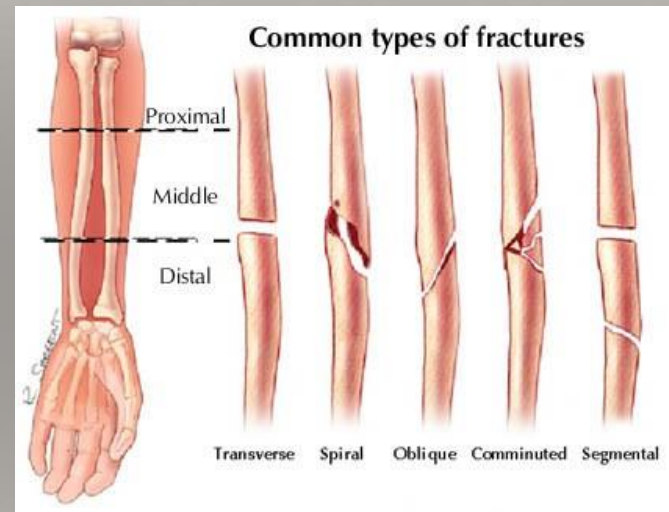
- 
- Morphology:
    - Spiral: loading mode is torsion.



- 
- **Morphology:**
    - Fracture with Butterfly fragment: loading mode is bending.
    - It also called a wedge fracture.



- Morphology:
  - Comminuted fracture: 3 or more fragments
  - Segmental fracture



---

- Mechanism:

- High energy vs. low energy.
- Multiple injuries vs. isolated injury.
- Pathological fracture: normal load in presences of weakened bone (tumor, osteoporosis,infection)
- Stress fracture: normal bone subjected to repeated load (military recruits).

- 
- **Associated soft tissue injuries:**
    - Close fracture: skin integrity is maintained.
    - Open fracture: fracture is exposed to external environment .

Any skin breach in proximity of a fracture is an open fracture until proven otherwise.



**QUESTIONS ?**

---



# **FRACTURE HEALING**

---





# NATURAL BONE HEALING

---

- Indirect bone healing (endochondral ossification) occurs in nature with untreated fracture.
- It is called indirect because of formation of cartilage at intermediate stage.
- It runs in 4 stages:
  - Hematoma formation
  - Soft callus formation
  - Hard Callus formation
  - Remodeling



## Inflammation

Soon after a fracture occurs, a hematoma forms at the injury site. Macrophages and inflammatory leukocytes move into the damaged area to scavenge debris and begin producing the pro-inflammatory agents that initiate healing.



## Soft callus

Inflammation triggers cell division and the growth of new blood vessels. Among the new cells, chondrocytes secrete collagen and proteoglycans, creating fibrocartilage that forms the soft callus.



## Hard callus

Through endochondral ossification and direct bone formation, woven bone replaces the soft callus to create a hard callus around the broken fragments of bone.



## Remodeling

Over time, mechanically strong, highly organized cortical bone replaces the weaker, disorganized woven bone. Because it is continually remodeled, bone is the only tissue to heal without a scar.

# PRINCIPLES OF EVALUATION

---



# DIAGNOSIS: HISTORY

---

- \* Patients complain of pain and inability to use the limb (if they are conscious and able to communicate)
- \* What information can help you make the diagnosis?

# DIAGNOSIS: HISTORY

---

- \* **Onset:**

- \* When and how did the symptoms begin?
- \* Specific traumatic incident vs. gradual onset?

- \* **If there was a specific trauma, the details of the event are essential information:**

- \* **Mechanism of injury?**
- \* Circumstances of the event? Work-related?
- \* Severity of symptoms at the time of injury and progression after?



# DIAGNOSIS: PHYSICAL EXAM

---

## \* Inspection

- \* Swelling
- \* Ecchymosis
- \* Deformity
  
- \* If fracture is open:
  - \* Bleeding
  - \* Protruding bone



# DIAGNOSIS: PHYSICAL EXAM

---

## \* Palpation

- \* Bony tenderness

# DIAGNOSIS: PHYSICAL EXAM

---

- \* If a fracture is suspected what should we rule out?
  - \* Neurovascular injury (N/V exam)
  - \* Compartment syndrome
  - \* Associated MSK injuries (examine joint above and below at minimum)



# DIAGNOSIS: IMAGING

---

- \* X-ray principles

- Two orthogonal view
  - AP.Displacement
  - lateralAngulation
- Two joints – above and distal.
- Two limbs – to compare in pediatric farcture.
- Two occasions.
- SpecialView.

# DIAGNOSIS: IMAGING

---

- \* NB: Fractures hurt, immobilization helps.
- \* Immobilizing a patient in a backslab is the most effective way to relieve pain from a fracture and may be done BEFORE getting x-rays

# DIAGNOSIS: IMAGING

---

- \* Fractures may be obvious on x-ray
- \* Undisplaced or stress fractures are sometimes not immediately apparent



---

- \* Secondary signs of fracture on x-ray:

- \* **Soft tissue swelling**

- \* Fat pad signs

- \* Periosteal reaction

- \* Joint effusion

- \* Cortical buckle



---

- \* Secondary signs of fracture on x-ray:

- \* Soft tissue swelling

- \* **Fat pad signs**

- \* Periosteal reaction

- \* Joint effusion

- \* Cortical buckle



---

- \* Secondary signs of fracture on x-ray:

- \* Soft tissue swelling

- \* Fat pad signs

- \* **Periosteal reaction**

- \* Joint effusion

- \* Cortical buckle



---

- \* Secondary signs of fracture on x-ray:

- \* Soft tissue swelling

- \* Fat pad signs

- \* Periosteal reaction

- \* **Joint effusion**

- \* Cortical buckle



---

- \* Secondary signs of fracture on x-ray:

- \* Soft tissue swelling

- \* Fat pad signs

- \* Periosteal reaction

- \* Joint effusion

- \* **Cortical buckle**





# HOW TO DESCRIBE A FRACTURE

---

- \* Clinical parameters
- \* Radiographic parameters

# CLINICAL PARAMETERS

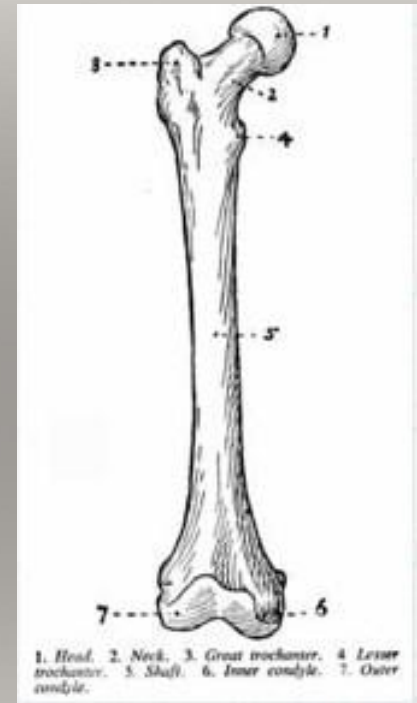
---

- \* Open vs.closed
  - \* ANY break in the skin in proximity to the fracture site is OPEN until proven otherwise
- \* Neurovascular status
- \* Presence of clinical deformity

# LOCATION

---

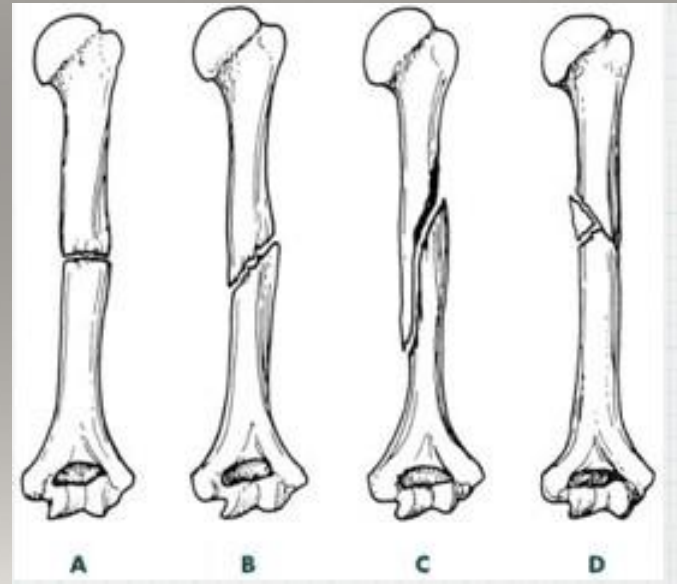
- \* Which bone?
- \* Which part of the bone?
  - \* Epiphysis -intraarticular?
  - \* Metaphysis
  - \* Diaphysis -divide into 1/3s
  - \* Use anatomic landmarks when possible
    - \* e.g.medial malleolus,ulnar styloid,etc



# PATTERN

---

- \* Simple vs. comminuted
- \* Complete vs. incomplete
- \* Orientation of fracture line
  - \* Transverse
  - \* Oblique
  - \* Spiral



# DISPLACEMENT

---

- \* Displacement is the opposite of apposition
- \* Position of distal fragment relative to proximal
- \* Expressed as a percentage



# ANGULATION

---

- \* Deviation from normal alignment
- \* Direction of angulation defined by apex of
- \* Expressed in degrees



# FRACTURE DESCRIPTION: SUMMARY

---

- \* Clinical parameters
  - \* Open vs. Closed
  - \* Neurovascular status
  - \* Clinical deformity
- \* Radiographic parameters
  - \* Location
  - \* Pattern
  - \* Displacement
  - \* Angulation
  - \* Shortening

# TREATMENT PRINCIPLES

---

- 1. Reduction if necessary.**
- 2. Immobilization (definitive or temporary).**
- 3. Definitive treatment**
- 4. Rehabilitation.**



# INITIAL (REDUCTION)

---

- IF fracture is displaced.
- Meant to re-align fracture fragments.
- To minimize soft tissue injury.
- Can be consider definitive if fragments' position is accepted.
- Should be followed by immobilization.



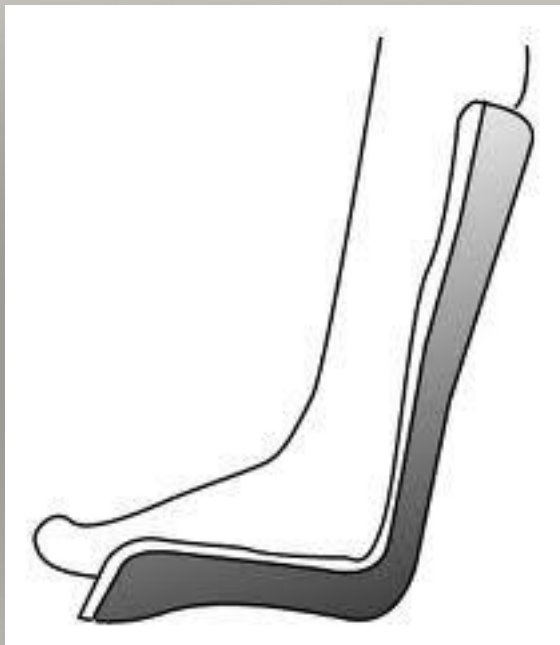
# INITIAL (IMMOBILIZATION)

---

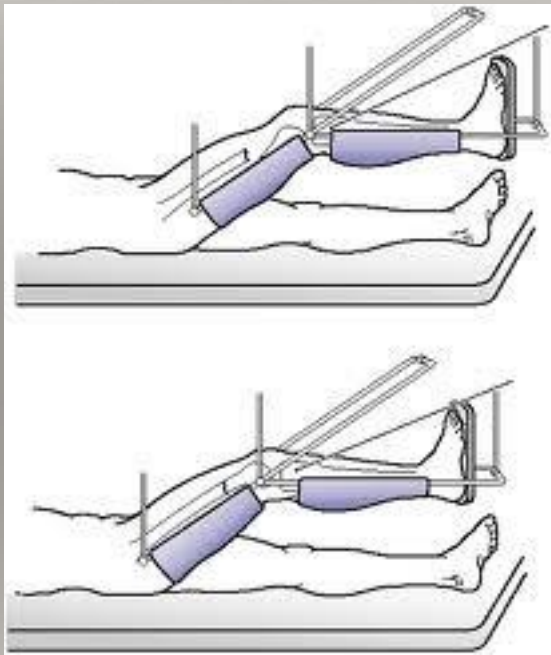
- To hold reduction in position.
- To provide support to broken limb
- To prevent further damage.
- **Control the Pain**

# INITIAL (IMMOBILIZATION)

---



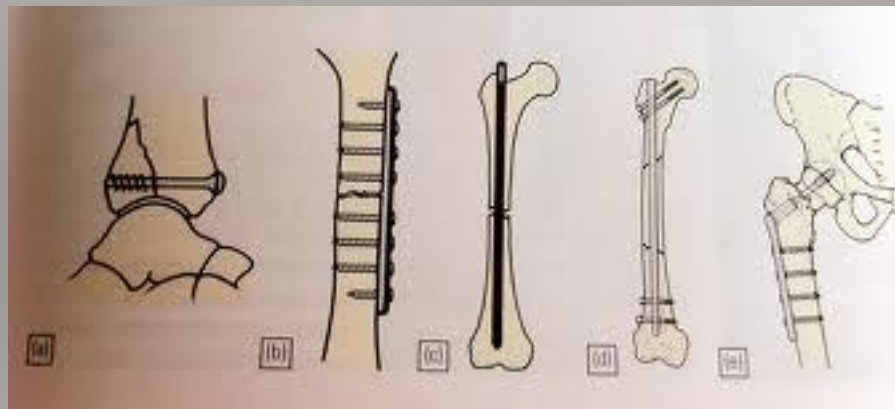




# DEFINITIVE

---

- If satisfactory reduction can not be achieved or held at initial stage.
- Reduction can be attempted close or open (surgery)
- Immobilization can be achieved with:
  - Plate and screws.
  - IM nail
  - EX-fix



# TREATMENT: PRINCIPLES

---

- Rehabilitation
  - Motion as early as possible without jeopardizing maintenance of reduction.
  - Wt bearing restriction for short period.
  - Move unaffected areas immediately



# TREATMENT: PRINCIPLES

---

- \* Reduce (if necessary)
  - \* to maximize healing potential
  - \* to insure good function after healing
- \* Immobilize
  - \* to relieve pain
  - \* to prevent motion that may interfere with union
  - \* to prevent displacement or angulation of fracture
- \* Rehabilitate
  - \* to insure return to function

# MULTIPLE TRAUMA

---

- Multi-disciplinary approach.
- Run by Trauma Team Leader (TTL) at ER. Orthopedic is part of the team.
- Follow trauma Protocol as per your institution.
- Treatment is prioritized toward life threatening conditions then to limb threatening conditions.

# TAKE HOME POINTS

---

- \* Fractures hurt –immobilization relieves pain.
- \* R/o open fracture, Compartment syndrome and N/V injuries.
- \* Principles of fracture treatment:
  - \* Reduce (if necessary)
  - \* Immobilize
  - \* Rehabilitate



**QUESTIONS?**

THANKS

---

