



PRINCIPLES OF FRACTURES (ADULTS)

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OBJECTIVES

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


Introduction

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

- **Extent:**
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 - **Buckle fracture**



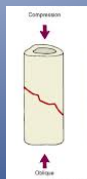
- **Location:**
 - Name of bone
 - Side
 - Diaphysis, metaphysis or epiphysis
 - Long bones (diaphysis): divide them in thirds (proximal, middle or distal third)
 - Metaphysis: intra-articular v.s extra-articular

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



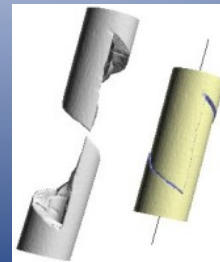
- **Morphology:**

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



- **Morphology:**

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



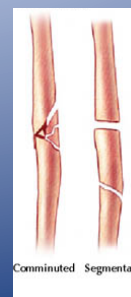
- **Morphology:**

- 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/athletes).

- **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.

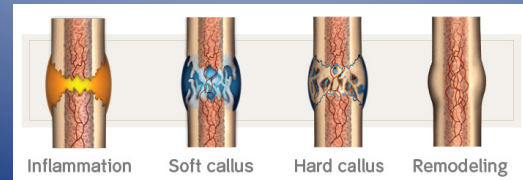


QUESTIONS ?

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



PRINCIPLES OF EVALUATION

HISTORY

- Pain: very severe one. Get complete pain history components
- Inability to use the affected limb.
- Inability to ambulate.
- Deformity.
- If it is a major trauma: Patient might not be able to communicate.
- Ask about mechanism of injury.

HISTORY



- Major Trauma (MVC):
 - ① Speed.
 - ② Front or back seated.
 - ③ Driver.
 - ④ Seat belted.
 - ⑤ Ejection.
 - ⑥ Deployed air bag.
 - ⑦ Death at scene.

HISTORY

- If you suspect pathological fracture:
 - Ask about prior pain before event happened.
 - Ask about constitutional symptoms.
 - Ask about history of cancer.
- If you suspect stress fracture:
 - Ask about recent increment of activities.

PHYSICAL EXAM



- Inspection:
 - Swelling
 - Deformity
 - Ecchymosis
 - Skin integrity:
 - Bleeding
 - Protruding bone

PHYSICAL EXAM

- Palpation:
 - Bony tenderness.
 - Examine joint above and below.
- ROM:
 - Can not be assessed in acute fracture.

PHYSICAL EXAM

- Vascular exam:
 - color.
 - Temperature.
 - Capillary refill (within 2 sec as compared to other side)
 - Pulses
 - Always compare contralateral side.
- Peripheral nerve exam of injured limb.
- Always check compartment tightness:
 - Wood like vs. soft

PHYSICAL EXAM

- **At the End of your exam, you must comment on:**
 - ① Skin is intact or not
 - ② N/V status is intact or not
 - ③ Compartments of limb are soft or not.

INVESTIGATIONS

- Start with basic and proceed to more specific tests.
 - ① Basic blood works.
 - ② X-rays of interest.
 - ③ advance radiological exams if needed.

INVESTIGATIONS

- X-rays:
 - 2 orthogonal (perpendicular) views: AP and lateral.
 - Joint above and below.
 - Special views: specific for the region of interest.
- Fracture does hurt:
 - Splint patient's injured limb before you send him to X-rays.
 - If there is gross deformity, re-align, splint then send for images.

INVESTIGATIONS

- Fracture can be obvious on images.
- Sometimes, careful assessment of radiographs is needed (i.e. stress fracture or non displaced fracture)



- Secondary signs of fracture on x-ray:

- **Soft tissue swelling**
- Fat pad signs
- Periosteal reaction
- Joint effusion
- Cortical buckle



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INVESTIGATIONS

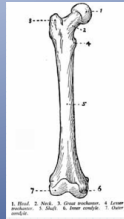
- Advanced radiological images:
 - If fracture extends to joint: obtain CT scan
 - If fracture is suspected but not seen on X-rays: consider doing MRI.

RADIOGRAPHIC DESCRIPTION OF FRACTURE

- Location
- Displacement:
 - Translation
 - Angulation
 - Shortening
 - Rotation
- Pattern.
- common eponymous

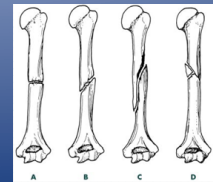
Location

- * Which bone?
- * Which part of the bone?
 - o Epiphysis -intraarticular?
 - o Metaphysis
 - o 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
 - o Transverse
 - o Oblique
 - o 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.
- Common epiphyseous

TREATMENT PATHWAY

- ① Reduction.
- ② Immobilization
- ③ Definitive treatment
- ④ Rehabilitation.

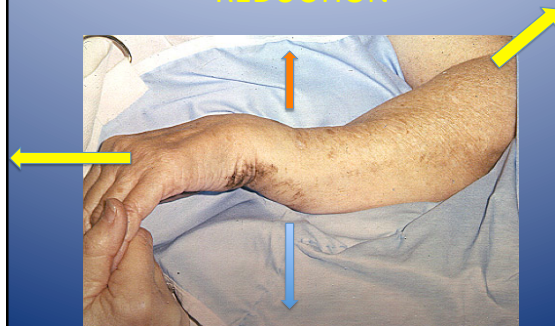
• *If the injured limb is grossly deformed, simple re-alignment and splinting should be initially undertaken*

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.
- Open reduction: take place at OR.

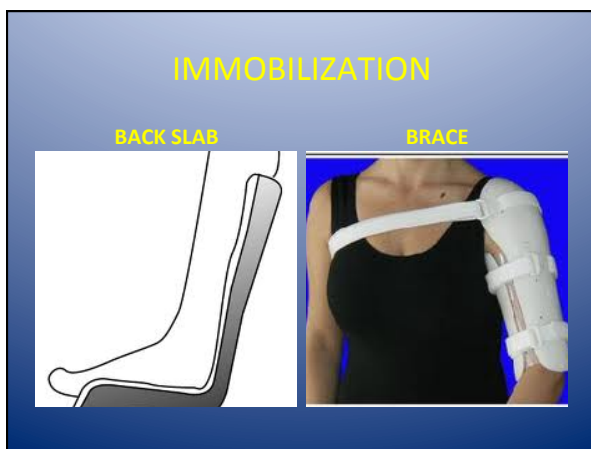


REDUCTION



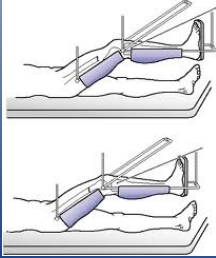
- ✓ Patient must receive adequate analgesic prior to reduction.
- ✓ Most occur under conscious sedation at Emerg.
- ✓ Reduction must be followed by immobilization.
- ✓ N/V status must be documented before and after reduction and immobilization

- ### IMMOBILIZATION
- To hold reduction in position.
 - To provide support to broken limb
 - To prevent further damage.
 - **Control the Pain**
 - *Most fractures require an immobilization of joint above and below*



IMMOBILIZATION

SKELETAL TRACTION

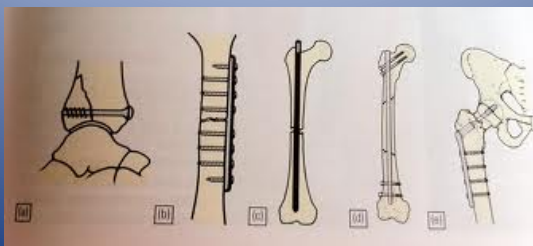


SKIN TRACTION



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 (6-8 weeks).
- 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.

COMPLICATIONS

- If fracture extends into joint or close:
 - O.A
 - Stiffness
- Fracture healing:
 - Nonunion: doesn't heal after double the expect time.
 - Malunion: healed with mal-alignment.
- Fracture specific: AVN after femur neck fracture.
- Medical complications: LL fractures, VTE
- Surgical related: infection, hardware failure.

Take home points

- ✳ Fractures hurt –immobilization relieves pain.
- R/o open fracture, Compartment syndrome and N/V injuries.
- Principles of fracture treatment:
 - ✳ Reduce
 - ✳ Immobilize
 - ✳ Rehabilitate

QUESTIONS?

THANKS