

PRINCIPLES OF FRACTURES (ADULTS)

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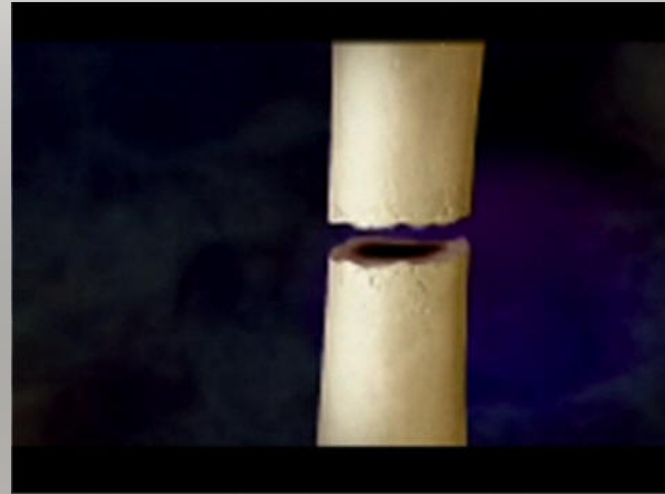
OBJECTIVES

- 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

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- **Extent:**
 - **Complete:** fracture extends 360° of bone circumference (all around)



- **Extent:**

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- Incomplete: seen almost only in children:
 - **Greensick**



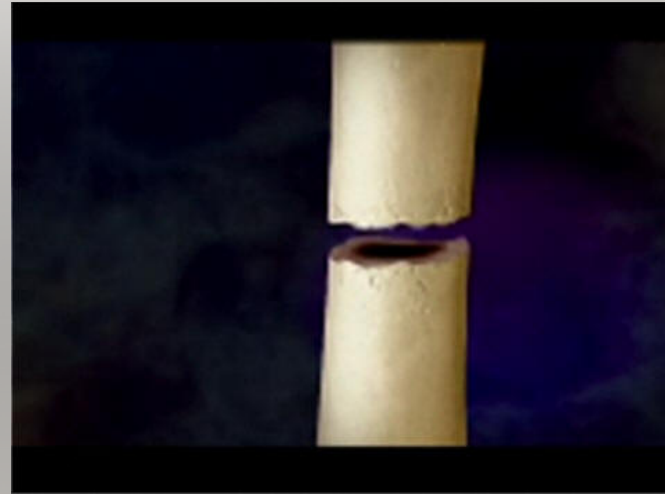
- **Extent:**

- Complete: fracture extends 360° of bone circumference (all around).
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 - Greensick
 - **Buckle fracture**

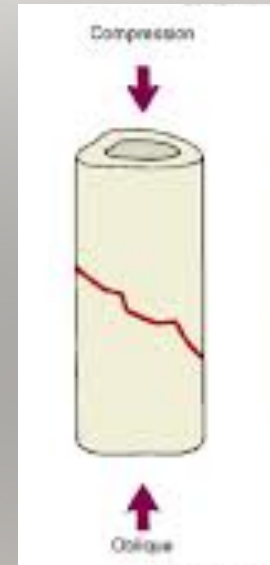


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- Location:
 - Name of bone
 - Side
 - Diaphysis, metaphysis or epiphysis
 - Long bones (diaphysis): divide them in thirds (proximal, middle or distal third)
 - Metaphysis: intra-articular v.s extra-articular

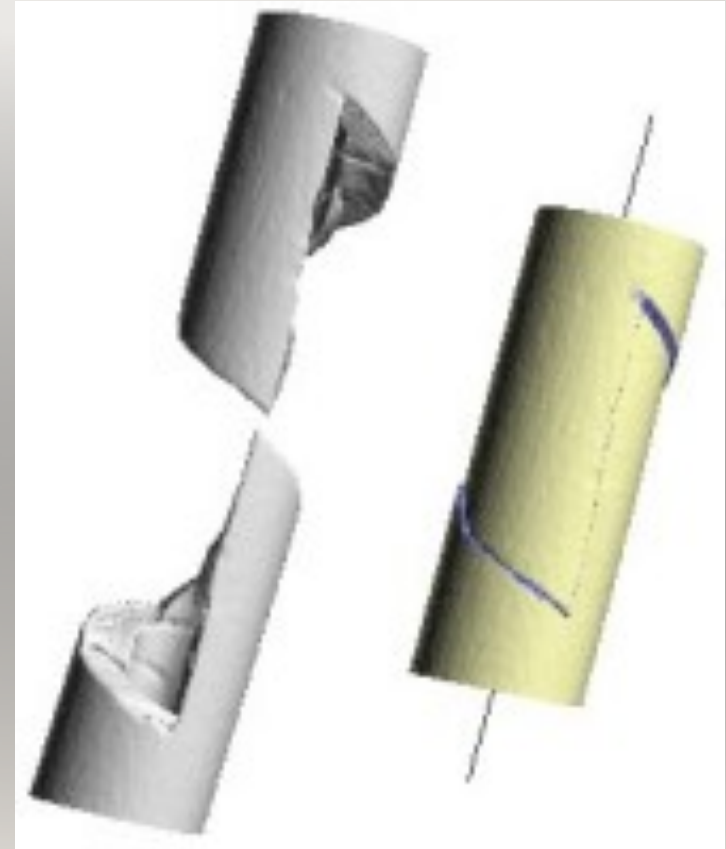
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- Morphology:
 - Transverse: loading mode resulting in fracture is tension



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



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- Morphology:
 - Spiral: loading mode is torsion.

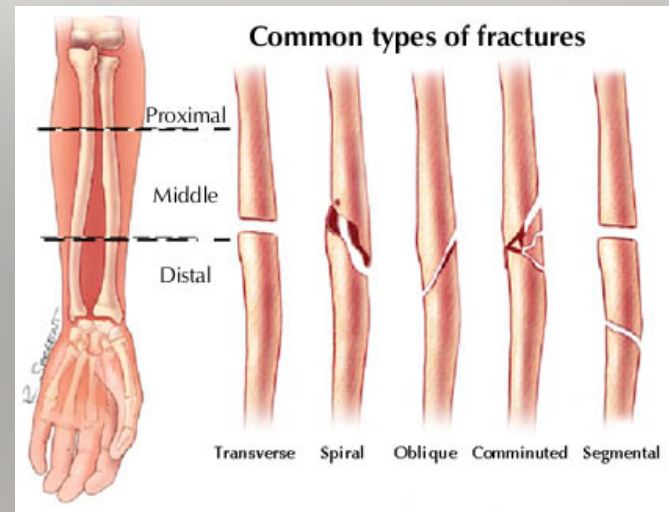


- **Morphology:**

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



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



- Mechanism:

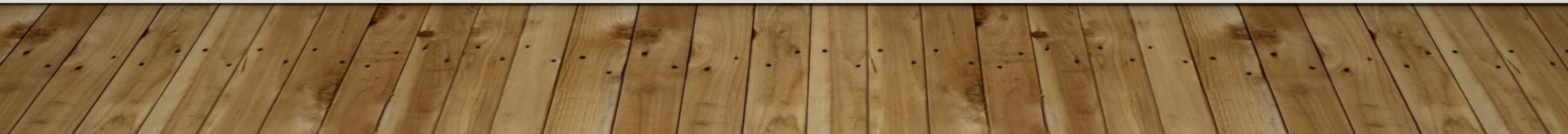
- High energy vs. low energy.
- Multiple injuries vs. isolated injury.
- Pathological fracture: normal load in presences of weakened bone (tumor, osteoporosis, infection)
- Stress fracture: normal bone subjected to repeated load (military recruits).

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

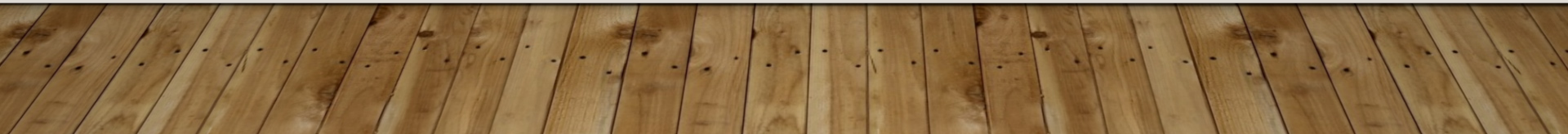
Any skin breach in proximity of a fracture is an open fracture until proven otherwise.



QUESTIONS ?

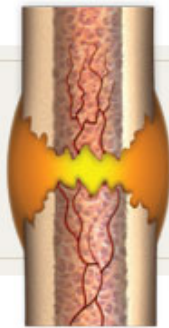


FRACTURE HEALING



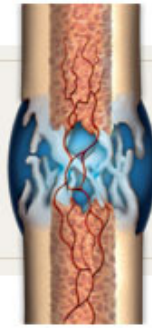
NATURAL BONE HEALING

- 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

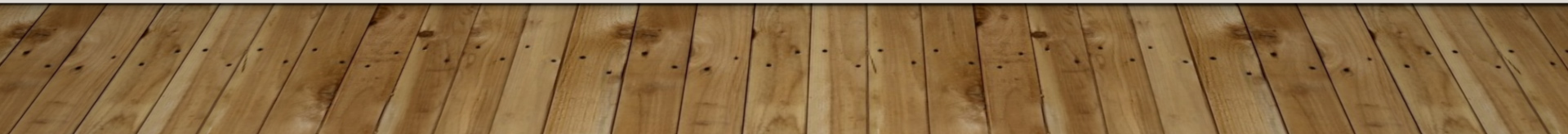
Through endochondral ossification and direct bone formation, woven bone replaces the soft callus to create a hard callus around the broken fragments of bone.



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?

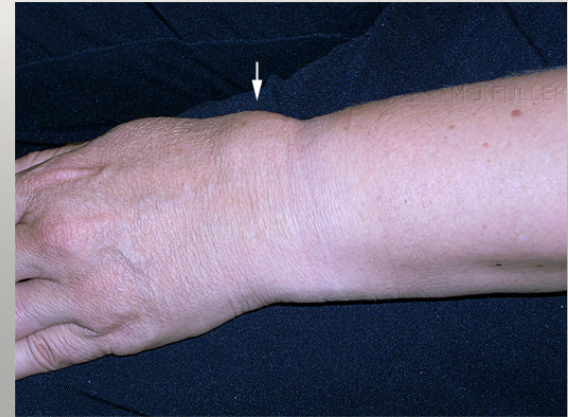


DIAGNOSIS: PHYSICAL EXAM

* 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
 - lateral. Angulation
- Two joints – above and distal.
- Two limbs – to compare in pediatric farcture.
- Two occasions.
- Special View.

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:

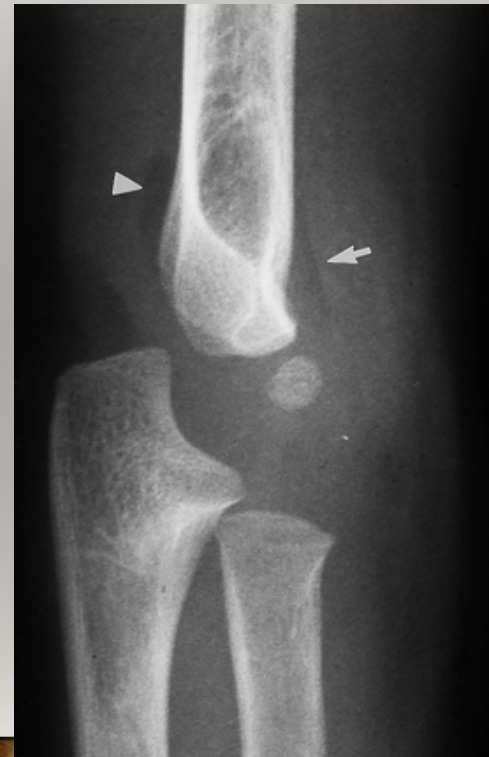
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- * Secondary signs of fracture on x-ray:

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- * Secondary signs of fracture on x-ray:

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- * **Cortical buckle**



HOW TO DESCRIBE A FRACTURE

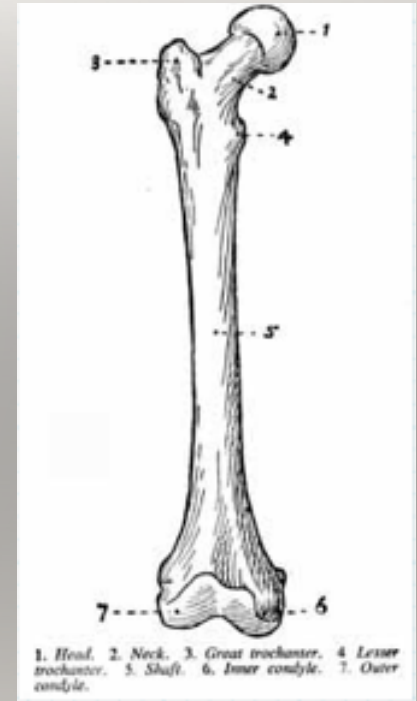
- * Clinical parameters
- * Radiographic parameters

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

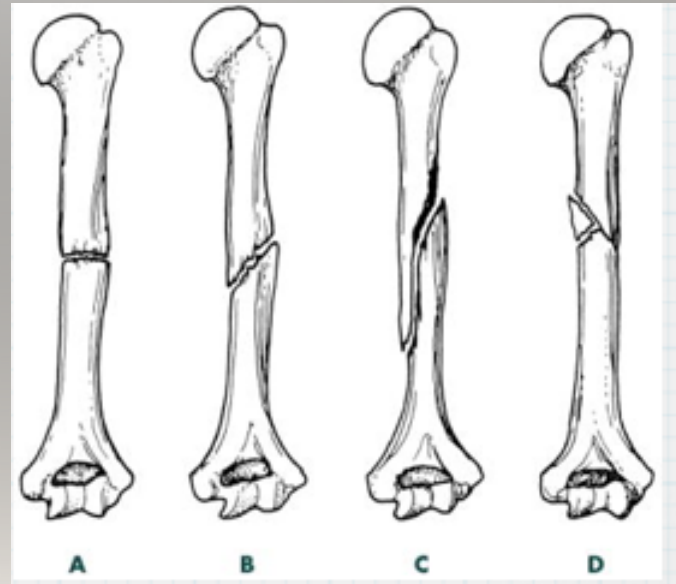
LOCATION

- * 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)

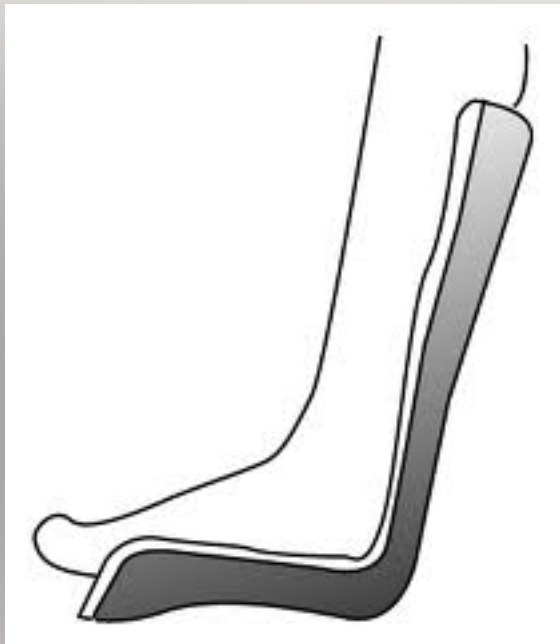
- IF fracture is displaced.
- Meant to re-align fracture fragments.
- To minimize soft tissue injury.
- Can be consider definitive if fragments' position is accepted.
- Should be followed by immobilization.



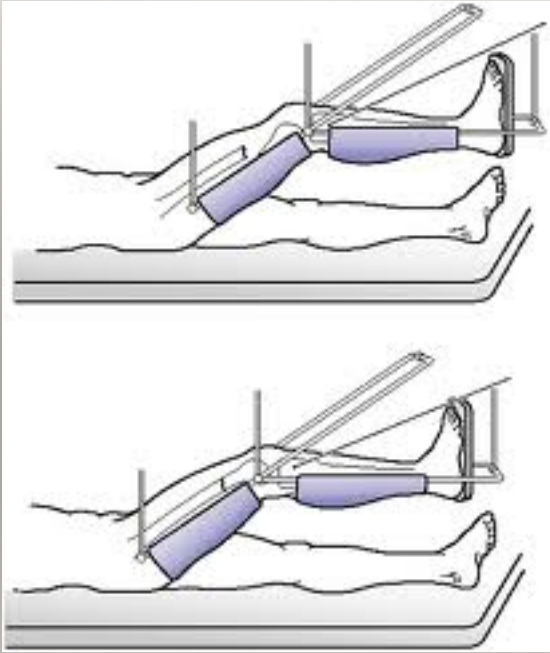
INITIAL (IMMOBILIZATION)

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

INITIAL (IMMOBILIZATION)

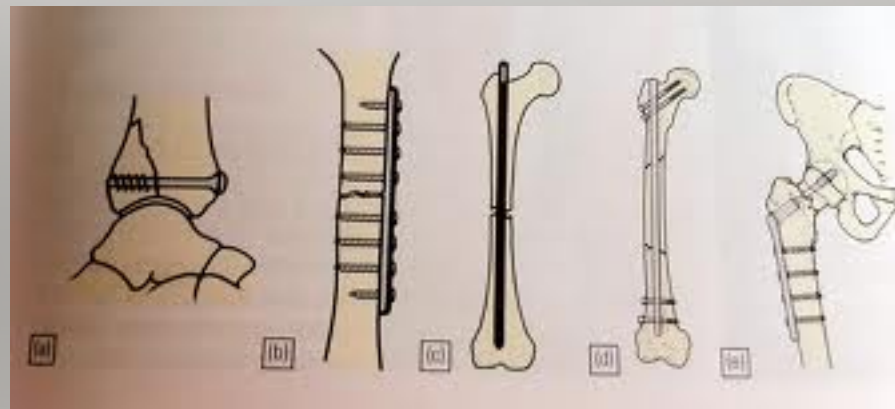






DEFINITIVE

- 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

