

BASIC FRACTURE RADIOLOGY

FOMC 2021

“Inside the mind of the orthopedic provider”

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Disclosures

- Consultant Synthes/Depuy Trauma

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OBJECTIVES

- Discover what the orthopedic provider is thinking when they look at imaging
- Present a systematic approach to interpreting orthopedic x-rays
- Present the language of fracture descriptions
- Case presentations

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ABCs APPROACH

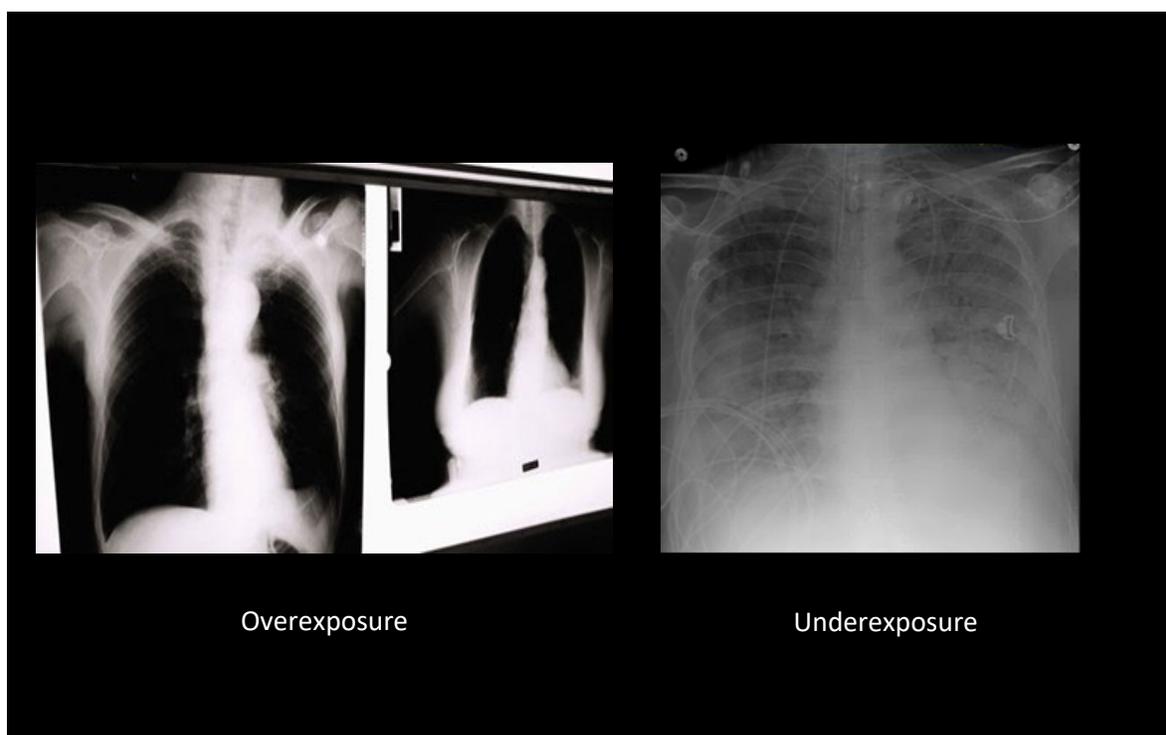
- A: Adequacy, Alignment
- B: Bones
- C: Cartilage
- S: Soft Tissues
- Apply ABCs approach to every orthopedic film we evaluate

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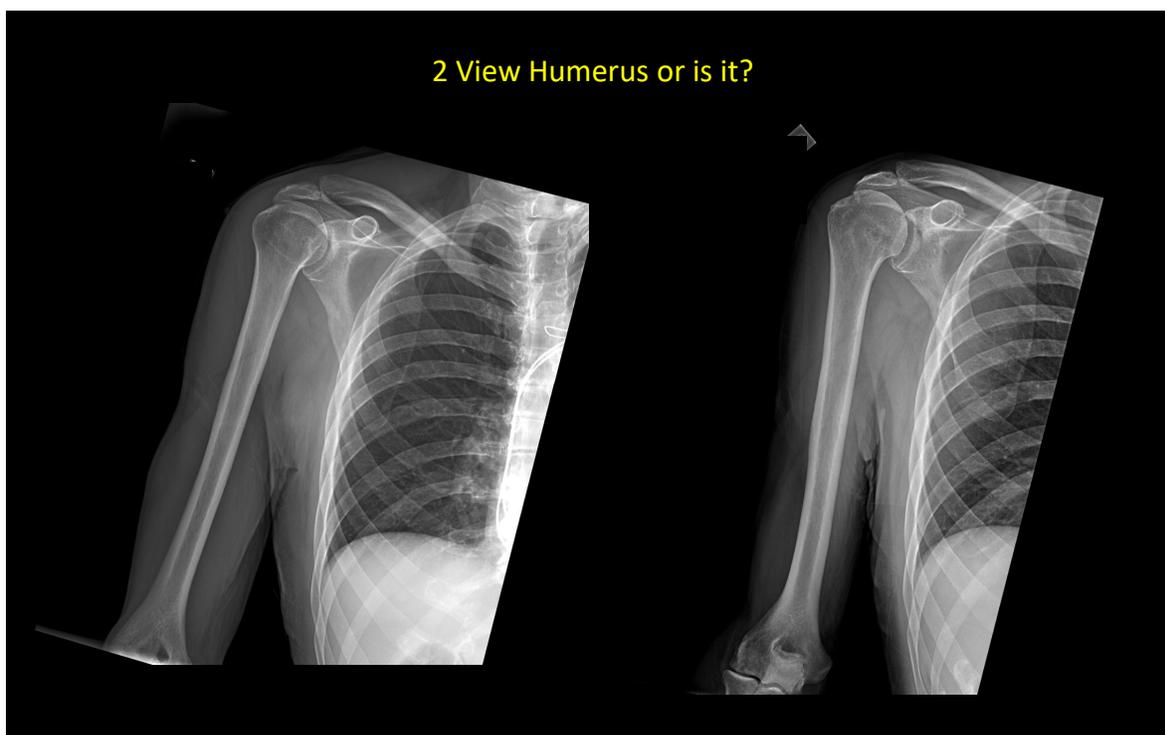
ADEQUACY

- All x-rays should have an adequate number of views.
 - Minimum of 2 views—AP and lateral
 - One View is No View!
 - 3 views preferred
 - Some bones require 4 views
- All x-rays should have adequate penetration

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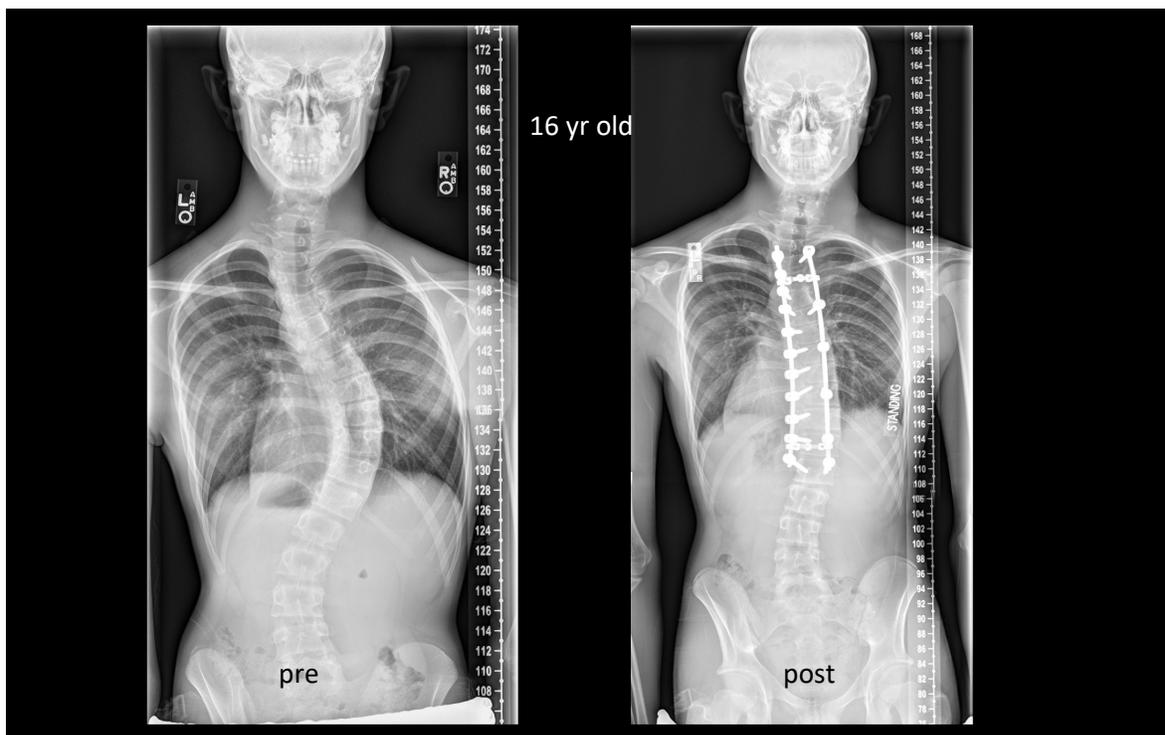


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ALIGNMENT

- Alignment: Anatomic relationship between bones on x-ray
- Normal x-rays should have normal alignment
- Fractures and dislocations may affect the alignment on the x-ray
- Do not be afraid to x-ray the "normal side" for comparison

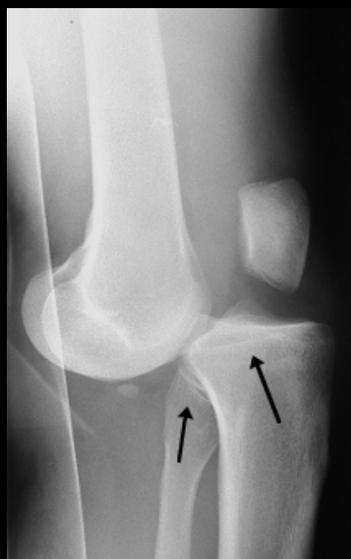
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DISLOCATION

- Note the dislocation, the articular surfaces of the knee no longer maintain their normal relationship
- Dislocations are named by the position of the distal segment
- This is an Anterior knee dislocation

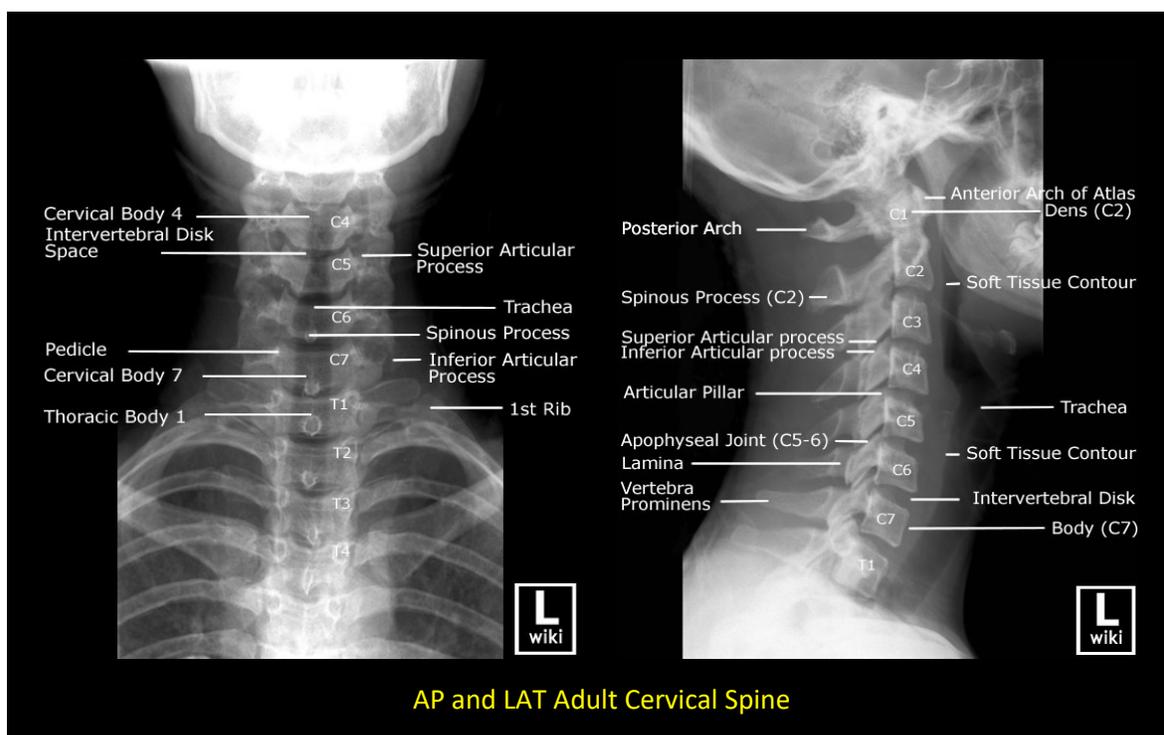


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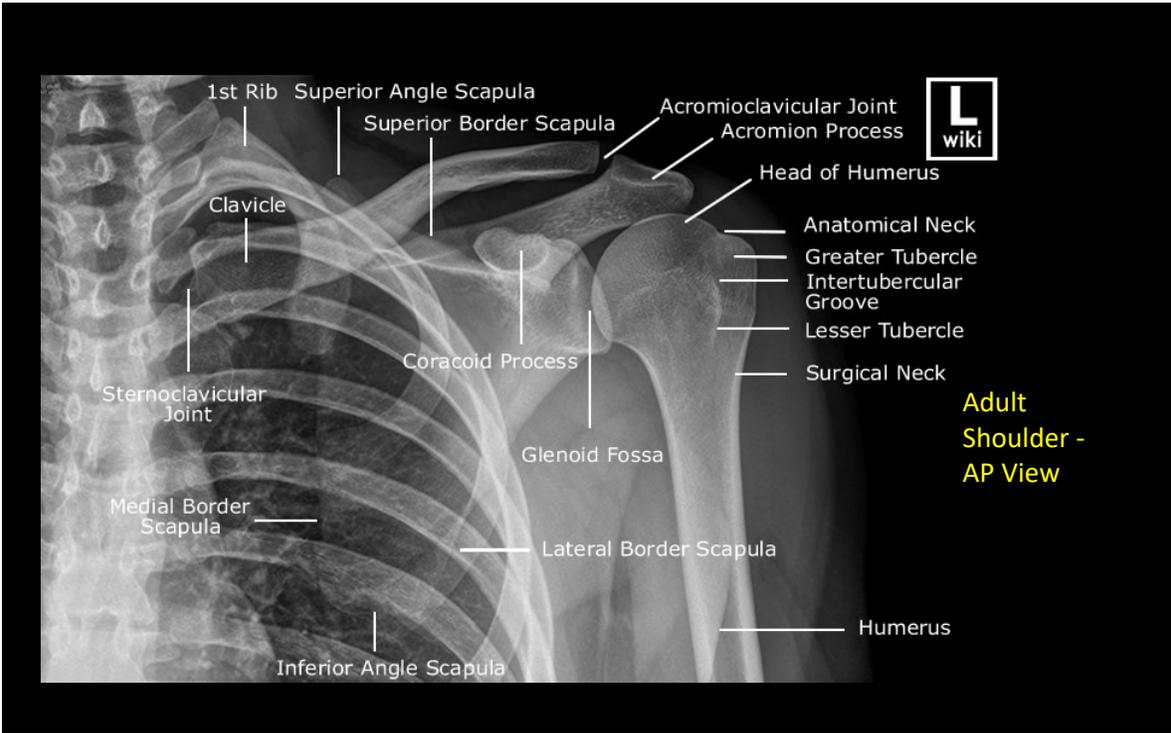
BONES

- Examine bones for fracture lines or distortions
- Examine the entire length of bone
- Fractures may be subtle!

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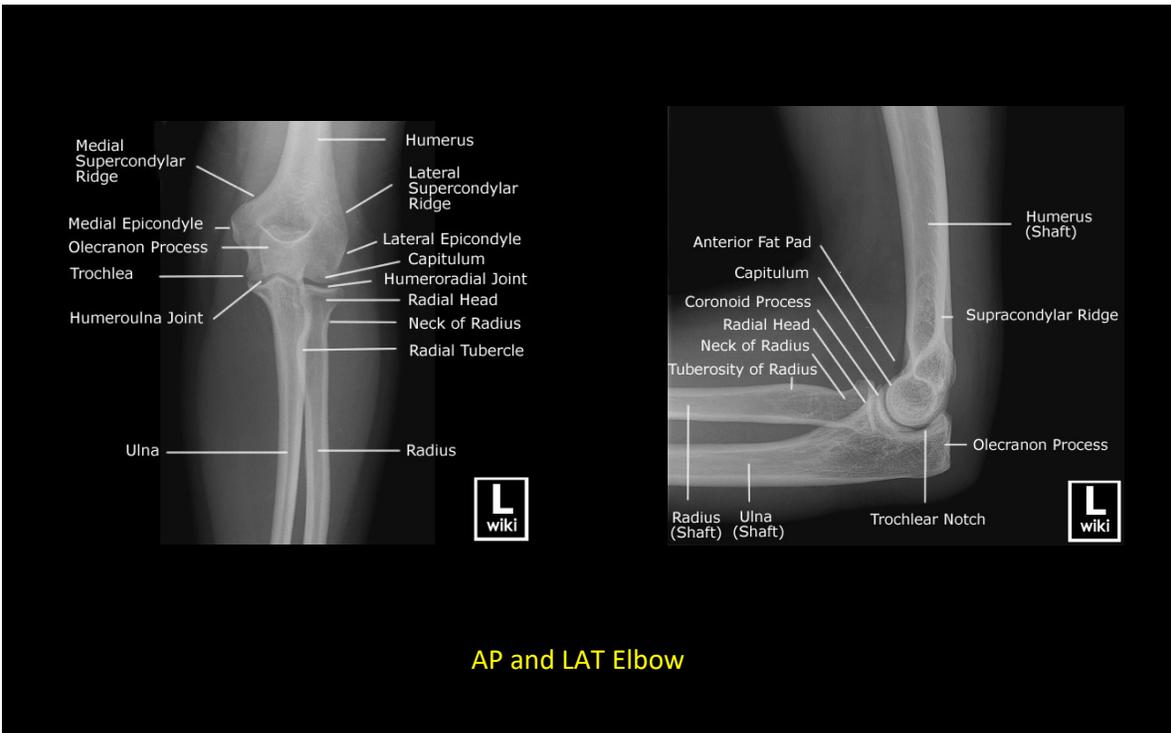


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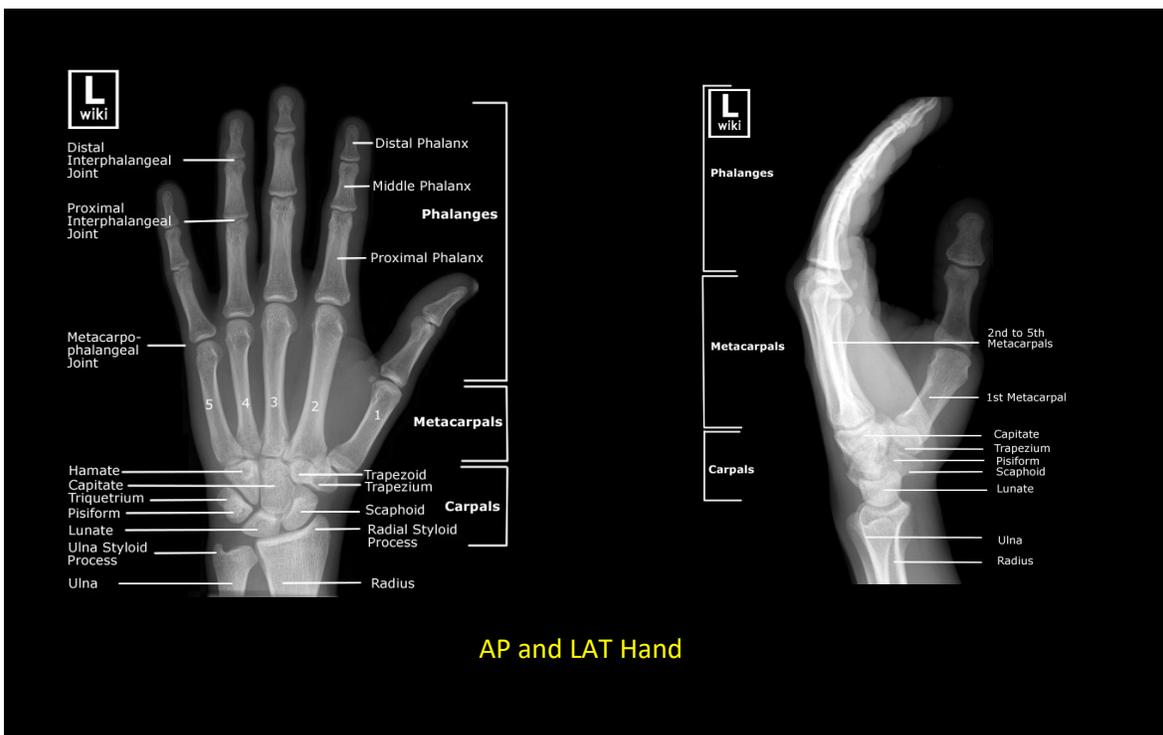
Adult
Shoulder -
AP View

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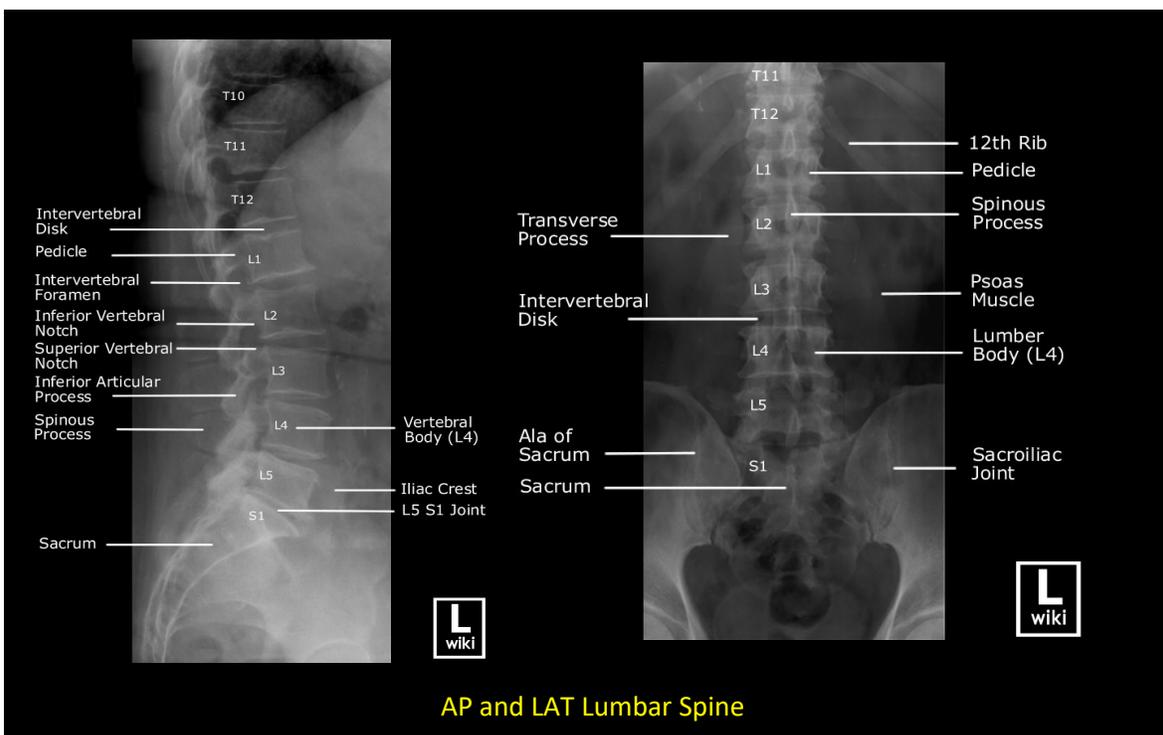


AP and LAT Elbow

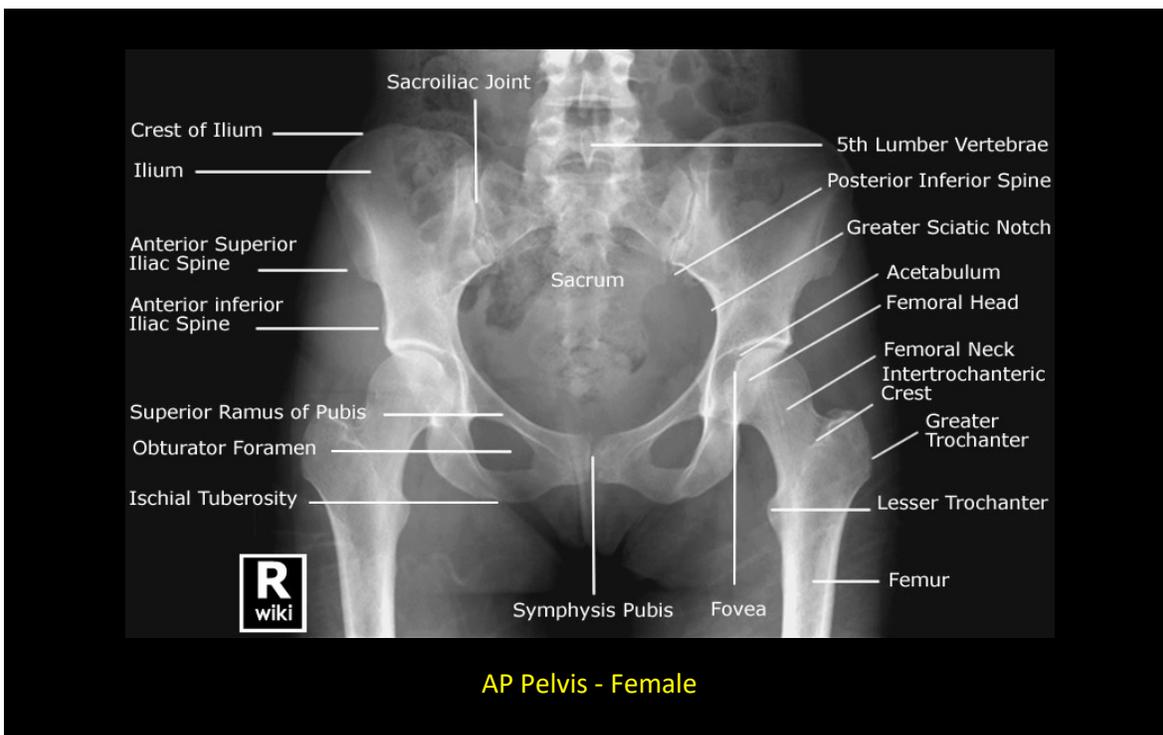
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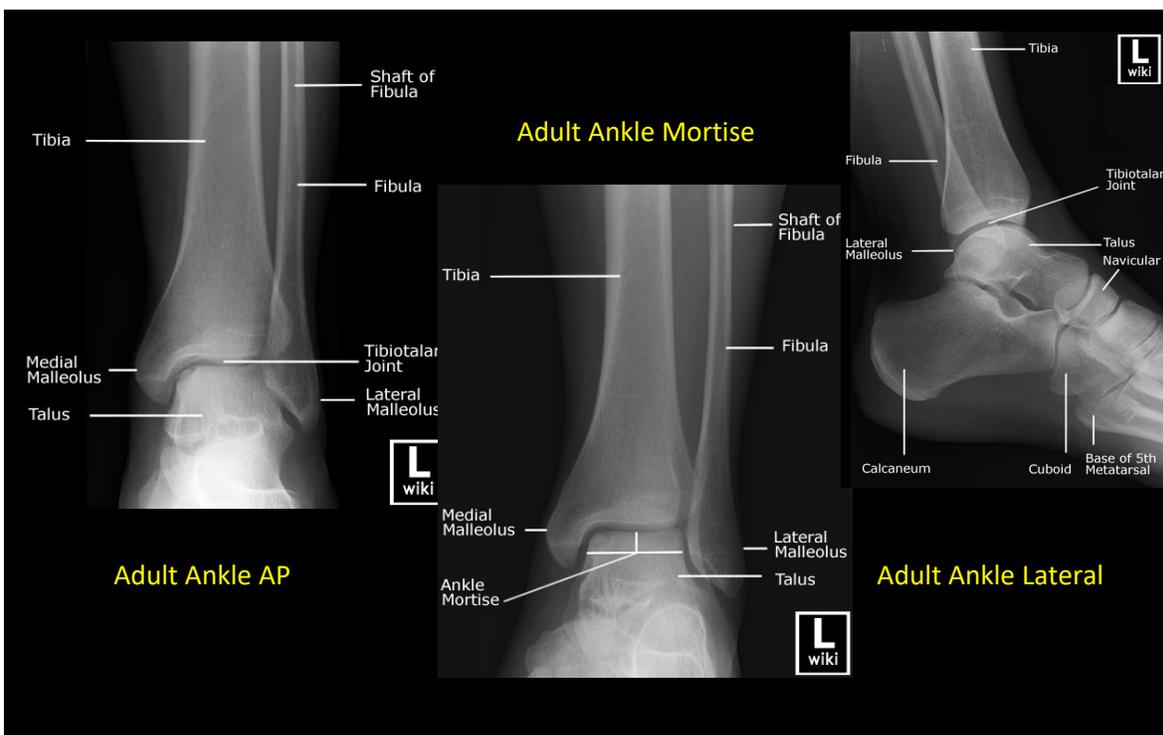
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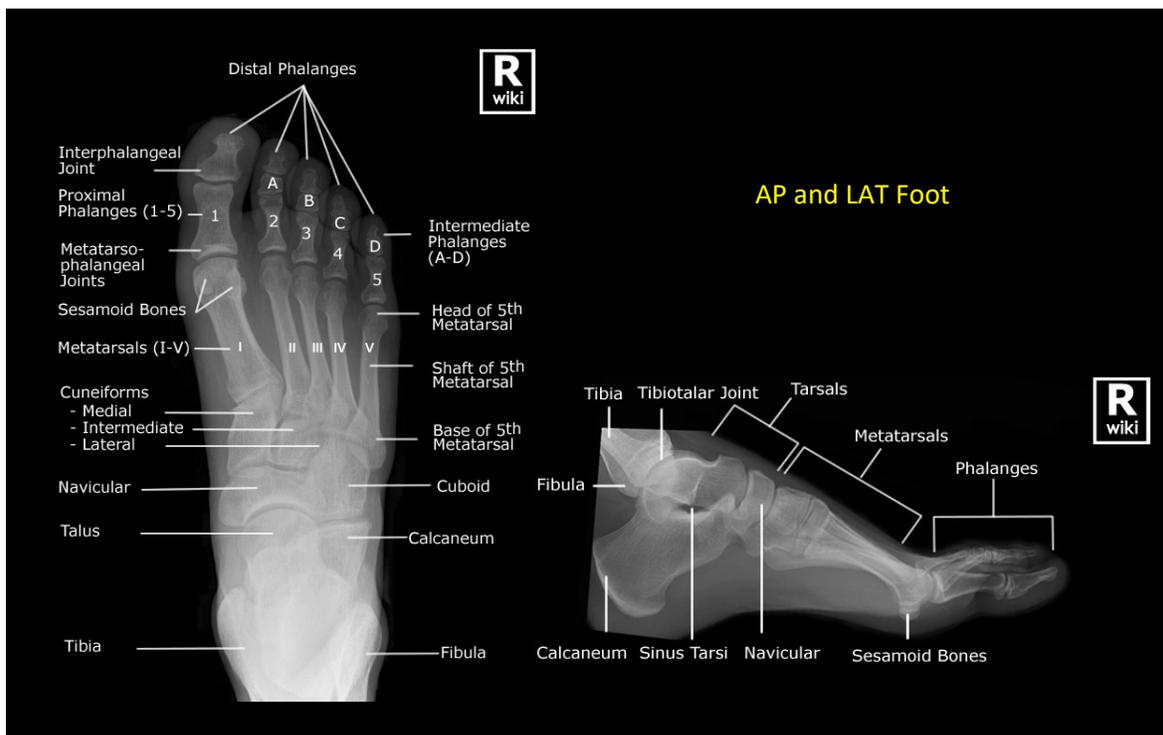
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CARTILAGE

- Cartilage implies evaluation of joint spaces on x-rays (you cannot actually see cartilage on x-rays)
- Widening of joint spaces signifies ligamentous injury and/or fractures
- Narrowing = degenerative cartilage loss (Arthritis)

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SOFT TISSUES

- Soft tissues implies to look for soft tissue swelling and joint effusions
- These can be signs of occult fractures

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Fat Pad signs

- This x-ray demonstrates a lateral elbow x-ray.
- There is swelling anteriorly which is displaced known as a pathologic anterior fat pad sign.
- There is swelling posteriorly known as a posterior fat pad sign.
- Both of these are signs of an occult fracture although none are visualized on this x-ray
- Remember, *soft tissue swelling* can be a sign of occult fracture!

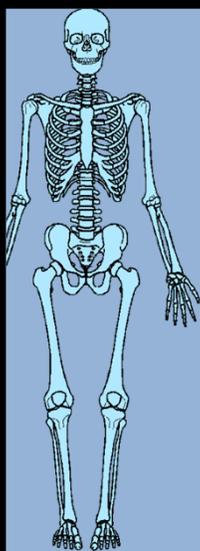


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WHERE ARE THE FRACTURES?



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Why are Fractures Hard?

There are 206 bones! And they are all different:
 Carpals: Scaphoid, Lunate, Triquetrum, Pisiform (proximal row), Hamate, Capitate, Trapezoid, Trapezium (distal row)
 Fingers: Thumb, Index, Long, Ring, Small (Metacarpals, Phalanges)
 Tarsals: Talus, Calcaneus, Navicular, Cuboid, 3 Cuneiforms
 Arm: Scapula, Humerus, Radius, Ulna
 Leg: Femur, Patella, Tibia, Fibula
 Pelvis: Sacrum, Innominate (Ilium, Ischium, Pubic)
 Spine: Cervical (7), Thoracic (12), Lumbar (5), [ribs & sternum]
 Skull: 1 big bone + Mandible, Maxilla, Nasal, Frontal, Parietal, Occipital, Temporal, (Zygomatic, Sphenoid, Ethmoid, Lacrimal)

Multiple fracture patterns (simple, comminuted, spiral, displaced, etc.)

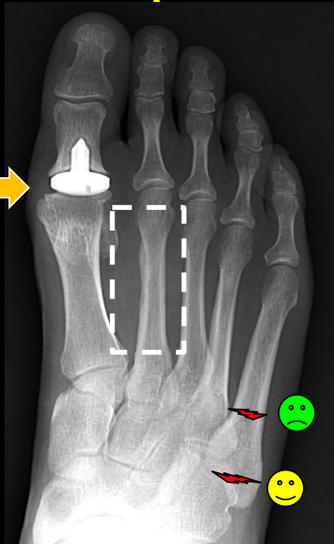
Some areas more prone to certain types of fractures

There are different structures (different bone types) within each bone

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Example: Metatarsals

- 1st MT: Fractures – Rare, Common OA
- 2nd MT: Fractures Common Stress (Fatigue)



5th MT:

- Fractures Very Common Base 5th MT
- 1) Avulsion Fx ⚡ 99% Heal
- 2) Jones Fx ⚡ 50% non-union

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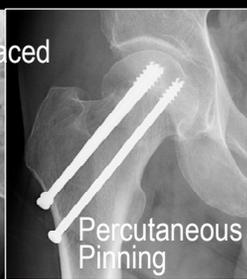
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Hip Fracture Flavors

Femoral Neck Fx. Impacted/min displaced



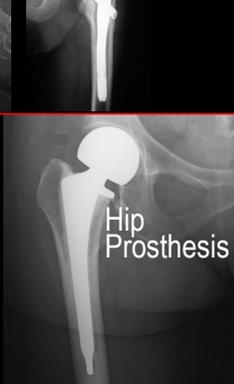
Subtrochanteric Fx



Intertrochanteric Fx min displaced



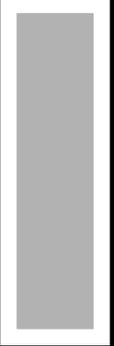
Femoral Neck Fx displaced



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Bone Model

**White Line =
Cortical Bone**



**Gray Fill =
Trabecular Bone
(Cancellus)**

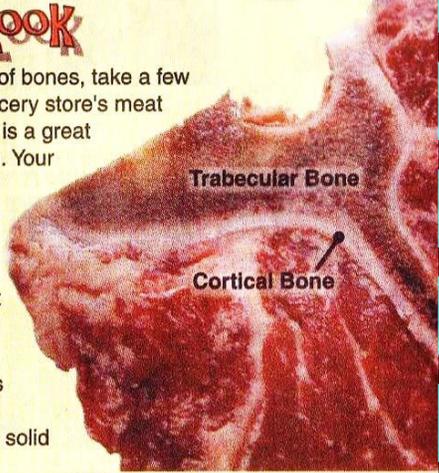
A Closer Look

To check out the inside of bones, take a few extra minutes at the grocery store's meat counter. A T-bone steak is a great example of bone design. Your bones are built the very same way a T-bone is built.

Hold one up and look closely. You'll blend right in. People finger meat packages a lot.

The outside of a bone is called the *cortical* bone (KOR-ta-kal). It's mostly solid with just a few cavities.

Inside the cortical bone is the *trabecular* bone (truh-BEK-u-lar). It's like a fine honeycomb of cavities that contain liquid bone marrow, special bone-rebuilding cells, blood cells, other chemicals and fats.

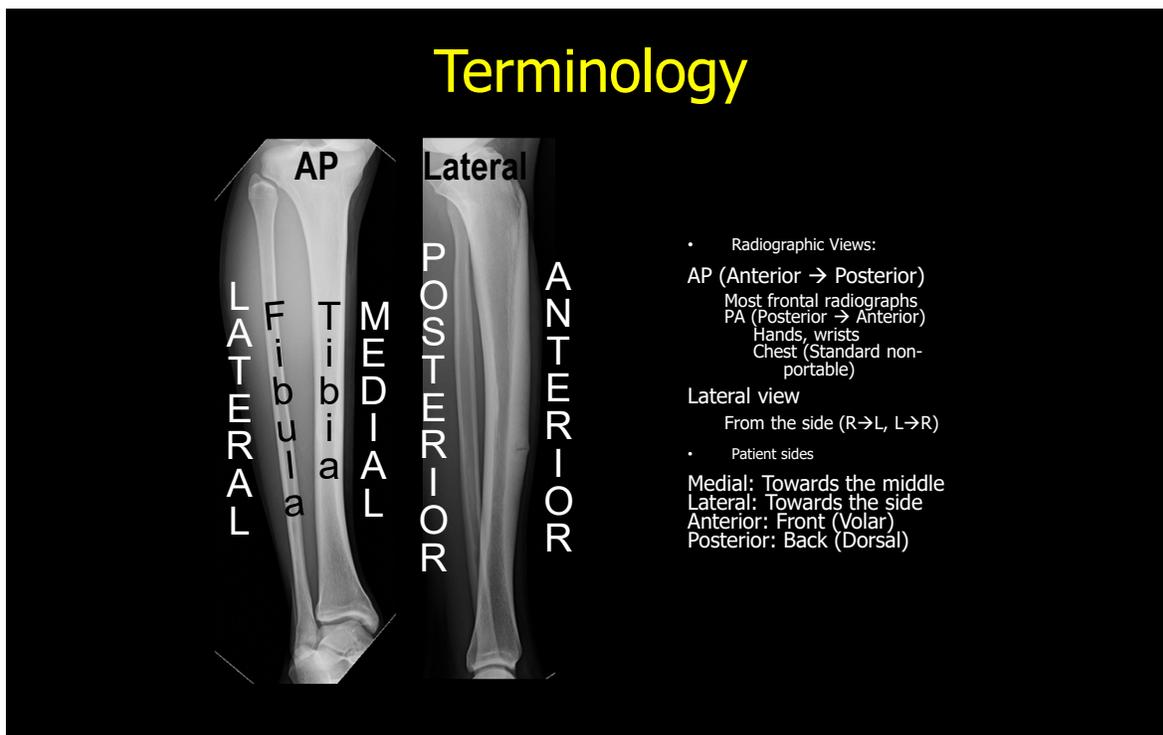


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Bone Within The Bone




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What are we looking for clinically?

OPEN vs CLOSED Fracture
Neurovascular Status
Compartments

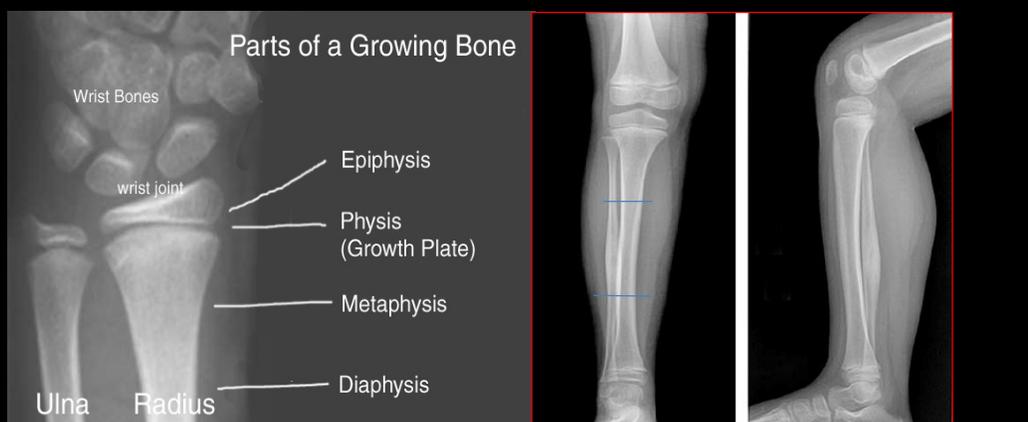
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What are we looking for Radiographically?

- Location
- Pattern
- Displacement
- Angulation

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Location



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Location

- Always important to describe as fracture of the shaft if so.
- If fracture involves distal or proximal metaphysis it is important to describe intra vs extra articular

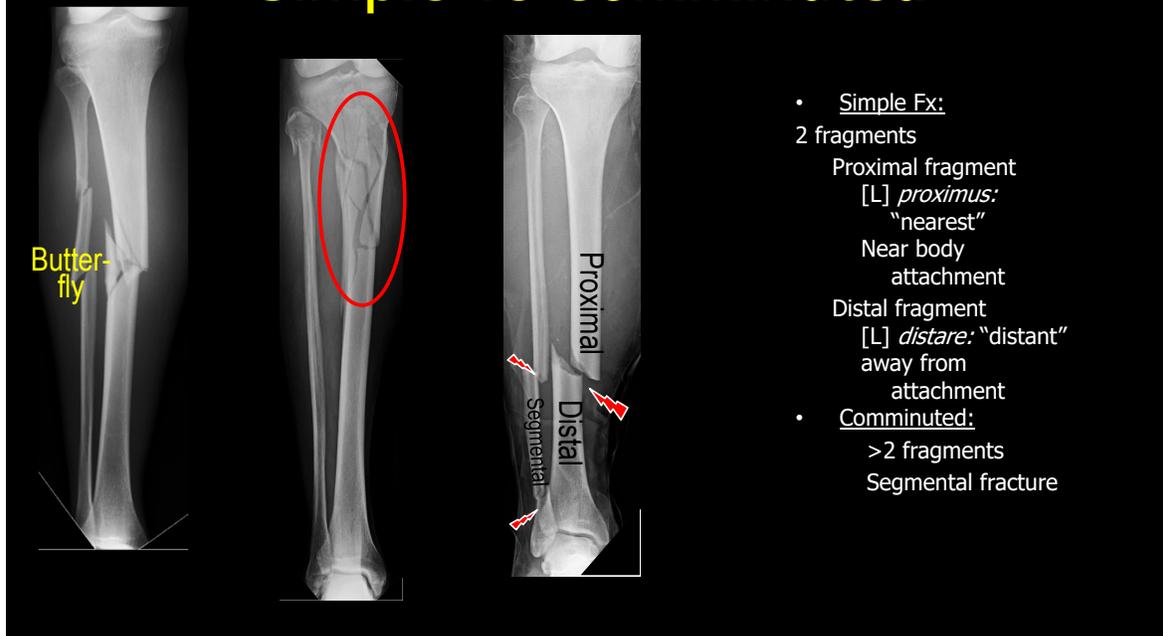
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Location



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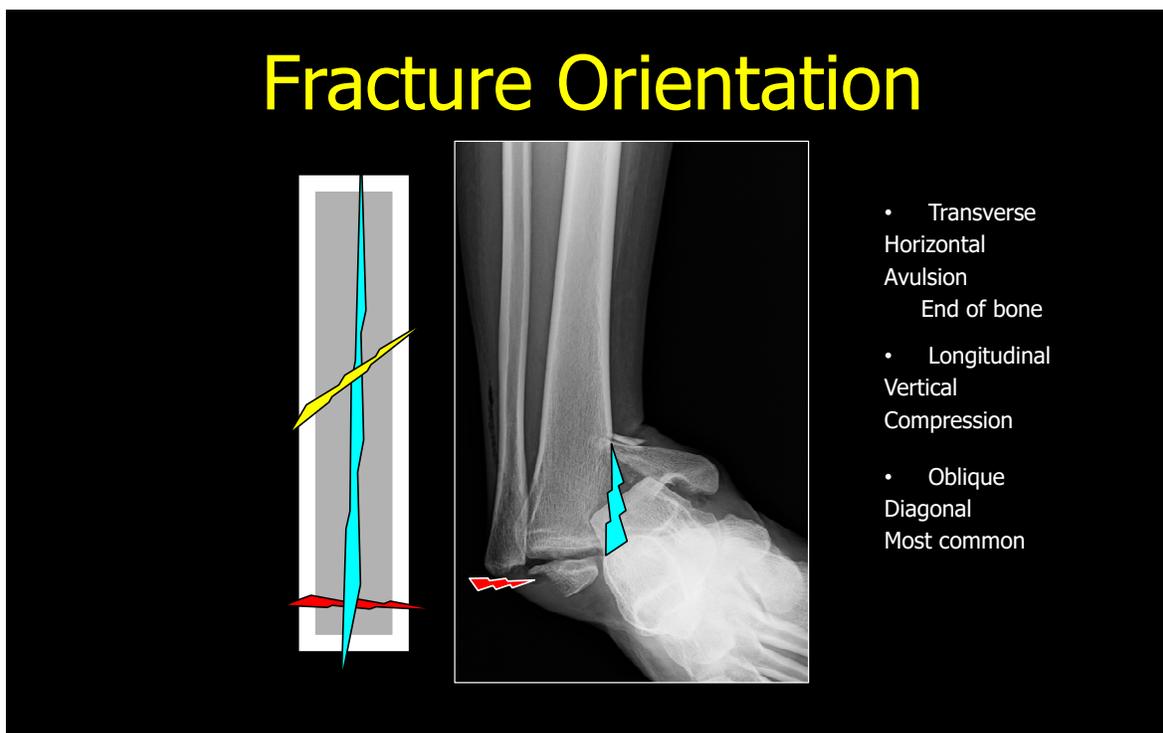
Simple vs Comminuted



- Simple Fx:
2 fragments
Proximal fragment
[L] *proximus*:
"nearest"
Near body
attachment
Distal fragment
[L] *distare*: "distant"
away from
attachment
- Comminuted:
>2 fragments
Segmental fracture

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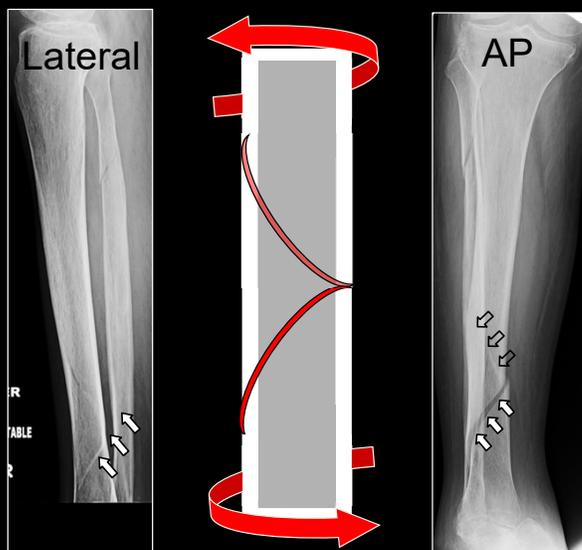
Fracture Orientation



- Transverse
Horizontal
Avulsion
End of bone
- Longitudinal
Vertical
Compression
- Oblique
Diagonal
Most common

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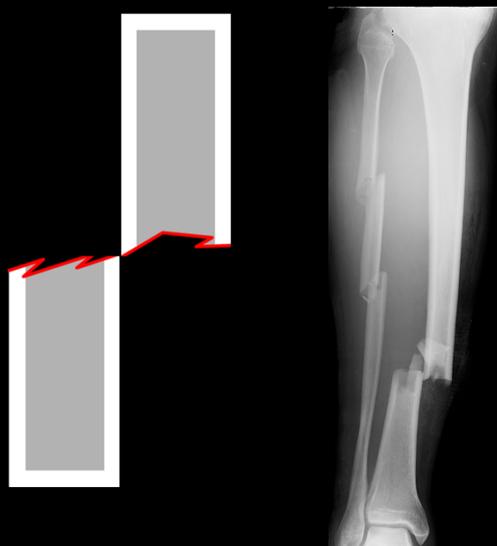
Fracture Orientation



- Spiral Fracture
Twisting injury
Resembles:
Oblique fracture
Butterfly frag.
Need multiple views to see the spiral

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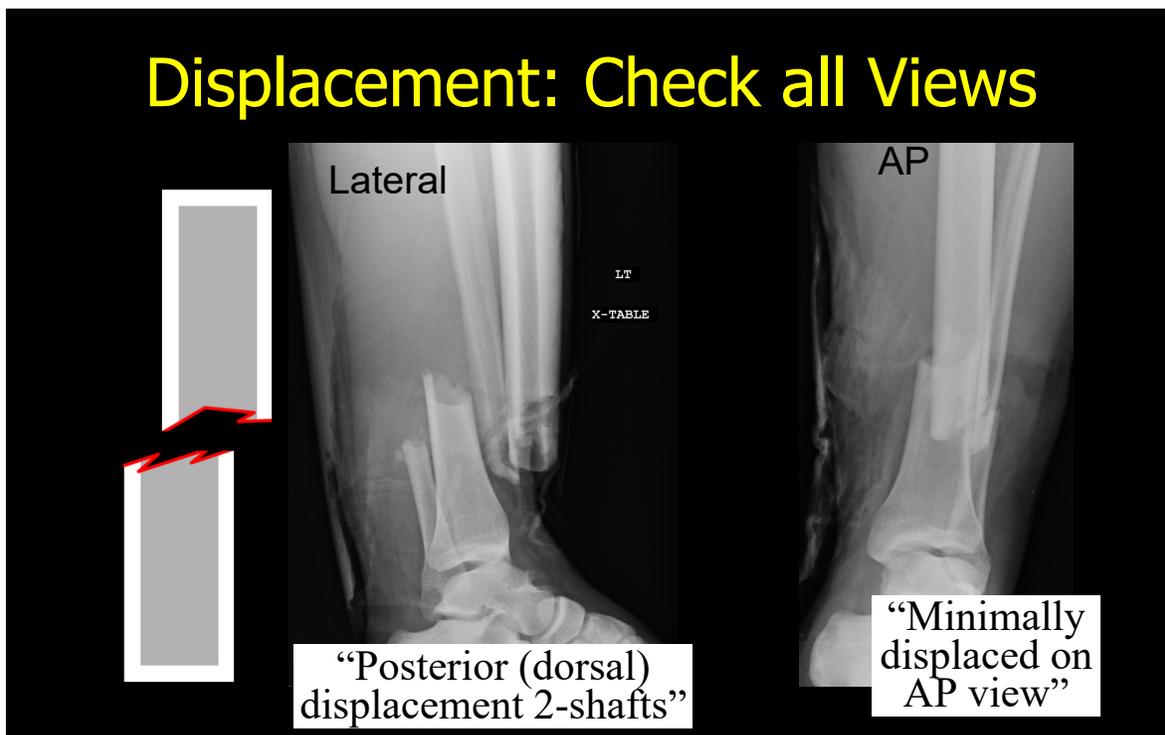
Displacement



- **RULE:**
 - We describe displacement of *distal* fragment relative to *proximal* fragment
- Displacement described in %
 “There is an transverse fracture of the distal 1/3 tibia shaft, with *lateral* displacement of the distal fracture fragment by 1-shaft width (100%). There is a segmental fracture of the midshaft fibula displaced 50%”

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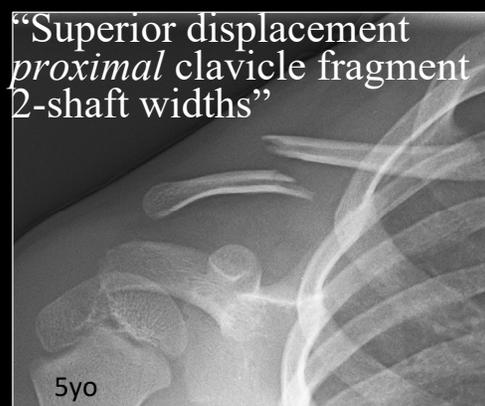
Displacement: Check all Views



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Displacement... exceptions

Clavicle
Proximal fragment relative to distal
 Neck muscles pull the *proximal* fragment up
 To avoid any confusion you will never be faulted for including which fragment you are using to reference displacement.



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Clavicle Fx

"Superior displacement *proximal* clavicle fragment >2-shaft widths, with a segmental fragment"



20yo

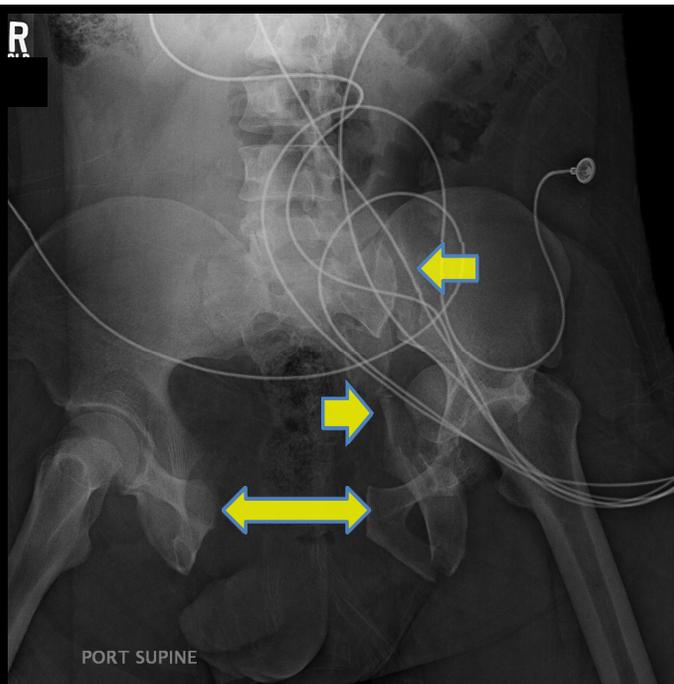


Required internal fixation

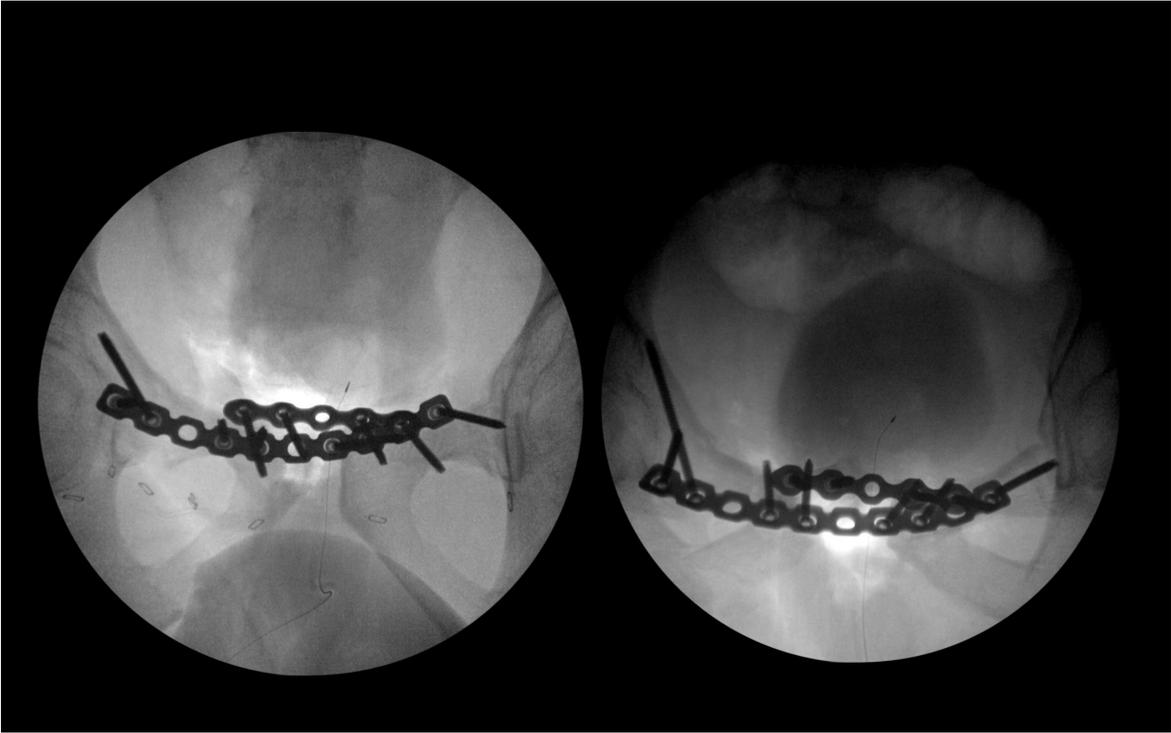
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Diastasis: Joint Widening

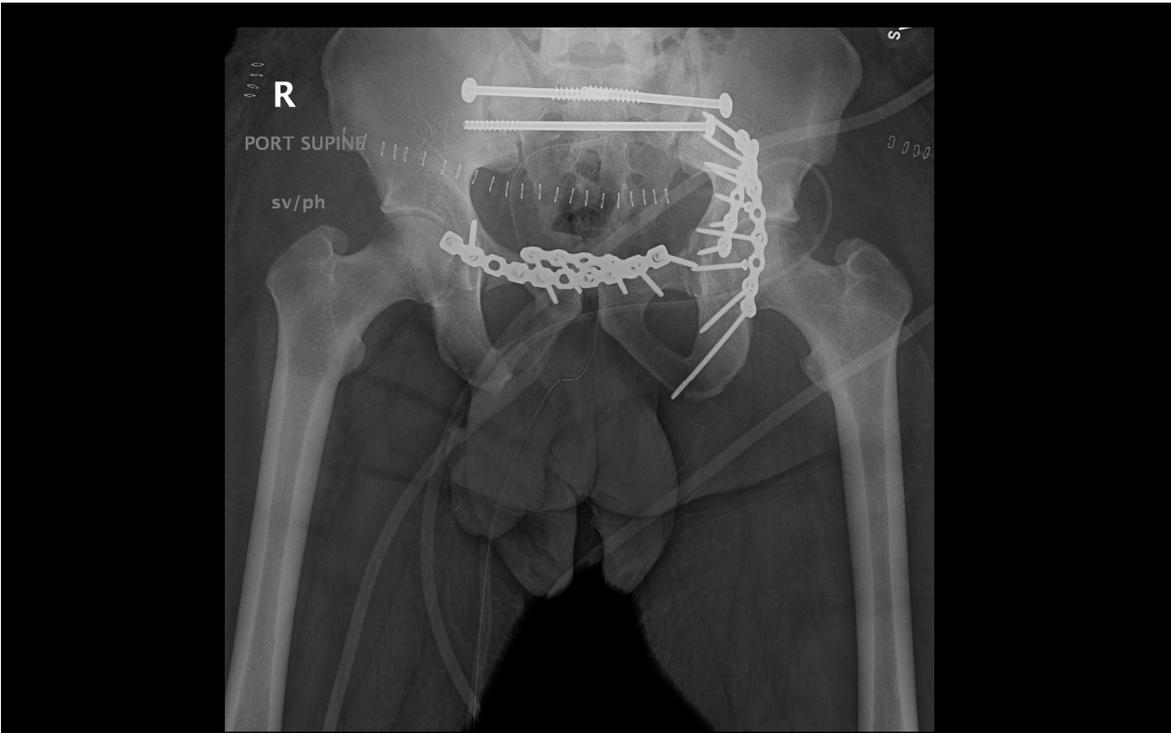
29 year old MVA



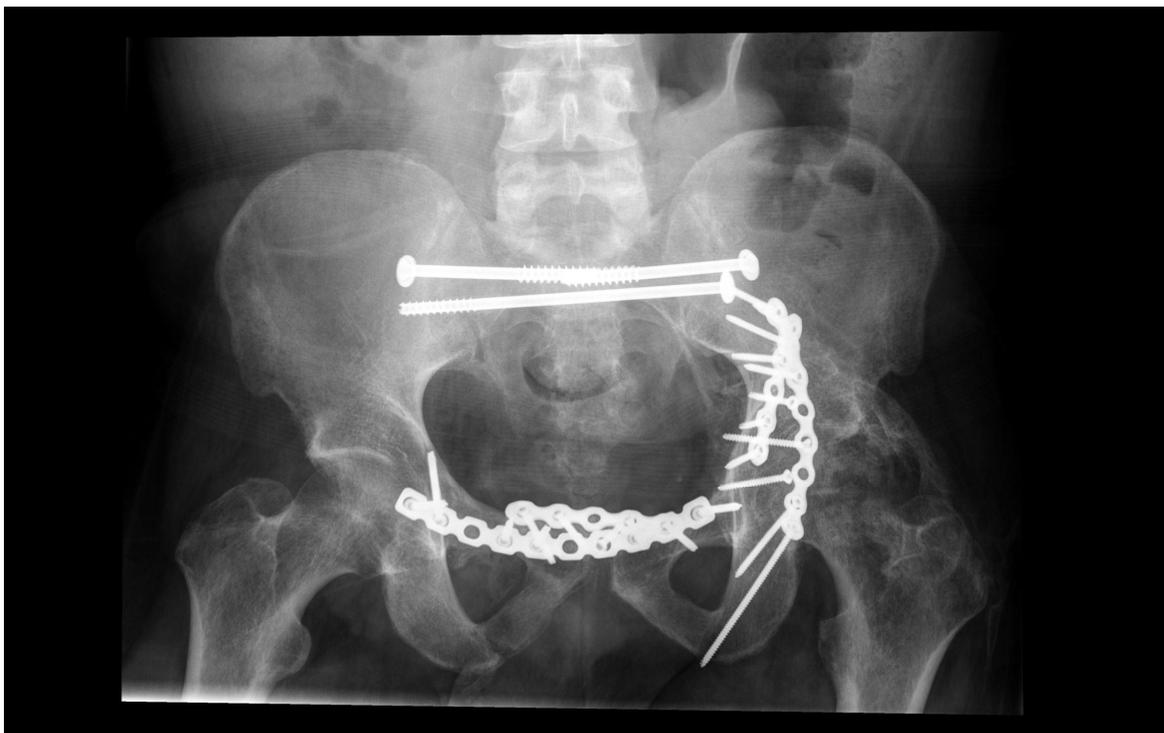
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Angulation

- Need to specify what is angulated relative to what.

“Lateral angulation of the distal fracture fragment”
 or
 “Apex medial angulation”
 or
 “*Valgus* angulation”

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Hallux Valgus

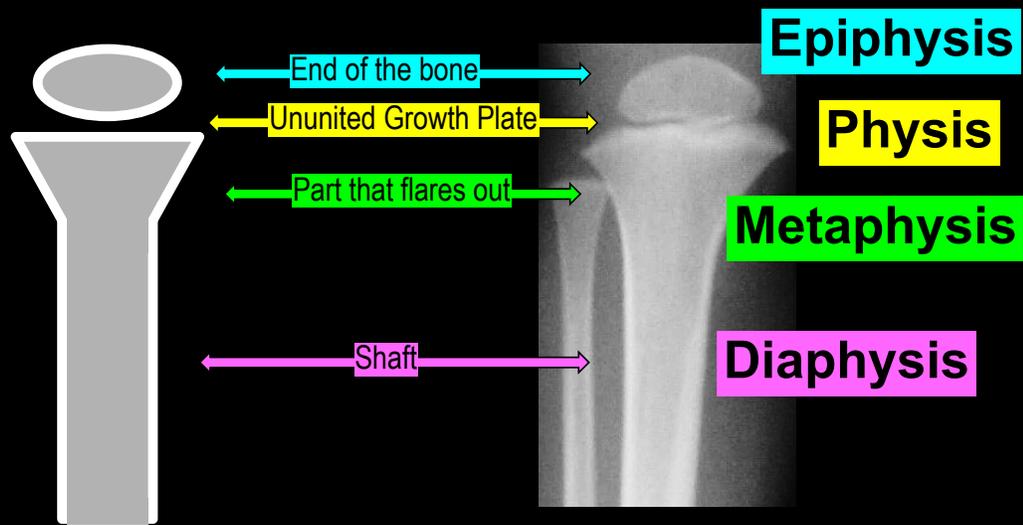


- "Bunion"
- 1st MTP (Metatarsal-phalangeal joint)
- "Hallux"
- Joint deviates medially**
- Distal segment in "Valgus"

Very common in women
?Due to tight pointy shoes

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Parts of the Immature Bone



2yo

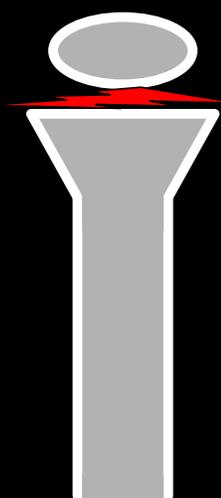
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Salter Harris Classification 1-5

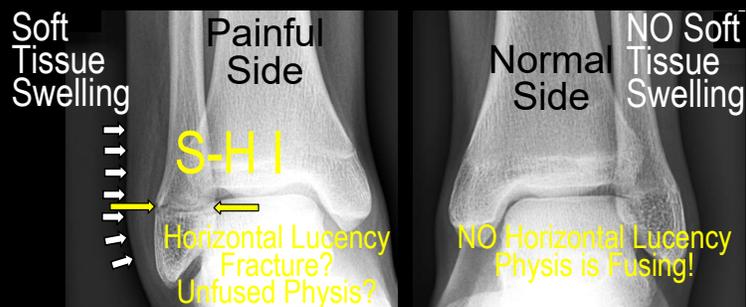
S= Same	1
A= Above	2
L= beLow	3
T= Through	4
Type 5 described as a pure crush	

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Salter-Harris: Type I Same

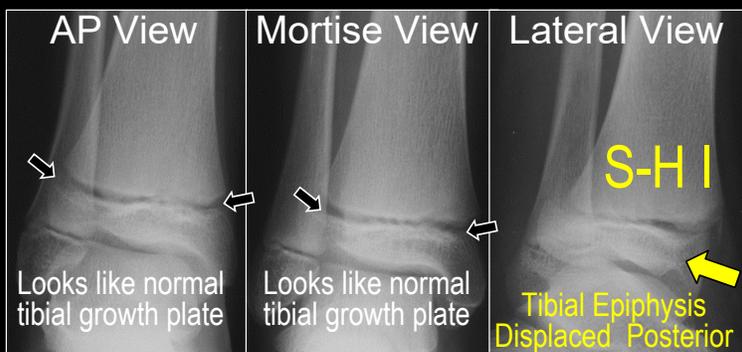
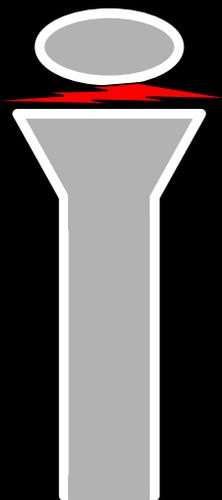


- Physis Only
- Can be quite subtle
- Especially when non-displaced
- Comparison with normal contralateral side helps



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Salter-Harris: Type I



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Salter-Harris Type II

Above (into metaphysis)

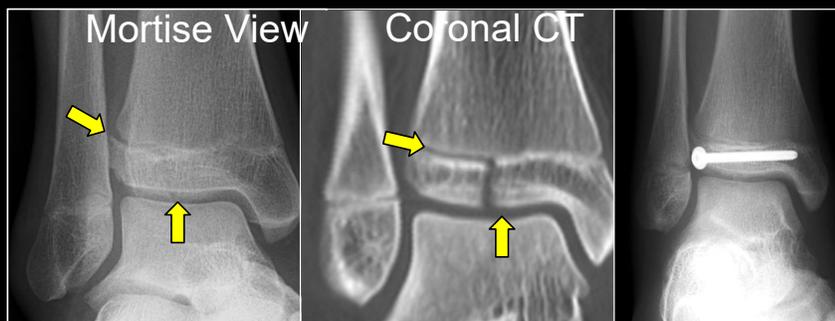
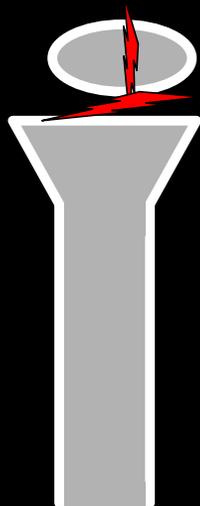


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Salter-Harris: Type III

beLow (into epiphysis)

- Physis + Epiphysis
Extends into joint
- Potentially more serious
>2mm articular step-off → surgery
- CT very helpful assess alignment

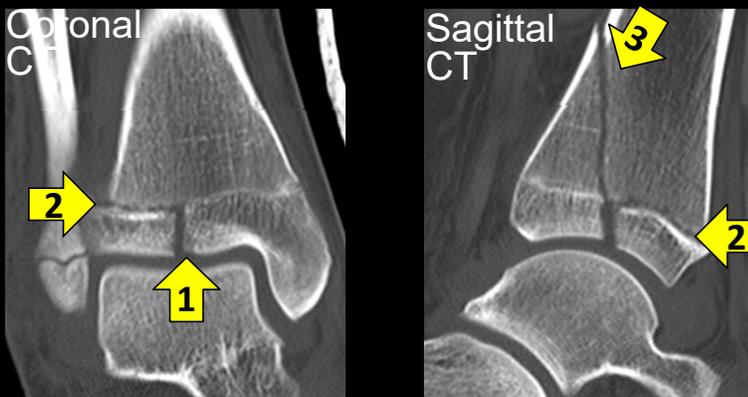
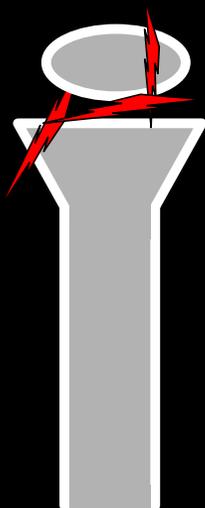


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Salter-Harris: Type IV

Through (through metaphysis and epiphysis)

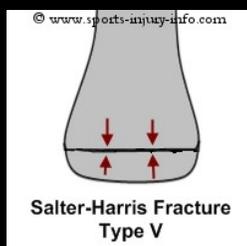
- + Epiphysis + Metaphysis
- Distal Tibia = "Triplane Fracture"
- Usually evaluated with CT



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Salter Harris: Type V

- Included for completeness. Described as less than 1% occurrence. I have not personally seen and have failed to see a radiographic film fitting this description. Always keep in mind and associate clinically with exam findings and mechanism (ex fall from significant height)



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Bowing (Plastic) Fractures



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Common "Clinic" Fractures

- Ankle and wrist fractures are common fractures you may see in clinic. Ankle fractures have slightly different terminology, but the basic principles still apply.

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Described by:

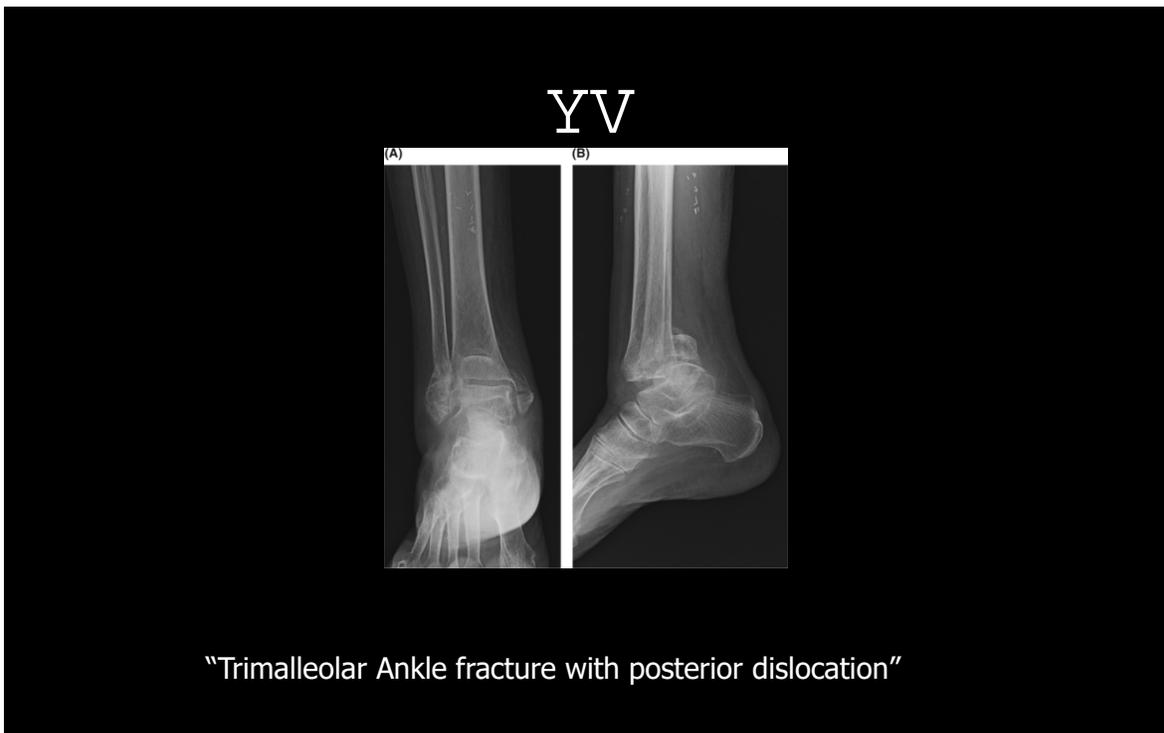
- 1) Malleoli involved (lateral, medial, posterior.. some or all)
 - Bimalleolar, trimalleolar, etc
- 2) Displacement
- 3) Mortise reduction (subluxed or dislocated?)

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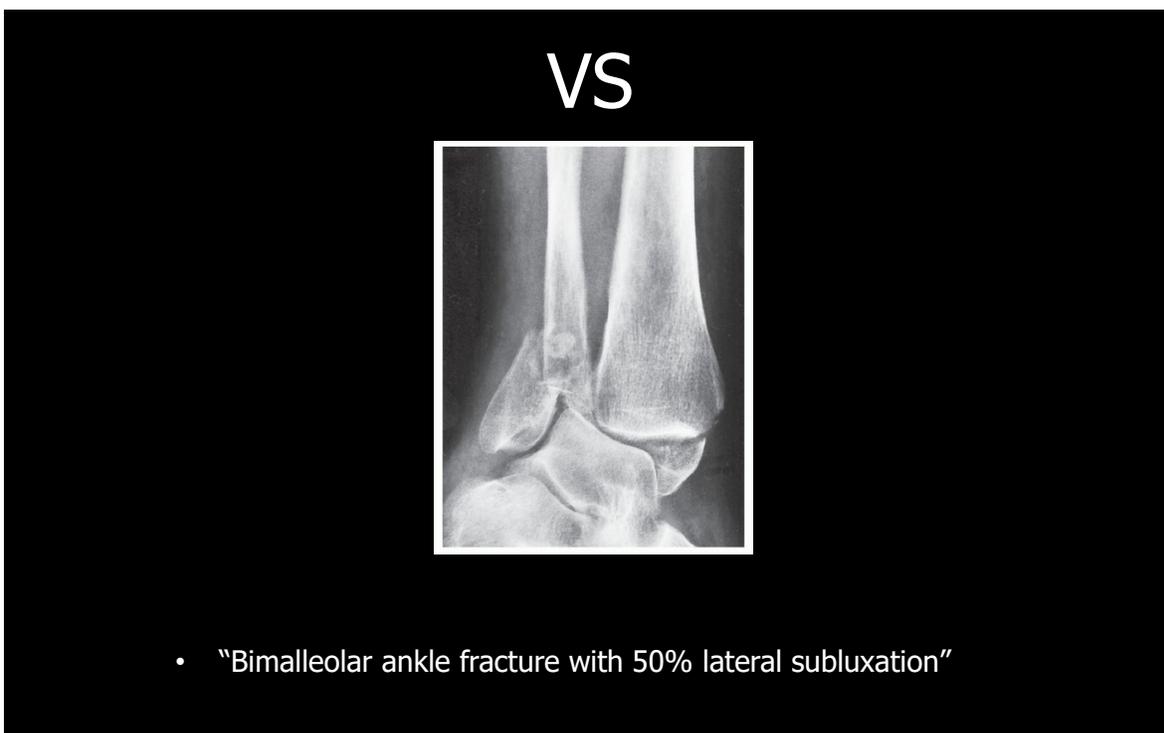


"nondisplaced lateral malleolus fracture with an intact ankle mortise
"or" nondisplaced lateral malleolus without subluxation"

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Distal Radius Fractures

Angulation and displacement principles still apply

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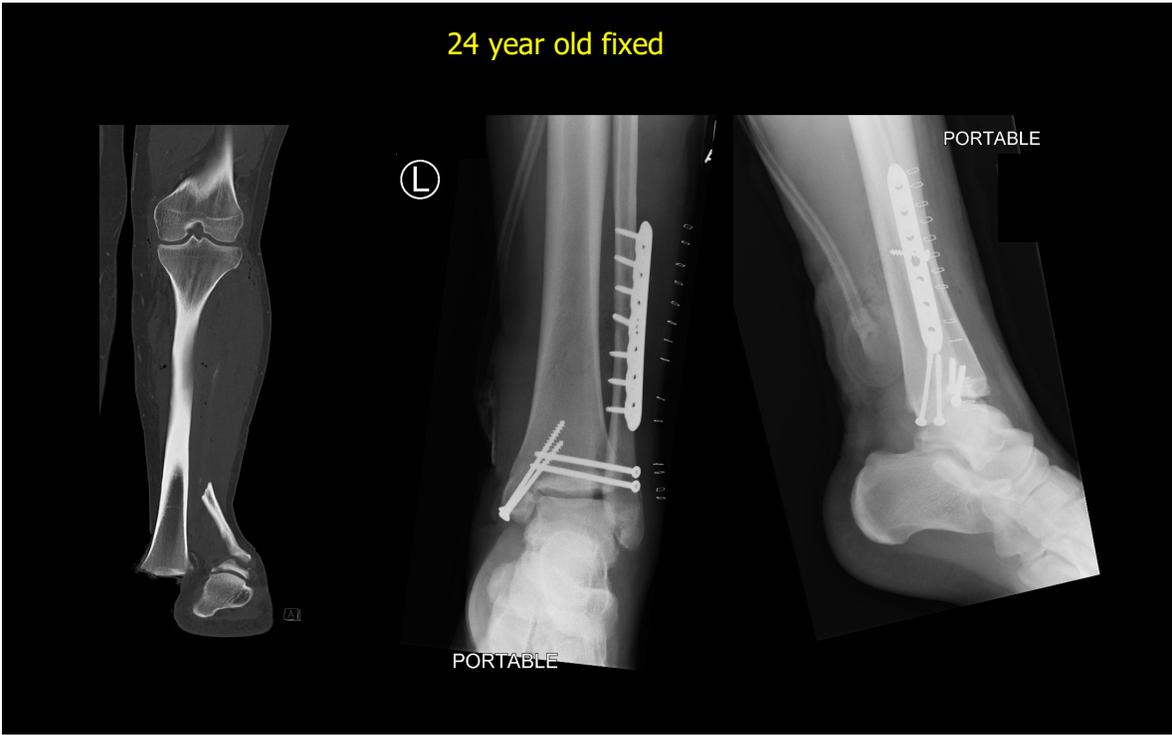
Case Presentations

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24 yr old with high speed MVA



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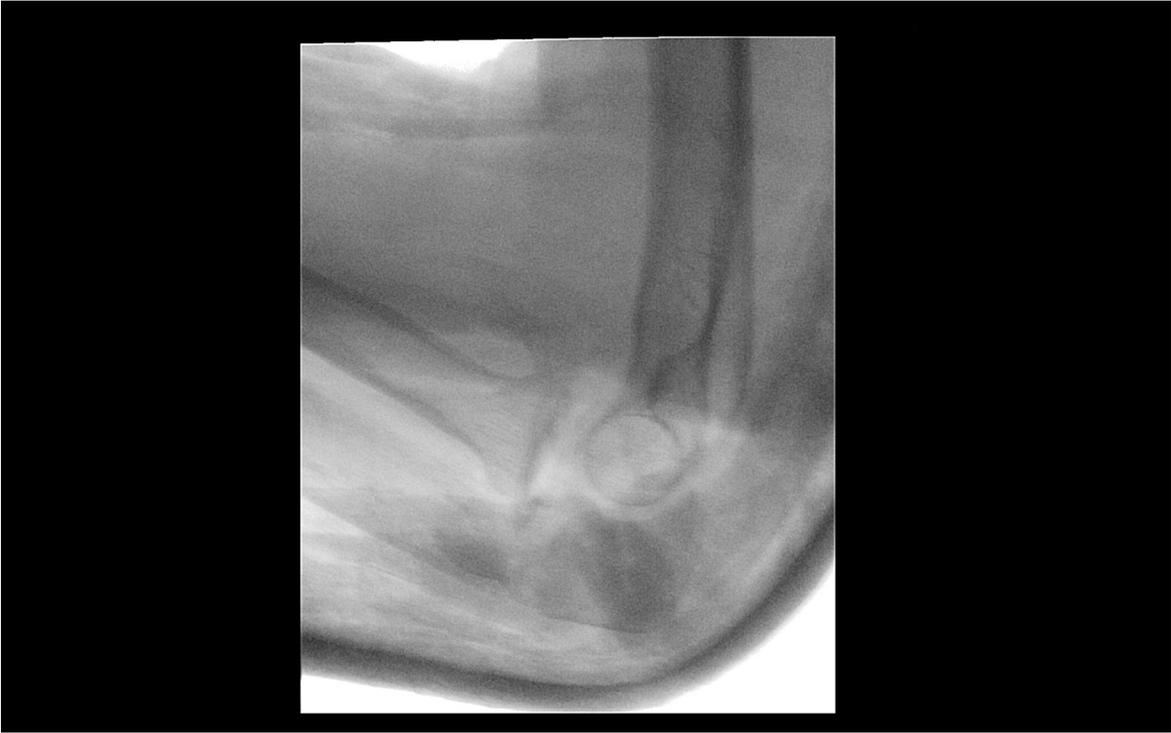
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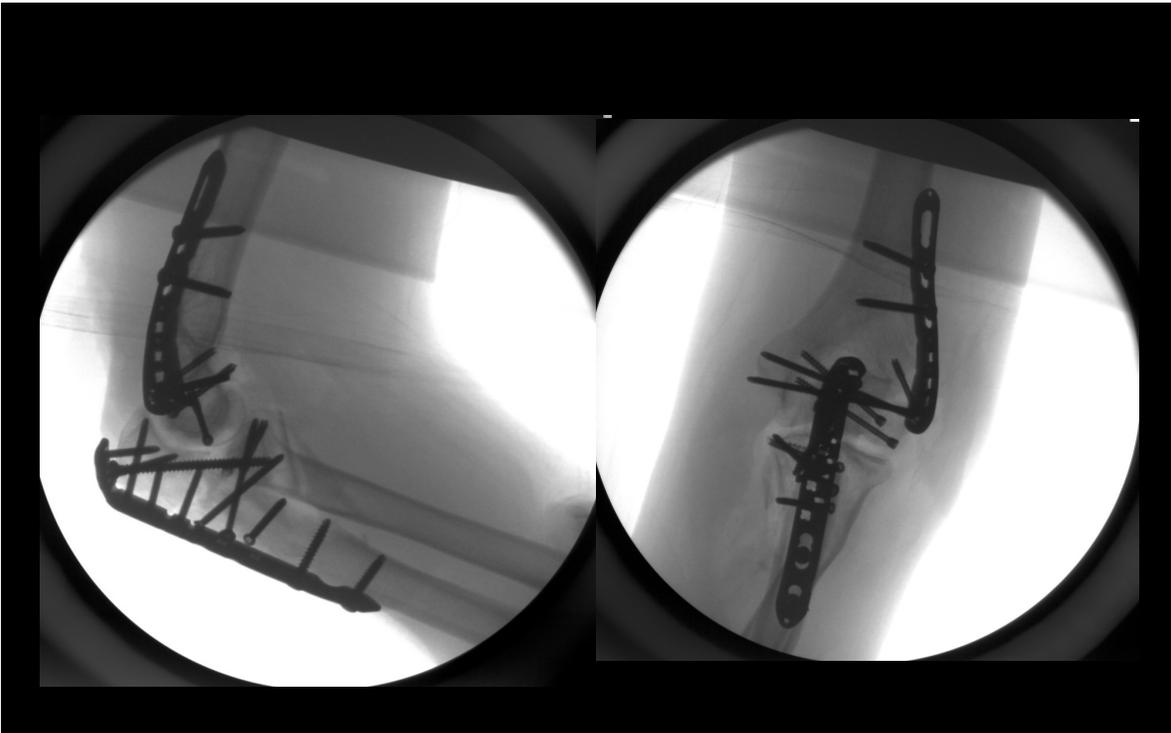
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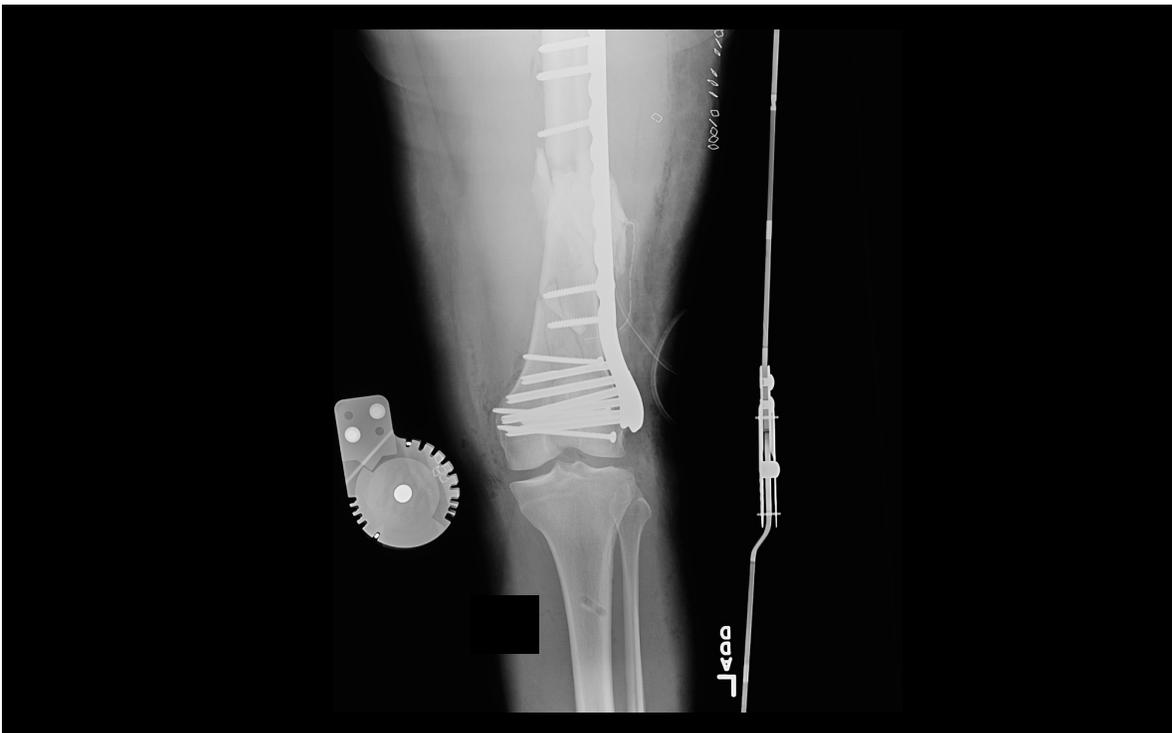
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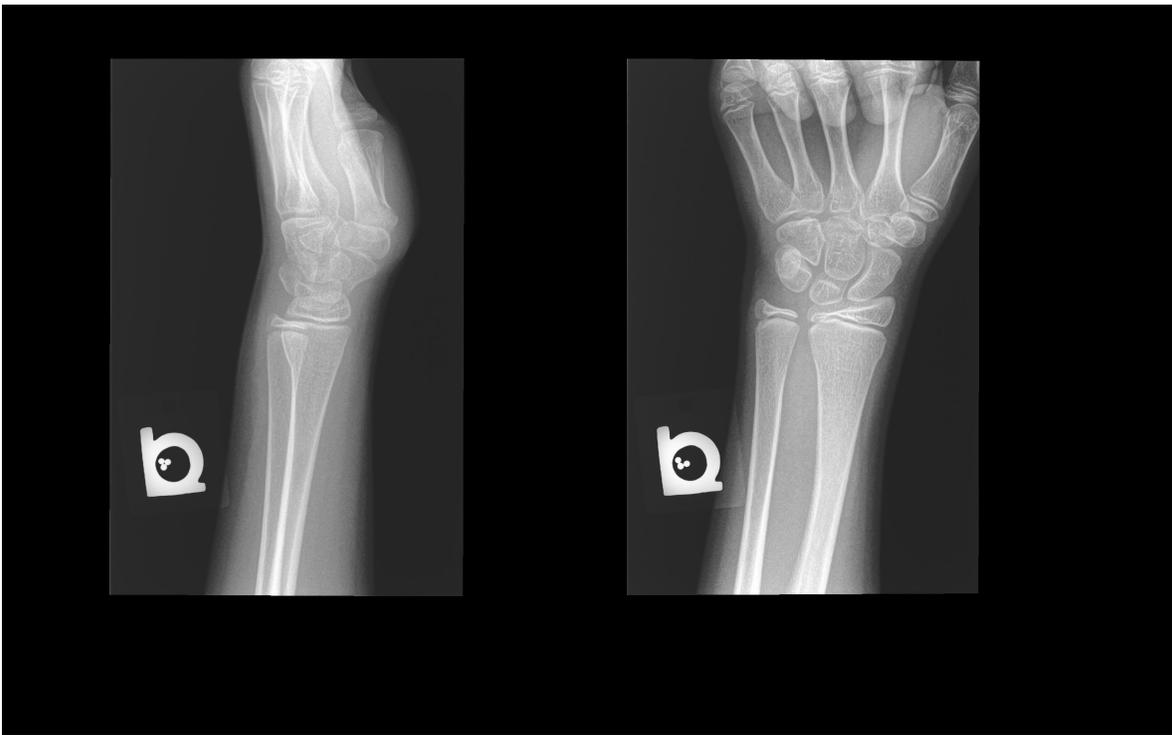
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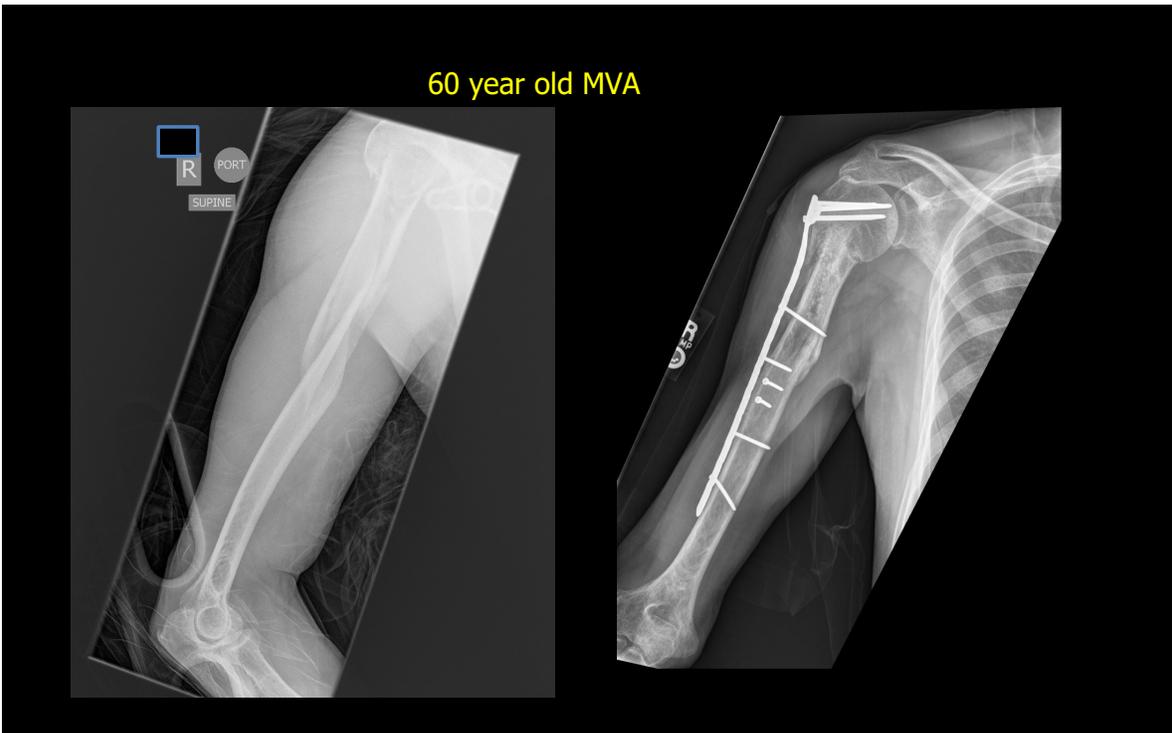
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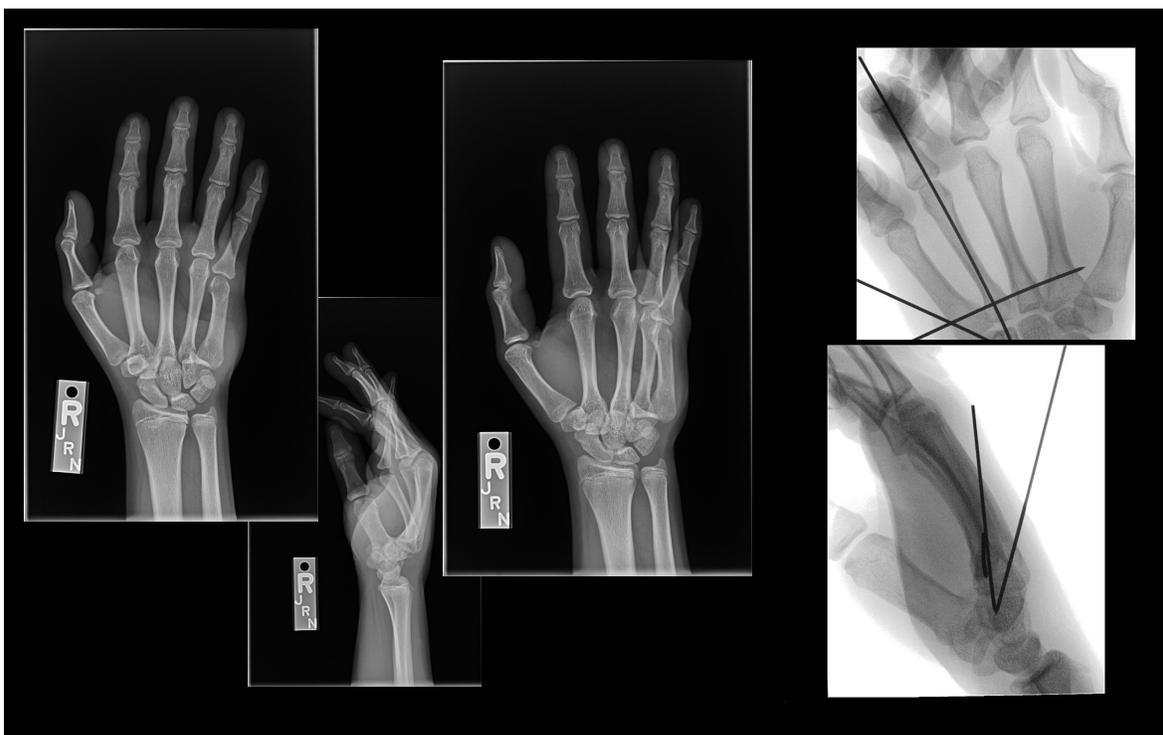
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References/Acknowledgements

1. University of Wisconsin, Dr. Schriebman for his Language of Fractures presentation

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