REVIEW OF ESSENTIAL X-RAY INTERPRETATION SKILLS

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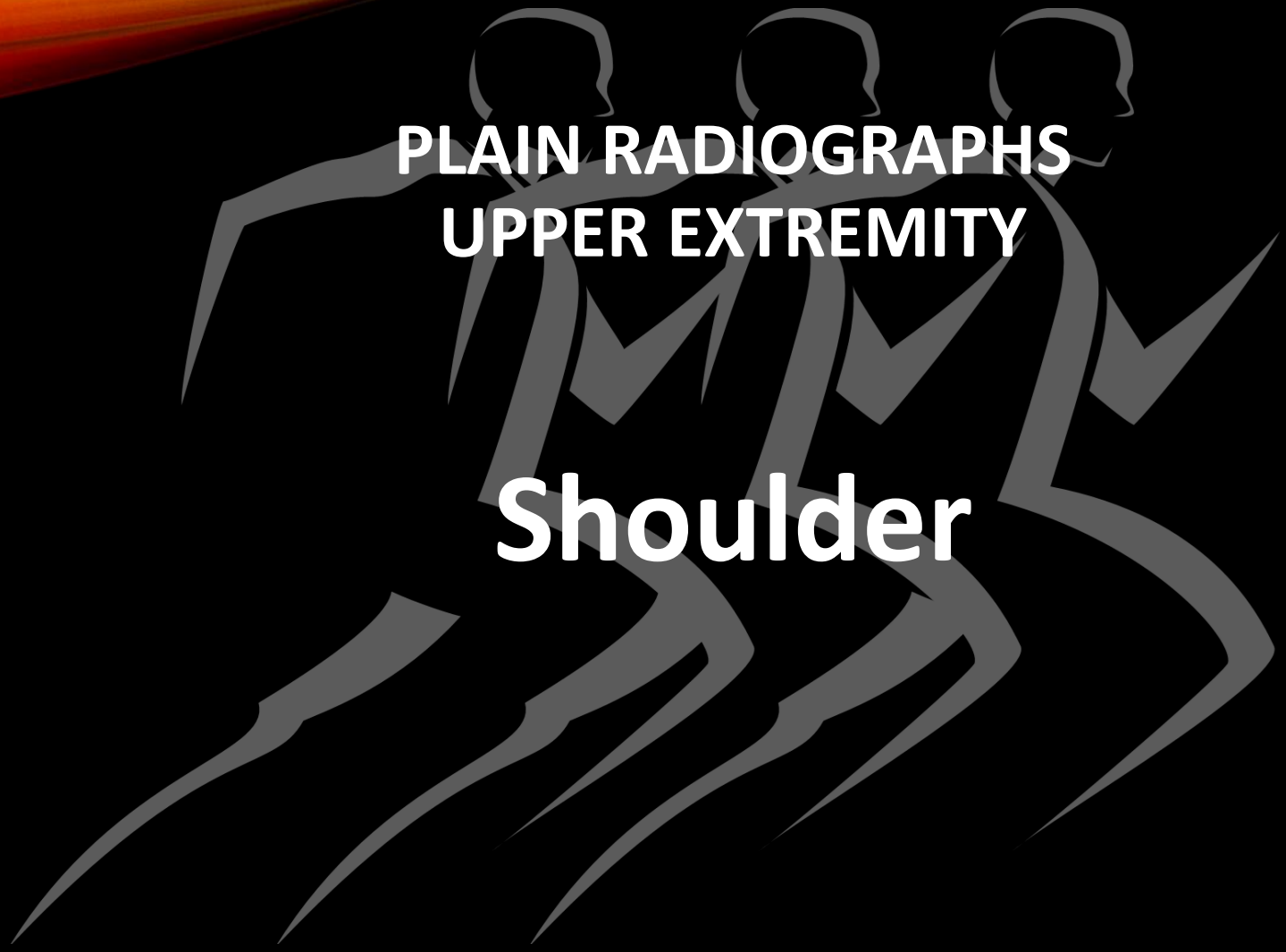
LEARNING OBJECTIVES

At the end of this lecture attendees will be able to ……

- Describe general bony anatomy of the musculoskeletal system
- Describe and interpret plain radiographs for the Glenohumeral joint
- Describe and interpret plain radiographs for Acromioclavicular joint
- Describe and interpret plain radiographs of the Ankle joint
- Describe and interpret plain radiographs of the Foot

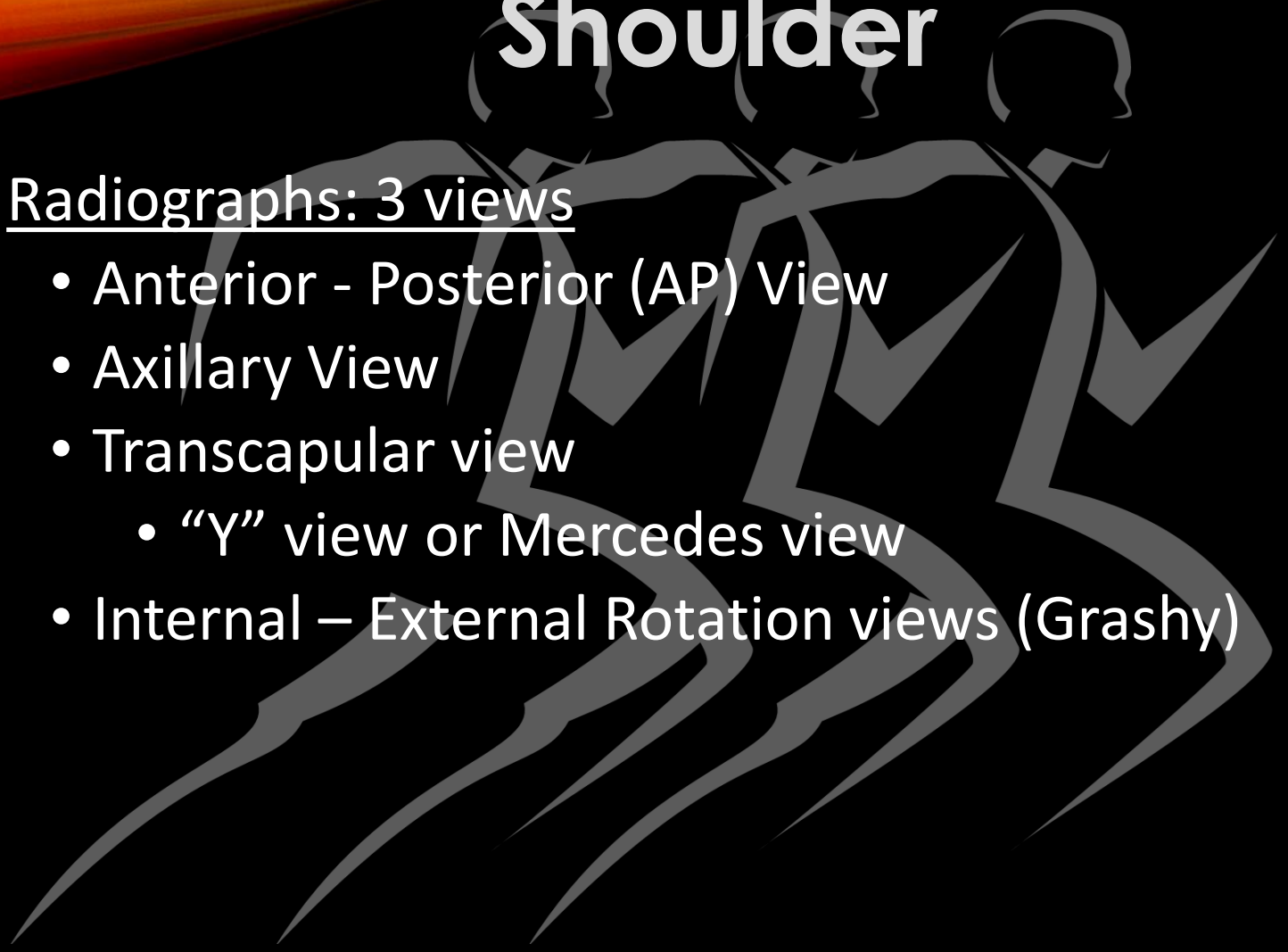
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PLAIN RADIOGRAPHS
UPPER EXTREMITY



Shoulder

Shoulder



- Radiographs: 3 views
  - Anterior - Posterior (AP) View
  - Axillary View
  - Transcapular view
    - “Y” view or Mercedes view
  - Internal – External Rotation views (Grashy)

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SHOULDER

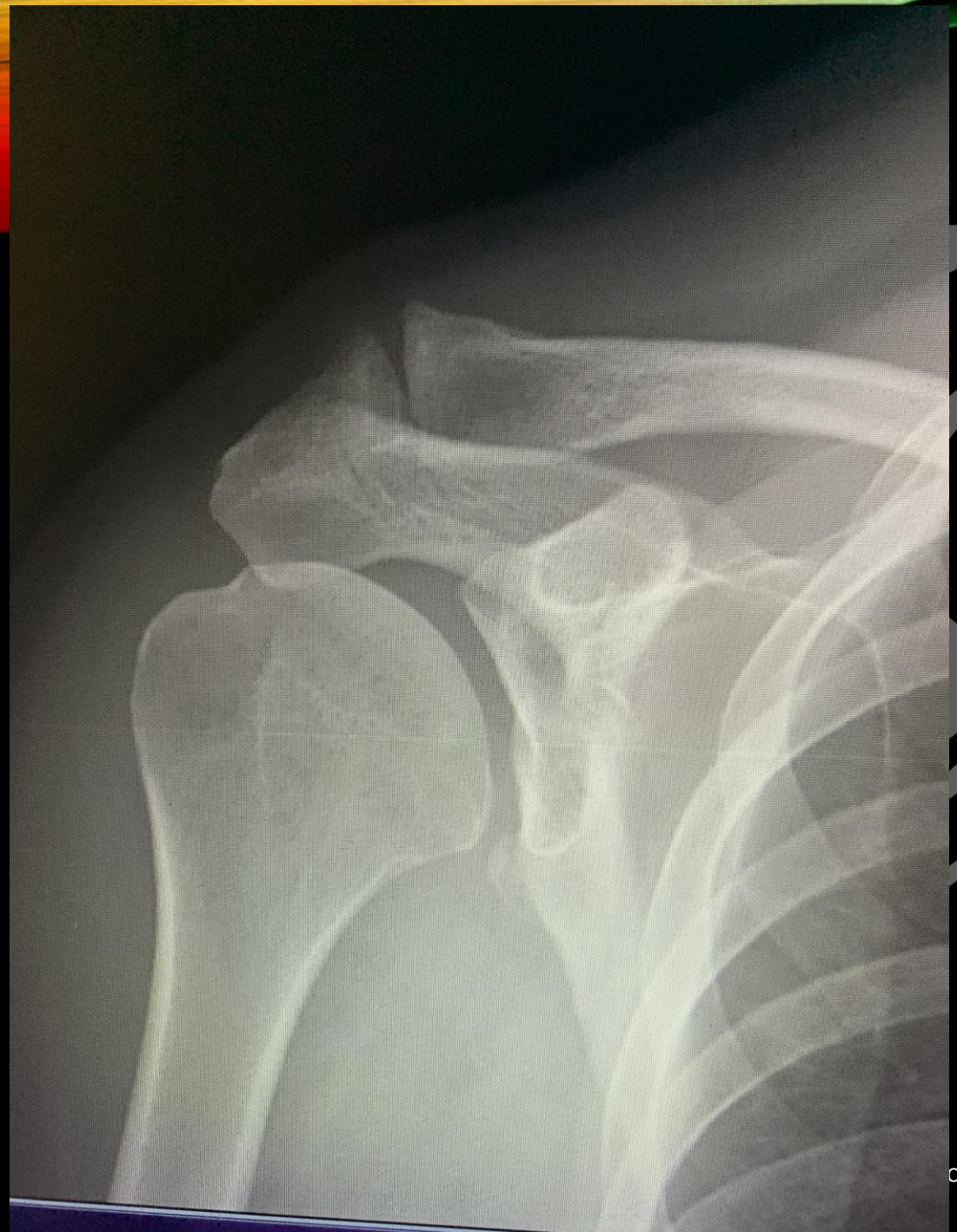
- Plain Radiographs:
  - X-ray does not look at soft-tissue assessment
  - Arthrogram can assess redundant joint capsule and tears in the RTC
- CT scan
  - assess intra-articular and complex proximal humerus fractures
  - Reconstruction vs. thin slices: Ask Radiologist
- Ultra-sound (US):
  - great for soft-tissue masses & RTC tear assessment
- MRI:
  - MR-arthrogram much better studies for assessment of soft-tissue injuries

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Shoulder

- Anterior-posterior (AP) View
  - Looks at anterior GH joint and AC joint
  - Assess Glenohumeral position
  - Degenerative changes: AC & Glenoid
  - Fractures
- Normal findings
  - Humeral head and glenoid are generally level with on another
  - Humerus overlaps small amount with glenoid "Crescent sign"
  - Humeral head apposes Glenoid

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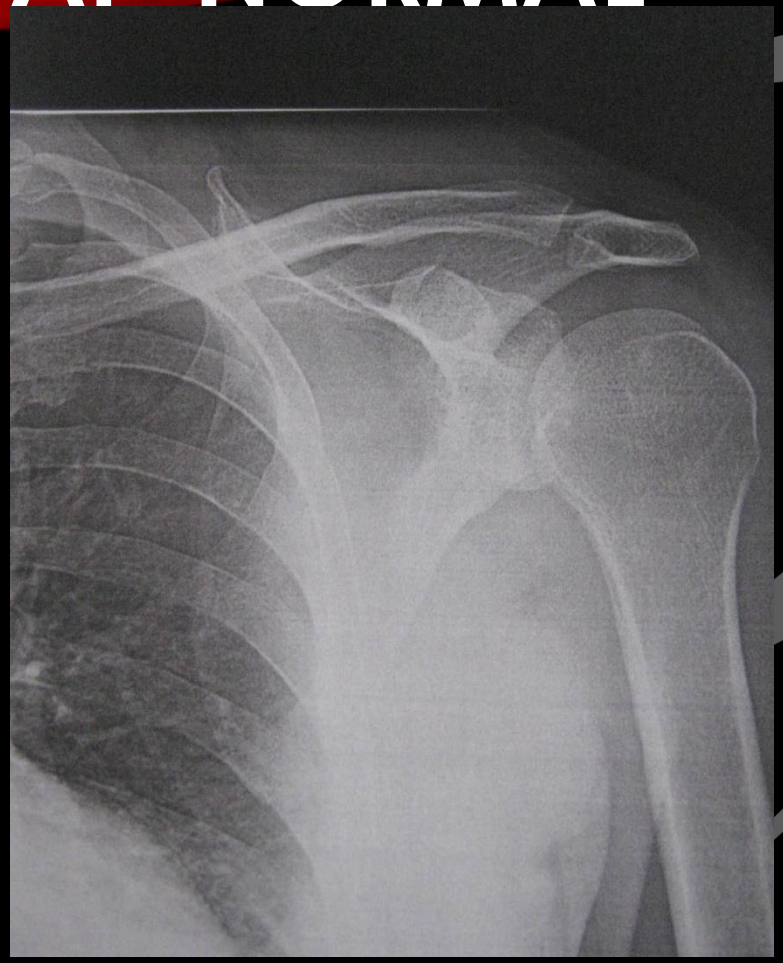
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Shoulder

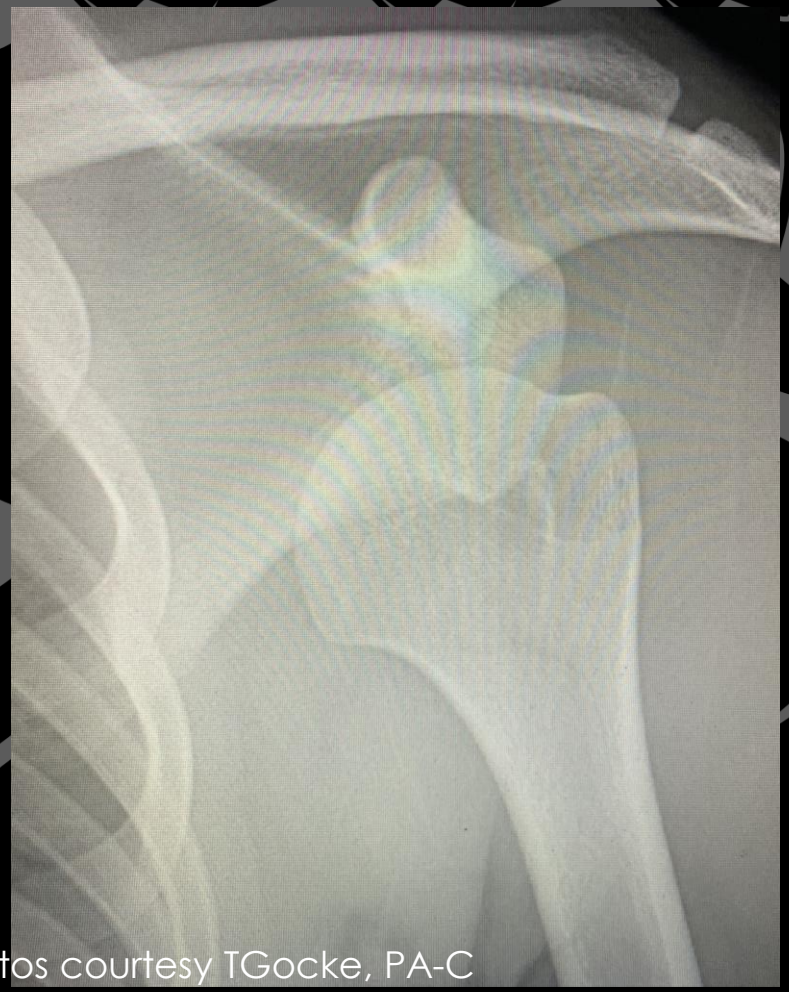
- Anterior-posterior (AP) View
  - Anterior dislocation
    - Humeral head anterior and inferior to glenoid
    - Humeral head looks bigger on AP x-ray
  - Posterior dislocation
    - Humeral head goes posterior to glenoid and looks like GH joint pulled apart
    - Loose “Crescent sign” appearance in normal joint
    - Humeral head looks smaller on AP x-ray

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AP-NORMAL



Anterior Dislocation





Photos courtesy TGocke, PA-C

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RADIOGRAPHIC EXAM

- Axillary View
  - Shot thru the armpit
  - Shows humeral head position in glenoid
  - Best able to identify Hills-Sach and bony Bankhart lesions
  - Remember: Coracoid process always points ANTERIOR



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RADIOGRAPHIC EXAM

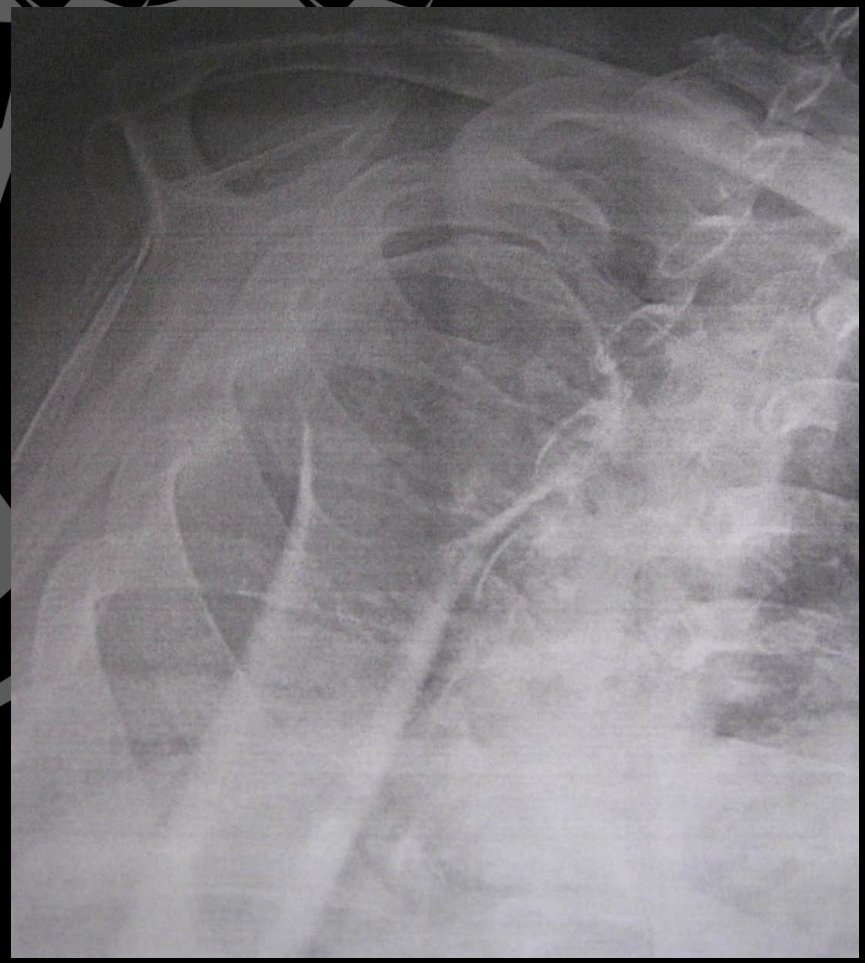
- Transcapular View: “Y” or Mercedes view
  - Formed by the Coracoid process, spine of the acromion and the scapular body
  - Assessment of GH joint dislocation and relocation after reduction
  - Identify Subacromial spurs
  - X-ray shot in the same plain as the scapular body

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TRANSCAPULAR VIEW

NORMAL DISLOCATION





Photos courtesy TGocke, PA-C

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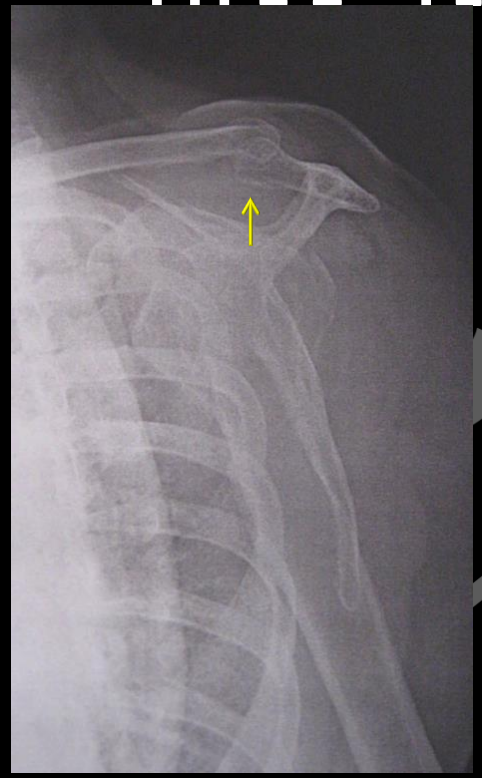
TRANSCAPULAR VIEW "ACROMIAL SPUR"

- Subacromial Spurs:
  - Osteophyte in the subacromial space
  - Decrease space for G-H range of motion
  - Subacromial bursae and Rotator Cuff tendon impinge
  - Spur graded by width
    - Type 1 - flat
    - Type 2 - 5mm
    - Type 3 - > 5mm

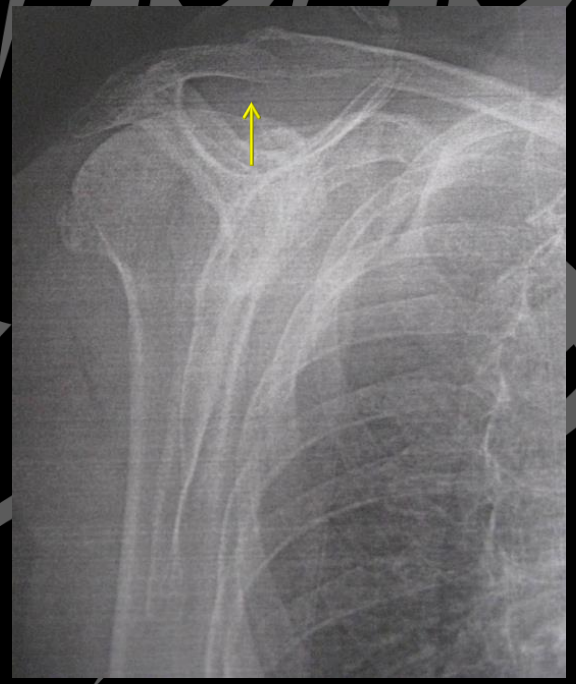
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TRANSCAPULAR VIEW: "ACROMIAL SPUR"

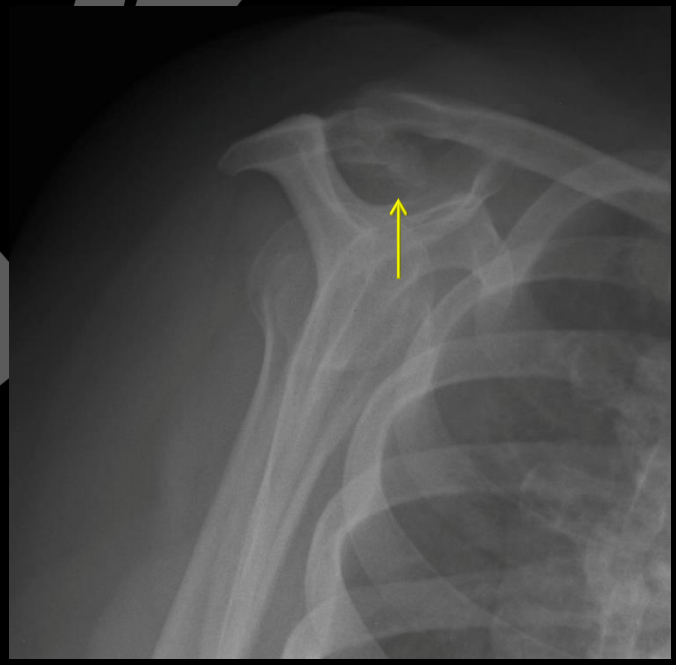
TYPE 1 – FLAT



TYPE 2 – 5MM



TYPE 3 > 5MM



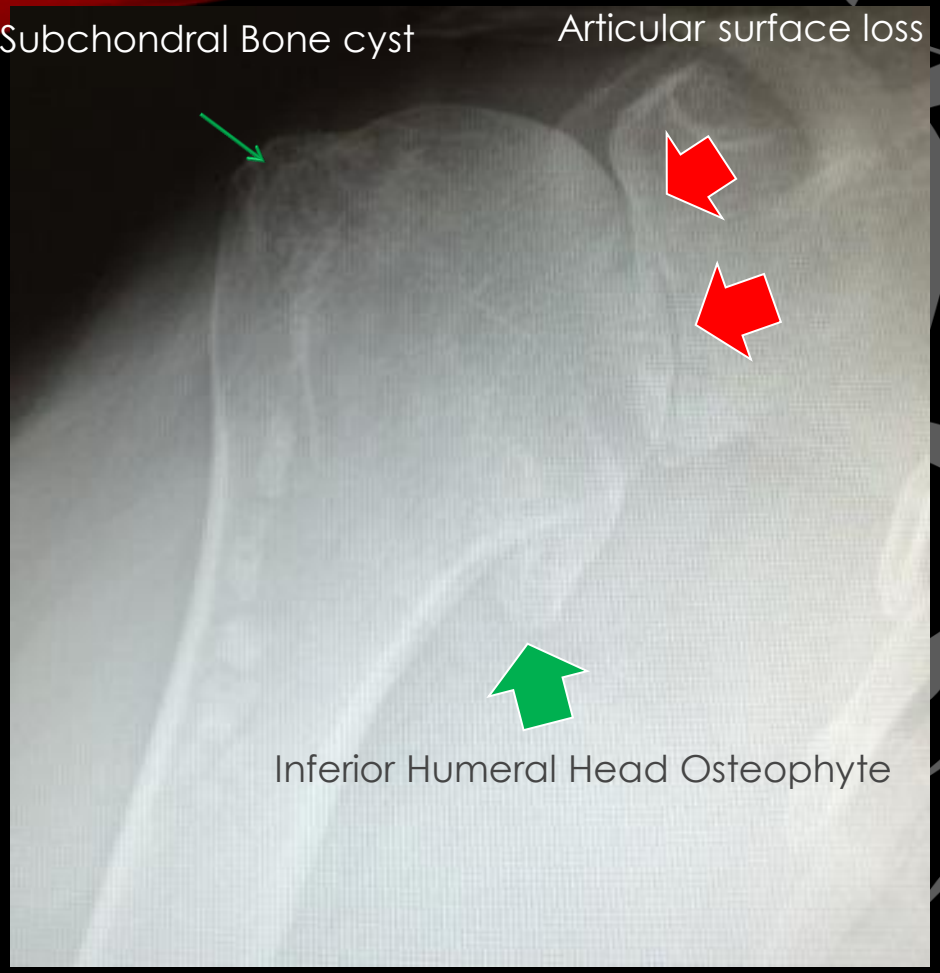
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GLENOHUMERAL JOINT ARTHRITIS

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GLENOHUMERAL JOINT ARTHRITIS



Radiographic Examination
X-ray: AP/AXILLARY/GRASHEY

Findings

- Subchondral cystic changes Humeral head and Glenoid Fossa
- Posterior Humeral head subluxation with posterior Glenoid wear pattern
- Osteophytes inferior Glenoid and Humeral head
- Superior Humeral Head migration – RTC tear

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GLENOHUMERAL JOINT ARTHRITIS

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ACROMIOCLAVICULAR JOINT ARTHRITIS

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ACROMIOCLAVICULAR JOINT ARTHRITIS

- Commonly affected by traumatic and degenerative conditions
- Chronic degenerative changes result from repetitive activity
  - Osteolysis commonly associated with weight lifting or heavy labor activities
- Symptoms similar to RTC impingement syndrome
- AC joint changes cosmetic appearance 2nd to osteophyte formation
- Contributing Factors:
  - Repetitive overhead activities
    - Wt lifters – Swimmers – Throwers

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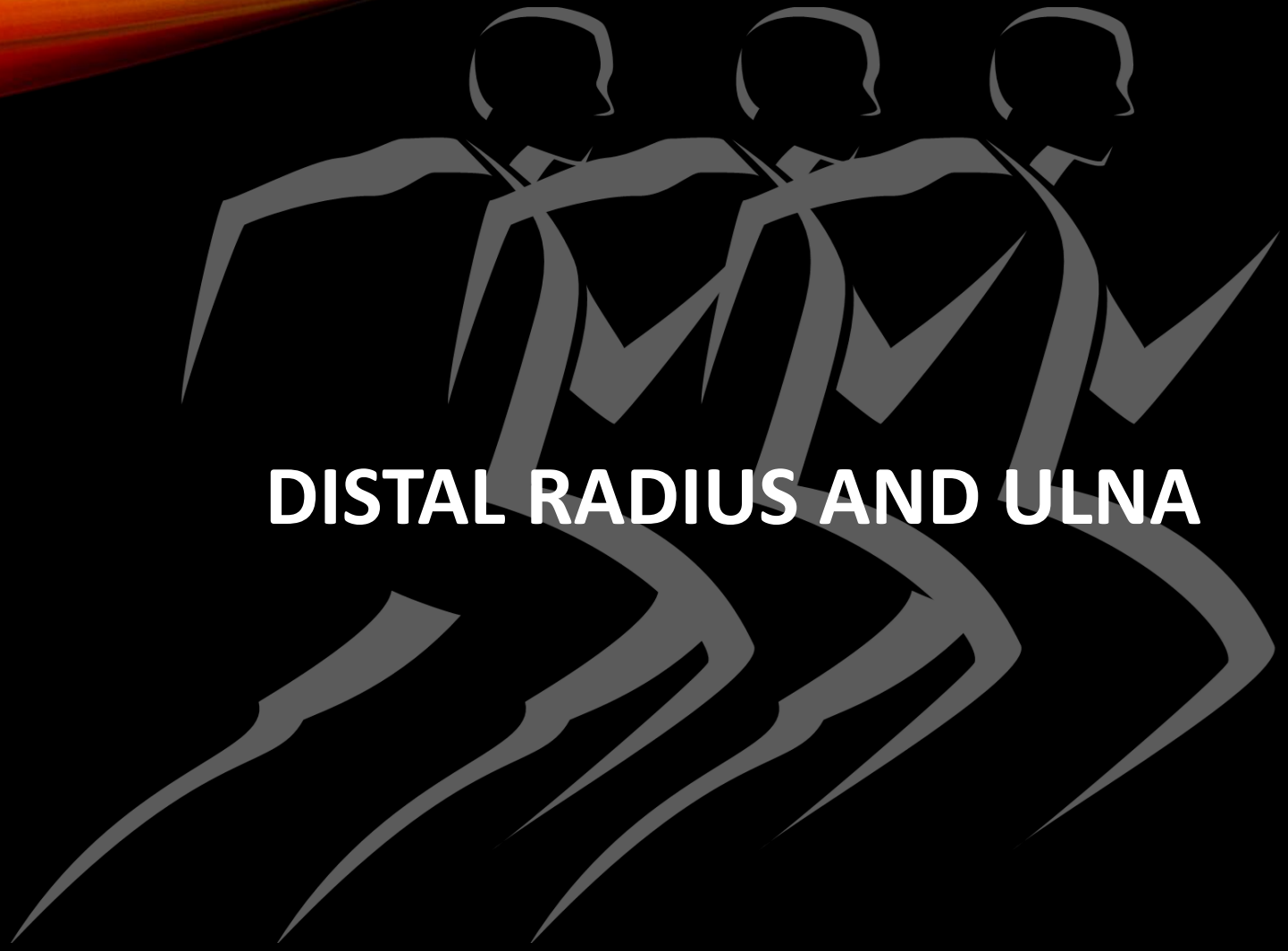
ACROMIOCLAVICULAR JOINT ARTHRITIS

Radiographs

- AP/Axillary/Outlet
  - Narrowing AC joint
  - Osteophytes – more common inferior vs. superior
  - Old fx
- MRI/CT – not always necessary

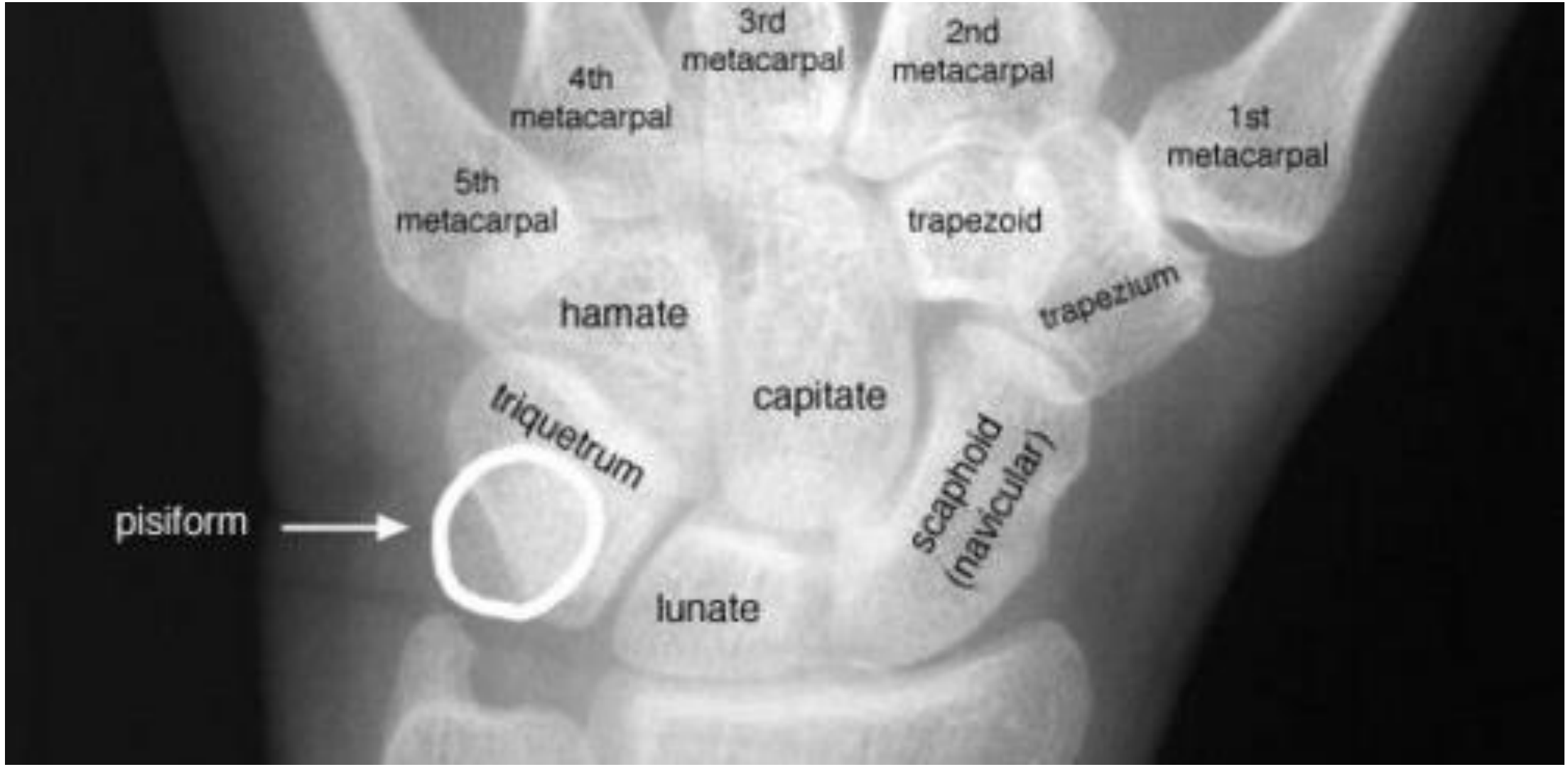


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DISTAL RADIUS AND ULNA

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CARPAL BONES

Wrist (Carpal bones)

- X-rays
  - PA, Lateral, Oblique, Clenched fist view and Snuffbox view
  - Clenched Fist view:
    - Adds stress to Scapholunate ligament looking for instability
  - Snuffbox view:
    - Essential for identifying fx in carpal scaphoid

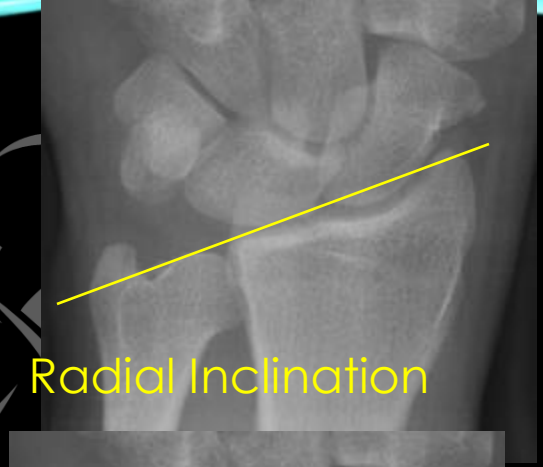


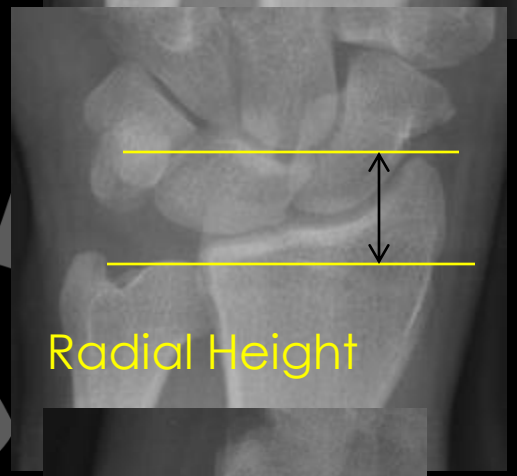
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DISTAL RADIUS & ULNA

Radiographs

- Radial Inclination
  - Normal: 23 degrees (< 5 degrees)
- Radial Height
  - Normal10-12 mm (ulnar negative)
  - Variant <5mm
  - **Fx: ulnar positive (loose radial height)**
- Radial articular surface
  - Normal :Congruent
  - Variant: <2mm step-off
- Palmar Tilt
  - Normal 10 degrees







Pictures courtesy T Gocke, PA-C

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RADIOLOGY REVIEW

Normal Carpal bone anatomy

Parallelism –

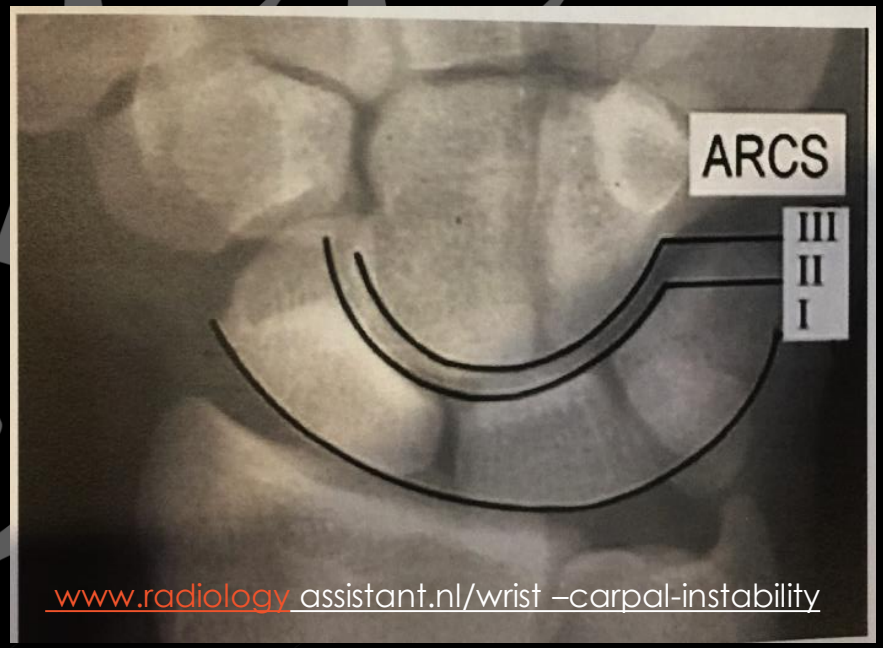
- 2mm width between carpal bones

Symmetric appearance

- Capitolunate joint sets standard for Carpal joint symmetry

Carpal Arcs

- I: Convex curve Scaphoid/Lunate/Triquetrum
- II: Concave curve Scaphoid/Lunate/Triquetrum
  - Between proximal & Distal Carpal rows
- III: Convex curve Capitate/Hamate



www.radiology assistant.nl/wrist –carpal-instability

Miler, MA, Thompson SR, Hart JA; Review of Orthopaedics, sixth edition, 2012, Elsevier, Phila, PA.; p340-341
Johnson TR, Steinbach LS: Essentials of Musculoskeletal Imaging, 2004, AAOS, Rosemont, IL; p 372-376
www.radiologyassistant.nl/en/p42a29ec06b9e8/wrist-carpal-intability.html

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DISTAL RADIUS FRACTURES

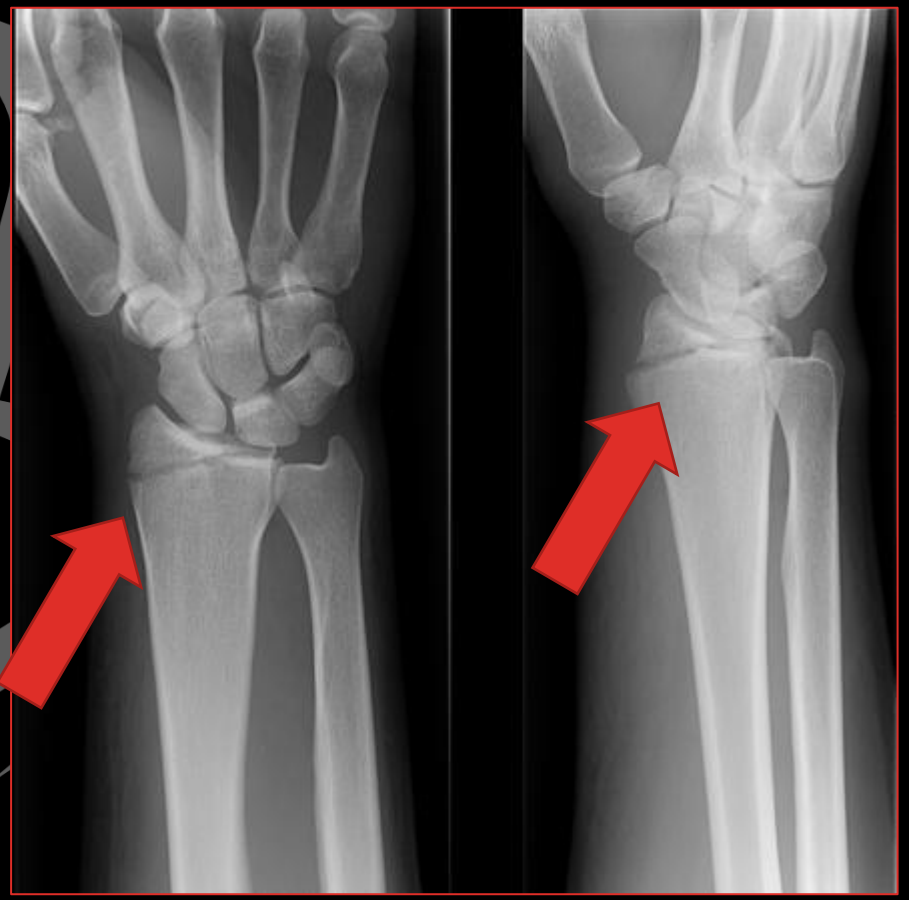
General:

Distal Radius Fx names	Description
• Colles' fx	Dorsal displaced, extra-articular
• Chauffer's fx	Radial Styloid fx
• Smith's fx	Volar displaced extra-articular
• Die Punch Fx	Depressed intra-articular distal radius fx into Lunate fossa
• Barton's fx	Intra-articular Radiocarpal fx-dislocation w/ volar or dorsal displacement

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DISTAL RADIUS FRACTURES

- Radial Styloid Process Fracture
  - “Chauffer’s fx”
  - Intra-articular
  - Styloid fx spares metaphyseal bone
  - “Snuffbox pain “
    - Don’t ignore possible associated scaphoid injury



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DISTAL 1/3 RADIUS FRACTURES

Colle's Fracture

- Extra-articular
- Dorsal fx line
- Dorsal displacement
- Dorsal comminution
  - Elderly
  - Osteoporosis
- Hand /wrist follows radius
- Radial deviation
- Prominent ulna
- Mechanism
  - Fall on flexed wrist



Picture Courtesy TGocke, PA-C



Picture Courtesy TGocke, PA-C

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DISTAL RADIUS FRACTURES

Colles Fracture

- Lateral X-ray wrist
  - Loss volar/palmar tilt
  - Dorsal cortex comminution
  - Hand follows distal radius fx fragment



X-ray courtesy Tom Gocke, PA-C Library

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DISTAL RADIUS FRACTURES

Smith's Fracture

- Extra-articular
- Volar fx line
- Volar displacement
- Hand /wrist follows radius
- Radial deviation
- Prominent ulna
- Volar deformity
- Mechanism
  - Fall on flexed wrist



Picture courtesy T Gocke, PA-C

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DISTAL RADIUS FRACTURES

Barton's Fracture

- Intra-articular Radiocarpal fx-dislocation w/ volar/dorsal displacement
- Hand /wrist follows radius
- Volar/dorsal deformity



Picture courtesy T Gocke, PA-C

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DISTAL RADIUS FRACTURES

Die-Punch Fracture

- Depressed intra-articular distal radius fx into Lunate fossa
- Articular surface incongruent
- May have comminuted fx
- MRI or CT scan for comminuted fx with > 2mm displacement





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DISTAL RADIUS FRACTURES

Torus Fracture

- "Buckle fx"
  - Skeletally immature
  - FOOSH mechanism
  - Same symptoms adult distal radius fx
  - Often overlooked on x-ray





X-ray courtesy Tom Gocke, PA-C Library

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CARPAL BONES INJURIES

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CARPAL BONES

Wrist (Carpal bones)

- X-rays
  - AP, Lateral, Oblique, Clenched fist view and Snuffbox view
  - Clenched Fist view:
    - Adds stress to Scapholunate ligament looking for instability
  - Snuffbox view:
    - Essential for identifying fx in carpal scaphoid



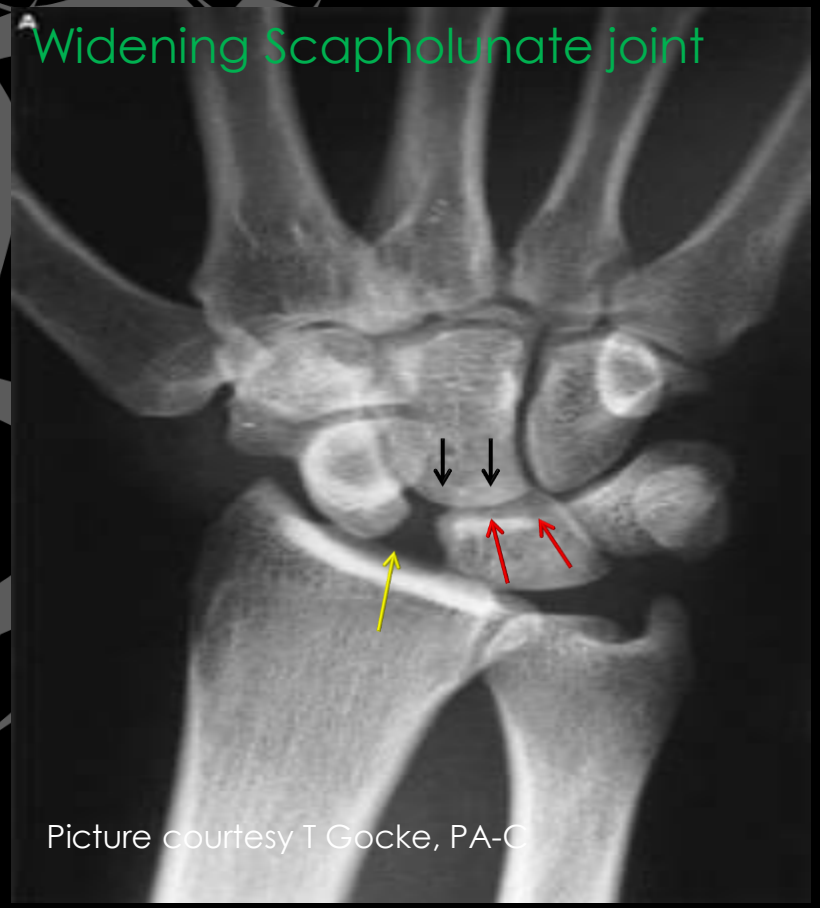
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CARPAL BONE INJURIES

Scapholunate Ligament Injury

- Radiology
  - X-ray views: AP, Lateral, Oblique, Scaphoid, Clench-Fist
  - AP x-ray
    - **SL gap** > 4mm clenched fist view (Terry Thomas sign)
    - Dorsal & volar margins **distal Lunate** **proximal Capitate** are not superimposed (normal)



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CARPAL BONE INJURIES

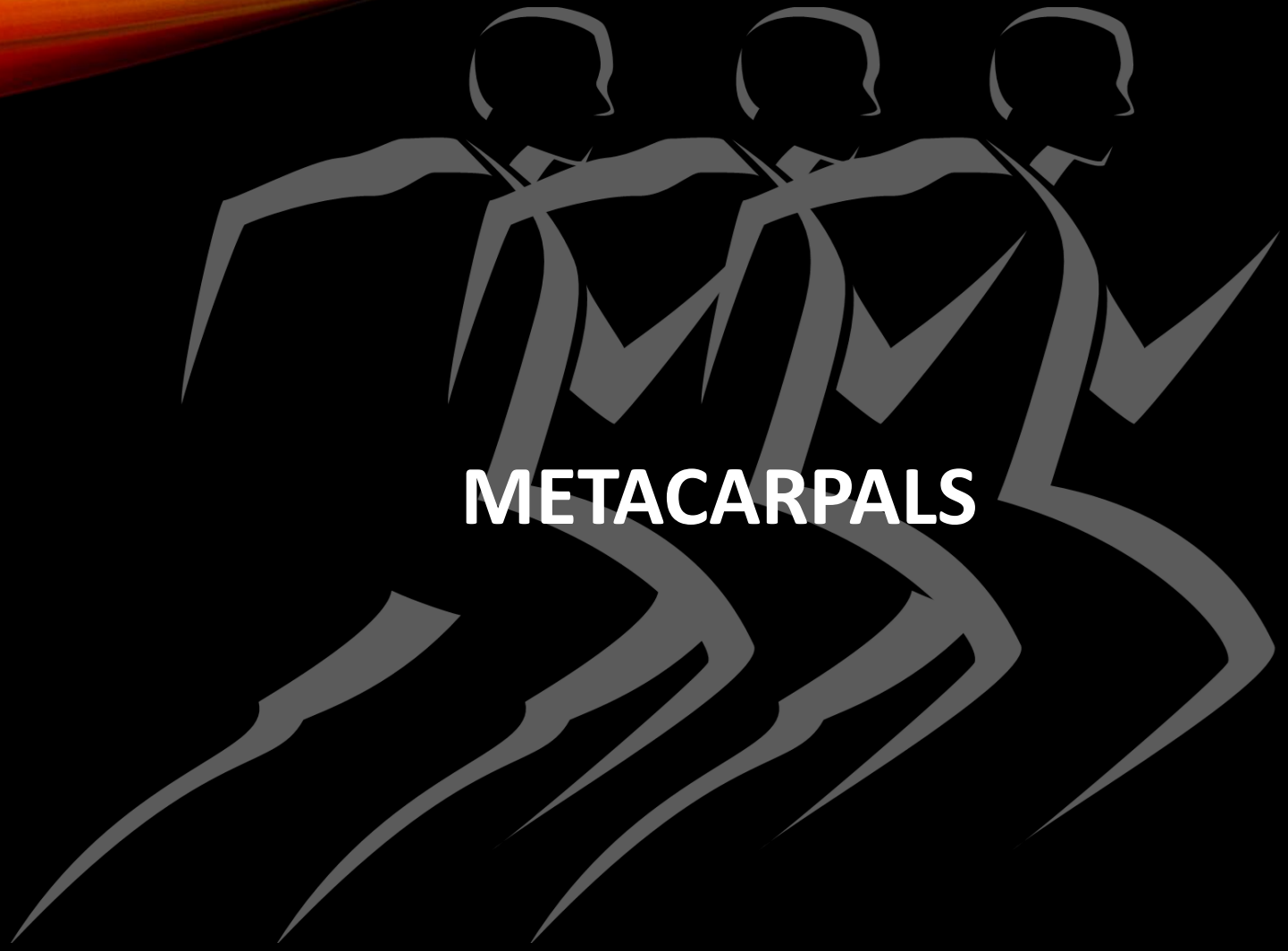
Scaphoid Fx

Radiology:

- Snuffbox view
  - Suspect scaphoid fx, snuffbox pain, FOOSH
    - scaphoid view: 30 degree wrist extension, 20 degree ulnar deviation
    - negative x-ray & high suspicion for fx: repeat 14-21 days



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METACARPALS

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METACARPAL FRACTURES

- Radiographs
  - X-ray: AP, oblique, and lateral films
    - AP view looks @ overall alignment MC shaft
      - Fx pattern, shortening, rotation
    - Lateral view looks @ angulation
      - Some Angulation metacarpal fx accepted
      - Limited amount based on involved finger
      - Index and Long static accept less deformity
      - Ring & Small more flexible accept more deformity

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METACARPAL FRACTURES

- Radiographs
  - Oblique view improves looks @ base MC
    - Improves look @ CMC joint injuries
    - Supinated lateral – best looks @ Index & Long CMC jt.
    - Pronated lateral – best looks @ Ring & Small CMC jt.
  - **Malrotation not acceptable any MC or phalanx fx**
  - **CT Scan**
    - Indicated with multiple fractures @ CMC joints
    - Poorly visualized CMC joint(s) on plain x-ray

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METACARPAL FRACTURES

Metacarpal Head FX

- Inherently unstable
- Non-comminuted FX
  - Operate
    - >25% head involved
    - > 1mm step-off
    - Malrotation
- Comminuted
  - Immobilize 70 degrees flexion for 2 weeks
  - Start ROM after 2weeks



Nelson, Wongworawat: Tolerances, 3rd edition 2009

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METACARPAL FRACTURES

Metacarpal Neck FX

- Index & Long Fingers
  - 15 degrees angulation
- Ring Finger
  - 30-40 degrees angulation
- Small Finger
  - 50-60 degrees angulation
  - Some cases 70 degrees angulation shown not to have significant impairment hand function

Nelson, Wongworawat: Tolerances, 3rd edition 2009



X-rays courtesy Tom Gocke PA-C Library

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METACARPAL FRACTURES

Metacarpal Shaft FX

- Minimal displacement
- NO malrotation
- 5mm shortening
- 10 degrees coronal angulation any MC
- Index & Long Fingers
  - 10 degrees sagittal angulation
- Ring & Small Fingers
  - 20-30 degrees sagittal angulation

Nelson, Wongworawat: Tolerances, 3rd edition 2009



X-rays courtesy Tom Gocke PA-C

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METACARPAL FRACTURES

Metacarpal Base FX

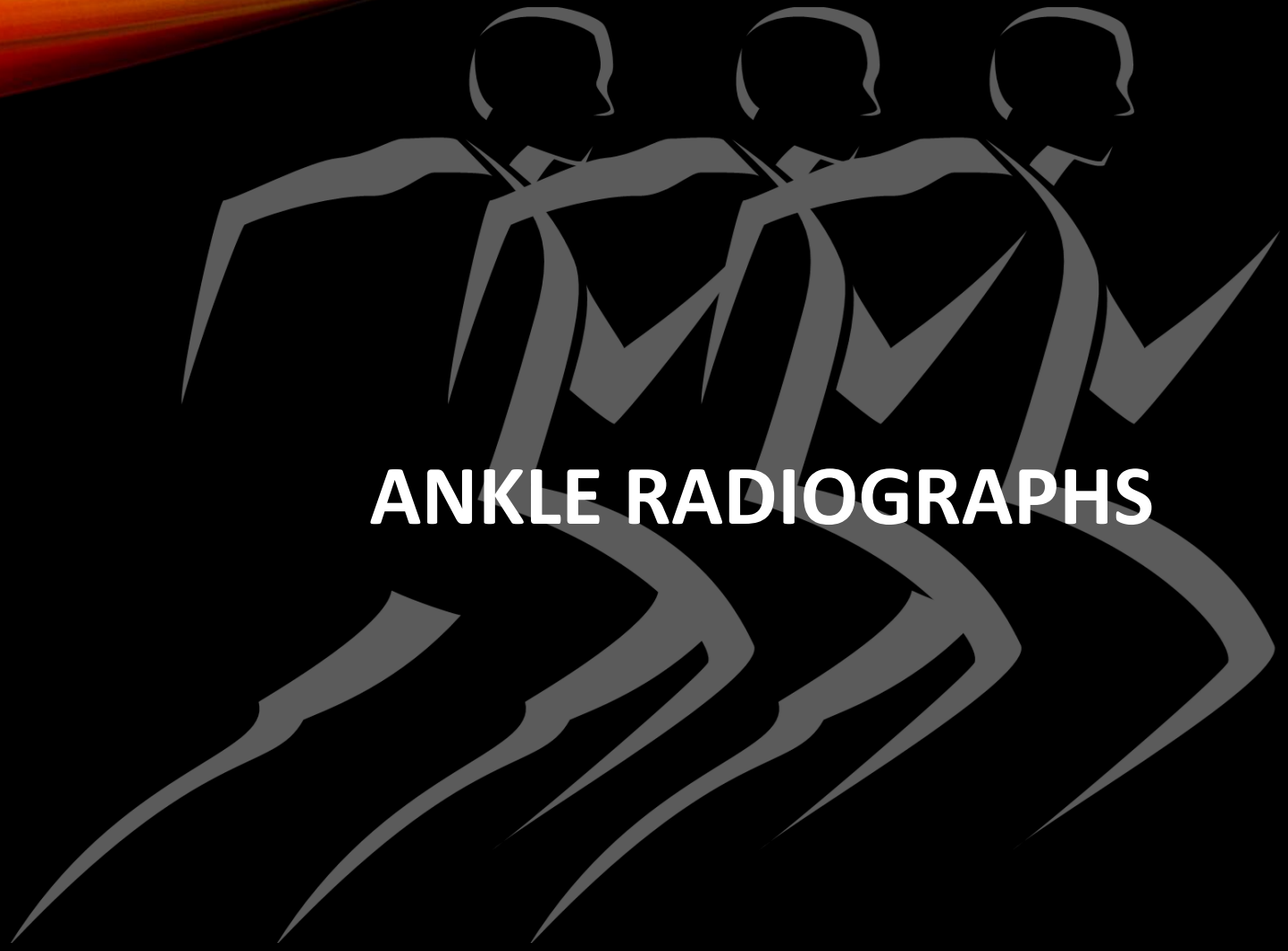
- Index, Long & Ring Fingers
  - Variable – controversial acceptable Fx alignment
- Small Finger
  - Intra-articular CMC joint
    - "Baby Bennett's fx"
  - Inherently unstable
  - No acceptable shortening, angulation or malrotation
  - Needs CRPP

Nelson, Wongworawat: Tolerances, 3rd edition 2009



X-ray courtesy Tom Gocke PA-C Library

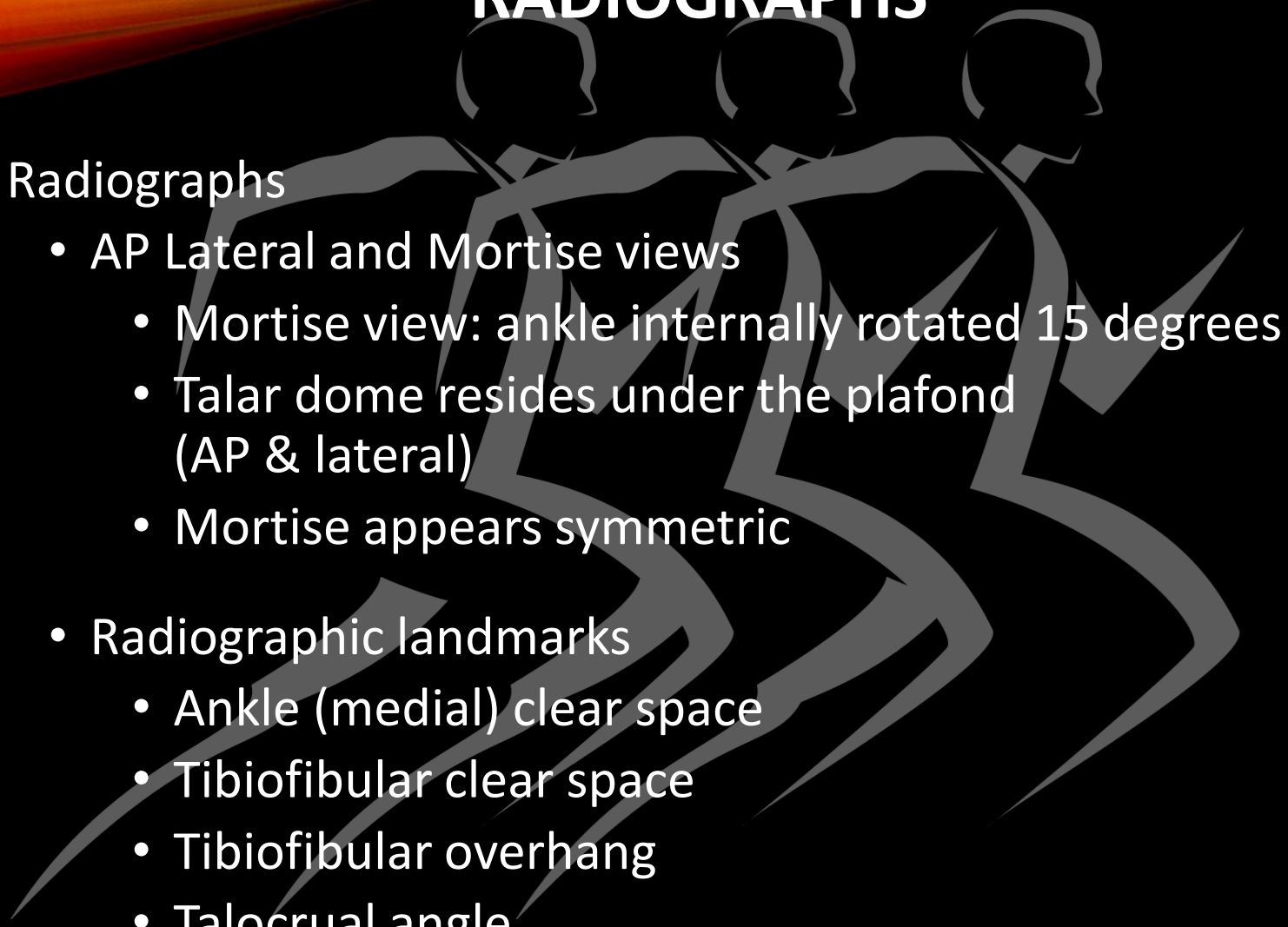
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ANKLE RADIOGRAPHS

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RADIOGRAPHS

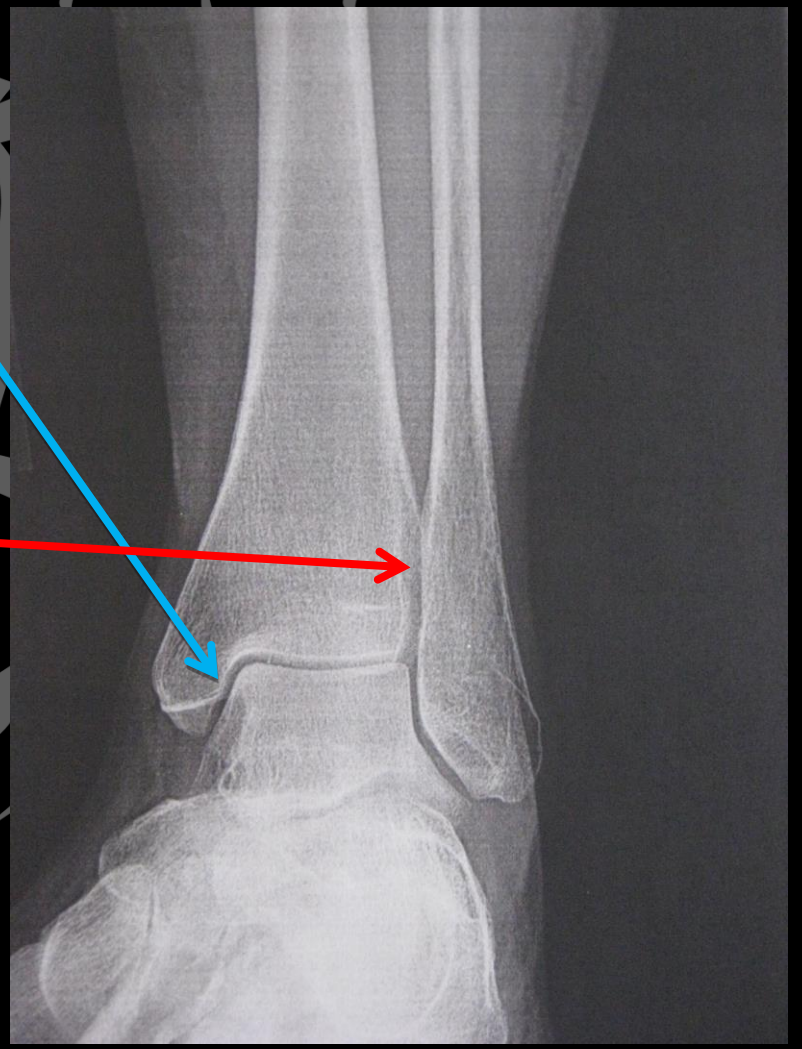


- Radiographs
  - AP Lateral and Mortise views
    - Mortise view: ankle internally rotated 15 degrees
    - Talar dome resides under the plafond (AP & lateral)
    - Mortise appears symmetric
  - Radiographic landmarks
    - Ankle (medial) clear space
    - Tibiofibular clear space
    - Tibiofibular overhang
    - Talocrual angle

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RADIOGRAPHS

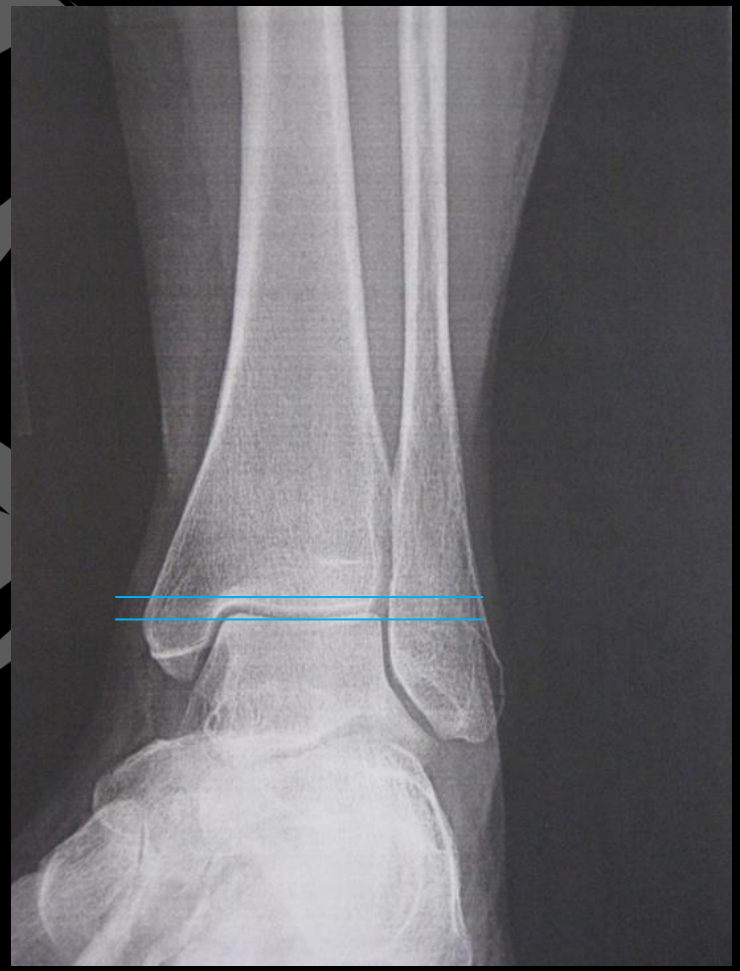
- Ankle (medial) clear space
  - Normal range <4 mm between tibia
- Tibiofibular clear space
  - Normal range <5 mm between tibia & fibula



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RADIOGRAPHS

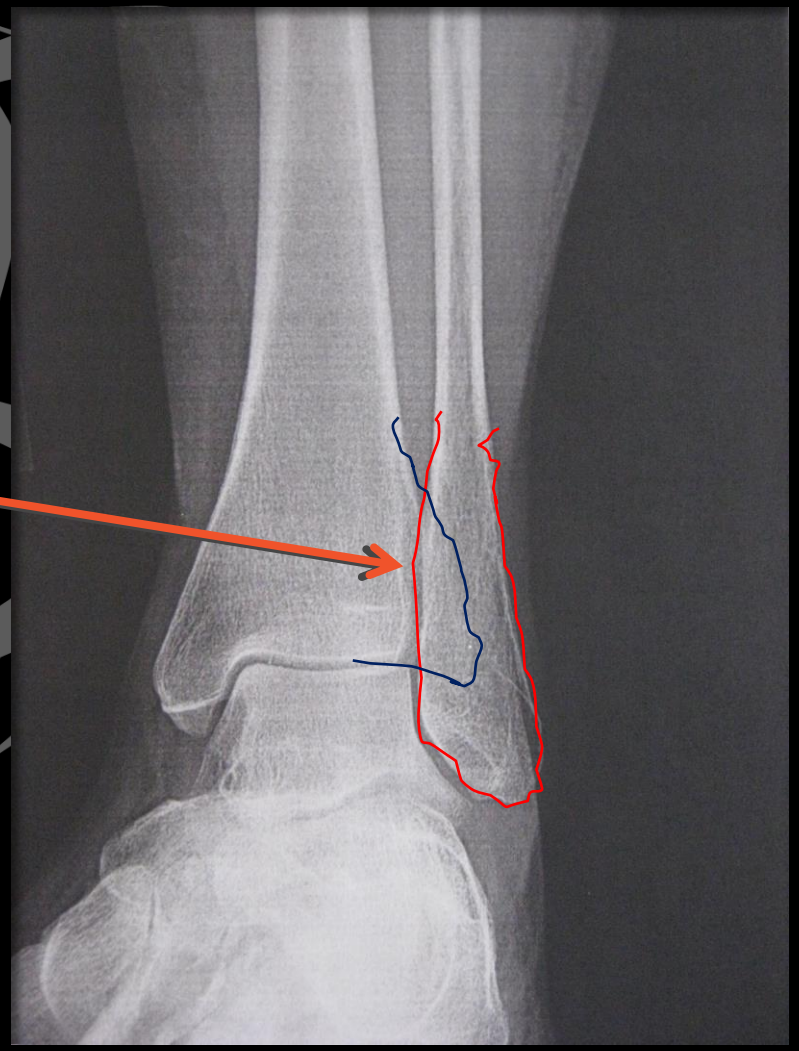
- Talar Tilt
  - Parallel lines draw plafond and articular surface talus at ankle mortise
  - Normal < 10 degrees
  - Abnormal



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RADIOGRAPHS

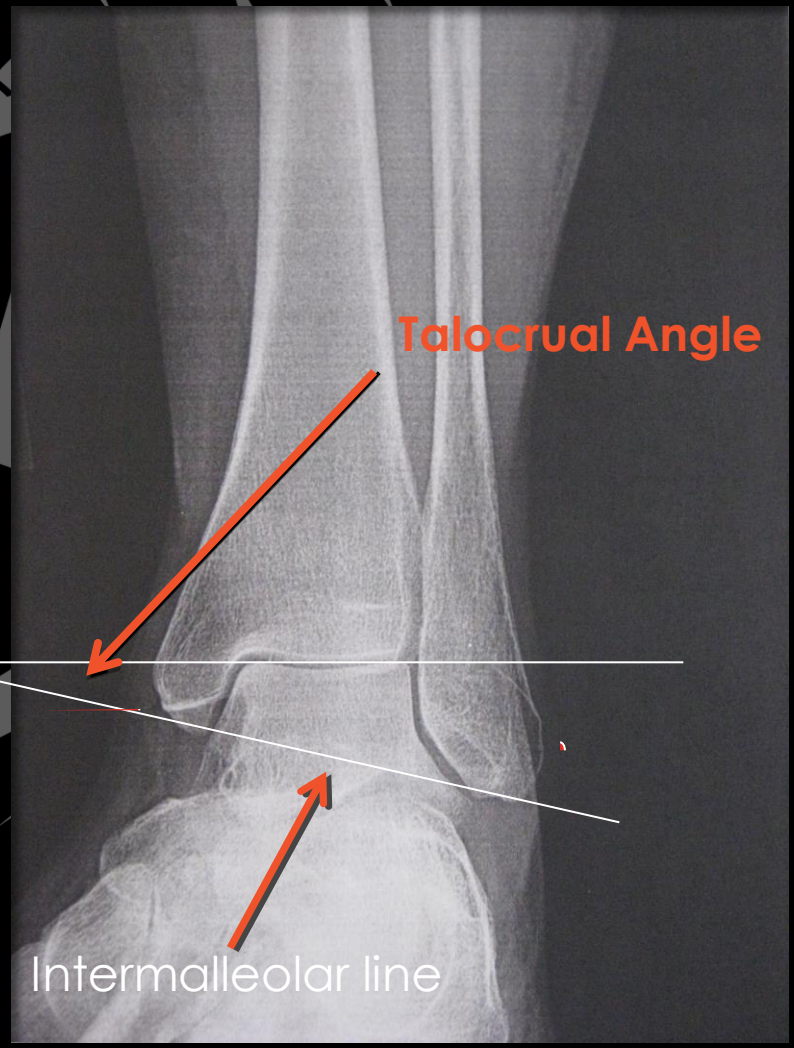
- Tibiofibular overlap
  - Normal range >10 mm between tibia & fibula
  - Fibular notch



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RADIOGRAPHS

- Talocrual Angle
  - Normal measurement 8-15 degrees
  - Strong indicator of syndesmosis disruption, because the fibula will be shortened and externally rotated
  - Talocrual Angle should be compared to the contralateral normal side



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RADIOGRAPHS

- Radiographs
  - AP Lateral and Mortise views
    - Mortise view: ankle internally rotated 15 degrees
    - Check medial Clear space
    - Normal mortise configuration
    - Talar dome fits under Plafond in ALL views



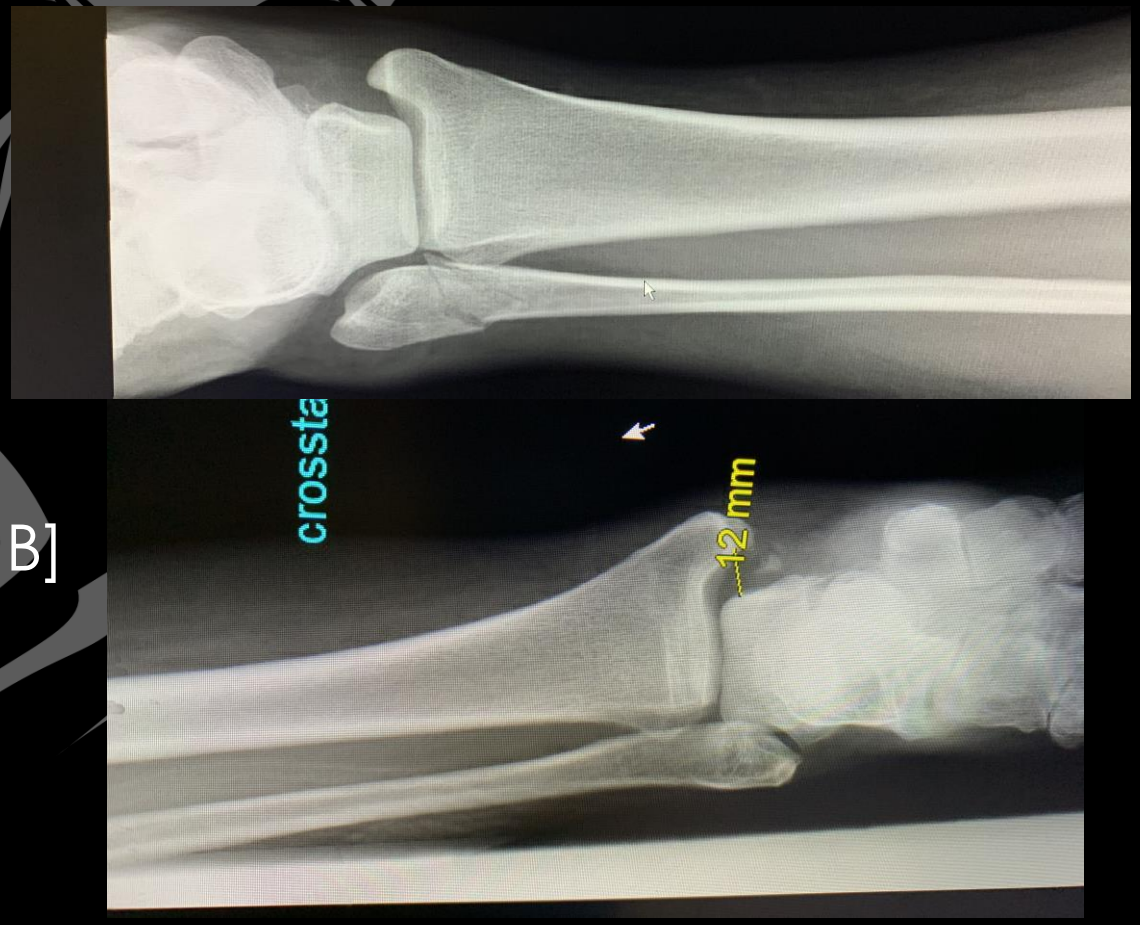


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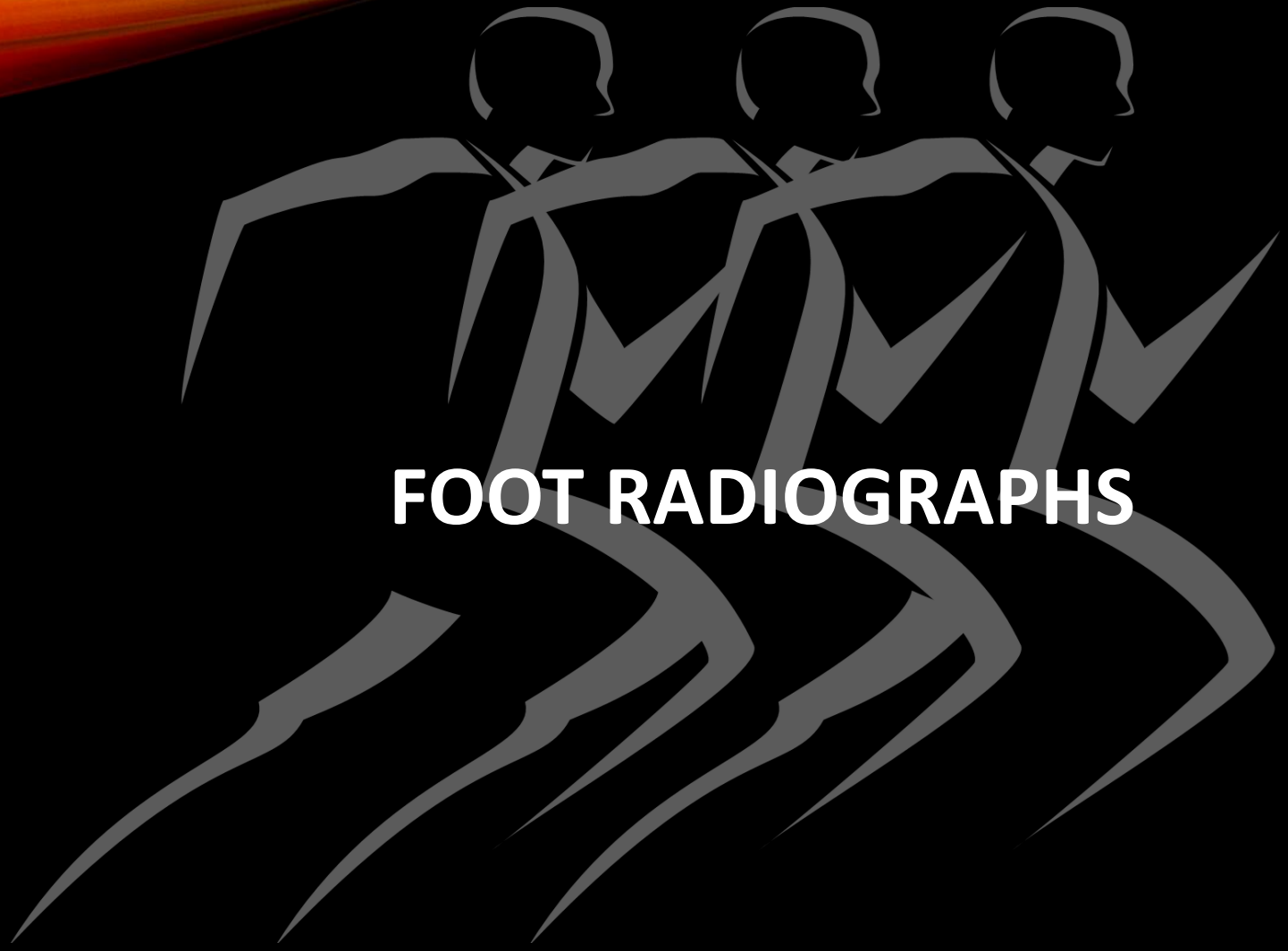
GRAVITY STRESS VIEW ANKLE

Gravity Stress View Ankle

- MCS >4mm on gravity stress view
- unstable ankle in supination-external rotation injury
- Deltoid ligament injury
- Positive findings related to need for surgical stabilization ankle fx [Weber B]

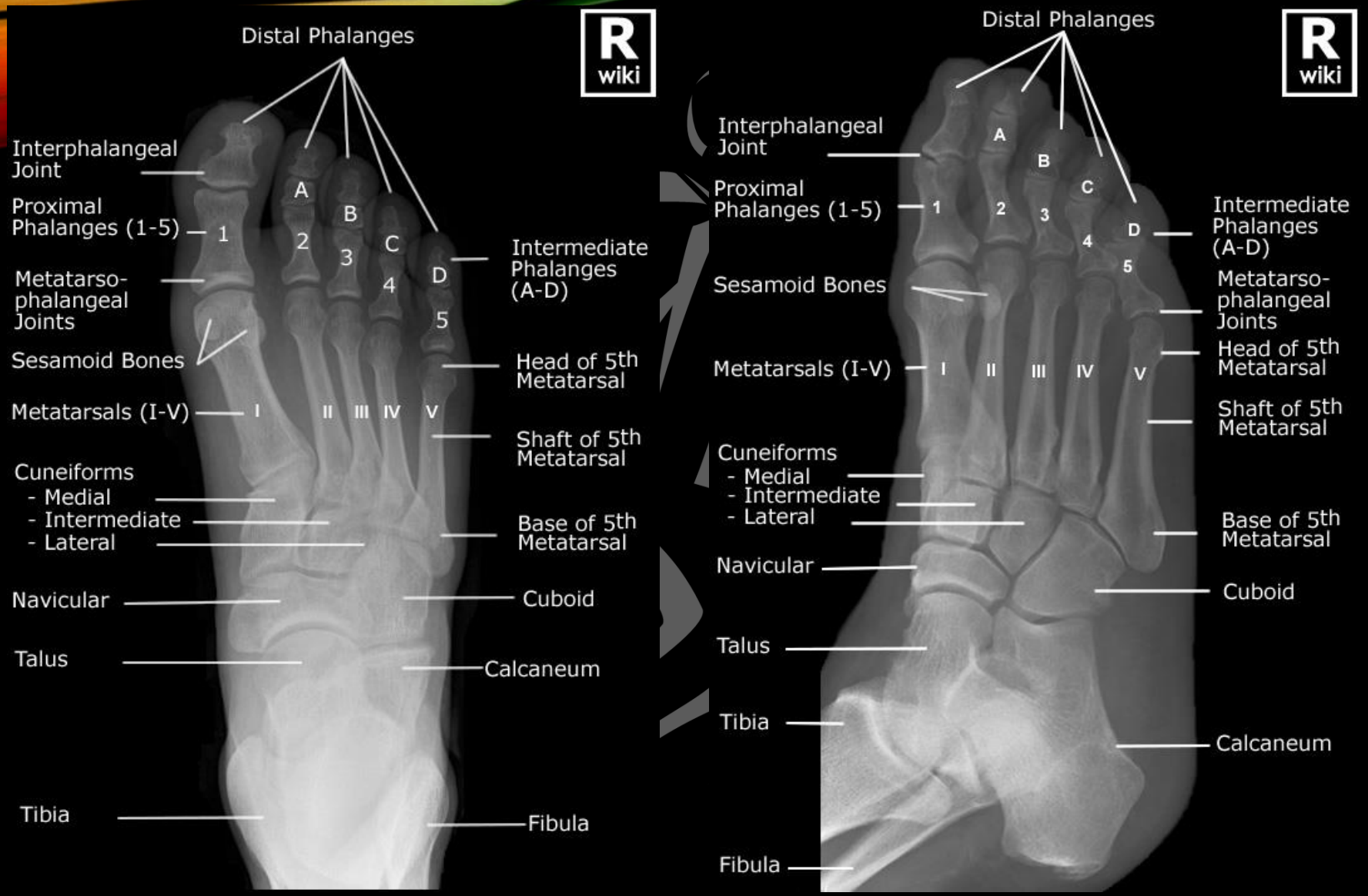


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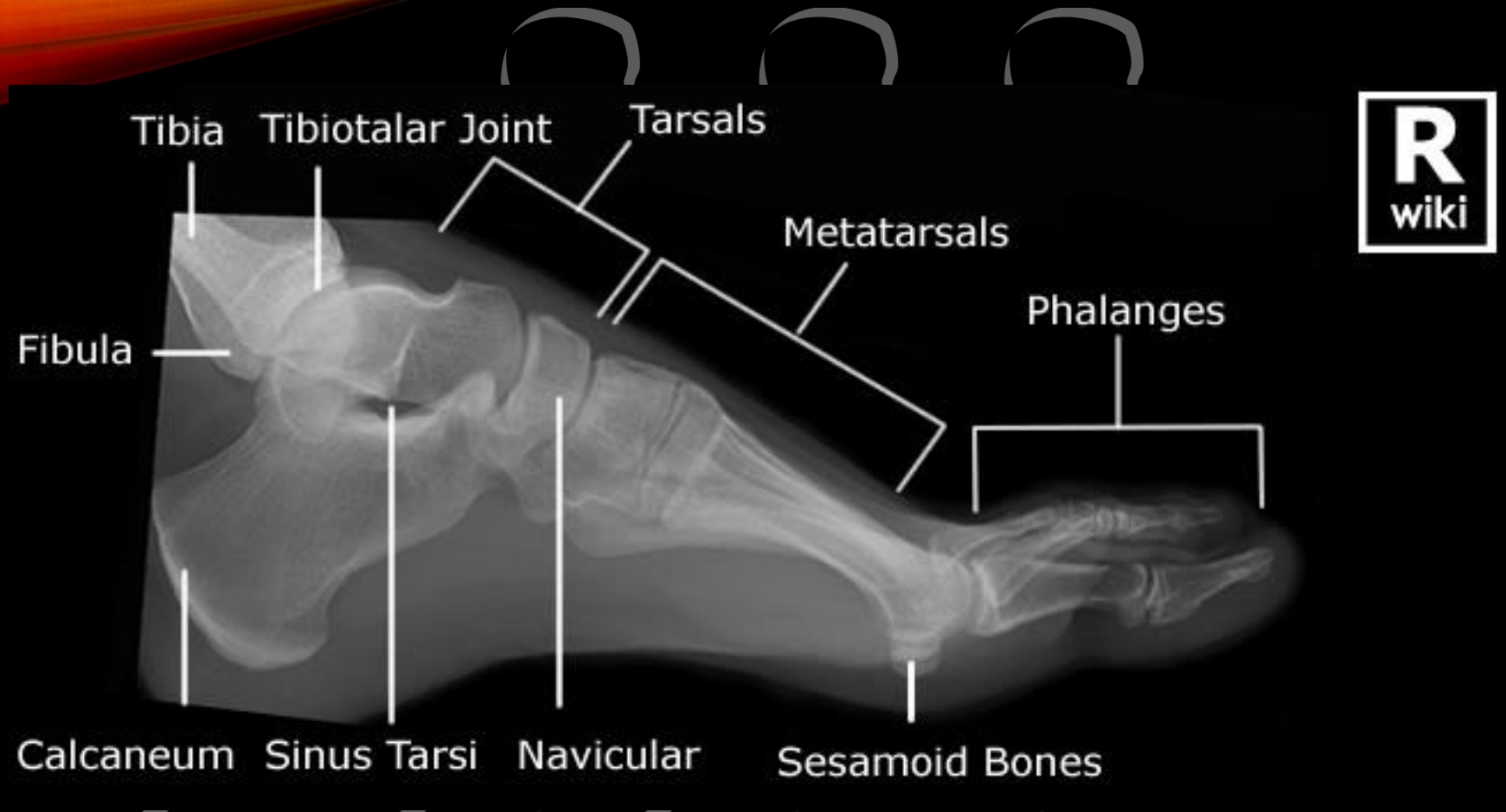
FOOT RADIOGRAPHS

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RADIOGRAPHS

- Foot: AP, LATERAL & OBLIQUE
  - WT-BEARING –best to assess:
    - Hallux valgus angle (HVA)
    - Intermetatarsal angle (IMA)
    - CHARCOT foot
    - Lis-franc – pain/swelling allows

- **NORMAL ALIGNMENT**
  - 1^{ST} MT -1^{ST} CUNEIFORM
  - 2^{ND} MT – 2^{ND} CUNEIFORM
  - 3^{RD} MT – 3^{RD} CUNEIFORM
  - 4^{TH} & 5^{TH} MT – CUBOID



Photos courtesy TGocke, PA-C

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RADIOGRAPHS

- Lateral & Harris heel views
  - Calcaneal Fracture
    - Loss Bohler's angle and angle of Gissane
    - Harris/Beeth heel view – Calcaneal fx
    - CT scan w/ recon images best for calcaneous fx







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RADIOGRAPHS

Harris/Beeth views

- Harris/Beeth heel view:
  - Best detect Calcaneal fxs
- Normal: no varus or valgus angulation
- Abnormal:
  - Loss length Calcaneous
  - Varus/valgus deformity
  - Hind foot appears deformed
- CT scan w/ recon images best for calcaneous fx

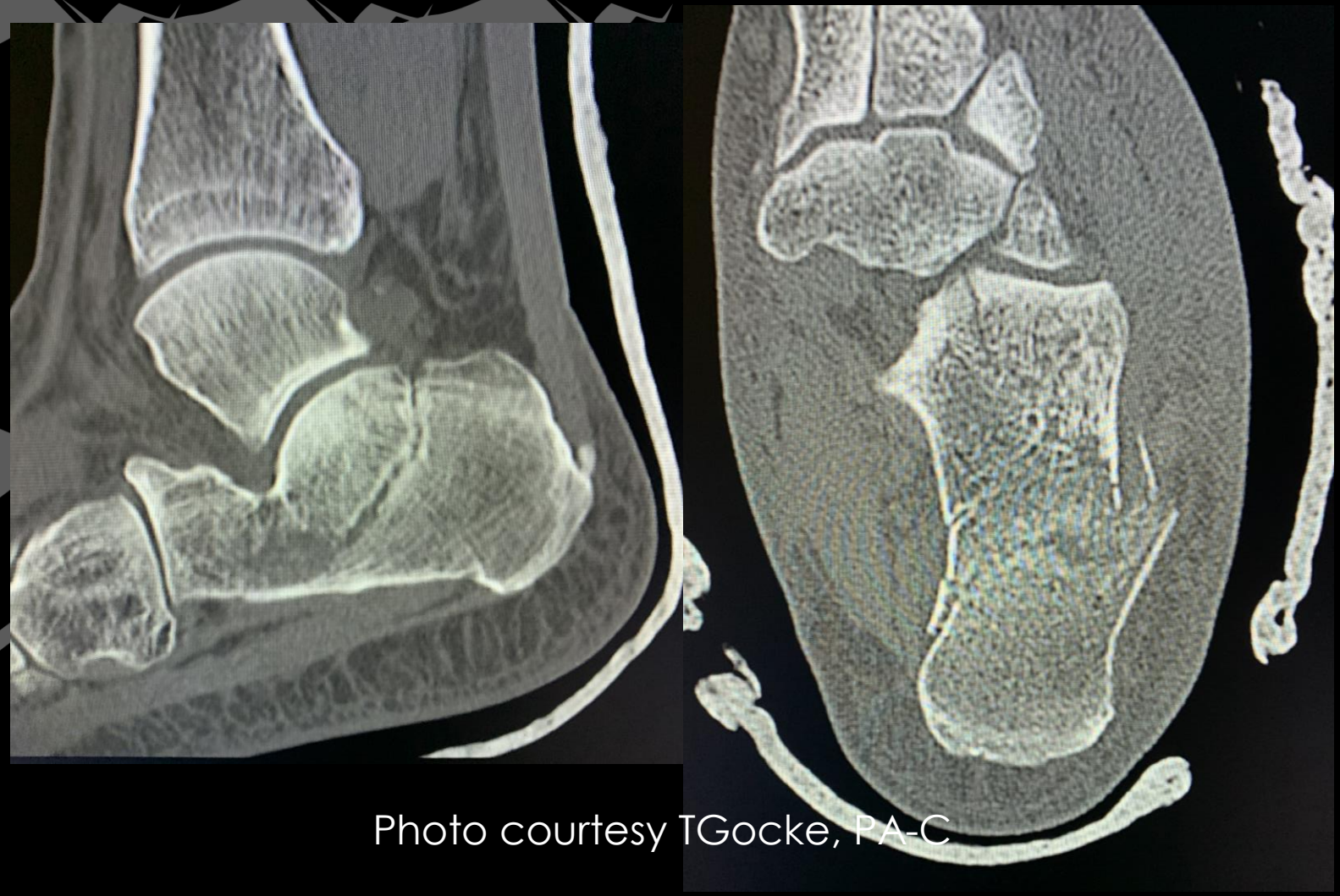


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