# Introduction to Orthopaedic Trauma for OR staff

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# Objectives

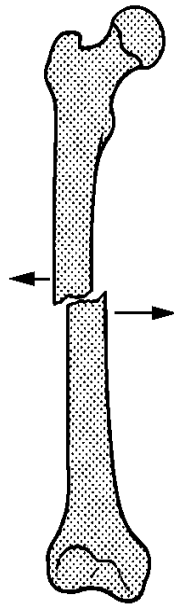
- Working under sterile conditions
- Bone anatomy and function
- Modes of fracture healing
- ABC’s of fracture healing
- Implants

# Working under sterile conditions

- **Move with a purpose – planned actions**
- **Keep distance – know where the sterile areas are**
- **Communicate closely – you are part of a team**
- **Avoid turning your back to others in sterile gown**
- **Watch for subtle contamination**
- **Establish a consistent work flow**
  - **Position your tools always on the same place**
  - **Keep trays and tables apart**

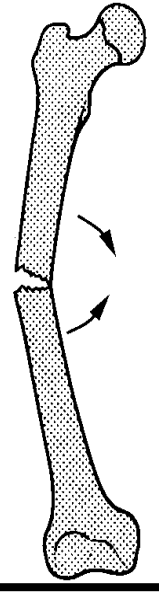
# Terminology

Displacement - Describes direction of cortical discontinuity between the distal fragment compared to the proximal fragment



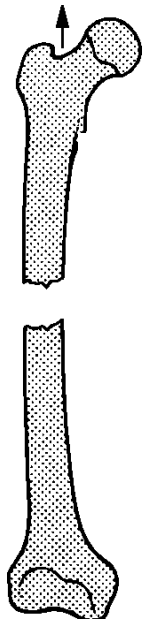
Angulation - Describes angle of apex between fragments

- Varus (lateral) vs. Valgus (medial)
- Anterior vs. Posterior

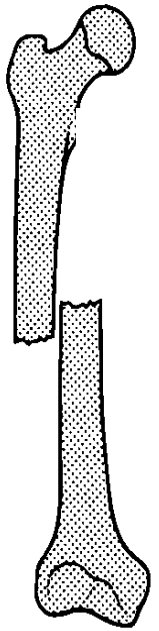


# Terminology

Distraction - Fracture has lengthened the affected segment usually due to rupturing of muscle

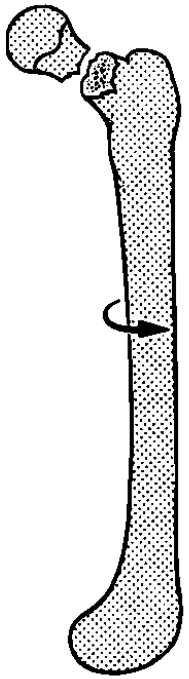


Shortening - Fracture has shortened the affected segment usually by muscle spasm



# Terminology

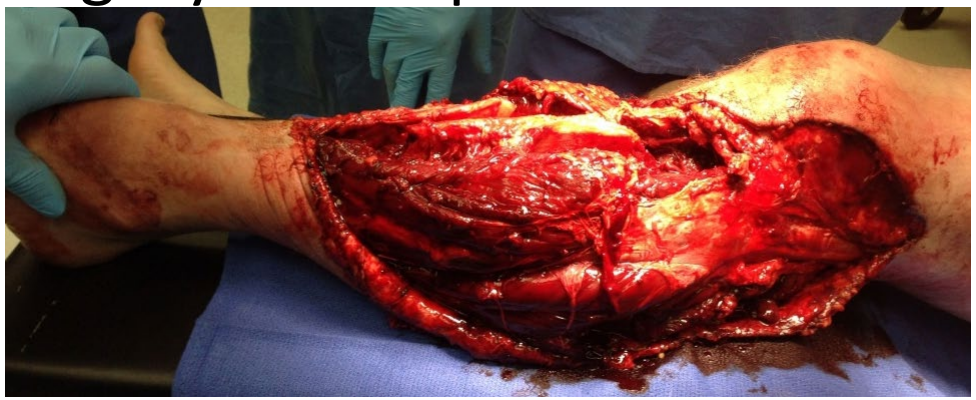
Rotation - torsion of the distal fractured limb segment



Avulsion - pulling apart the bone by a tension force from a ligament or tendon

# Terminology

- Open Fracture - Skin integrity is disrupted and communicates with the fracture site

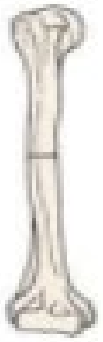


- Closed Fracture - Skin integrity is maintained

# Terminology

- Simple - Single Circumferential Fracture line
  - Spiral - fracture caused by a twisting force

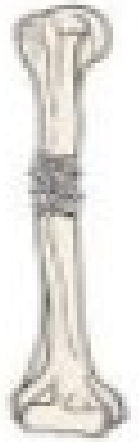
- Transverse - Fracture pattern perpendicular to long axis of the bone (<30 degrees)



- Oblique - Fracture pattern at oblique angle to long axis of the bone(>30 degrees)

# Terminology

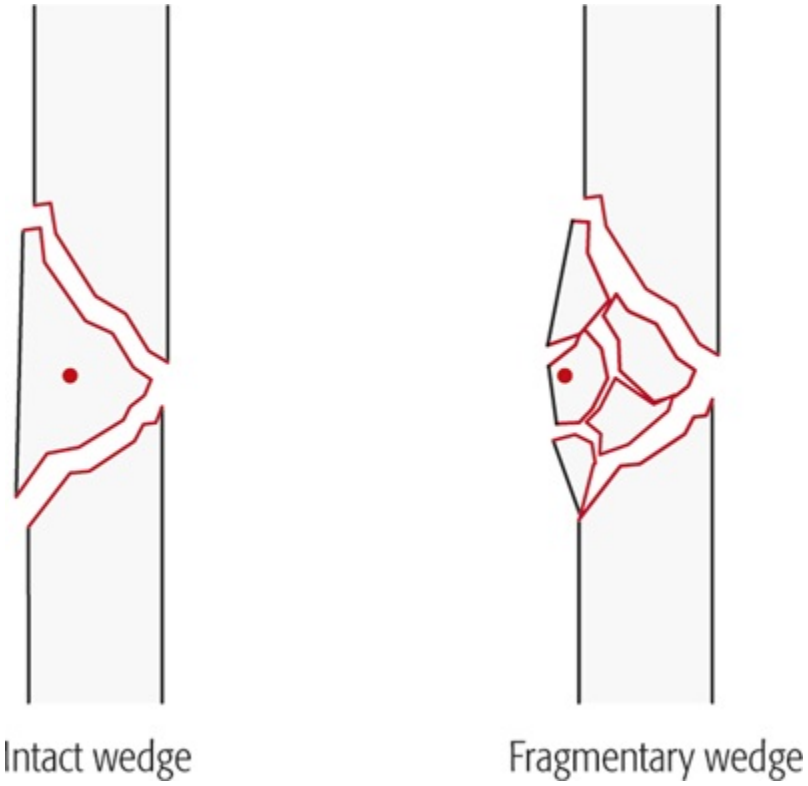
- Multifragmentary - multiple bone fragments



- Depressed - cortical joint surface is pushed into the cancellous bone beneath

# Terminology

Wedge-
fractures are characterized by contact between the main fragments after reduction usually restoring the normal length of the bone. The wedge fragment may be intact, or in multiple fragments (fragmentary wedge)

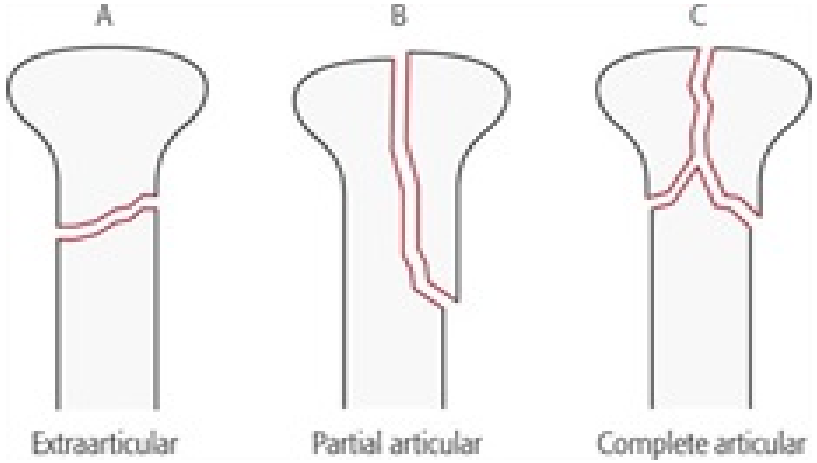


# Terminology

**Extraarticular**–The fracture line may be metaphyseal or epiphyseal, but it always spares the articular surface

**Partial articular**–The fracture involves part of the articular surface

**Complete articular**– The fracture disrupts the articular surface which is completely separated from the diaphysis.



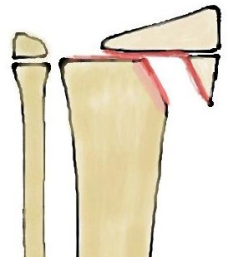

- Meinberg, EG MD; Agel, J MA, ATC; Roberts, CS MD, MBA; Karam, MD MD; Kellam, JF MD* Fracture and Dislocation Classification Compendium—2018, Journal of Orthopaedic Trauma: January 2018 - Volume 32

# Terminology

- Impacted - Bone is compressed upon itself (Torus Fracture)

- Greenstick - Pediatric fracture with cortex broken on one side but only buckled or bent on the other side

- Epiphyseal Plate Involvement – injury to the growing area of a child's bone
  - Salter Harris Classification



# Implants &Techniques

# Spectrum of Fracture Fixation Stability

**Increasing Stability**

Cast

K wire fixation

External Fixation

IM Nail

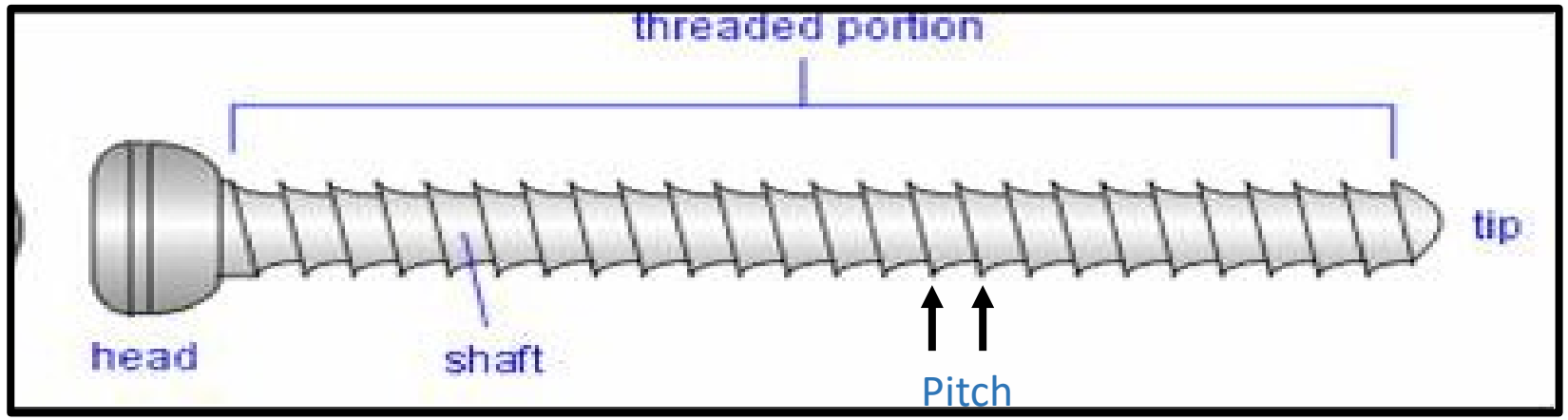
Bridge Plate

Lag screws and Protection plate

**Less vascular/biologic damage**

# Screw Design

- Head: various types for screwdriver purchase
- Shaft: core of the screw = drill diameter for screw insertion
- Thread: purchase power of screw, larger diameter than shaft
- Tip: blunt, self tapping or drilling



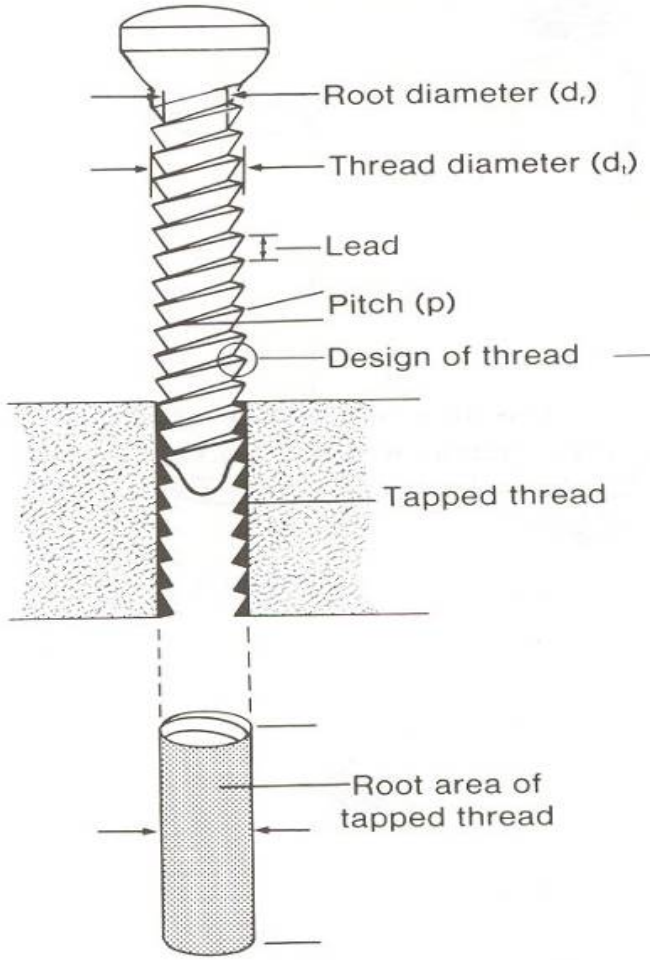
# Screw Design

- Head

Hex Phillips Torx

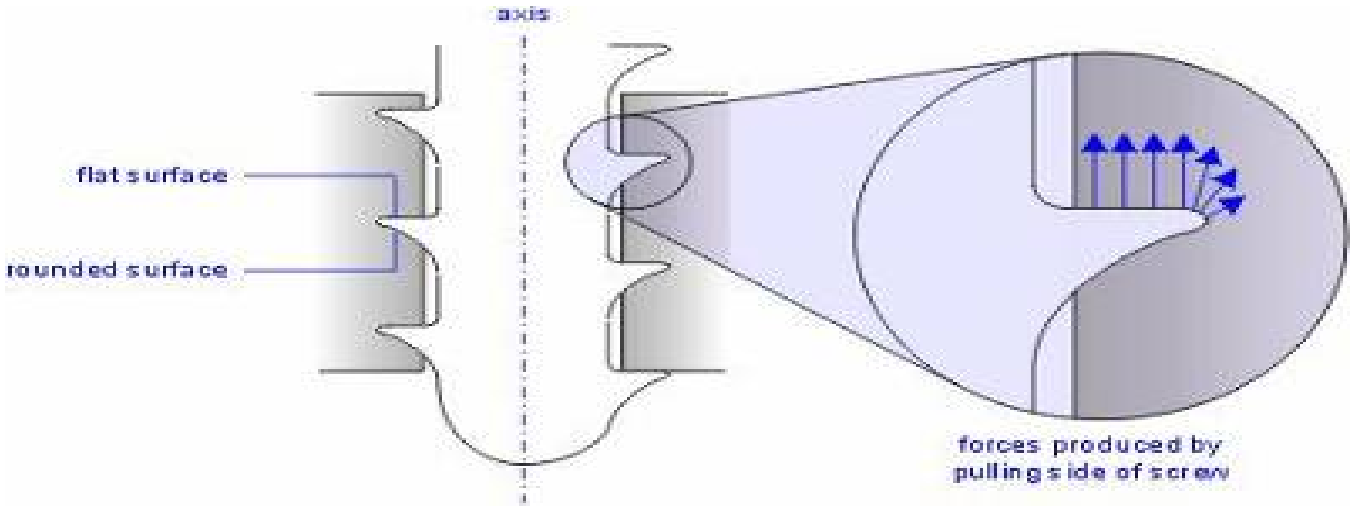
# Screw Design

- Core (root)
- Thread
- Profile
- Pitch
- Lead
- Root area of tapped thread (purchase)



# Screw Design - Thread Profile

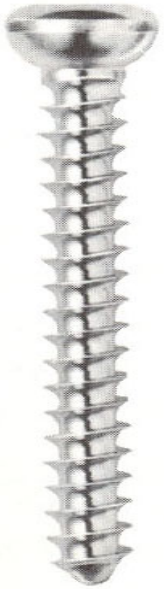
- Buttress shape
- Flat broad surface to resist pullout, increase holding power
- Differs between cortical and cancellous designs



# Screw Design - Types

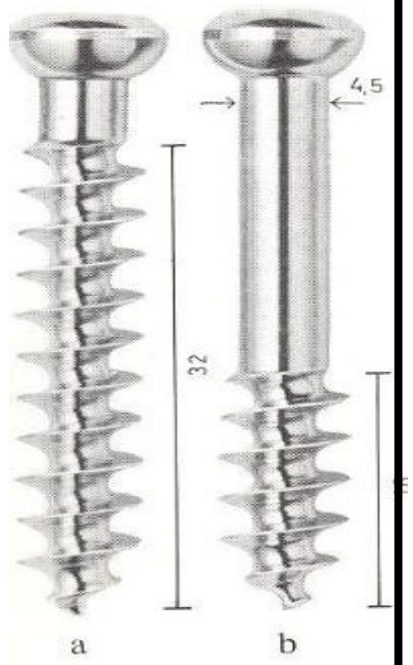
## CORTICAL

- Decrease thread to core diameter ratio
- Small pitch
- More threads to purchase in cortex
- Thus better “bite” when used despite smaller width of screw when used in cortex




## CANCELLOUS

- Larger pitch
- Don’t usually tap for these
- Relies on surface area of thread to obtain a bite in the softer bone of the metaphysis
- Bigger thread – increased thread / core ratio



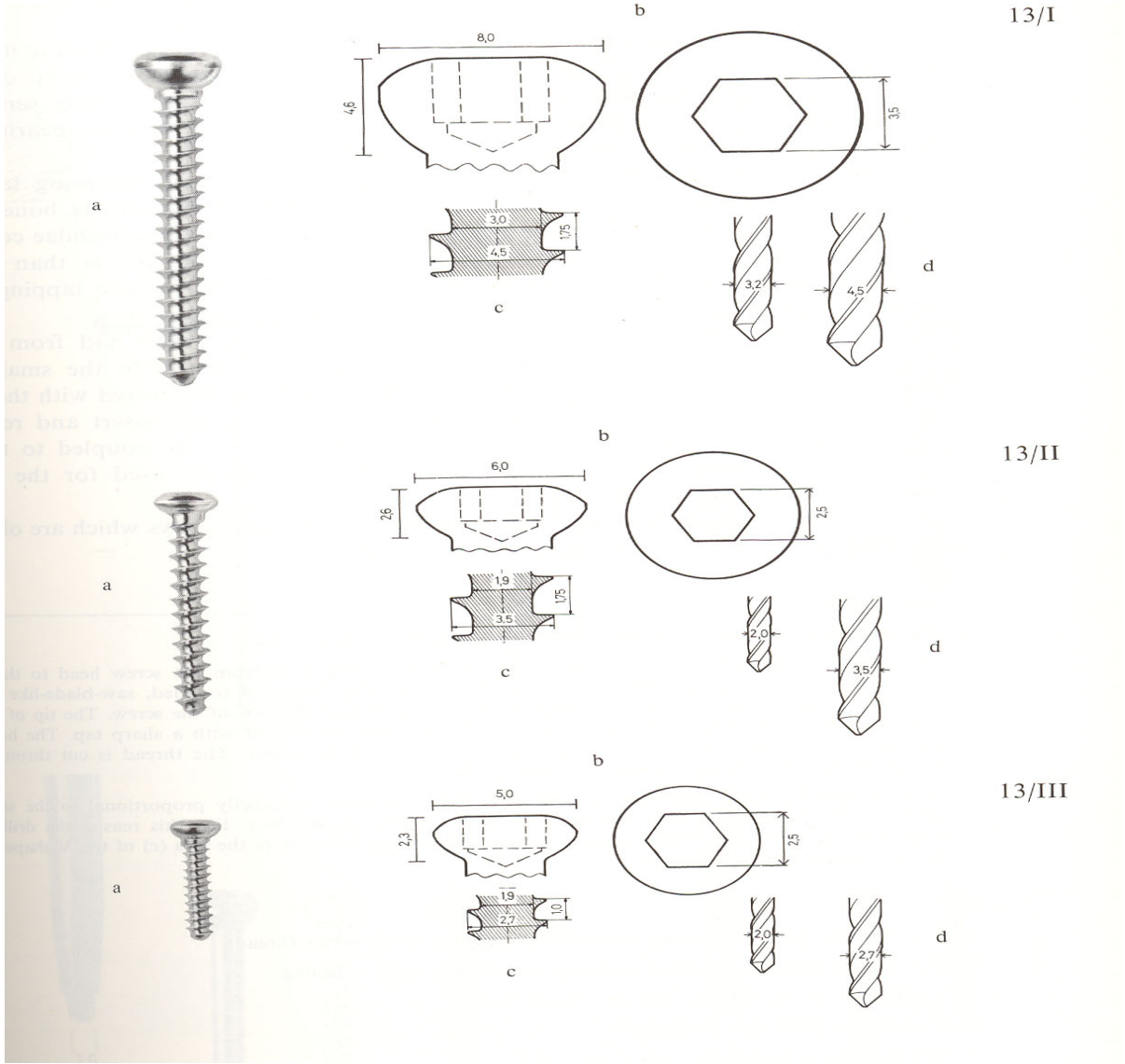
# Screw Types - Cannulated Screws

- “More Accurate” placement?
- Thread depth is less to accommodate guide wire – weaker
- Guide wire may shear off
- Cost

- Over used!!!

# Screw Design - Size

- Large fragment
  - 3.2 and 4.5
- Small fragment
  - 2.5 and 3.5
- Mini fragment
  - 2.0 and 2.7 and smaller

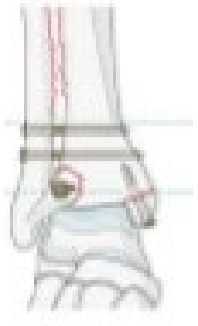


# Screw Design - Locking head Screws

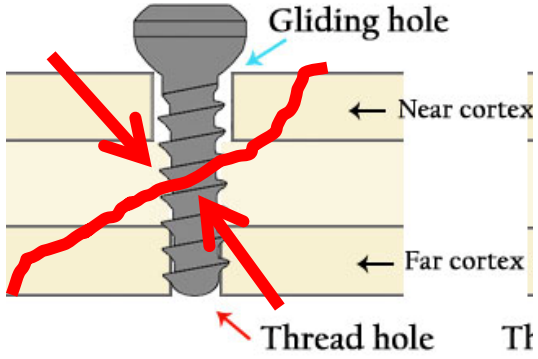
- Smaller pitch = greater number of threads per given distance
- Better holding strength in dense bone eg. Cortex
- “Star drive” or Torx rather than hex – head

# Screw Function

- Position screw - hold something like a plate or bones in a position



- Lag screw – compresses two fragment together

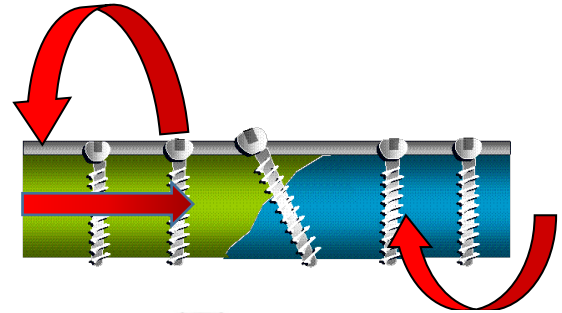


# Plates

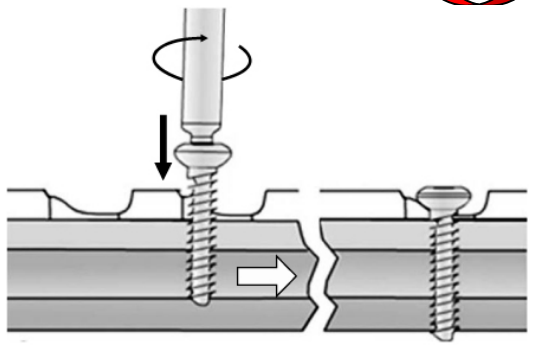
- Function to hold fracture reductions
- Attached to bone with screws
- Plate types  - manufacture or generic names
  - e.g. Limited contact dynamic compression plate (LCDCP)
- Plate Function
  - What the plate is doing
  - Any generic plate can perform any function

# Plate Functions

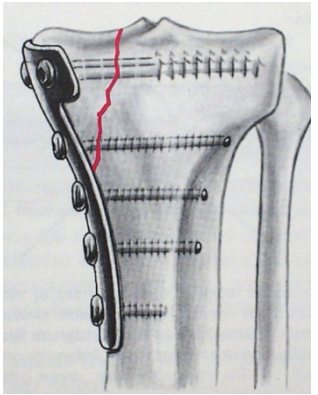
Neutralization plate – protects a lag screw against rotation and axial load



Compression plate - compresses the two fragments of a transverse fracture

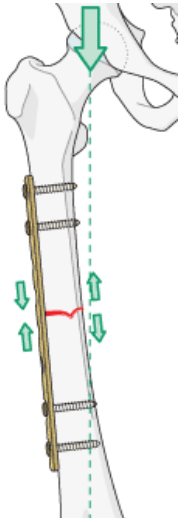


Buttress plate - supports and neutralizes axial load (also know as antiglide)

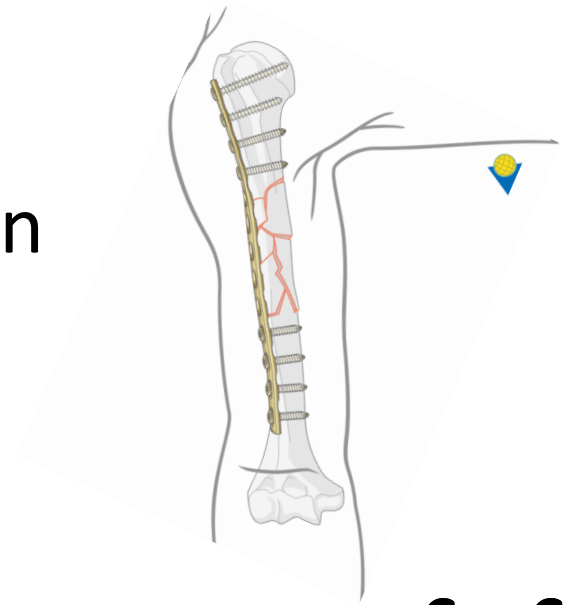


# Plate Functions

Tension Band Plate – on eccentric loaded bones to convert tension to compression



Bridge plate - spans an area of fragmentation



# Intramedullary Nails

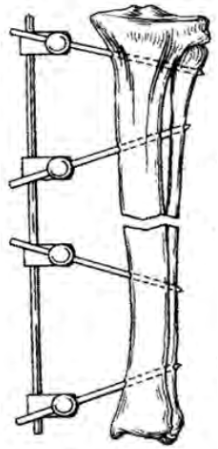
- Conventional Nails

- Reconstruction nails

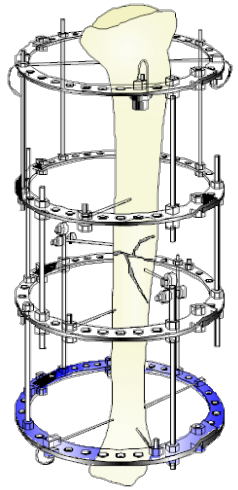
- Cephalomedullary Nails

# External Fixators

Standard frames



Thin Wire Ring Frames



# ABC's of Xrays

- **A**lignment
- **B**ones
- **C**artilage
- **S**oft Tissues

# Alignment

- Joint Alignment - most joints have two fairly congruent joint surfaces.

- Most joints in the extremities have one convex “ball” side and a concave “cup,” so that when in anatomic alignment the ball is centered in the cup.

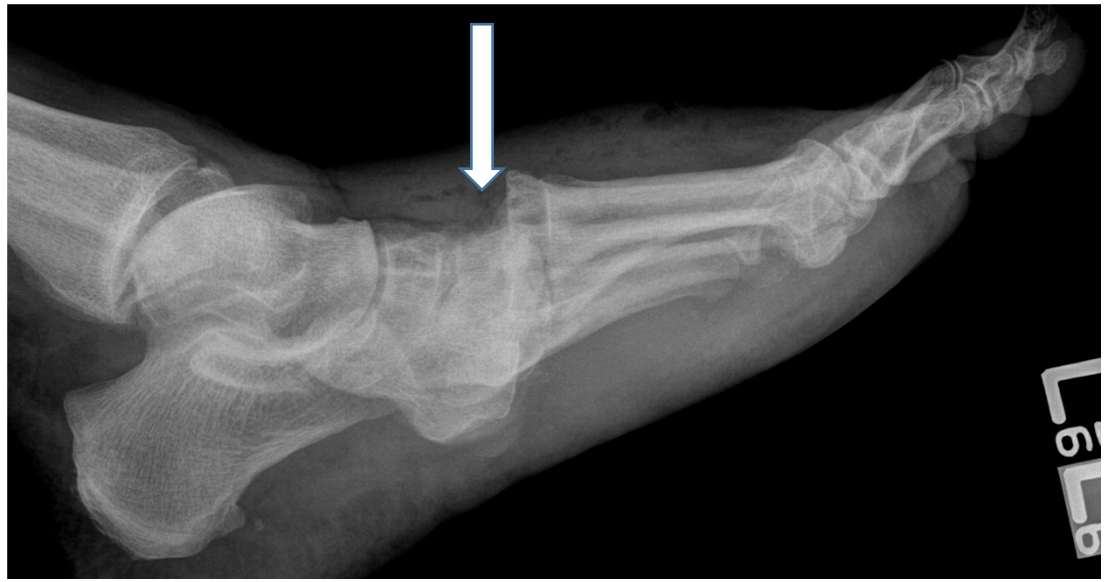
- Subluxation - Displacement of one joint surface in relation to the opposing side. resulting a partial loss of continuity of the joint surface.

- Dislocation - Displacement of one joint surface in relation to the opposing side. resulting a complete loss of continuity of the joint surface.

Ankle subluxation as the two joint surfaces remain in partial continuity

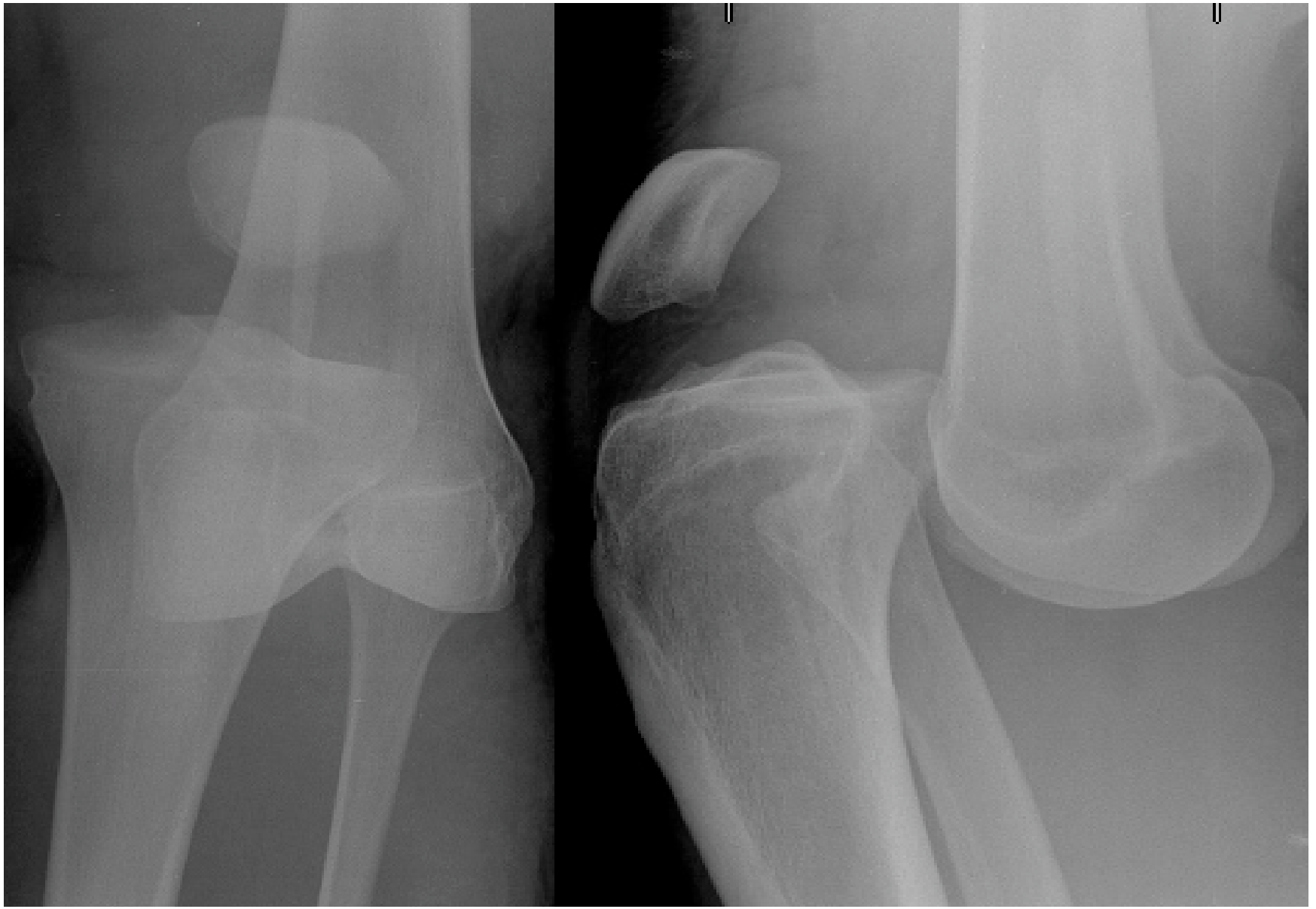
Ankle has been congruently reduced and stabilized with a plate and screws

# Lisfranc (tarsal/metatarsal) joints are dislocated as no part of any joint in in continuity with it opposite articular side



# Lisfranc joint has been congruently reduced and stabilized with multiple K wire

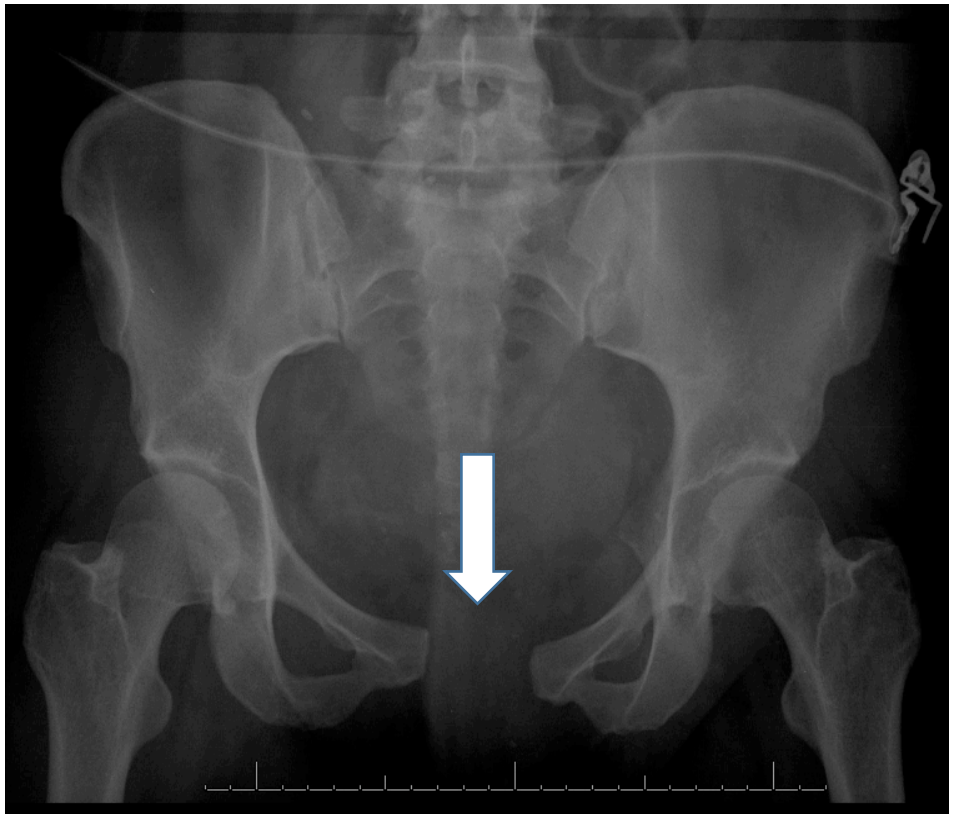
# Anterior Knee Dislocation

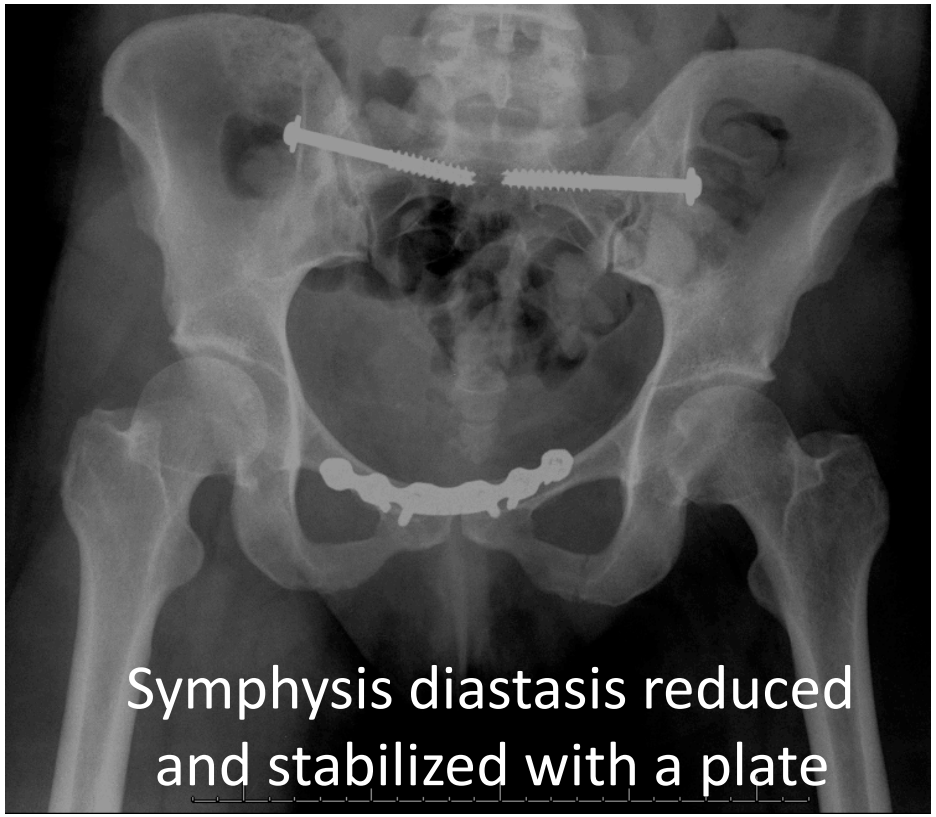


# Subtalar Joint Dislocation

# Alignment

- Diastasis - A displacement of one joint surface in relation to the other in a slightly moveable (sacro-iliac/pubic symphisis) or synarthrodial (cranial sutures) joint.





# Bones

- Radiographic abnormalities of the bones usually fall into one of the following categories:
  - Abnormality in opacity (determined by bone density)
    - Decrease manifests as lucency
    - Increase manifests as sclerosis
  - Abnormal contour
  - Abnormal size or shape

# Abnormalities in Opacity: Evaluating Lucencies

- Lucent Line - indicates a FRACTURE
- Focal Lucencies
  - Tumor
  - Infection
  - Simple Bone Cysts
- Diffuse Lucency
  - Drugs
  - Endocrine / Metabolic
  - Tumor

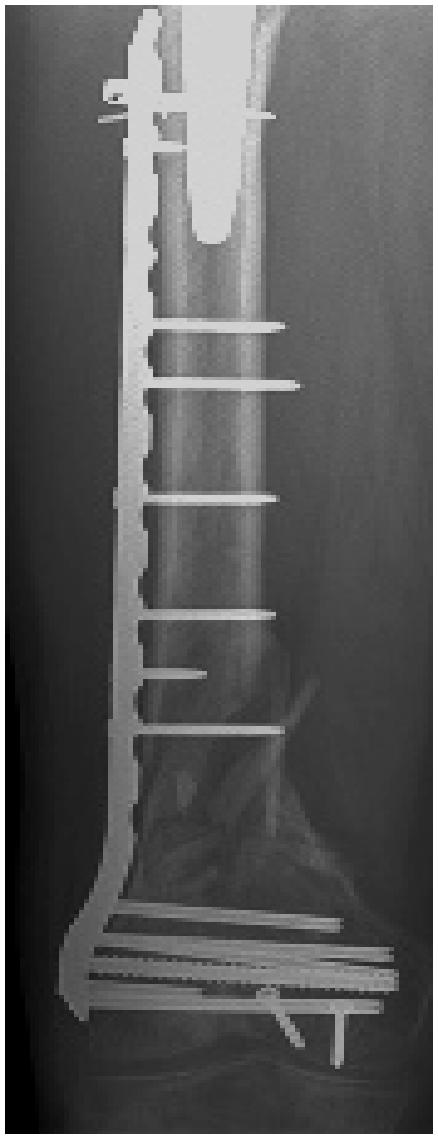
# Examples of Fractures & Fixation

# Iliac Wing Fracture

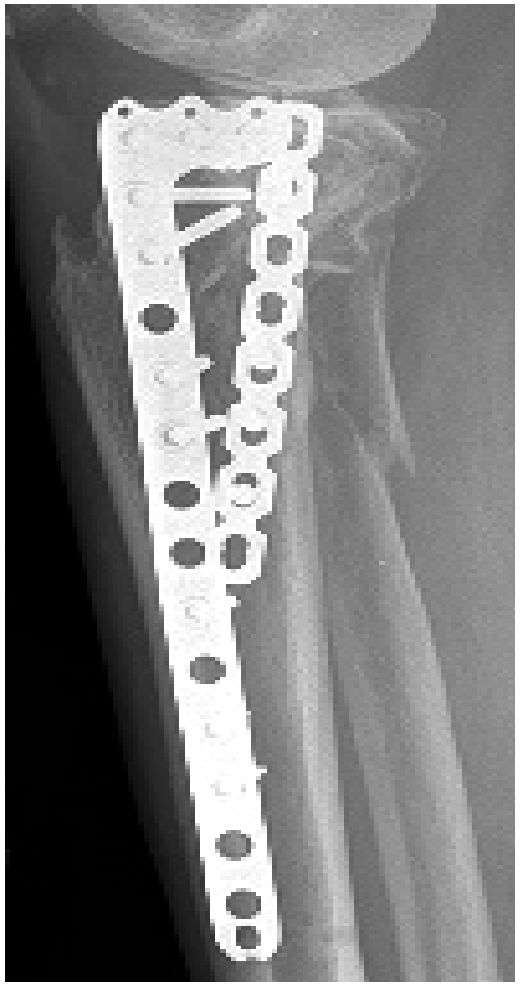
# Tibia Pilon Fracture

Fracture reduced and stabilized in a thin wire ring external fixator

# Supracondylar Femur Fracture

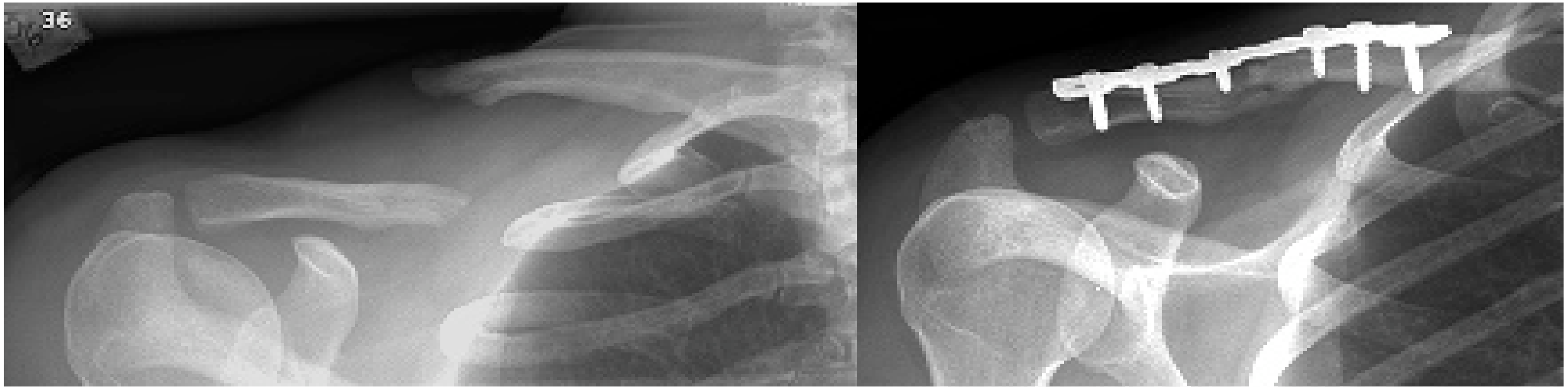


# Tibia Plateau Fracture



# Proximal Humerus Fracture

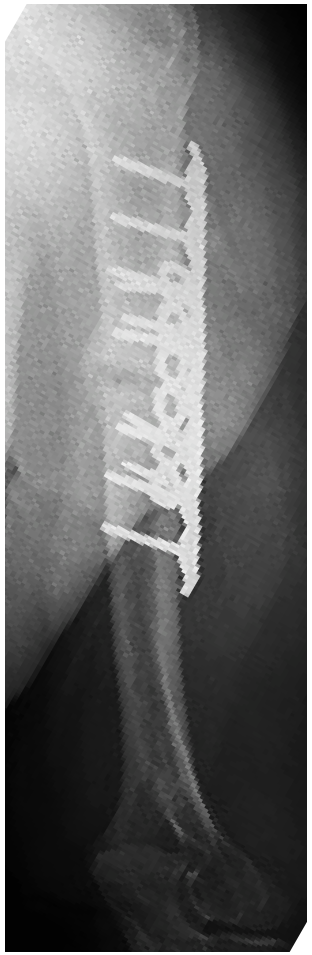
# Clavicle Fracture



# Trimalleolar Ankle Fracture

# Trimalleolar Ankle Fracture

# Humeral Shaft Fracture



# Summary

Working under sterile conditions - requires care and communication

Bone biology– bone has metabolic and mechanical roles

Fracture healing – primary/direct and secondary/indirect healing

ABC’s of fracture healing – **A**lignment, **B**ones, **C**artilage, **S**oft tissues

Implants – nails, plates, tension band wiring, external fixateurs

# References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