

# X-ray Interpretation Skills

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# Medical Decision Making is a Triad

- History – from patients/records
- Physical Examination
- Confirming Studies – Imaging, Labs, etc.

# Imaging

- X-ray
- Ultrasound
- CT Scan
- MRI
- Nuclear Medicine

# X-RAY

- Radiation Source
- Patient Exposed
- Capture Image
- Interpret Image

# X-RAY

- Ionizing Radiation
- Radiation damages cells

# X-RAY

- Patient Blocks Transmission of Radiation
  - Soft tissues Less
  - Bones More

# X-RAY

- Capture Image
  - Films
  - Digital

# X-RAY

- Interpret Image
  - Radiologist
  - Orthopaedist



# X-RAY

- Best for:
  - Hard tissue
  - Bones
  - Often combined with other imaging

# OBJECTIVES

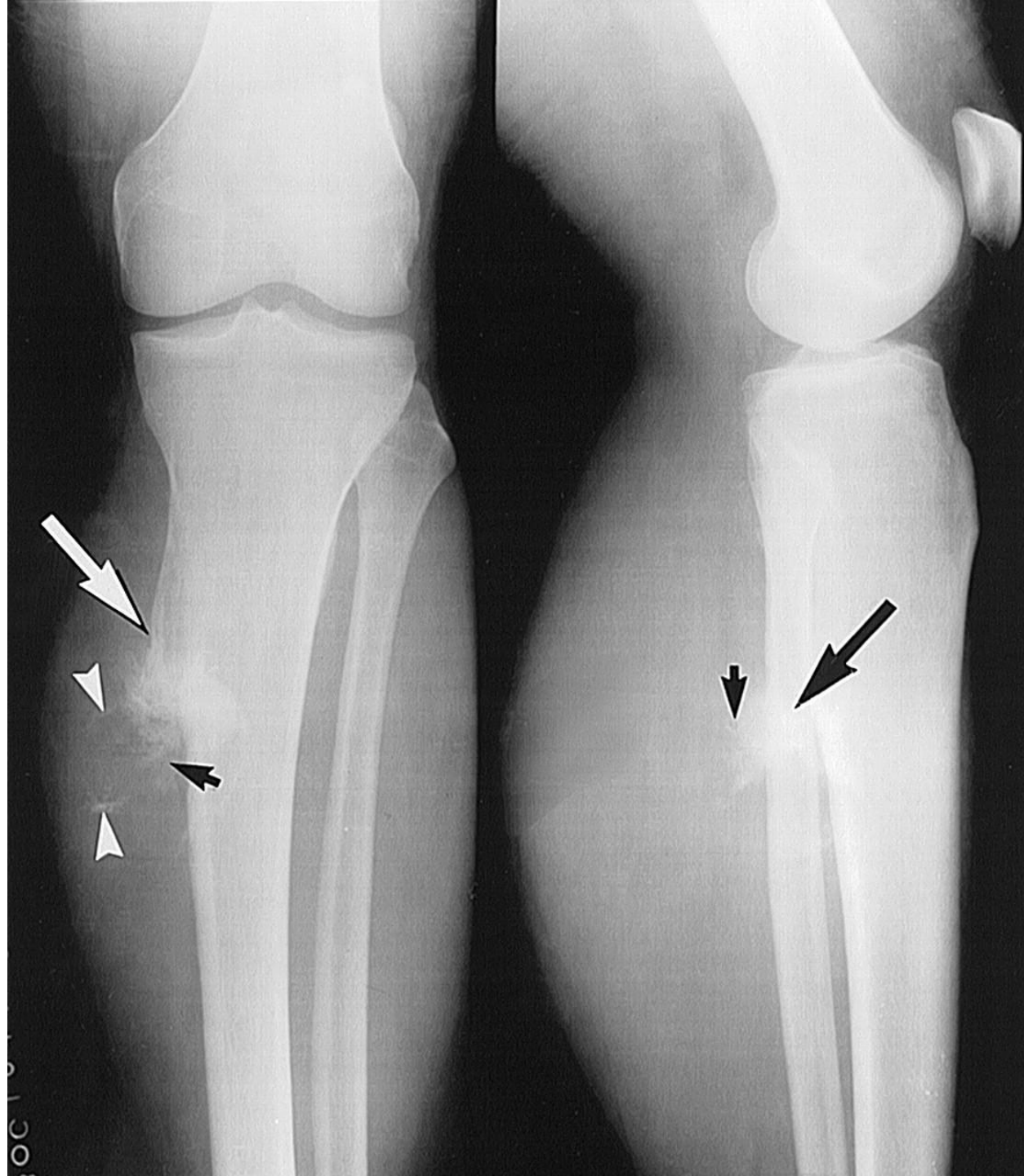
- Review a systematic approach to interpreting orthopedic x-rays
- Review the language of fracture description

# ABCs APPROACH

- Pre ABC: identify pt, read provided info
- A
  - Adequacy
  - Alignment
- B
  - Bones
- C
  - Cartilage
- S
  - Soft Tissues
- Apply ABCs approach to every orthopedic film you evaluate

# ADEQUACY

- All x-rays should have an adequate number of views.
  - Minimum of 2 views—AP and lateral
  - 3 views preferred
  - Joint above and joint below
- All x-rays should have adequate penetration



# ALIGNMENT

- Alignment: Anatomic relationship between bones on x-ray
  - Bone alignment vs other side
  - Bone alignment relative to proximal and distal bones
- Normal x-rays should have normal alignment
- Fractures and dislocations may affect the alignment on the x-ray



# BONES

1. Identify bone
2. Examine the whole bone for
  1. Discontinuity → fractures
  2. Change in bone shadow consistency → change in density
3. Describe bone abnormality
  1. Location
  2. Shape





B

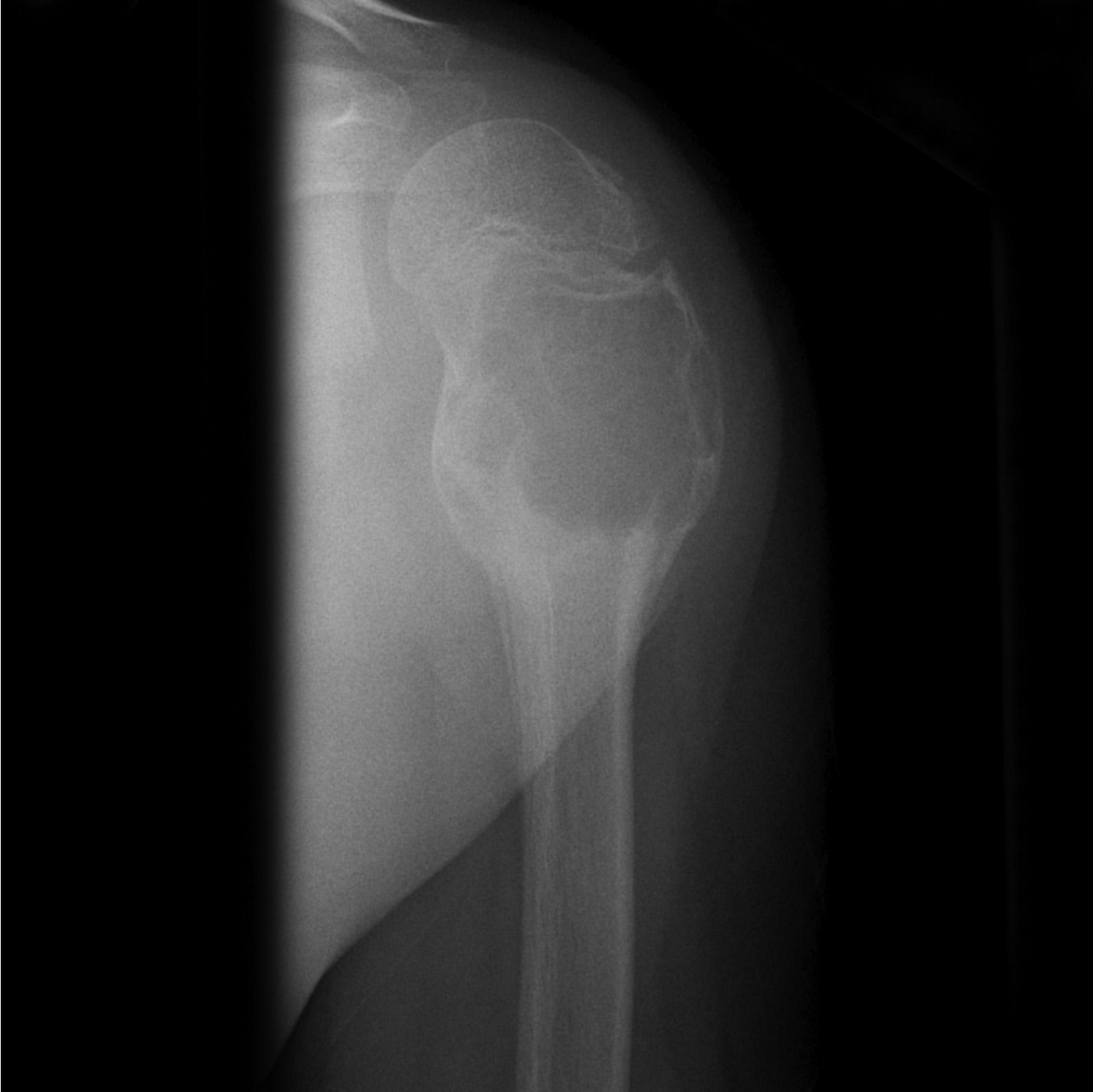


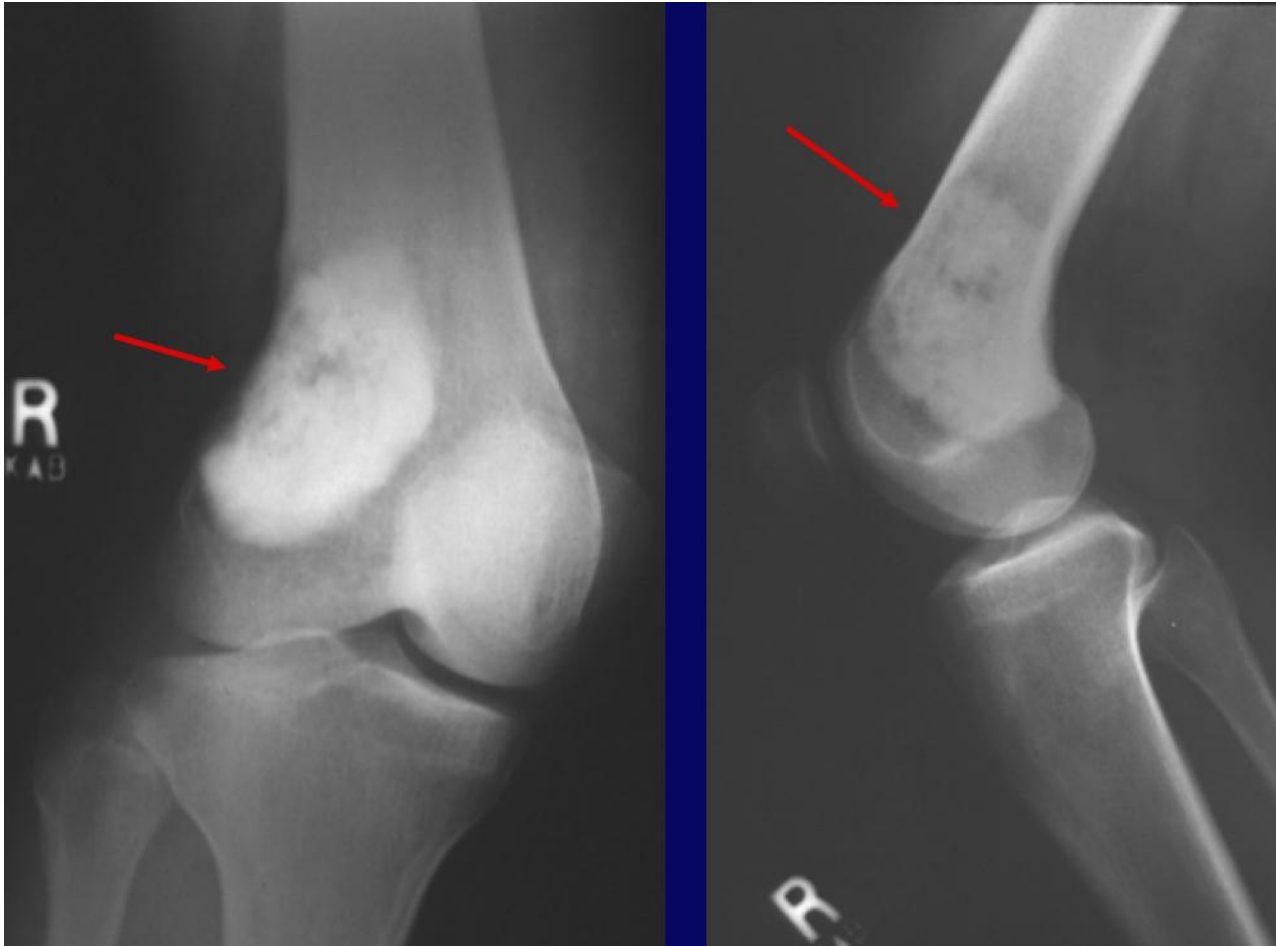
O











# CARTILAGE

- Cartilage
  - joint spaces on x-rays
  - you cannot actually see cartilage on x-rays
- Widening of joint spaces → signifies ligamentous injury and/or fractures
- Narrowing of joint spaces → arthritis



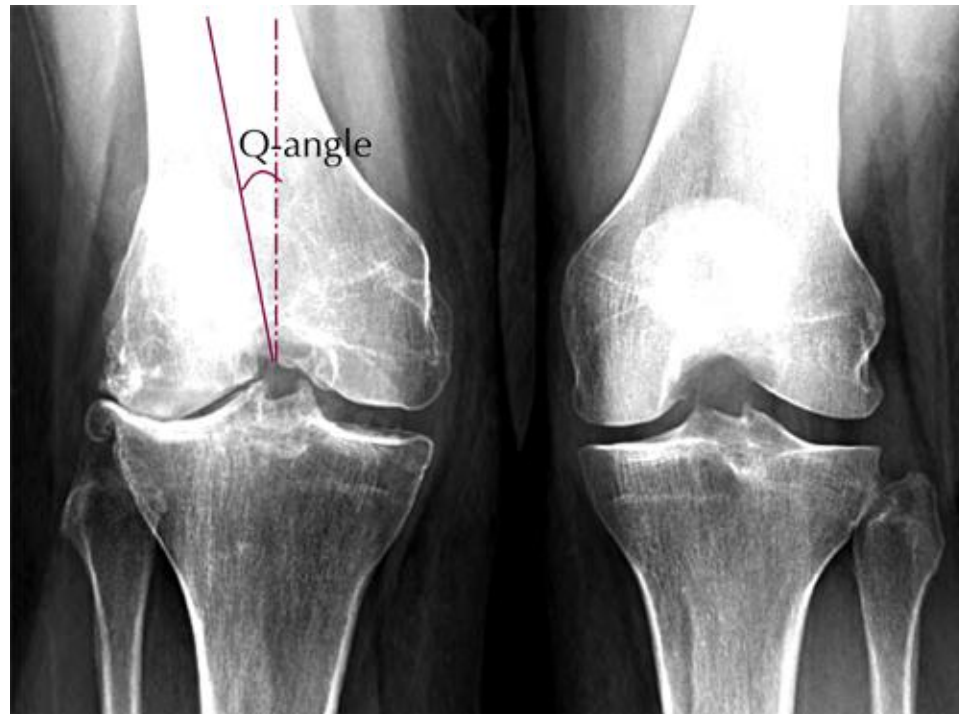
Figure 1

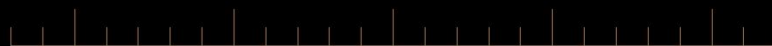


Figure 2









# SOFT TISSUES

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

# REVIEW: ABCs

- A
  - Assess *adequacy* of x-ray which includes proper number of views and penetration
  - Assess *alignment* of x-rays
- B
  - Examine *bones* throughout their entire length for fracture lines and/or distortions
- C
  - Examine *cartilages* (joint spaces) for widening
- S
  - Assess *soft tissues* for swelling/effusions

# EXAMPLE # 1



# EXAMPLE # 1...

- 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!

# EXAMPLE # 2...WHERE ARE THE FRACTURES?





# EXAMPLE # 2...

- If you follow ABCs, you will notice there is are problems with alignment on this x-ray (A)
- (B)...You will notice there are fracture lines through the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> metacarpals
- These are 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup>, midshaft metacarpal fractures.
- A teaching point: Notice the ring on this film. Always remove rings of patients with fractured extremities because swelling may preclude removal later.

# LANGUAGE OF FRACTURES

- Important for use to describe x-rays in medical terminology.
- Improves communication with orthopedic consultants

# LANGUAGE OF FRACTURES

- Things you must describe (clinical and x-ray):
  - Open vs Closed fracture
  - Anatomic location of fracture
  - Fracture line
  - Relationship of fracture fragments
  - Neurovascular status

# OPEN VS CLOSED

- Must describe to a consultant if fracture is open or closed
- Closed fracture
  - Simple fracture
  - No open wounds of skin near fracture
- Open fracture
  - Compound fracture
  - Cutaneous (open wounds) of skin near fracture site. Bone may protrude from skin
  - Open fractures are open complete displaced and/or comminuted

# OPEN FRACTURES

- Orthopedic emergency
- Requires emergency orthopedic consultation
- Bleeding must be controlled
- Management
  - IV antibiotics
  - Tetanus prophylaxis
  - Pain control
  - Surgery for washout and reduction

# ANATOMIC LOCATION

- Describe the precise anatomic location of the fracture
- Include if it is left or right sided bone
- Include name of bone
- Include location:
  - Proximal...Mid...Distal
  - To aid in this, divide bone into 1/3rds

FOR EXAMPLE....WHERE IS  
THIS LOCATED?



# EXAMPLE...

- This is a closed L distal femur fracture.
- The main thing I want you to take from this example is the description of location



# ANATOMIC LOCATION

- Besides location, it is helpful to describe if the location of the fracture involves the joint space—intra-articular

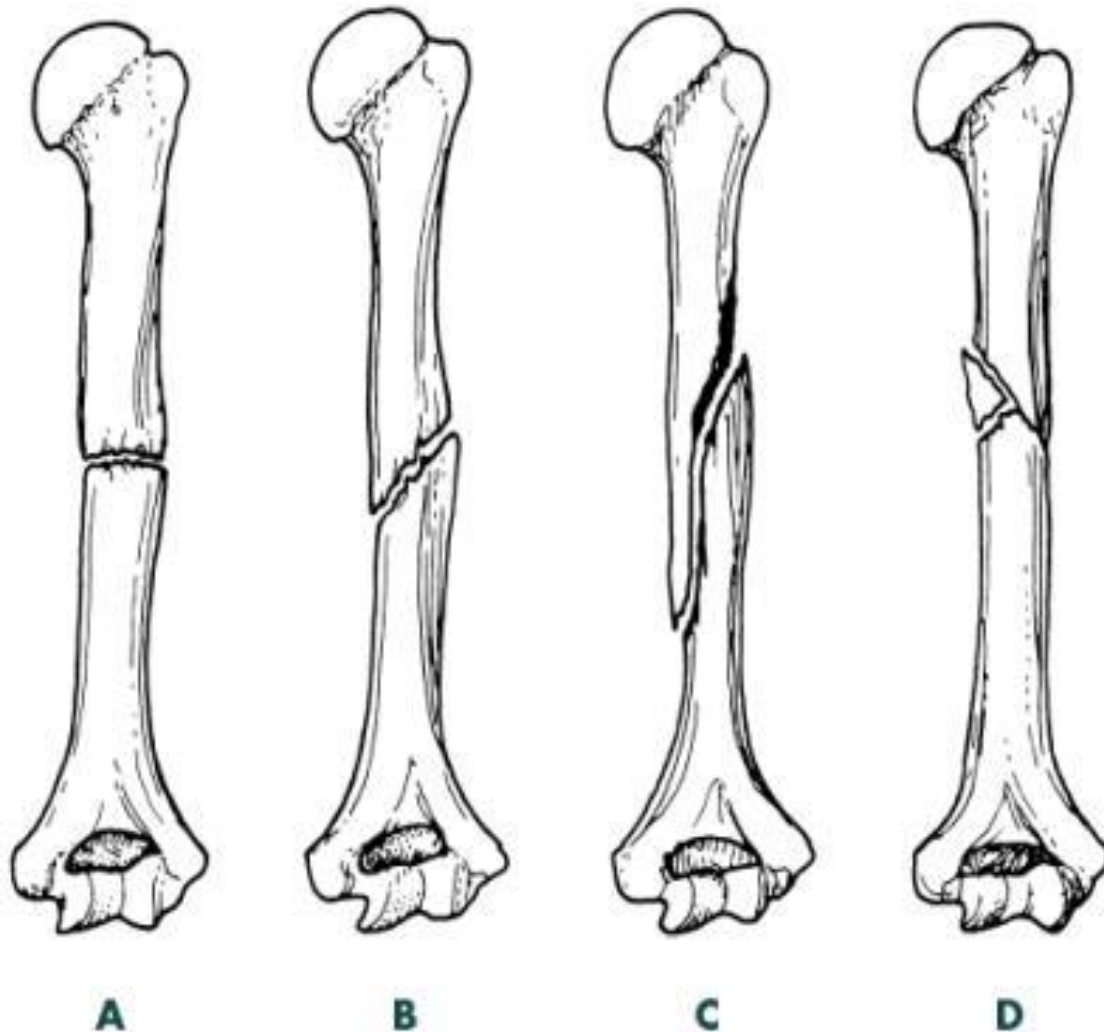
# INTRA-ARTICULAR FRACTURE OF BASE 1<sup>ST</sup> METACARPAL



# FRACTURE LINES

- Next, it is imperative to describe the type of fracture line
- There are several types of fracture lines

# FRACTURE LINES



# FRACTURE LINES

- A is a transverse fracture
- B is an oblique fracture
- C is a spiral fracture
- D is a comminuted fracture
- There is also an impacted fracture where fracture ends are compressed together

WHAT TYPE OF FRACTURE  
LINE IS THIS???



# ANS: TRANSVERSE FRACTURE

- Transverse fractures occur perpendicular to the long axis of the bone.
- To fully describe the fracture, this is a closed midshaft transverse humerus fracture.

# ANOTHER EXAMPLE OF FRACTURE LINE...





# ANS: SPIRAL FRACTURE

- Spiral fractures occur in a spiral fashion along the long axis of the bone
- They are usually caused by a rotational force
- To fully describe the fracture, this is a closed distal spiral fracture of the fibula

# ONE MORE EXAMPLE...



# ANS: COMMINUTED FRACTURE

- Comminuted fractures are those with 2 or more bone fragments are present
- Sometimes difficult to appreciate on x-ray but will clearly show on CT scan
- To fully describe the fracture, this is a closed R comminuted intertrochanteric fracture

# FRACTURE FRAGMENTS

- Terms to be familiar with when describing the relationship of fracture fragments
  - Alignment
  - Angulation
  - Apposition
  - Displacement
  - Bayonette apposition
  - Distraction
  - Dislocation

# ALIGNMENT/ANGULATION

- Alignment is the relationship in the longitudinal axis of one bone to another
- Angulation is any deviation from normal alignment
- Angulation is described in degrees of angulation of the distal fragment in relation to the proximal fragment—to measure angle draw lines through normal axis of bone and fracture fragment

# 20 DEGREES OF ANGULATION



# OTHER TERMS

- Apposition: amount of end to end contact of the fracture fragments
- Displacement: use interchangeably with apposition
- Bayonette apposition: overlap of fracture fragments
- Distraction: displacement in the longitudinal axis of the bones
- Dislocation: disruption of normal relationship of articular surfaces

# DESCRIBE FRACTURE FRAGMENTS





# ANSWER

- This is a closed midshaft tibial fracture....But how do we describe the fragments?
- This is an example of partial apposition; note part of the fracture fragments are touching each other
- Alternatively you can describe this as displaced  $\frac{1}{3}$  the thickness of the bone
- Remember apposition and displacement are interchangeable—we tend to describe displacement
- Final answer: Closed midshaft tibial fracture with moderate (33%) displacement

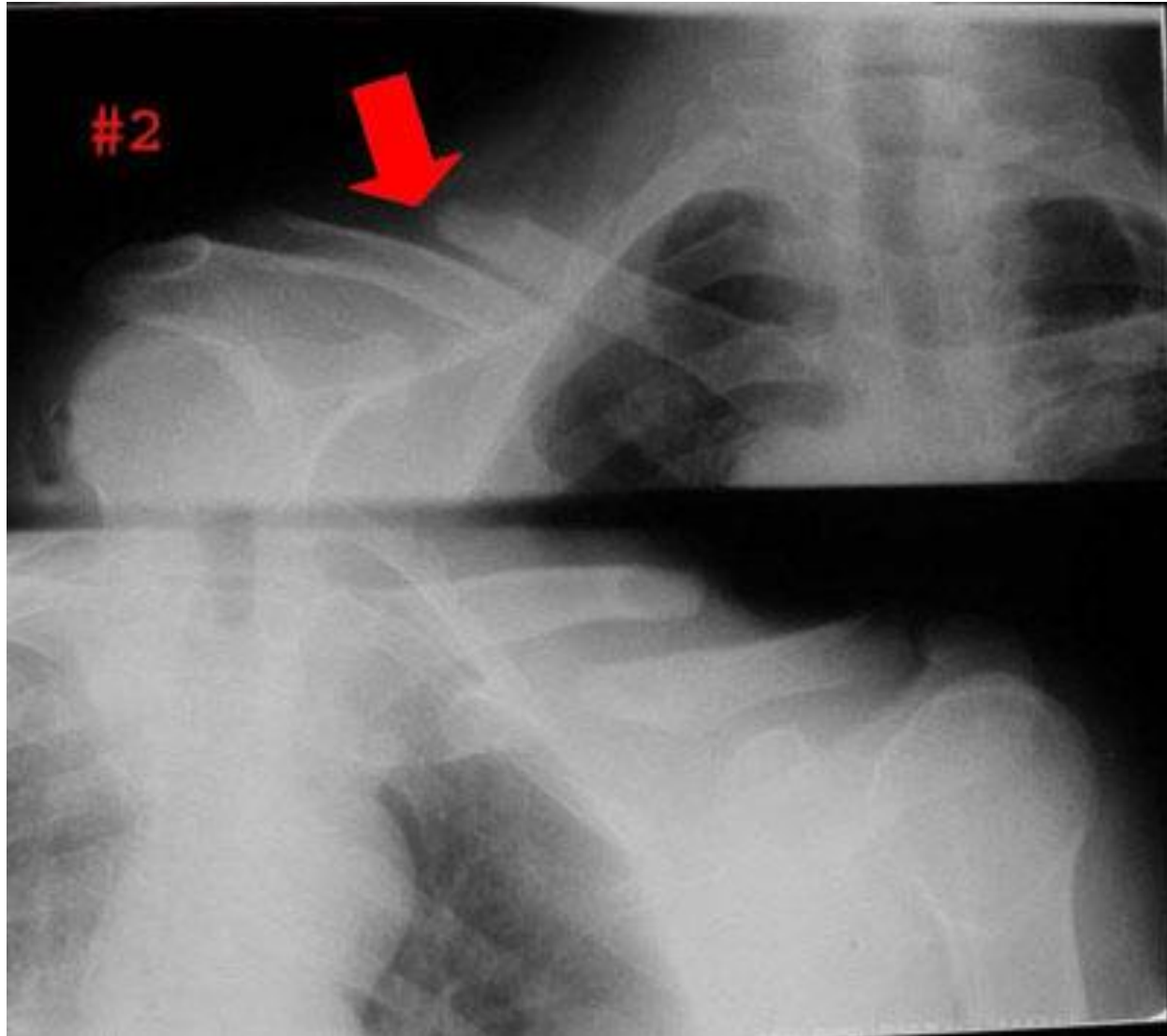
# ANOTHER ONE...



# ANSWER

- There are 2 fractures on this film
- Closed distal radius fracture with complete displacement. Also there is an ulnar styloid fracture which is also displaced
- The displacement is especially prominent on the lateral view highlighting the importance of multiple views.
- There may be intra-articular involvement as joint space is close by
- Remember, remove all jewelry from extremity fractures

# BAYONETTE APPPOSITION



# DISLOCATION



# DISLOCATION

- Note the dislocation on the previous slide; 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

# NEUROVASCULAR STATUS

- Finally when communicating a fracture, you will want to describe if the patient has any neurovascular deficits
- This is determined clinically

# LANGUAGE OF FRACTURES

- To review, when seeing a patient with a fracture and the x-ray, describe the following:
  - Open vs closed fracture
  - Anatomic location of fracture (distal, mid, proximal) and if fracture is intra-articular
  - Fracture line (transverse, oblique, spiral, comminuted)
  - Relationship of fracture fragments (angulation, displacement, dislocation, etc)
  - Neurovascular status



# DESCRIBE THIS R MIDDLE PHALANX FRACTURE



# ANSWER

- Oblique fracture of midshaft of R 4<sup>th</sup> middle phalanx with minimal displacement and no angulation
- Remember to comment if open vs closed & neurovascular status

# DESCRIBE TO ORTHO ATTENDING...



# ANSWER

- This one is a bit more challenging!
- R midshaft tibia fracture displaced  $\frac{1}{2}$  the thickness of the bone without angulation; also there is bayonette appositioning of the fracture fragments
- R midshaft fibular fracture with complete displacement and
- Also comment if the fracture is open vs closed & neurovascular status