

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

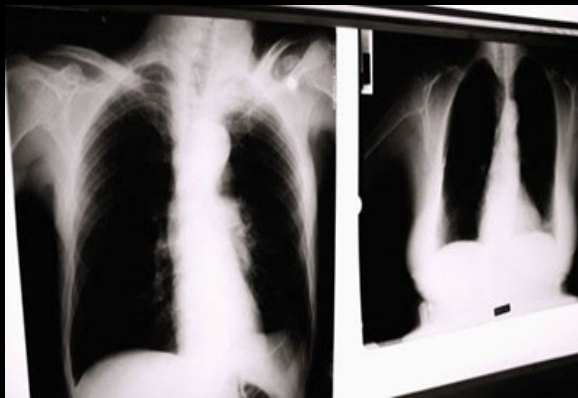
- A: Adequacy, Alignment
- B: Bones
- C: Cartilage
- S: Soft Tissues
- Apply ABCs approach to every orthopedic film we evaluate

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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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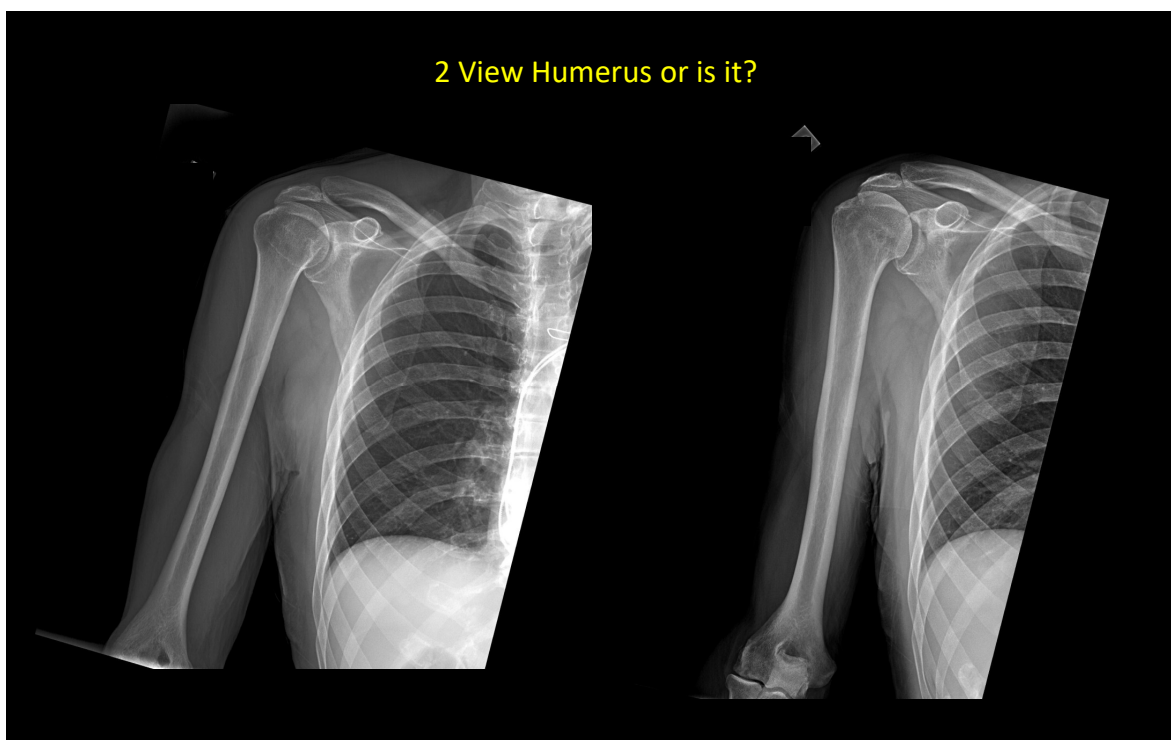


Overexposure



Underexposure

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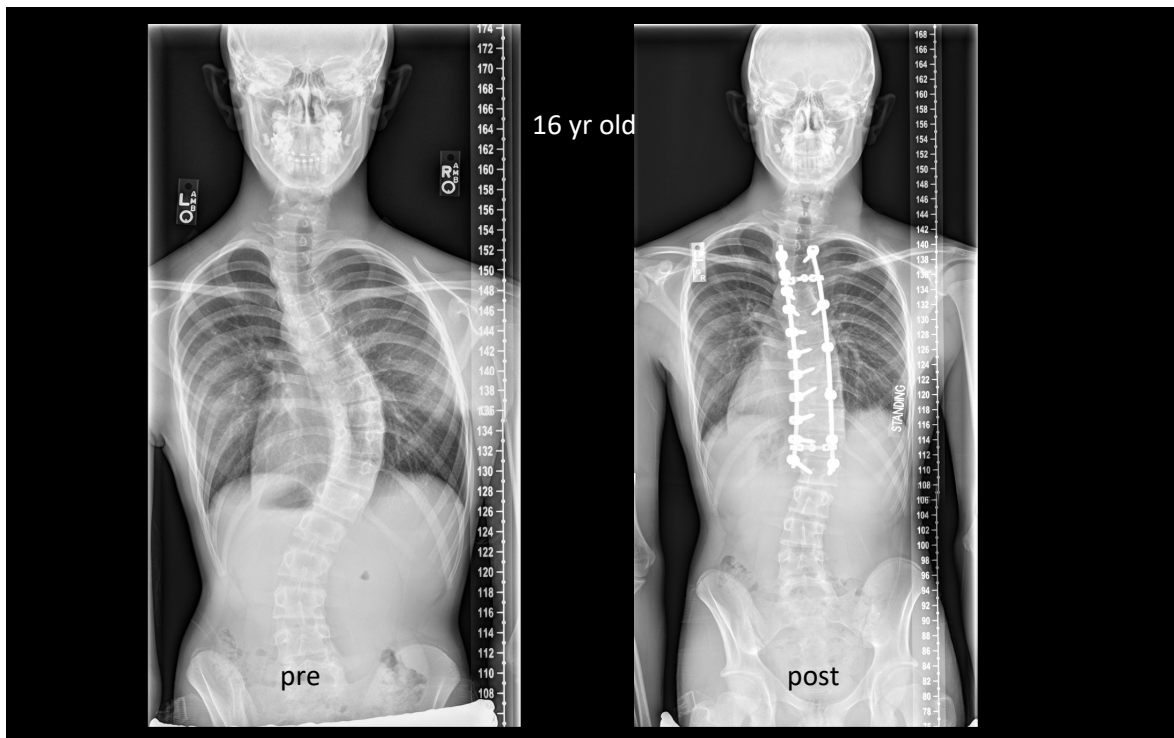


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ALIGNMENT

- 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

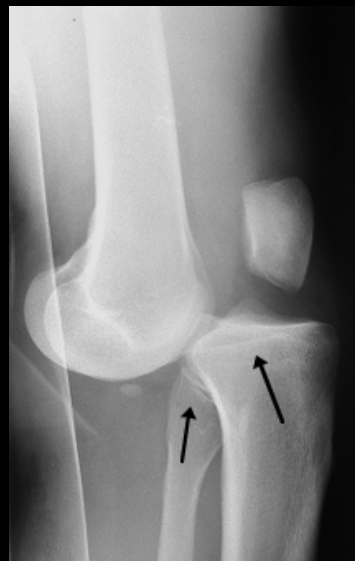
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DISLOCATION

- 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

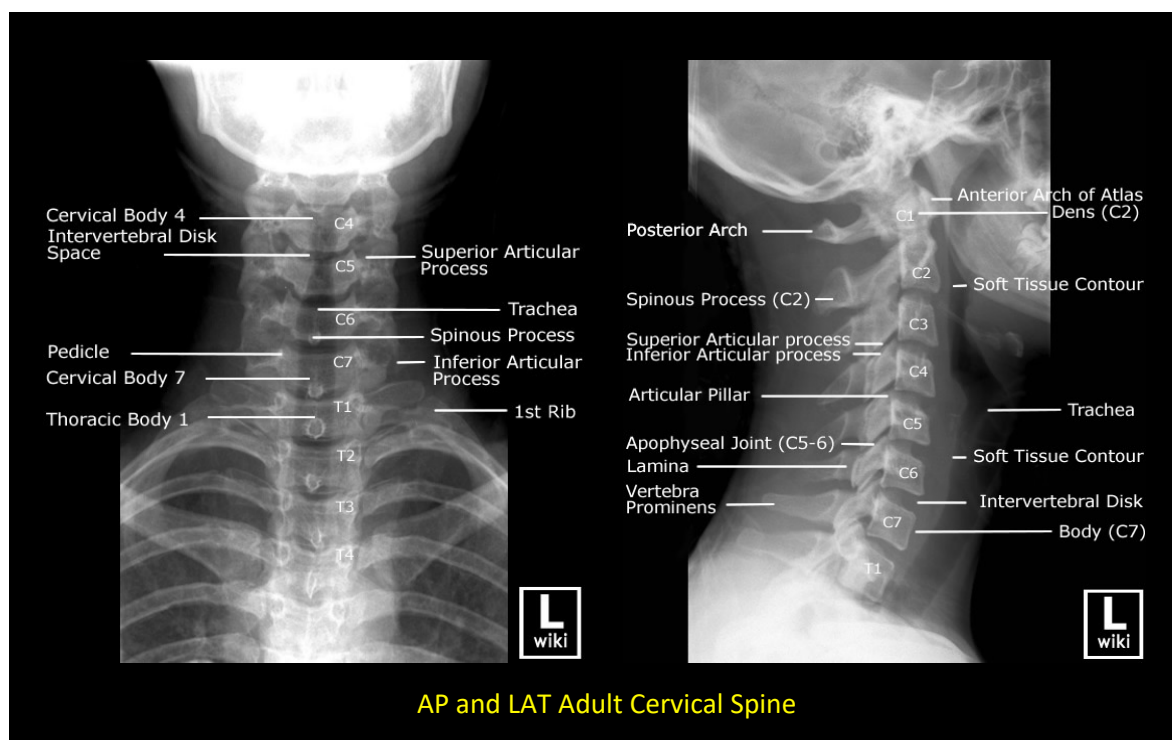


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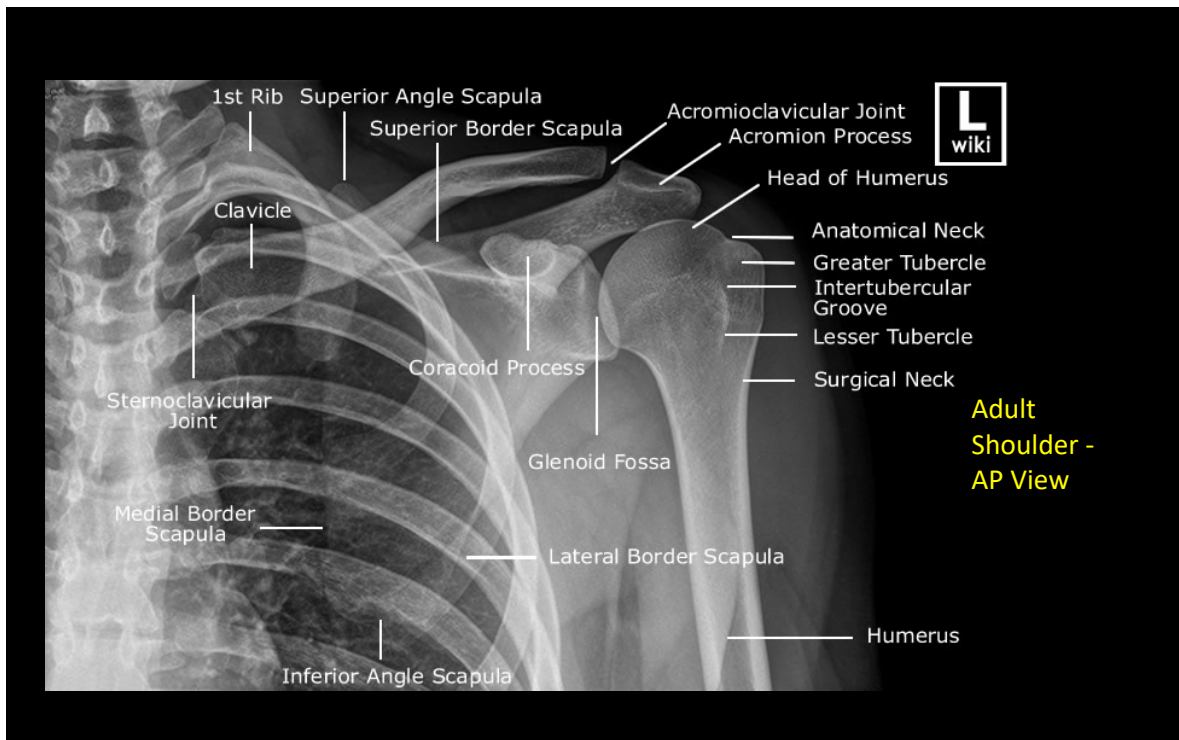
BONES

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

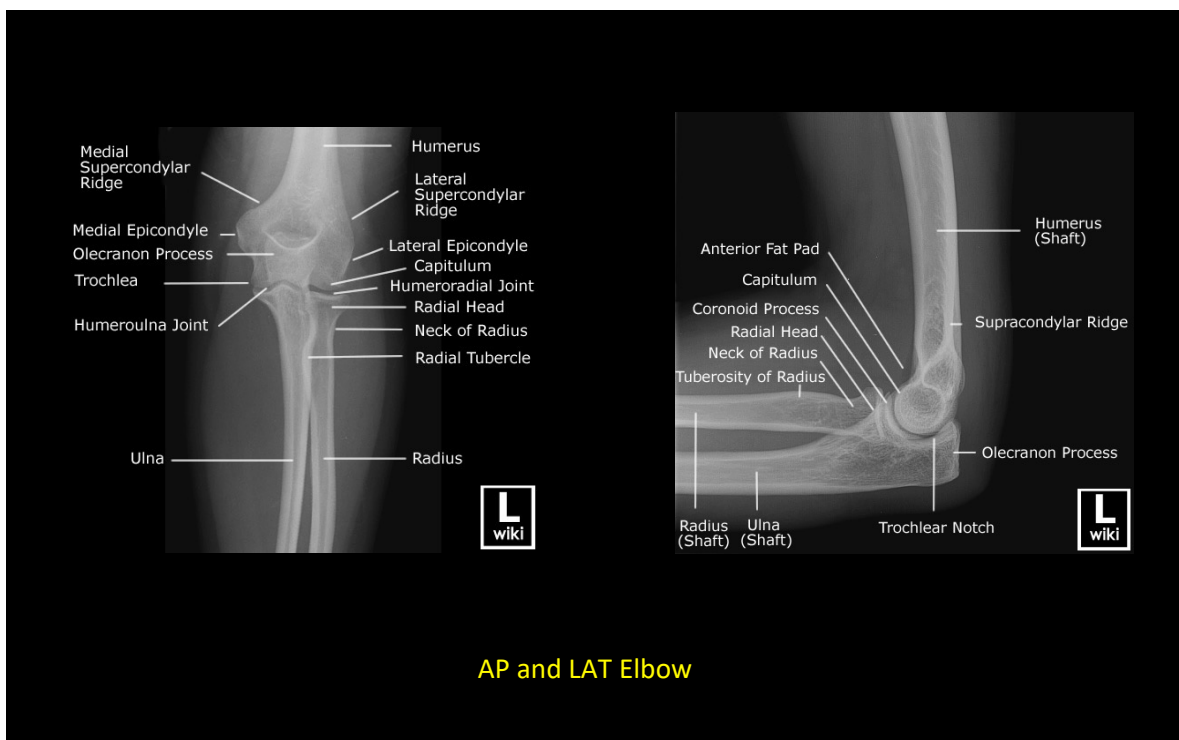
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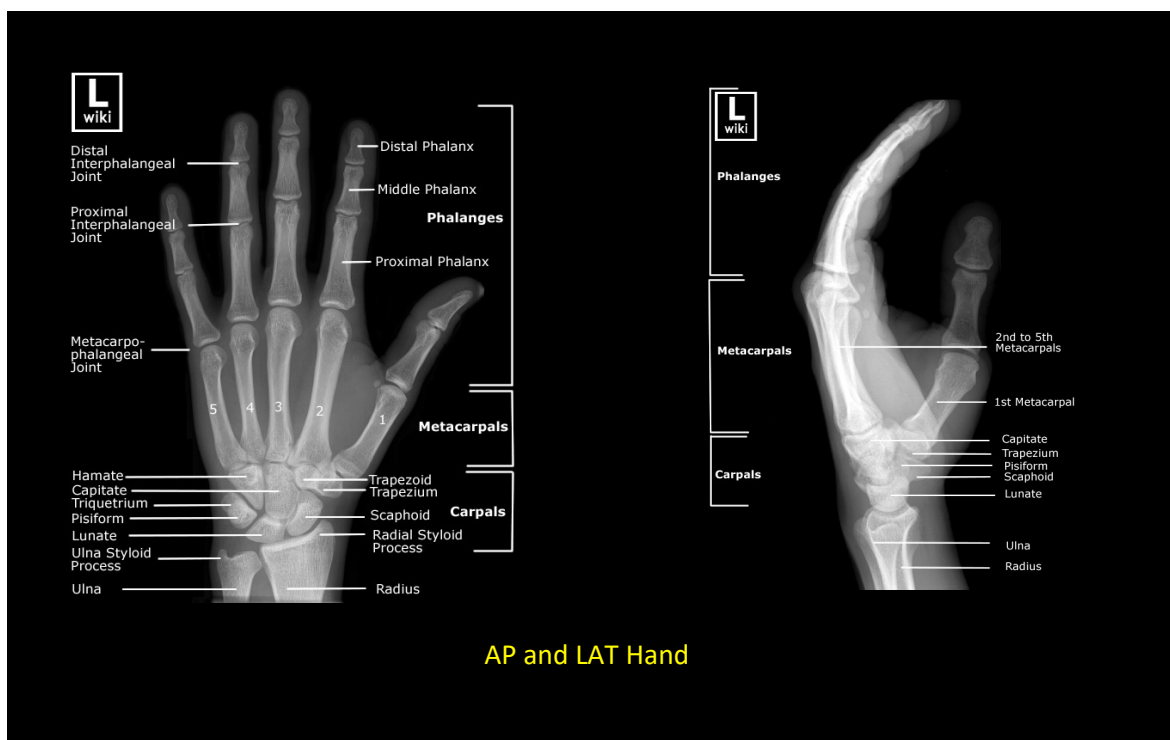
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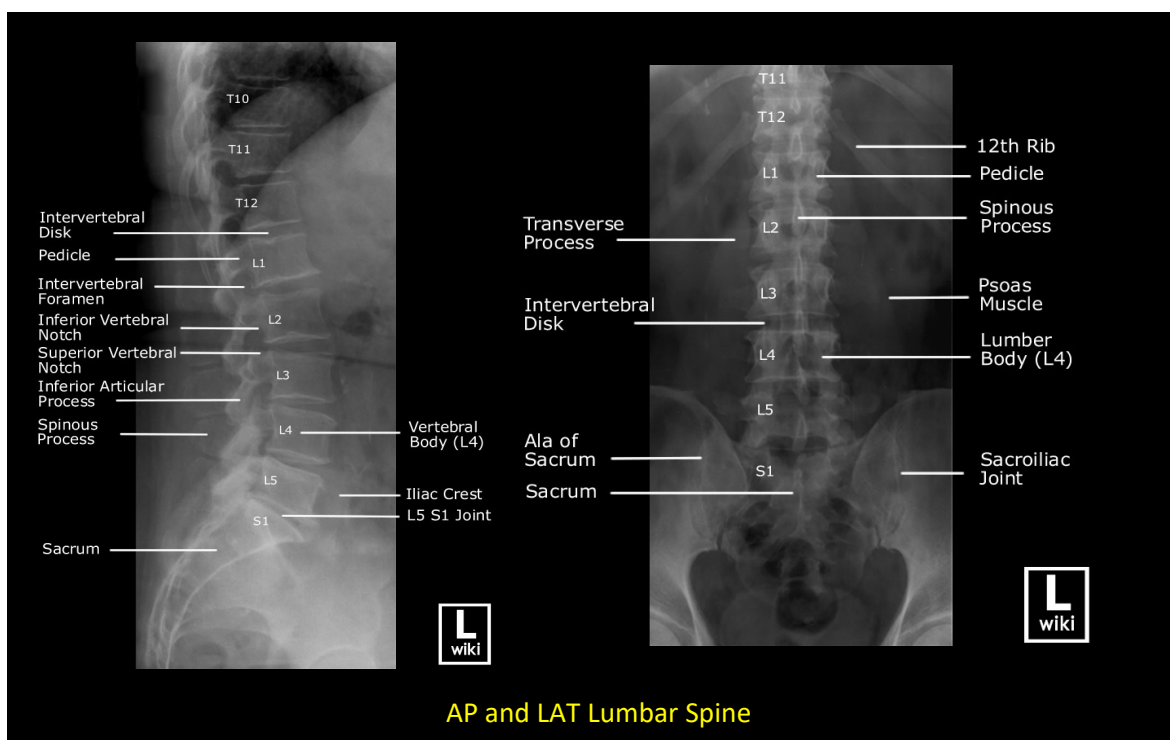
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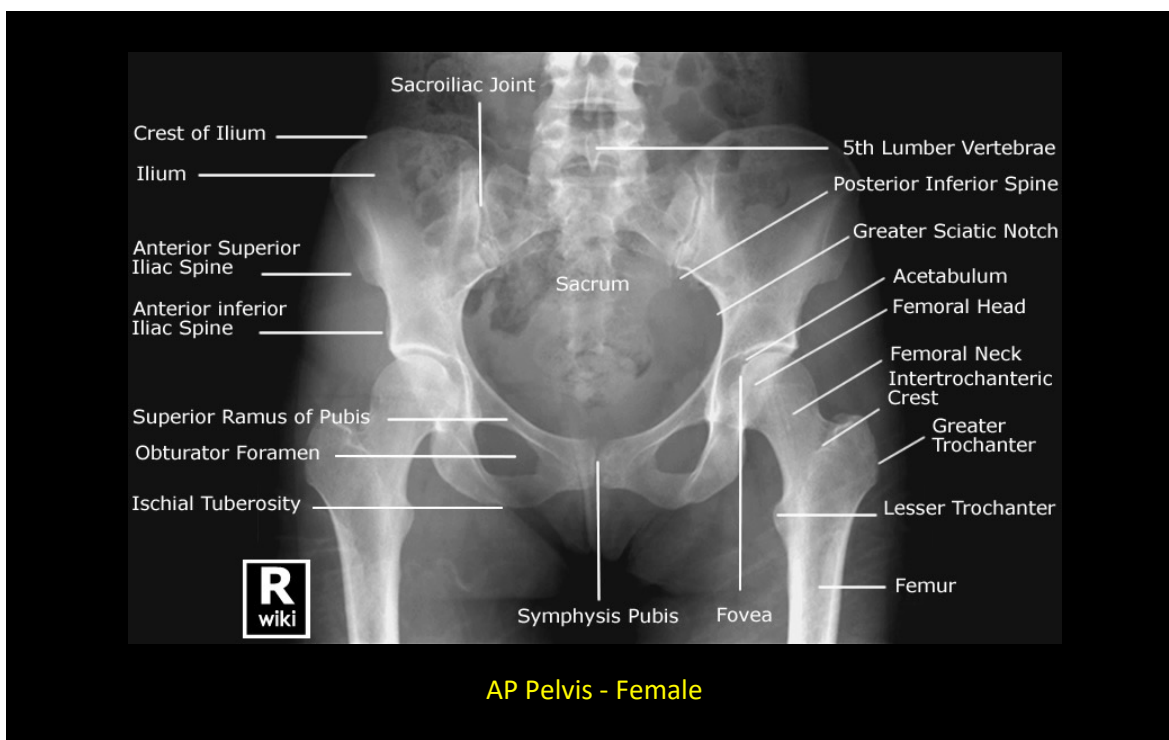
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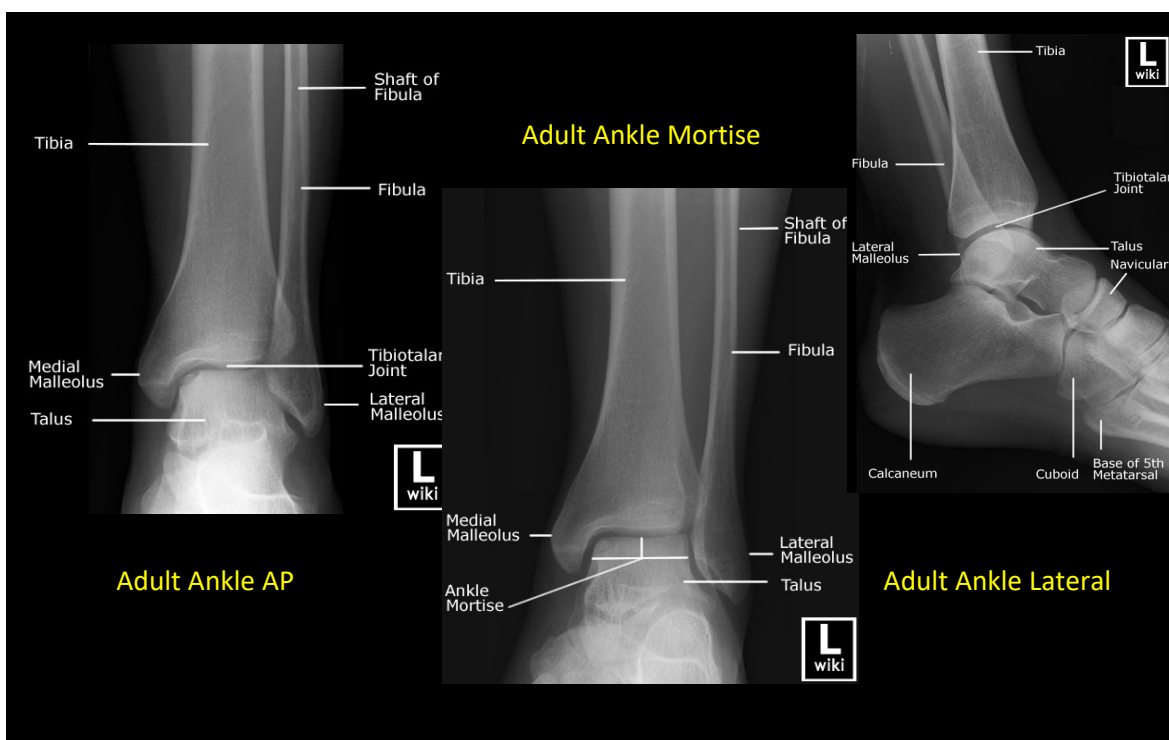
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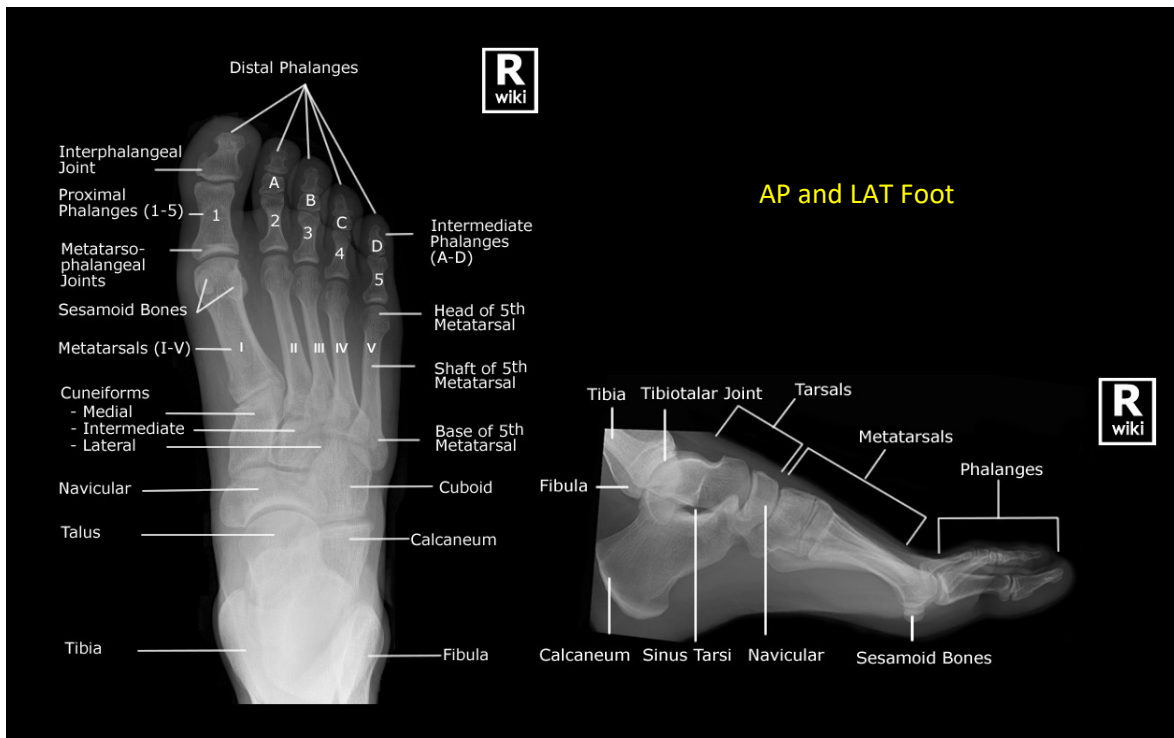
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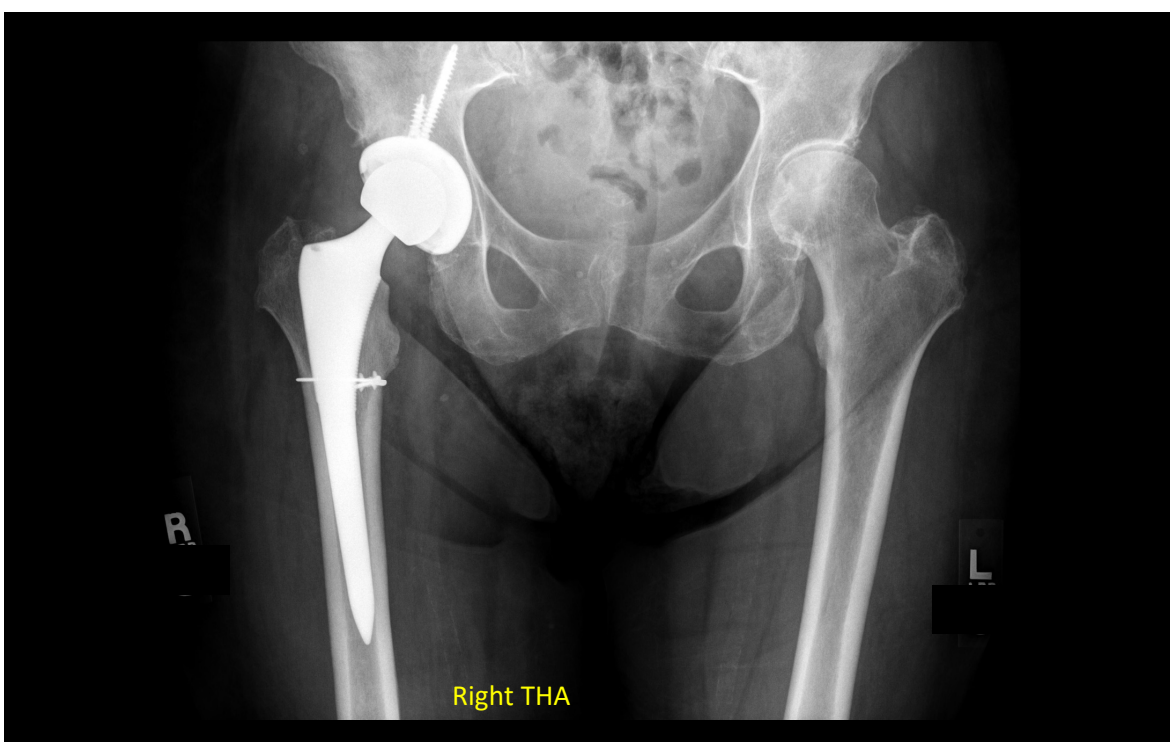
CARTILAGE

- 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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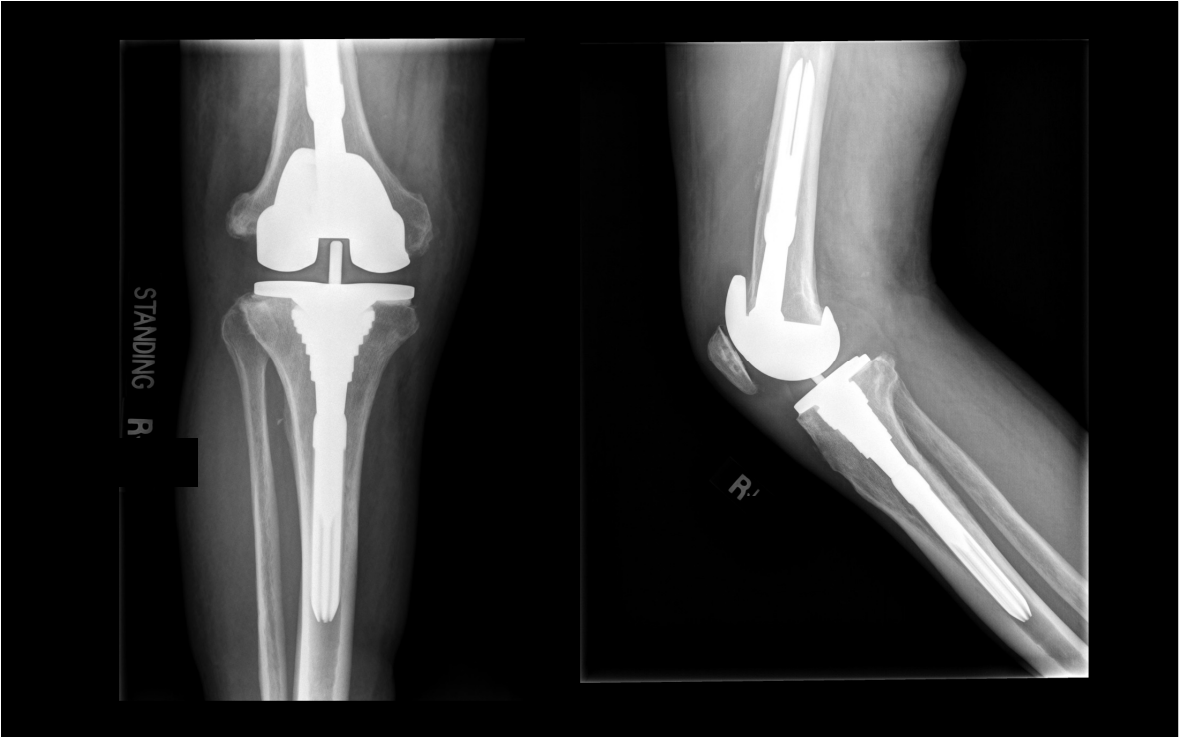
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SOFT TISSUES

- 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!

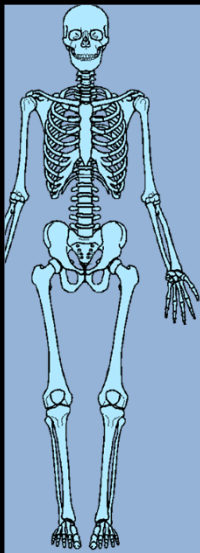


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WHERE ARE THE FRACTURES?



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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.)

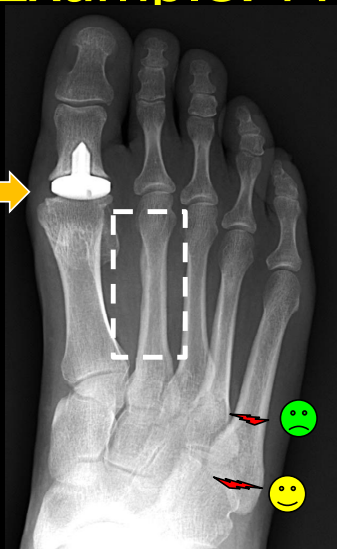
Some areas more prone to certain types of fractures

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:

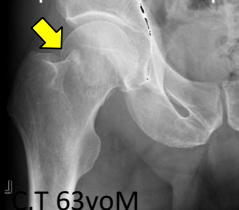
- Fractures Very Common
- Base 5th MT
 - 1) Avulsion Fx
± 99% Heal
 - 2) Jones Fx
± 50% non-union

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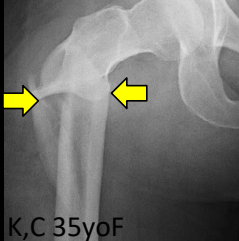
Hip Fracture Flavors

Femoral Neck Fx.
Impacted/min displaced

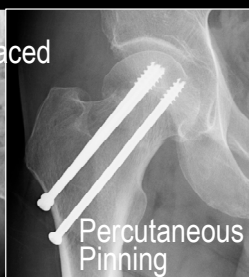


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Subtrochanteric Fx

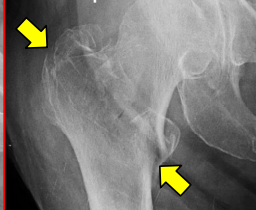


K,C 35yoF

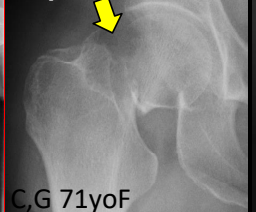


Percutaneous
Pinning

Intertrochanteric Fx
min displaced



Femoral Neck Fx
displaced



C,G 71yoF



Intramedullary nail



Dynamic
Hip
Screw or



IM nail

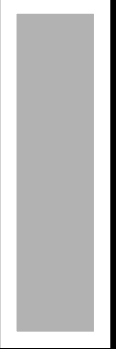


Hip
Prosthesis

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Bone Model

**White Line =
Cortical Bone**



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

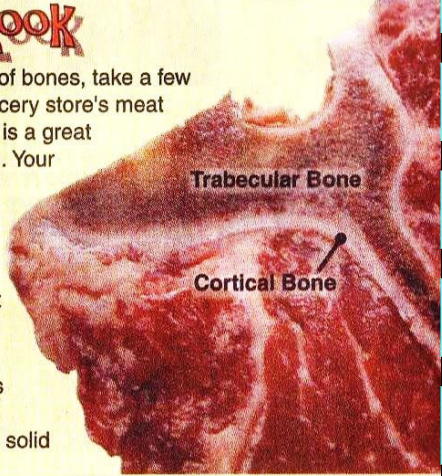
A CLOSER LOOK

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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Terminology



- Radiographic Views:

AP (Anterior → Posterior)

Most frontal radiographs

PA (Posterior → Anterior)

Hands, wrists

Chest (Standard non-portable)

Lateral view

From the side (R→L, L→R)

- Patient sides

Medial: Towards the middle

Lateral: Towards the side

Anterior: Front (Volar)

Posterior: Back (Dorsal)

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What are we looking for clinically?

OPEN vs CLOSED Fracture

Neurovascular Status

Compartments

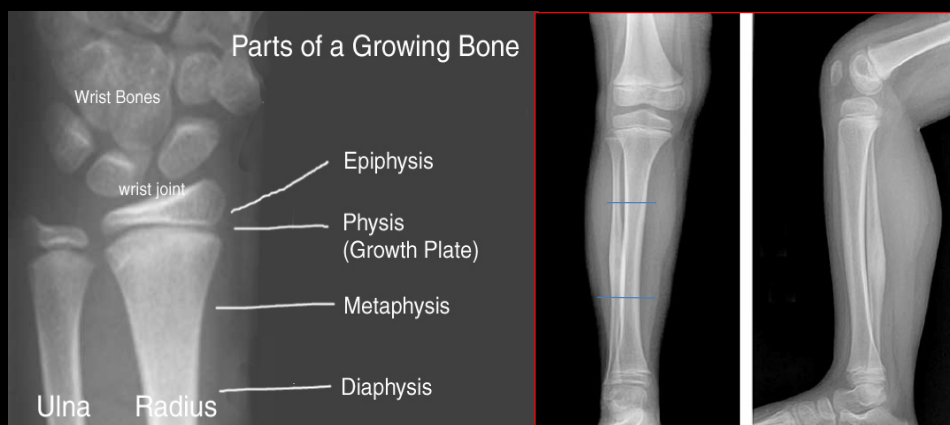
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What are we looking for Radiographically?

- 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

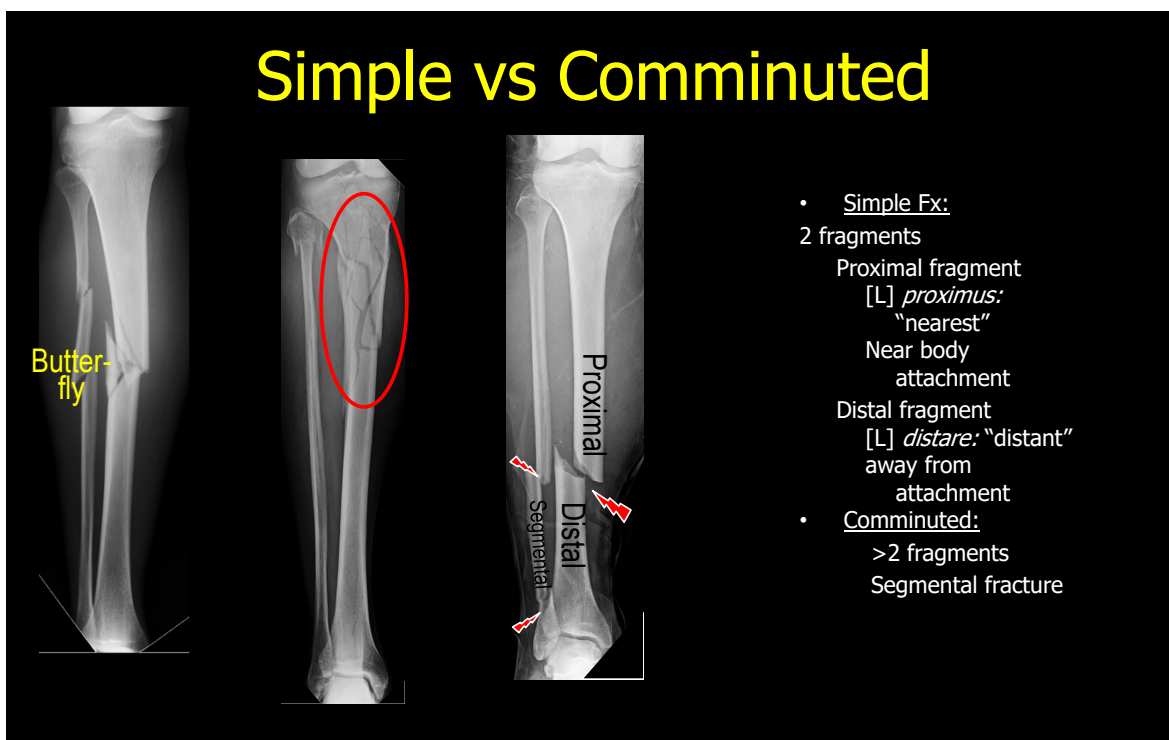
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Location



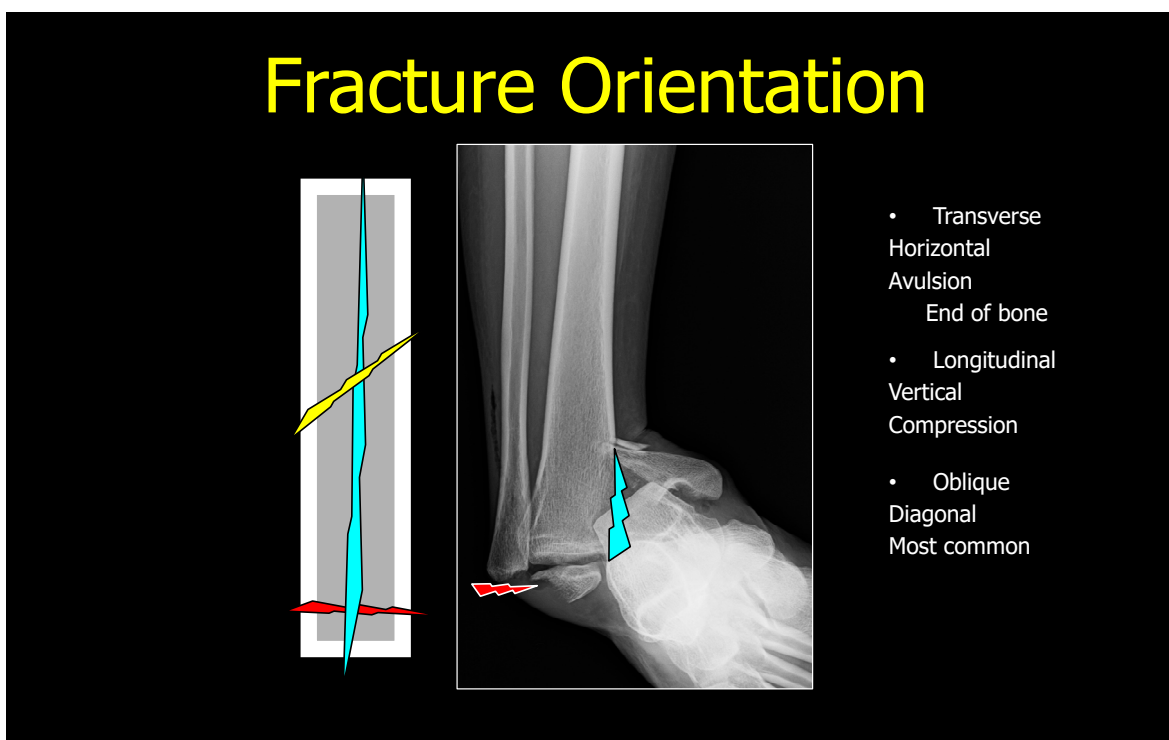
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Simple vs Comminuted



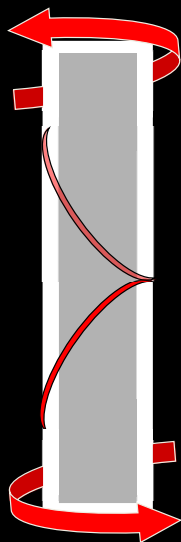
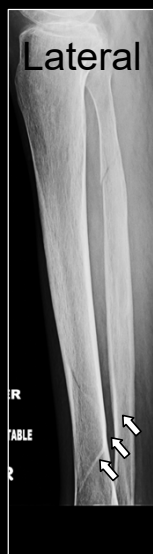
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Fracture Orientation



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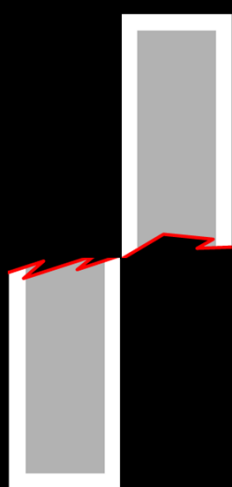
Fracture Orientation



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

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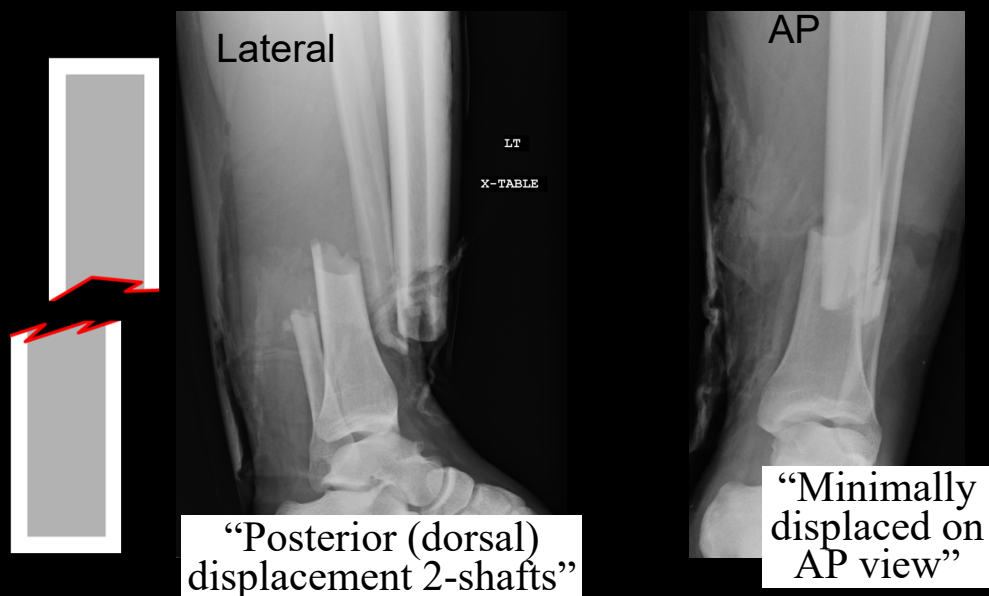
Displacement



- **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.



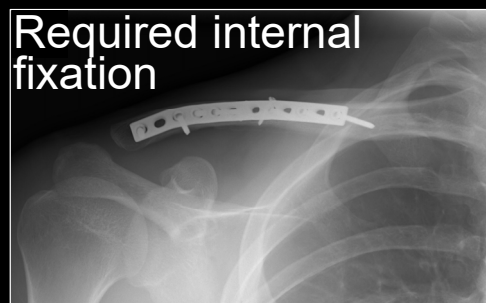
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Clavicle Fx

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



20yo

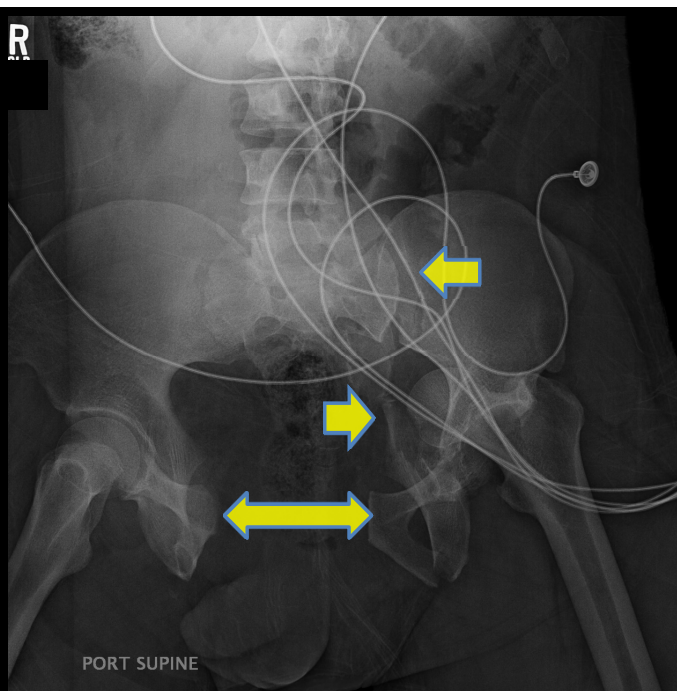


Required internal fixation

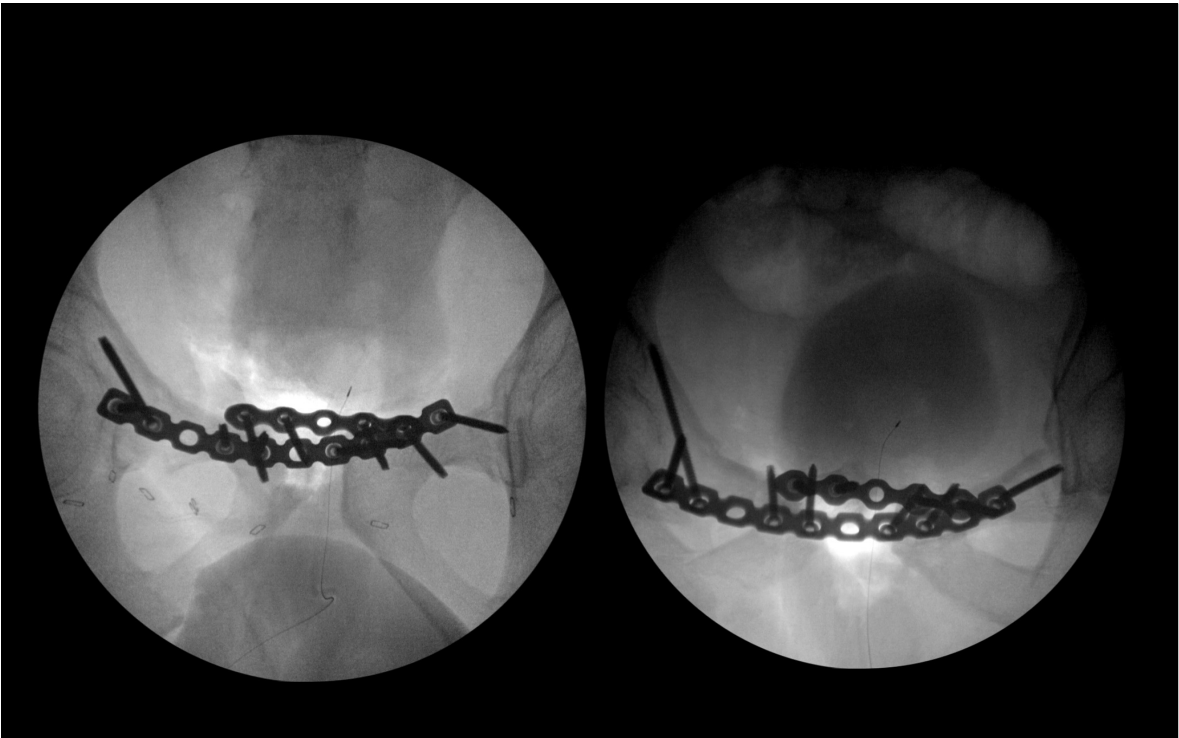
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Diastasis: Joint Widening

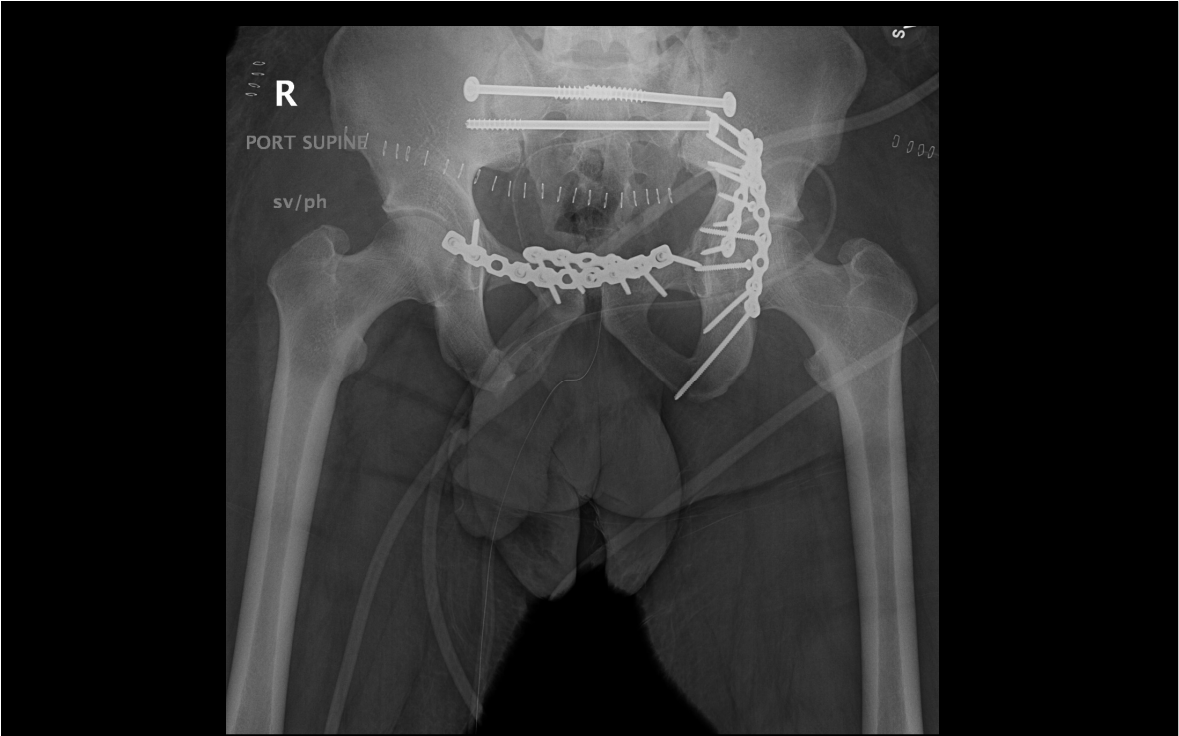
29 year old MVA



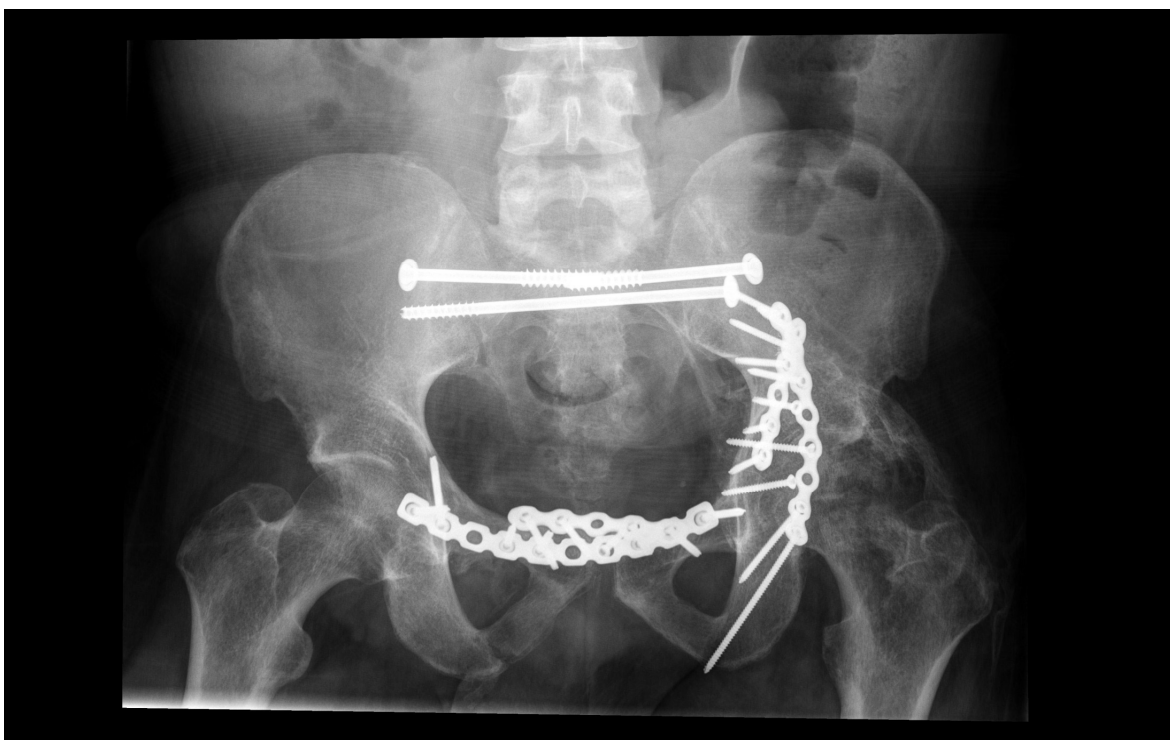
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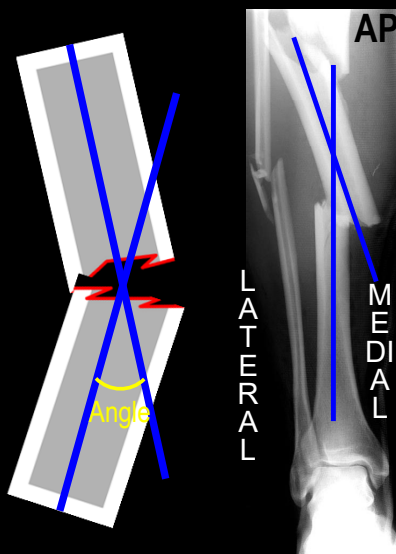
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Angulation

- 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

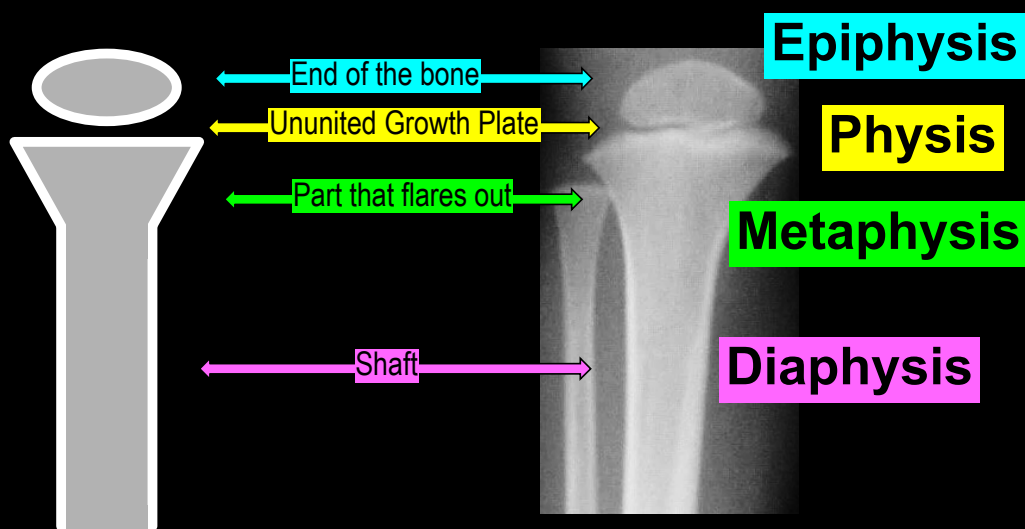


- "Bunion"
- 1st MTP (Metatarsal-phalangeal joint)
- "Hallux"
- Joint deviates medially**
- Distal segment in "Valgus"

Very common in women
?Due to tight pointy shoes

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Parts of the Immature Bone



2yo

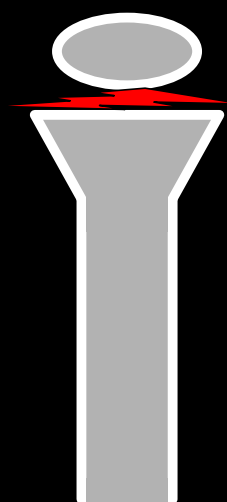
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Salter Harris Classification 1-5

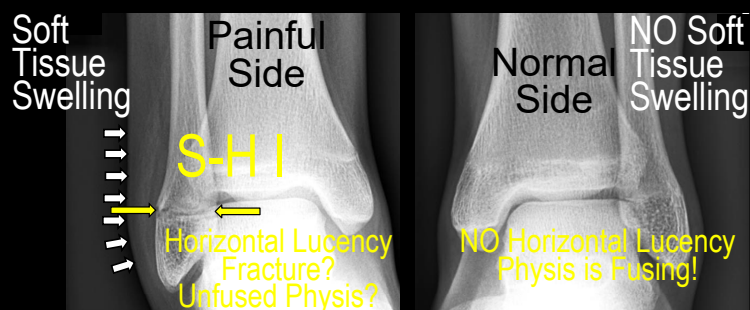
S= Same	1
A= Above	2
L= beLow	3
T= Through	4
Type 5 described as a pure crush	

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Salter-Harris: Type I Same

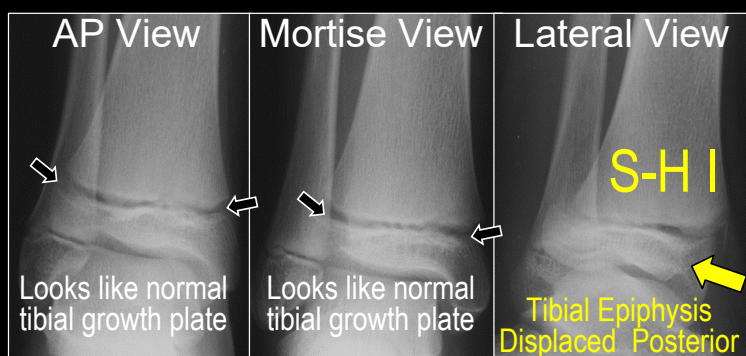
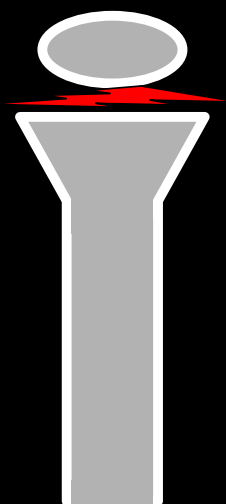


- Physis Only
- Can be quite subtle
- Especially when non-displaced
- Comparison with normal contralateral side helps



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Salter-Harris: Type I



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Salter-Harris Type II

Above (into metaphysis)

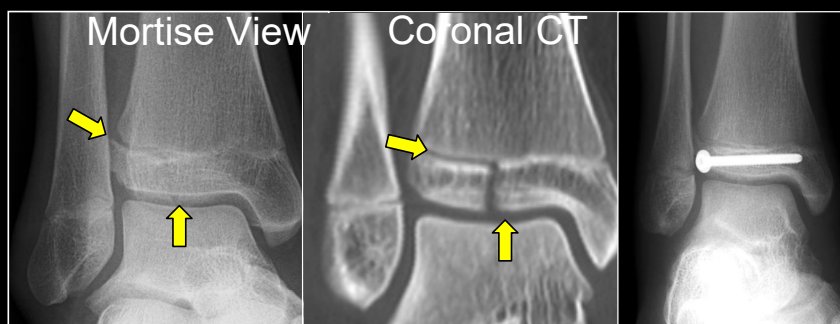
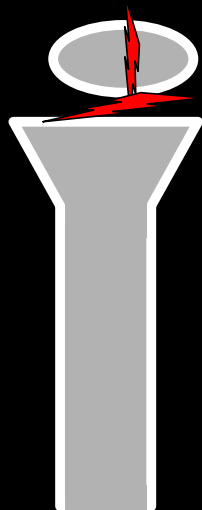


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Salter-Harris: Type III

beLow (into epiphysis)

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

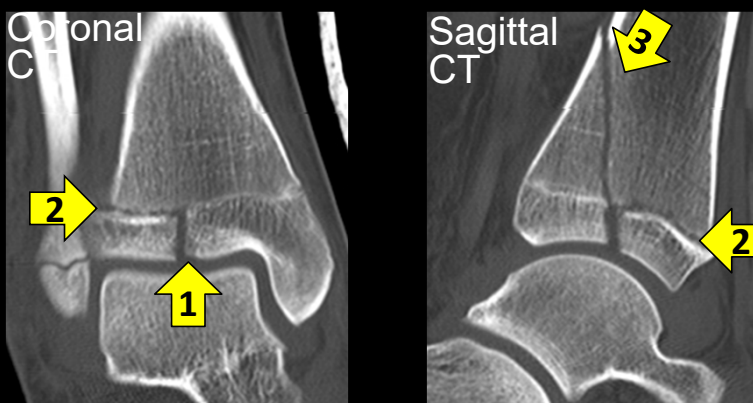
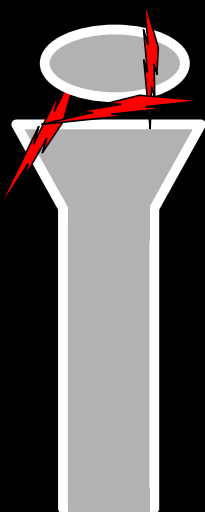


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Salter-Harris: Type IV

Through (through metaphysis and epiphysis)

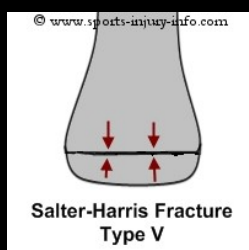
- + Epiphysis + Metaphysis
- Distal Tibia = "Triplane Fracture"
- Usually evaluated with CT



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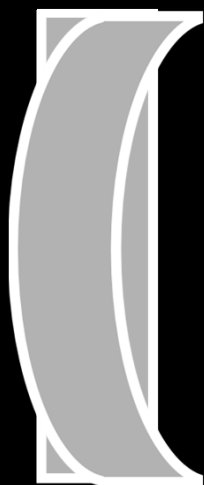
Salter Harris: Type V

- 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

Under
Anesthesia

@1 month

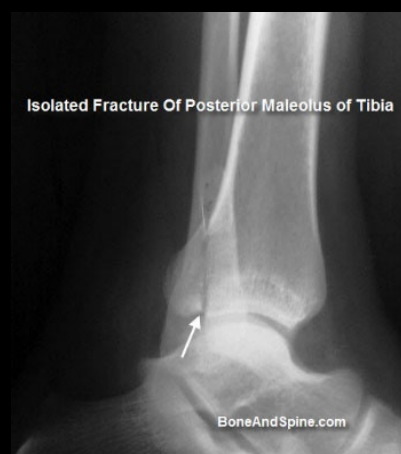
@2 months

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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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YV



“Trimalleolar Ankle fracture with posterior dislocation”

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VS



- “Bimalleolar ankle fracture with 50% lateral subluxation”

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Distal Radius Fractures

Angulation and displacement principles still apply

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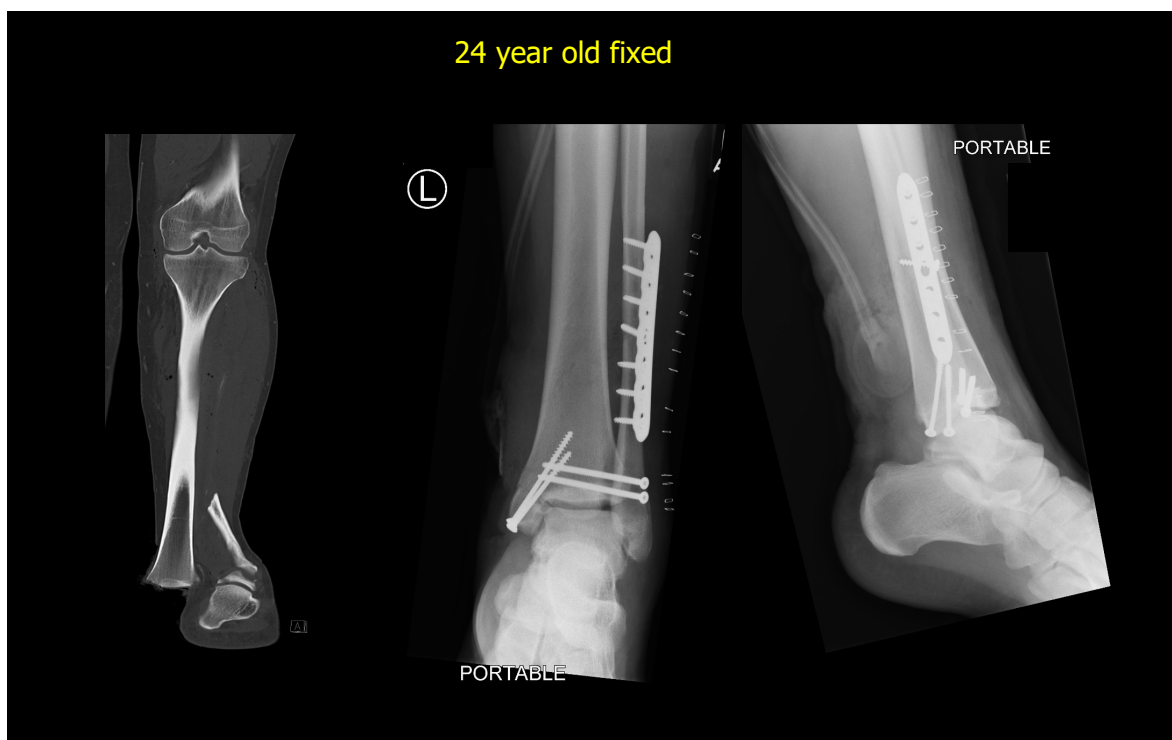
Case Presentations

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24 yr old with high speed MVA



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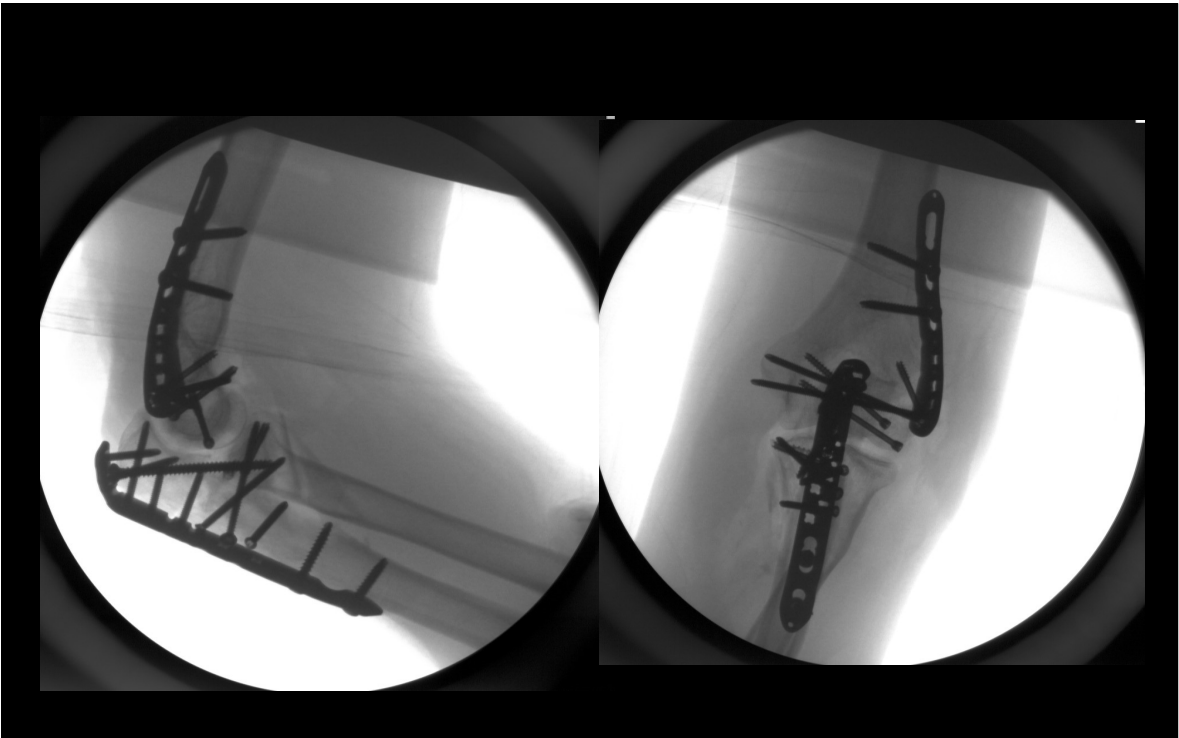
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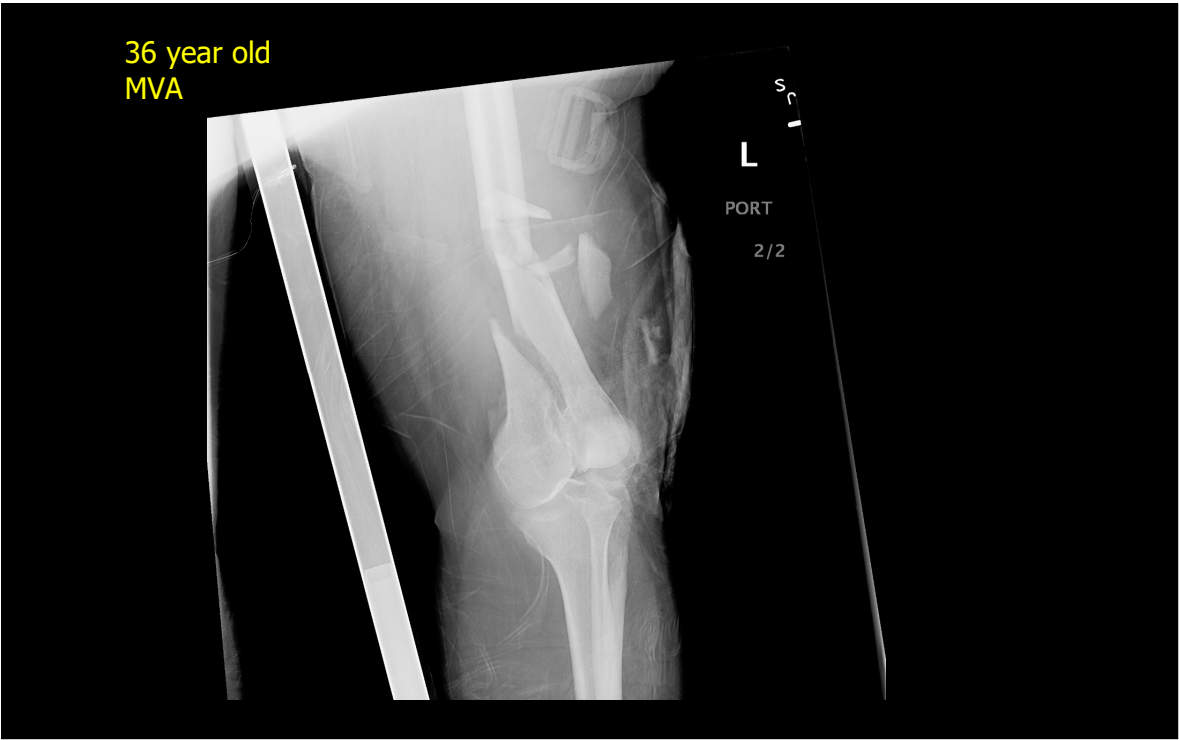
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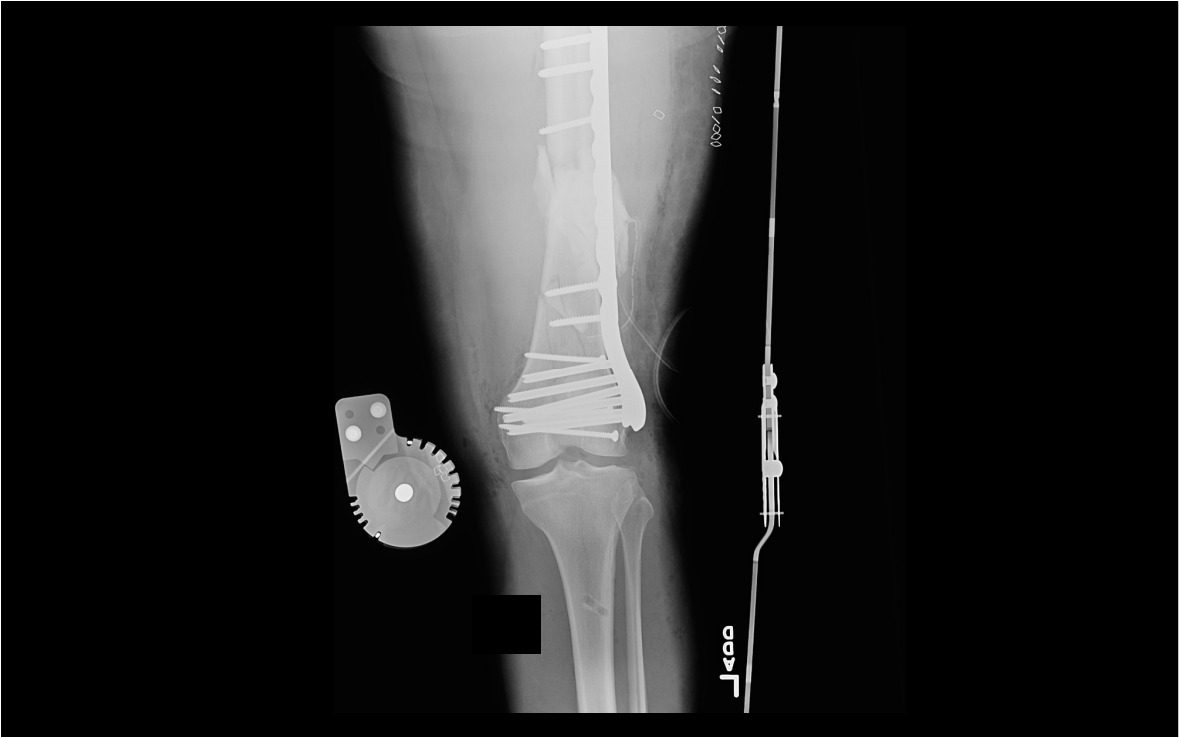
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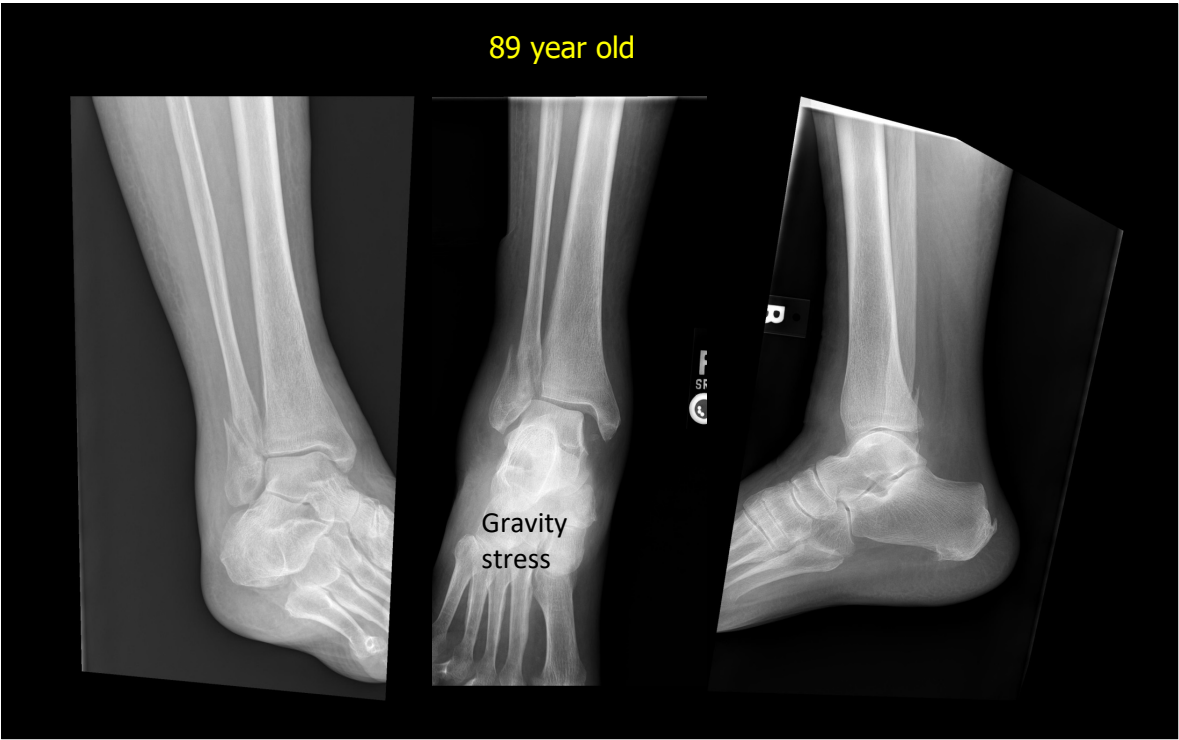
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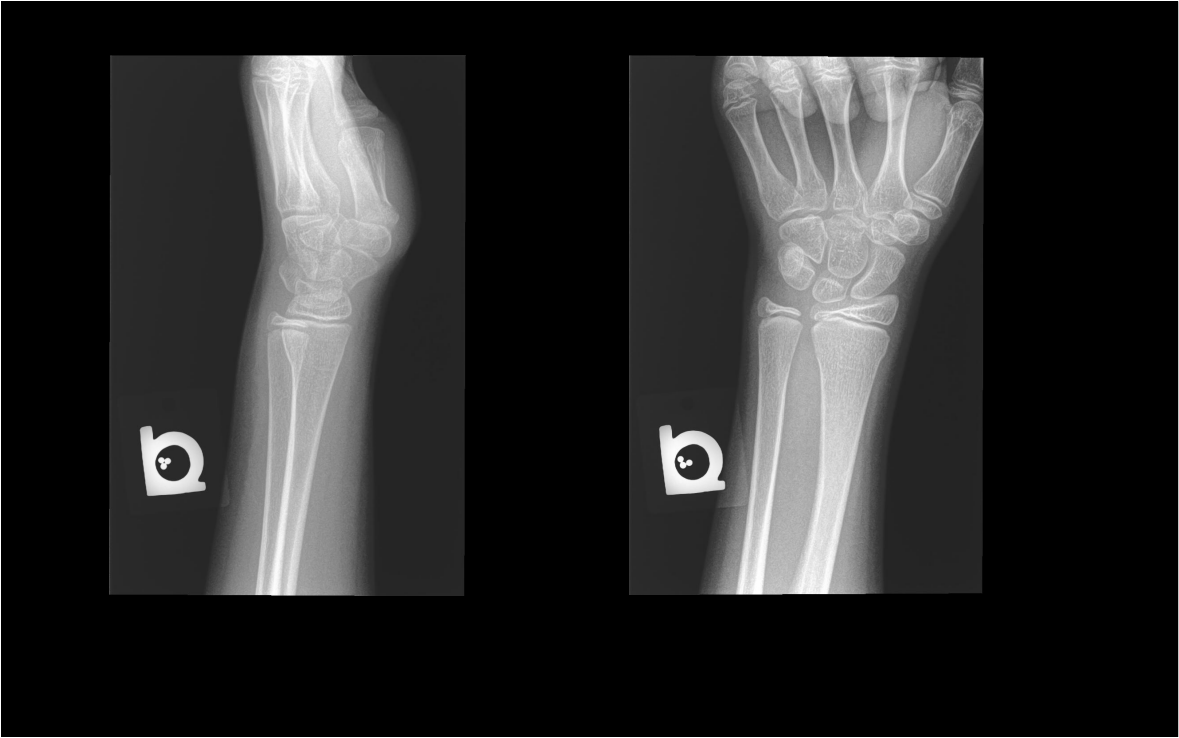
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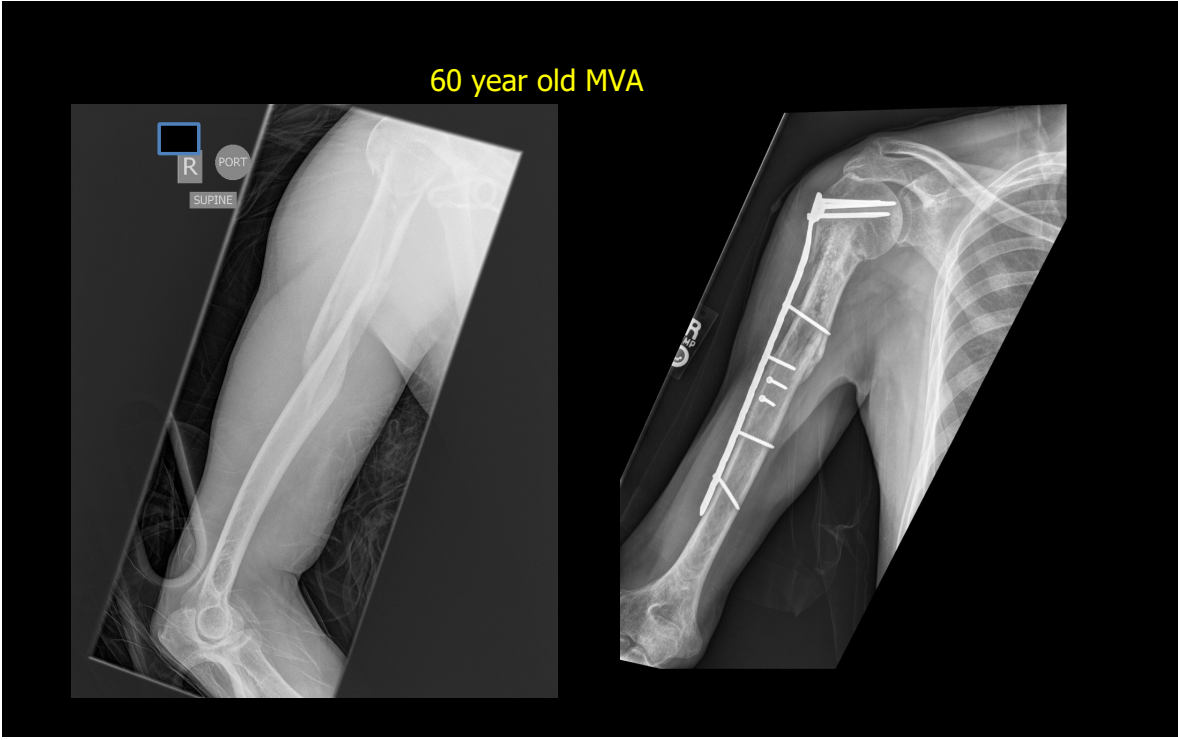
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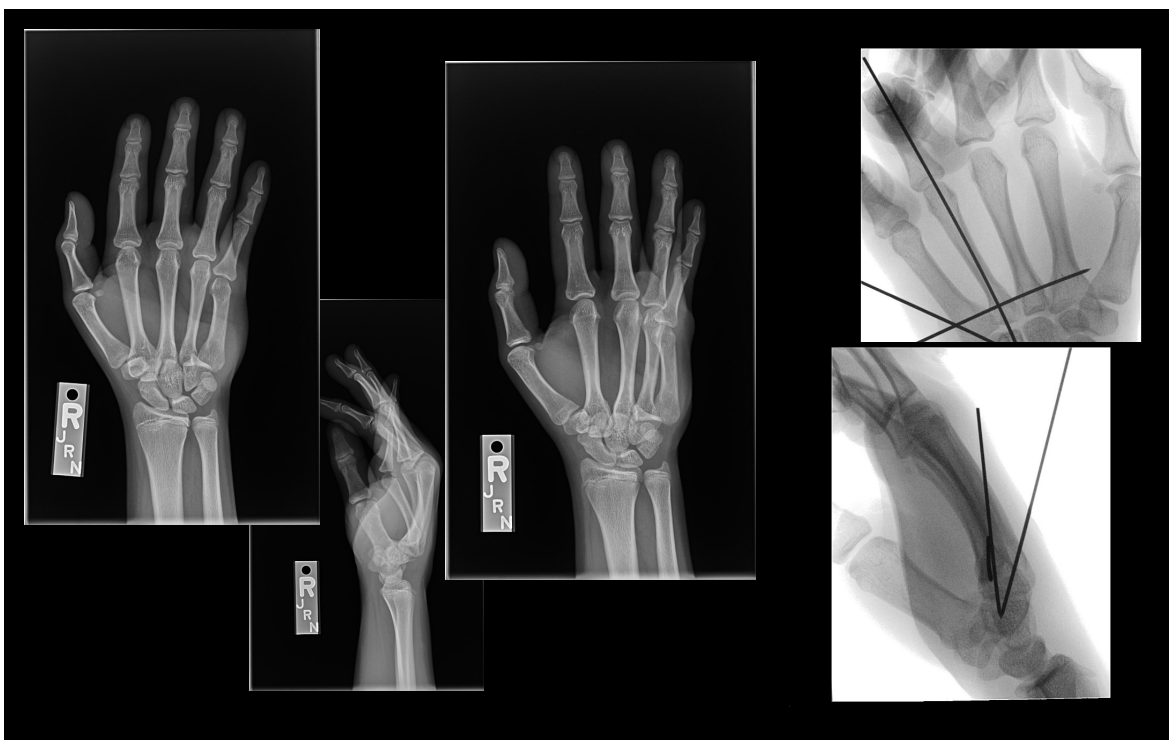
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References/Acknowledgements

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

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