Review of Essential X-ray Interpretation Skills

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Splinting/Casting Workshop Director, Guide to the MSK Galaxy Course

JBJS- JOPA Journal of Orthopaedics for Physician Assistants- Associate Editor

Americian Academy of Surgical Physician Assistants – Editorial Review Board

Learning Objectives

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

Describe general bony anatomy of the musculoskeletal

Describe and interpret plain radiographs for the Glenol

Describe and interpret plain radiographs for Acromiocla

Describe and interpret plain radiographs of the Ankle jo

Describe and interpret plain radiographs of the Foot

Describe and interpret plain radiographs of the Cervical spine

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)

Shoulder

Plain Radiographs:

- X-ray does not look at soft-tissue assessment
- Arthrogram can assess redundant joint capsule and tears 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 sc tissue injuries

Shoulder

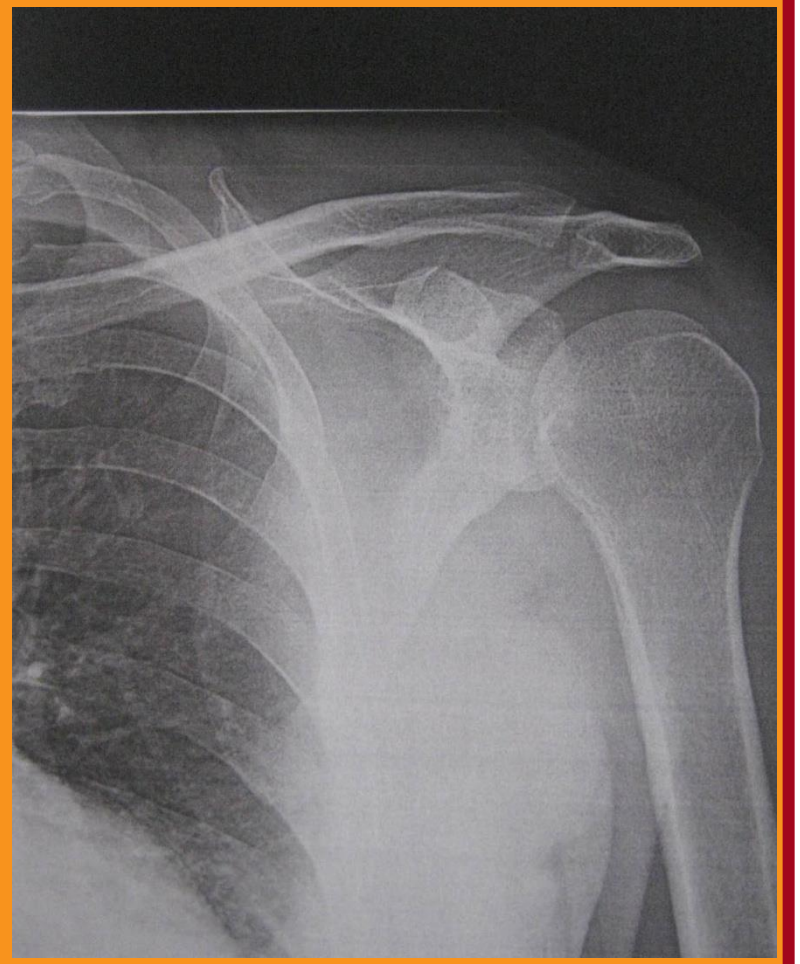
- Anterior-posterior (AP) View
  - Looks at anterior GH joint and AC joint
  - Assess Glenohumeral position
  - Degenerative changes: AC & Glenoid
  - Fractures
- Normal findings
  - Humeral head and glenoid are generally level with on another
  - Humerus overlaps small amount with glenoid “Crescent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

Shoulder

Anterior-posterior (AP) View

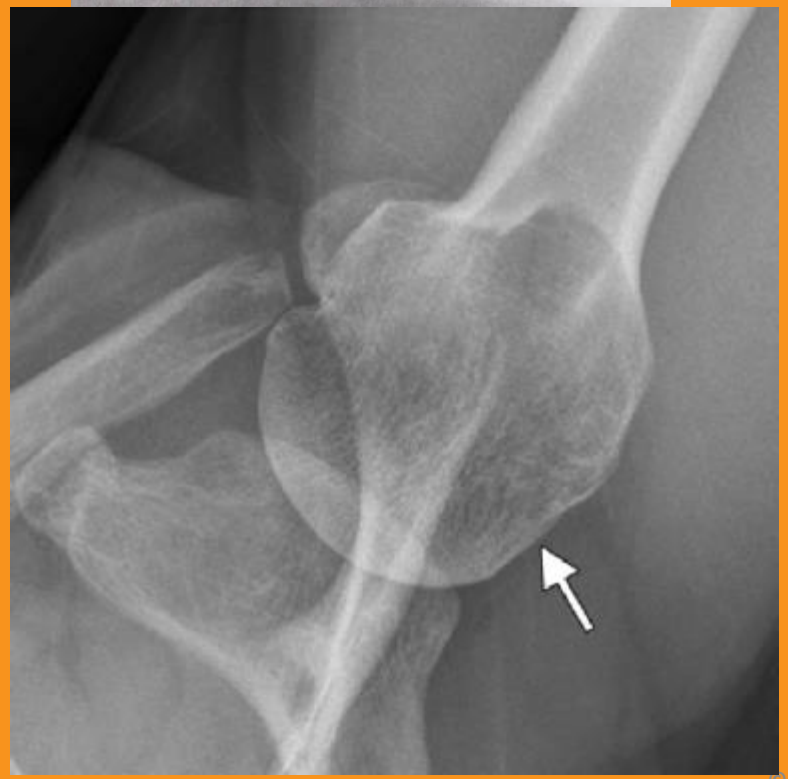
- Anterior dislocation
  - Humeral head anterior and inferior to glenoid
  - Humeral head looks bigger on AP x-ray
- Posterior dislocation
  - Humeral head goes posterior to glenoid and looks like GH joint pulled apart
  - Loose “Crescent sign” appearance in normal joint
  - Humeral head looks smaller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

AP-normal



Anterior Dislocation

Photos courtesy TGocke, PA-C



Shoulder

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

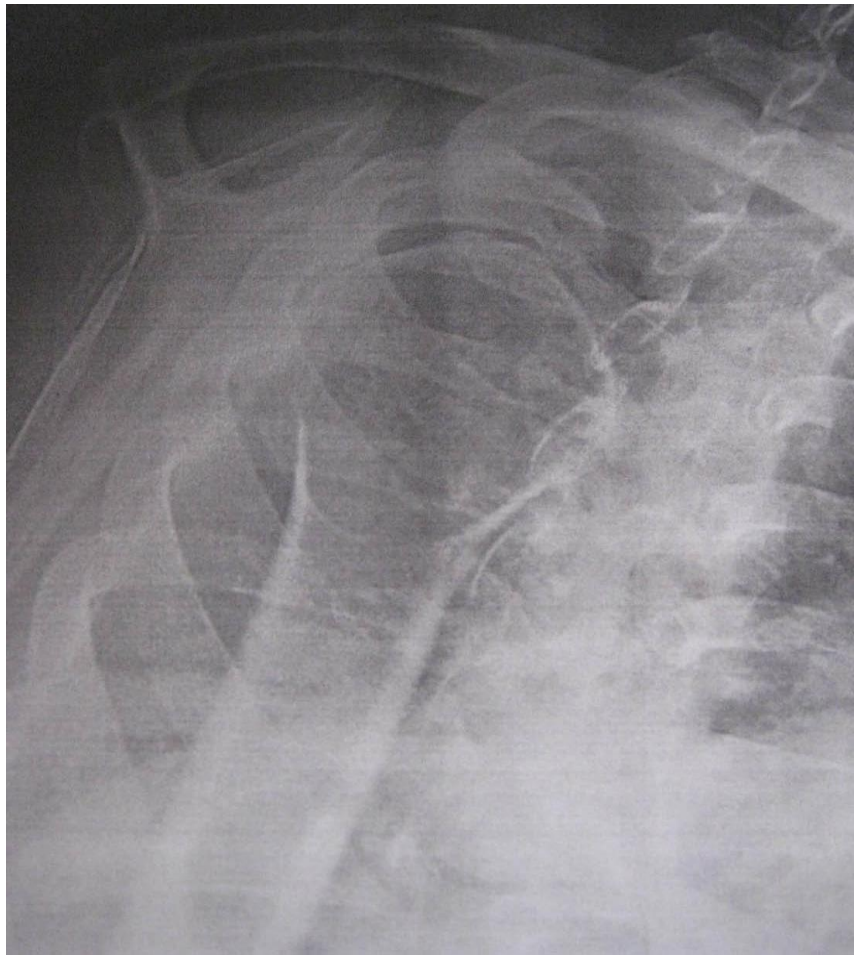
Shoulder

- 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

Transcapular View

Normal

Dislocation



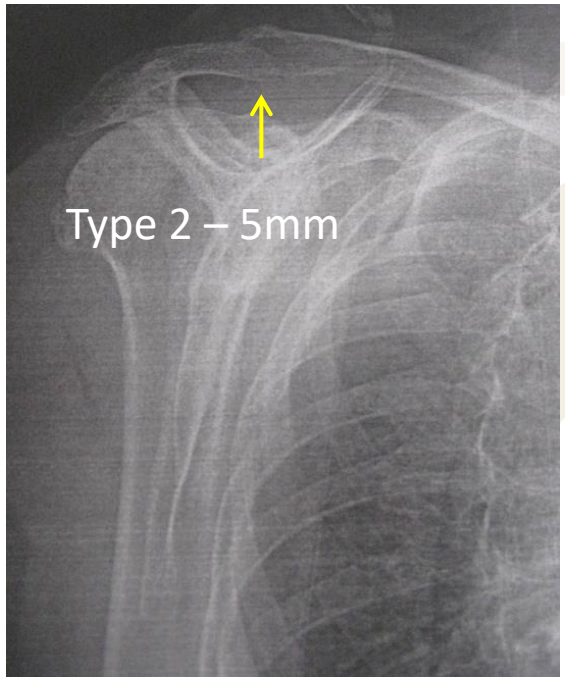
Photos courtesy TGocke, PA-C

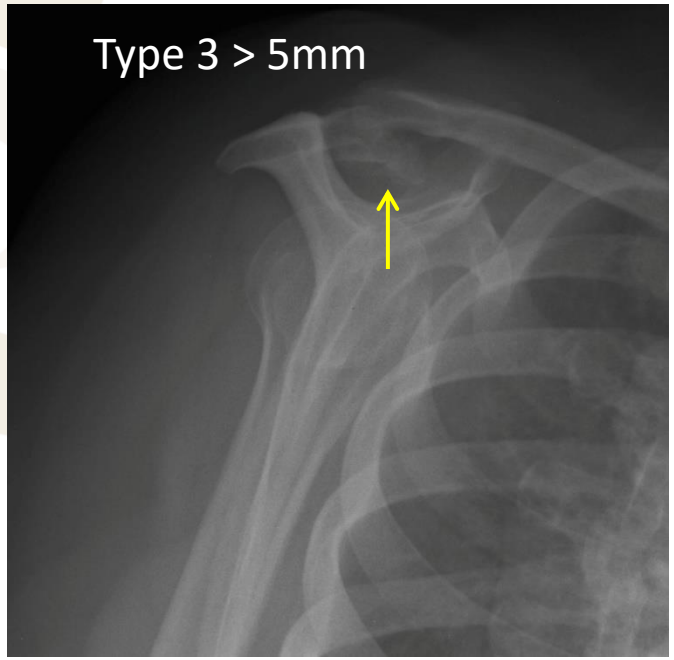
Transcapular view “Acromial spur”

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

Transcapular view: “Acromial spur”





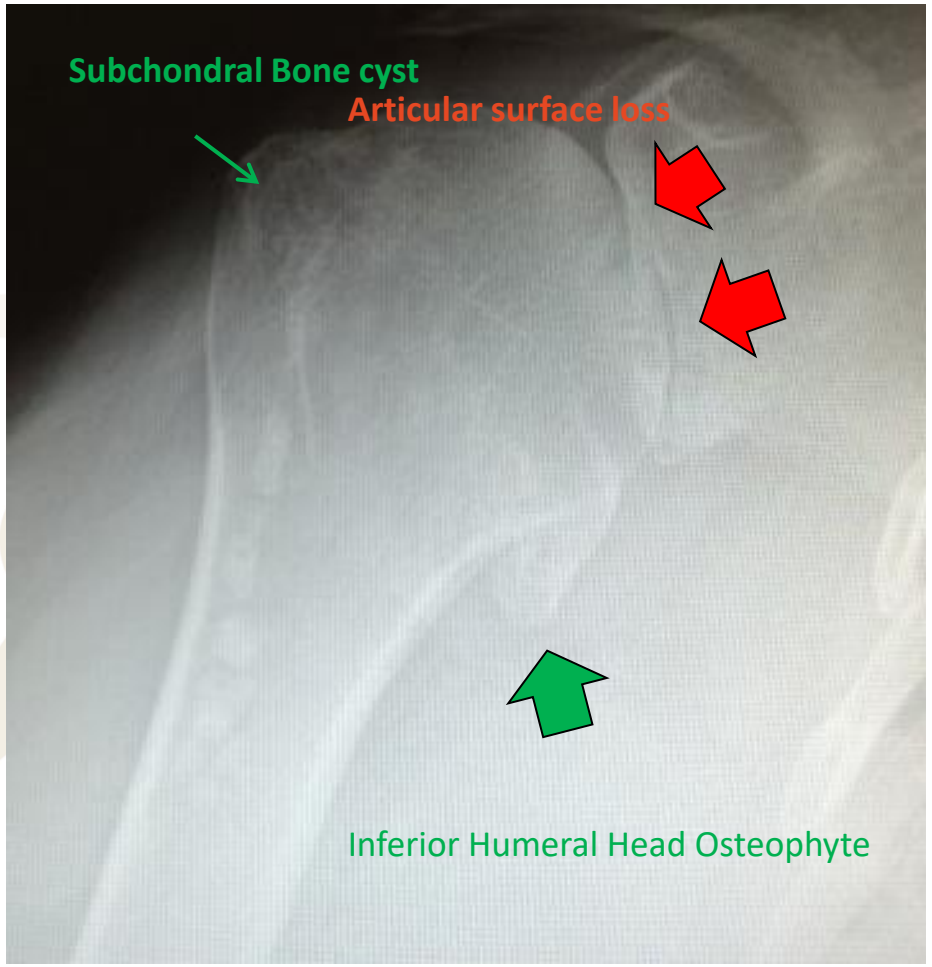
Glenohumeral Joint Arthritis

Glenohumeral Joint Arthritis

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



GLENOHUMERAL JOINT ARTHRITIS

Acromioclavicular Joint Arthritis

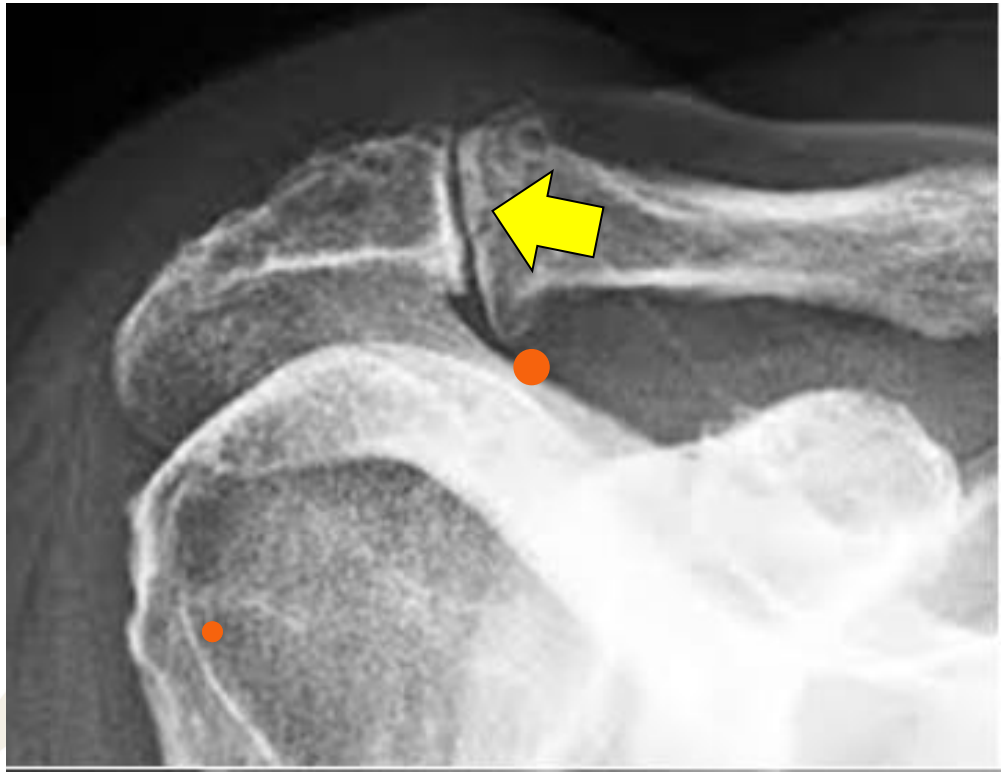
Acromioclavicular Joint Arthritis

- 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

Acromioclavicular Joint Arthritis

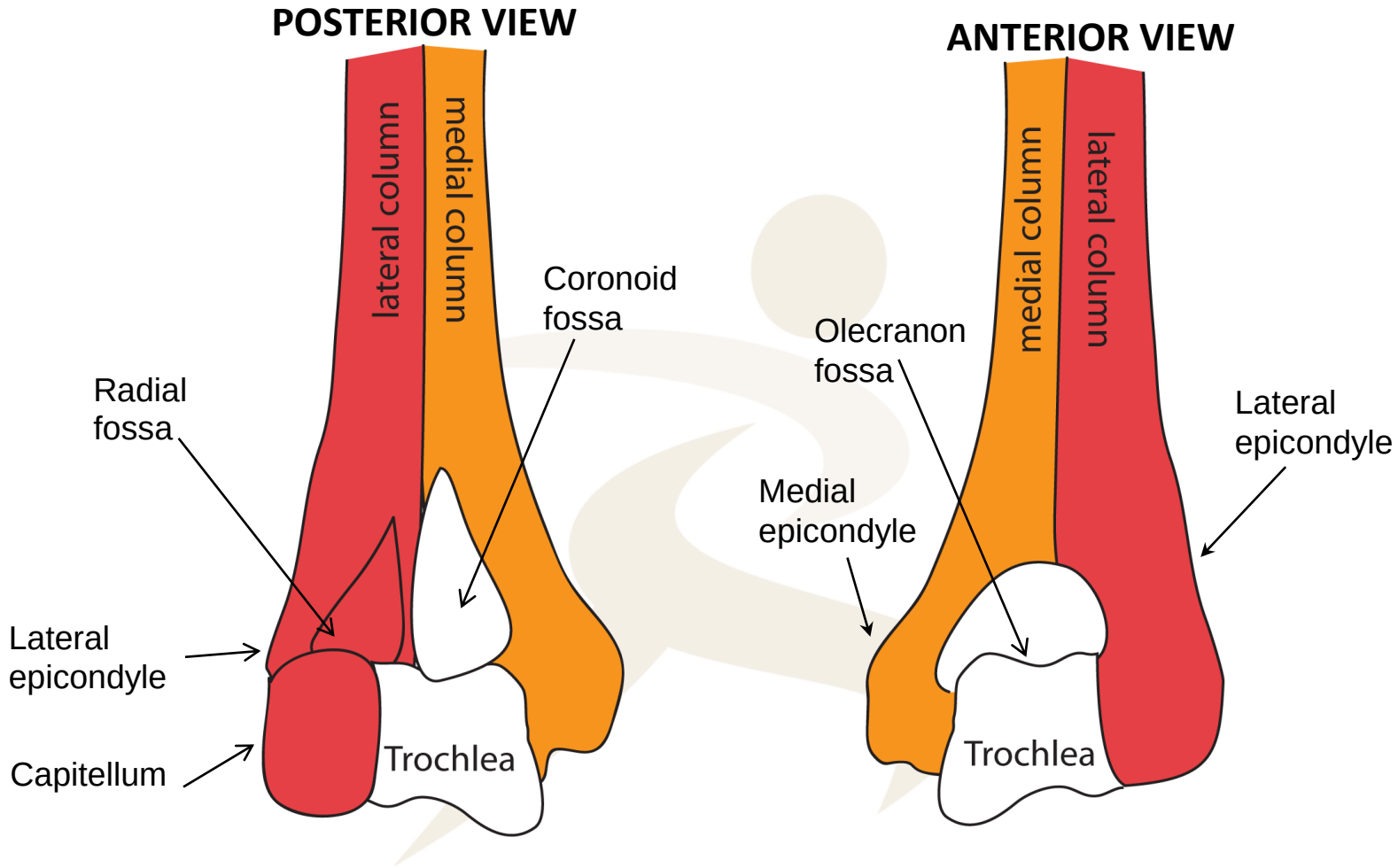
Radiographs

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



Elbow

Bony Landmarks

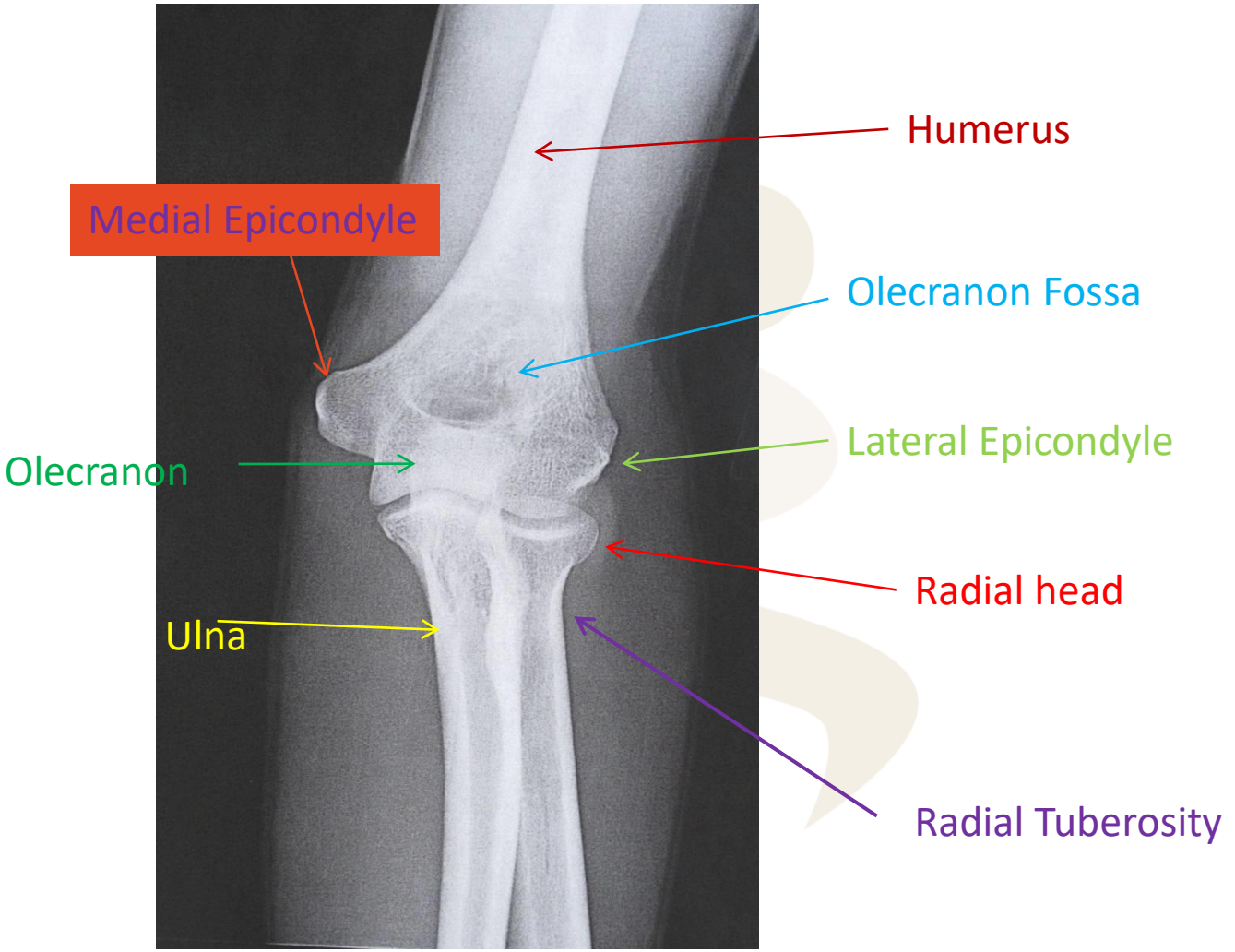


Supracondylar Humerus Fx

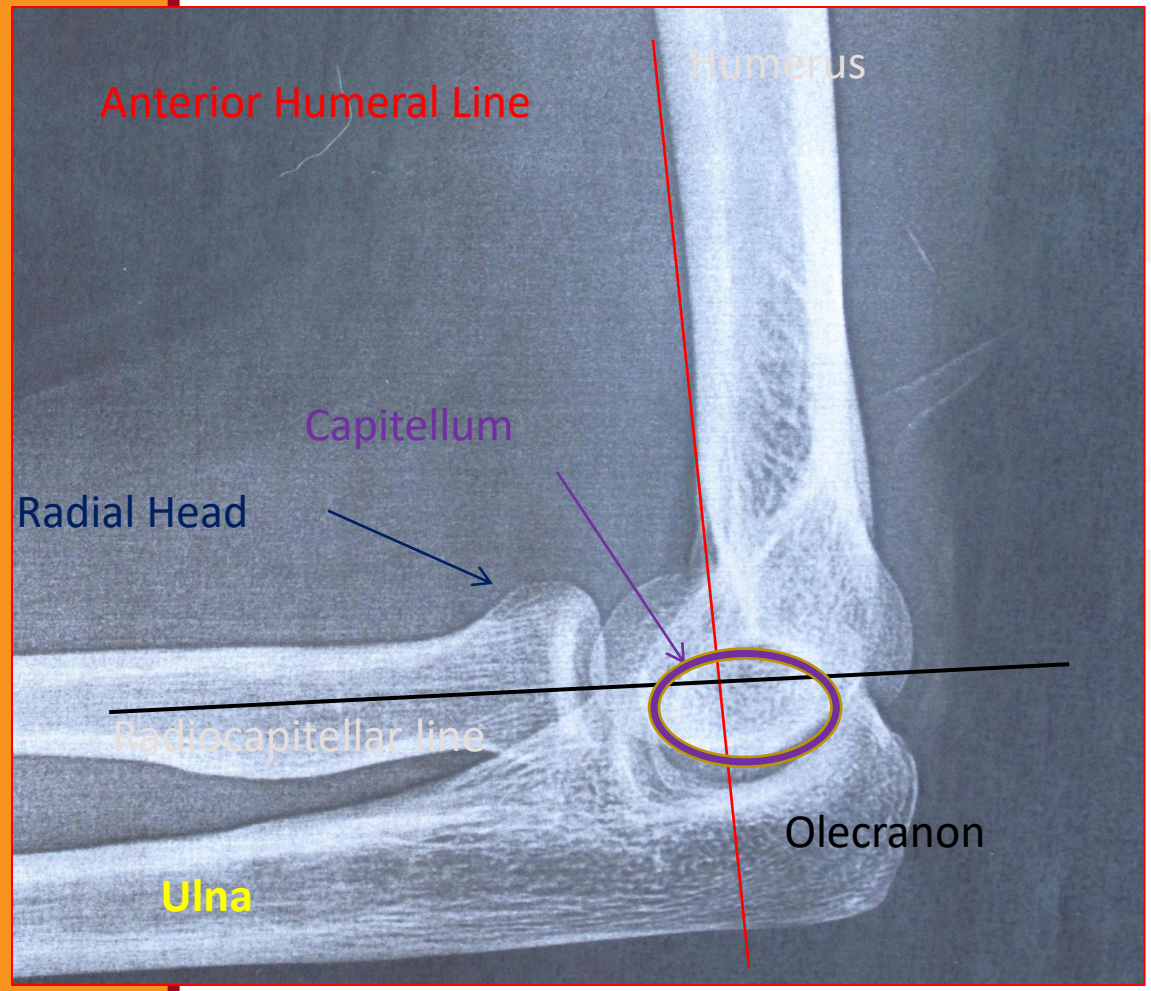
Epidemiology

- 30% all Elbow fx
  - Supracondylar
  - Single Column fx- Lateral
  - Bi-column fx- heavy damage
  - Young men & older female
  - Falls from standing height/high energy
- X-ray Images
  - AP, and Lateral
  - Comminuted, intra-articular – usually gets a CT Scan

Elbow XRAY Anatomy

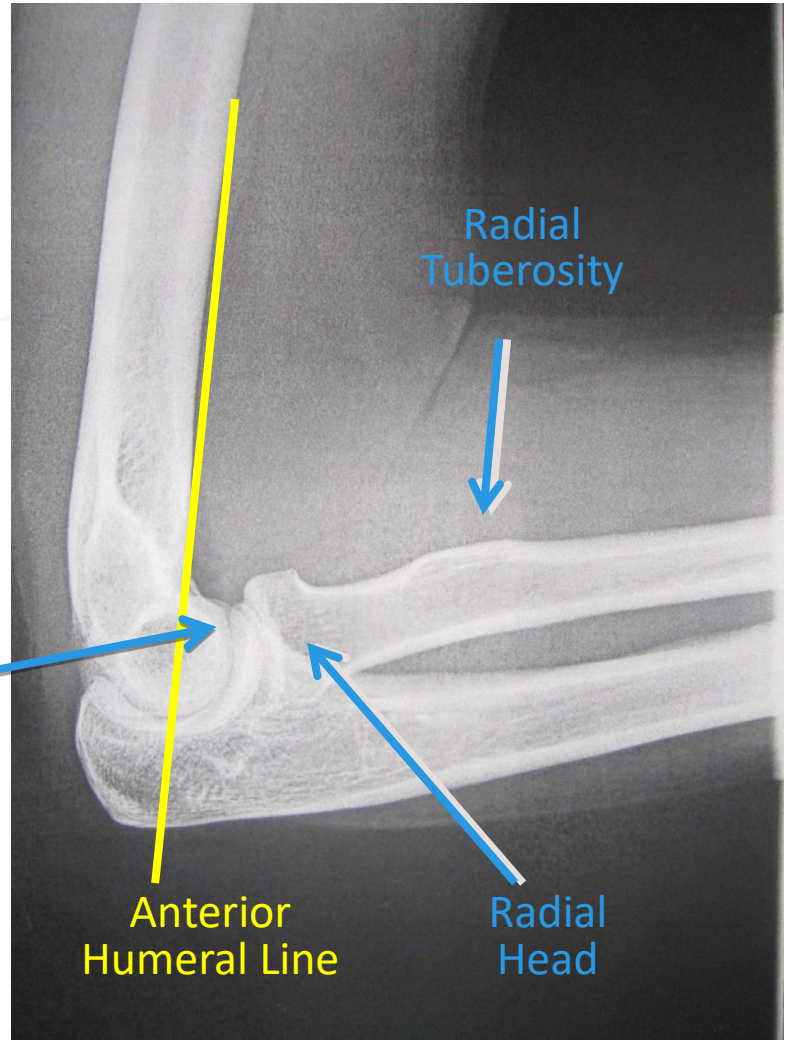


Radiology



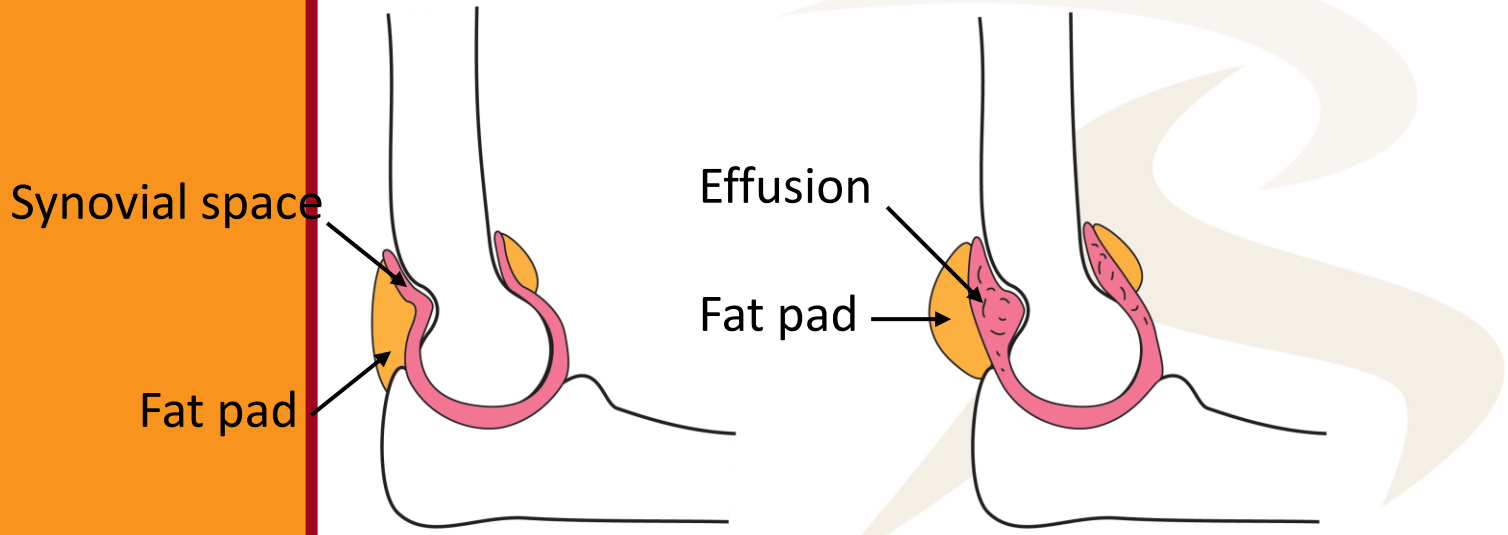
Elbow Anatomy

- Ligament
  - Radial Collateral
  - Ulnar Collateral
  - Annular (radial head)
- Tendon
  - Bicep–distal insert radial tuberosity
  - Triceps
  - Coranoid Process



Radiology

Fat Pad Sign



Peds elbow fx

Radial Head Fx

Radiographs

AP, lateral & radial head view

- Radial head view: oblique lateral
  - Helps see subtle fx radial head
- Check for Fat Pad signs
- Fx Tolerances: Rule of 3's (Radin & Riseborough, *JBJS-A*, 1966)
  - 1/3 radial head fx
  - 3mm displacement/diastasis
  - >30 degrees angulation

CT Scan

Needed with comminuted fx radial head

Helps with surgical preplanning

Radiology

Fat Pad Sign

Mason Type I

Mason Type II

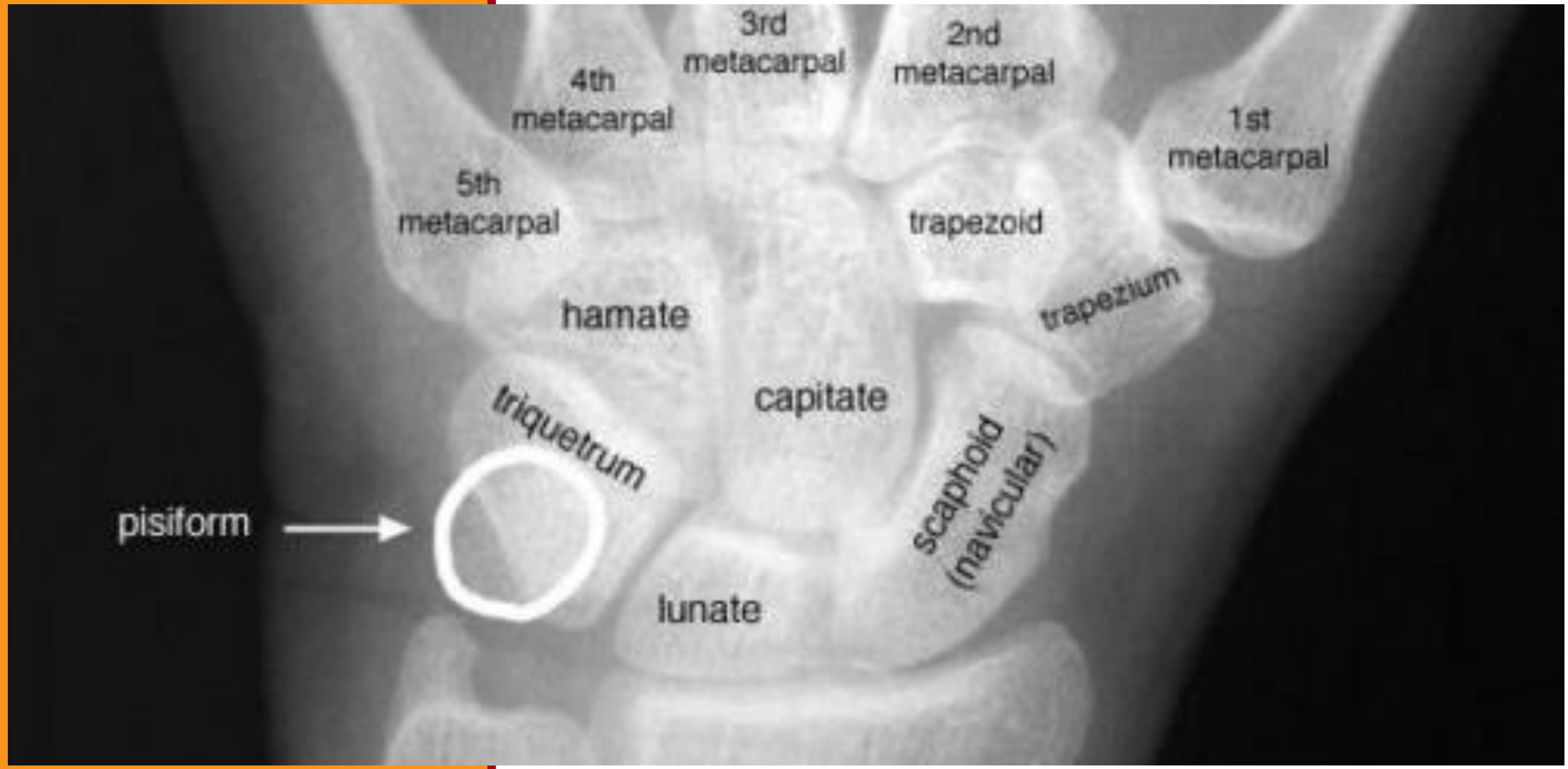
Mason Type III

Olecranon Fracture

Avulsion Fx

Transverse fx

Distal Radius & Ulna



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

Distal Radius & Ulna

Radiographs

Radial Inclination

- Normal: 23 degrees (< 5 degrees)

Radial Height

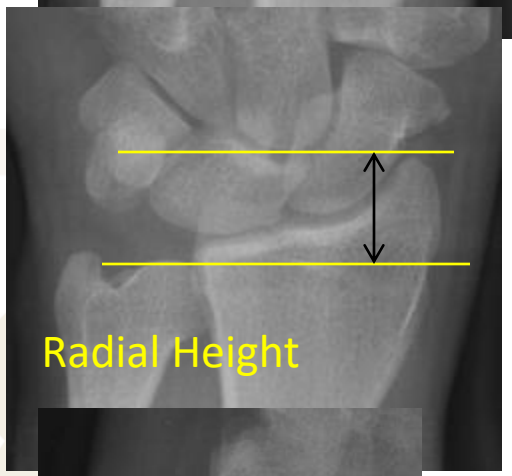
- Normal10-12 mm (ulnar negative)
- Variant <5mm
- **Fx: ulnar positive (loose radial height)**

Radial articular surface

- Normal :Congruent
- Variant: <2mm step-off

Palmar Tilt

- Normal 10 degrees



Pictures courtesy T Gocke, PA-C

Radiology Review

Normal Carpal bone anatomy

Parallelism –

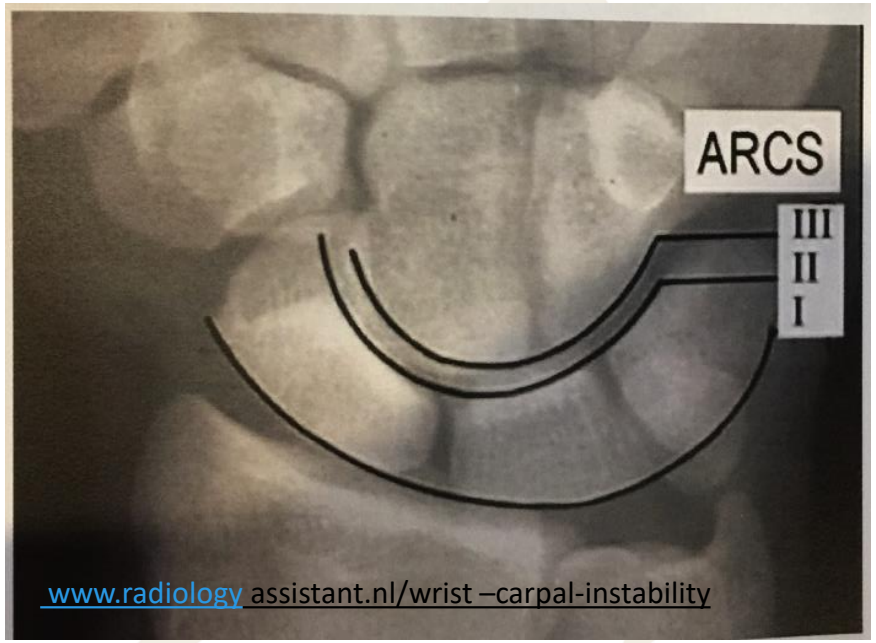
- 2mm width between carpal bones

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

Distal Radius Fractures

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

Fracture Description

- Fx location
- Open v. Closed:
  - Gustilio-Anderson classification
- Neurovascular status
- Angulation: direction fx apex
- Displacement vs. Non-displaced
- Comminution
- Impaction
- Rotation
- Articular extension

Photos courtesy TGocke PA-C

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

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

Carpal Bones Injuries

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

Picture courtesy T Gocke, PA-C

Carpal Bone Injuries

Scaphoid Fx

- **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**

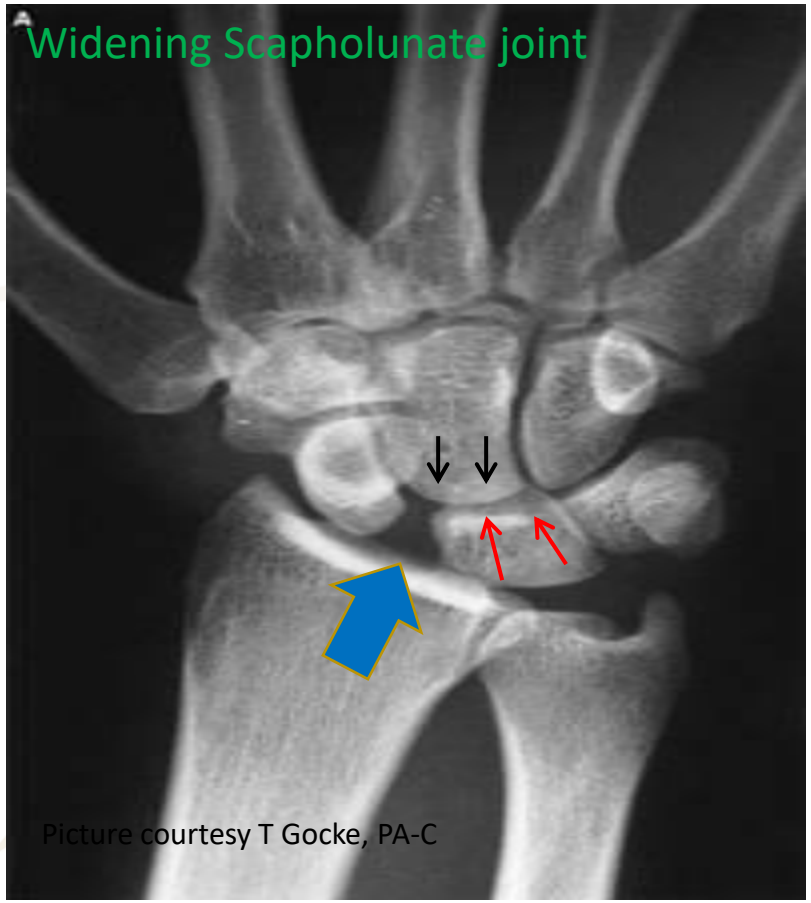
Photo courtesy T Gocke, PA-C

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)**



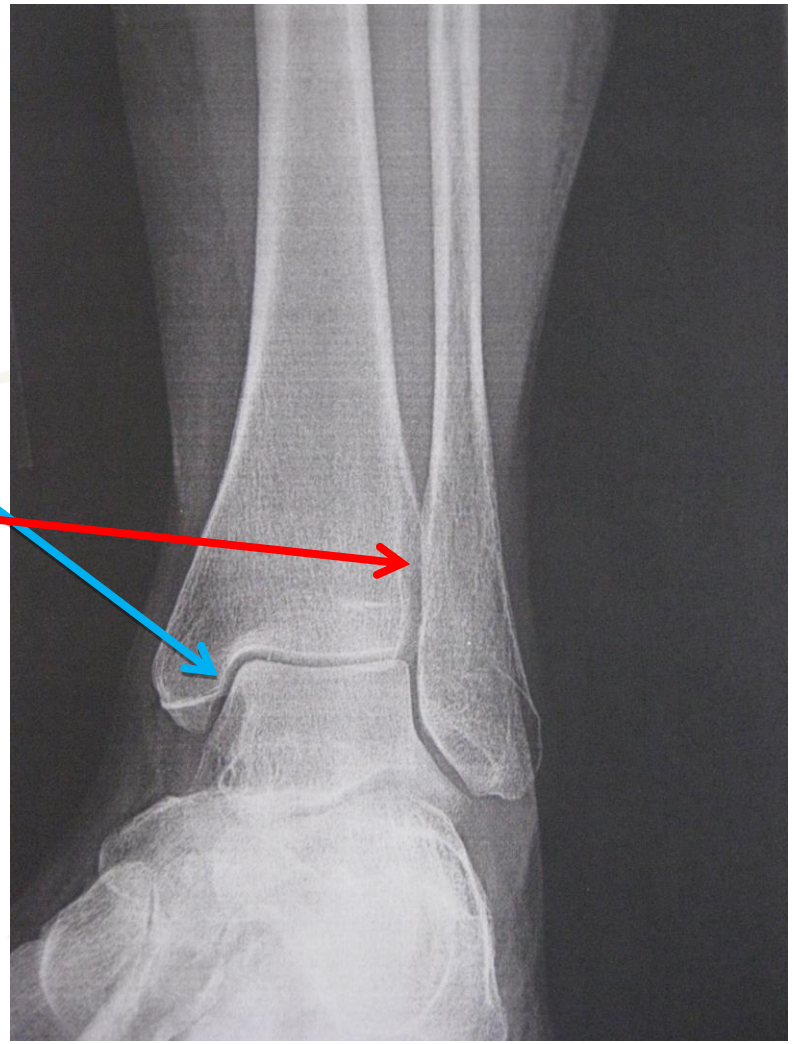
Ankle Radiographs

Ankle 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

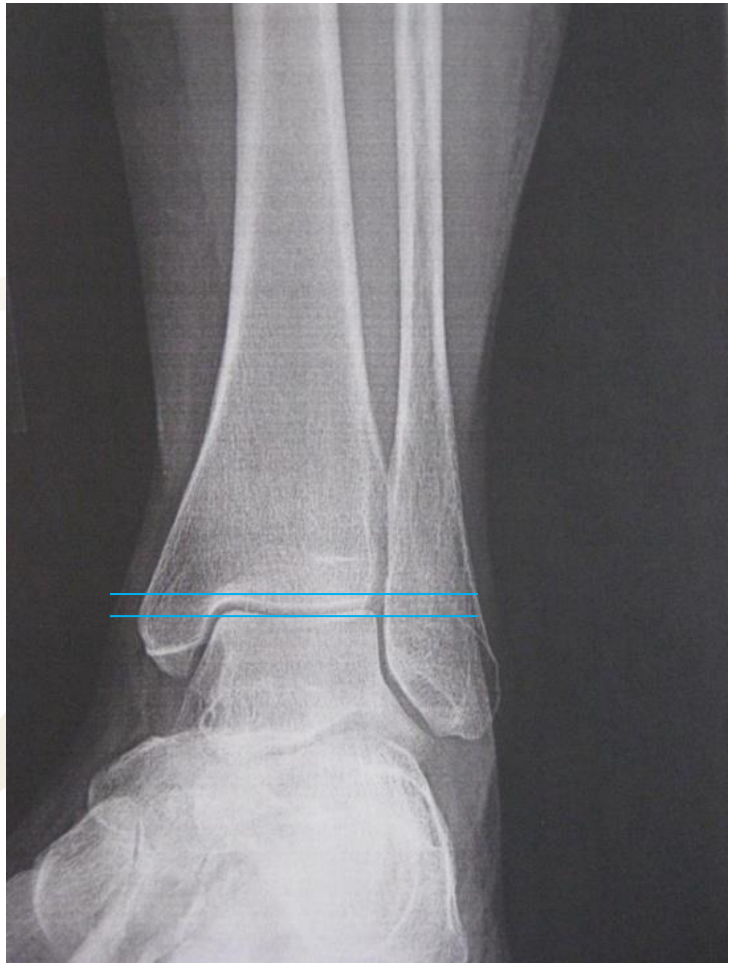
Ankle Radiographs

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



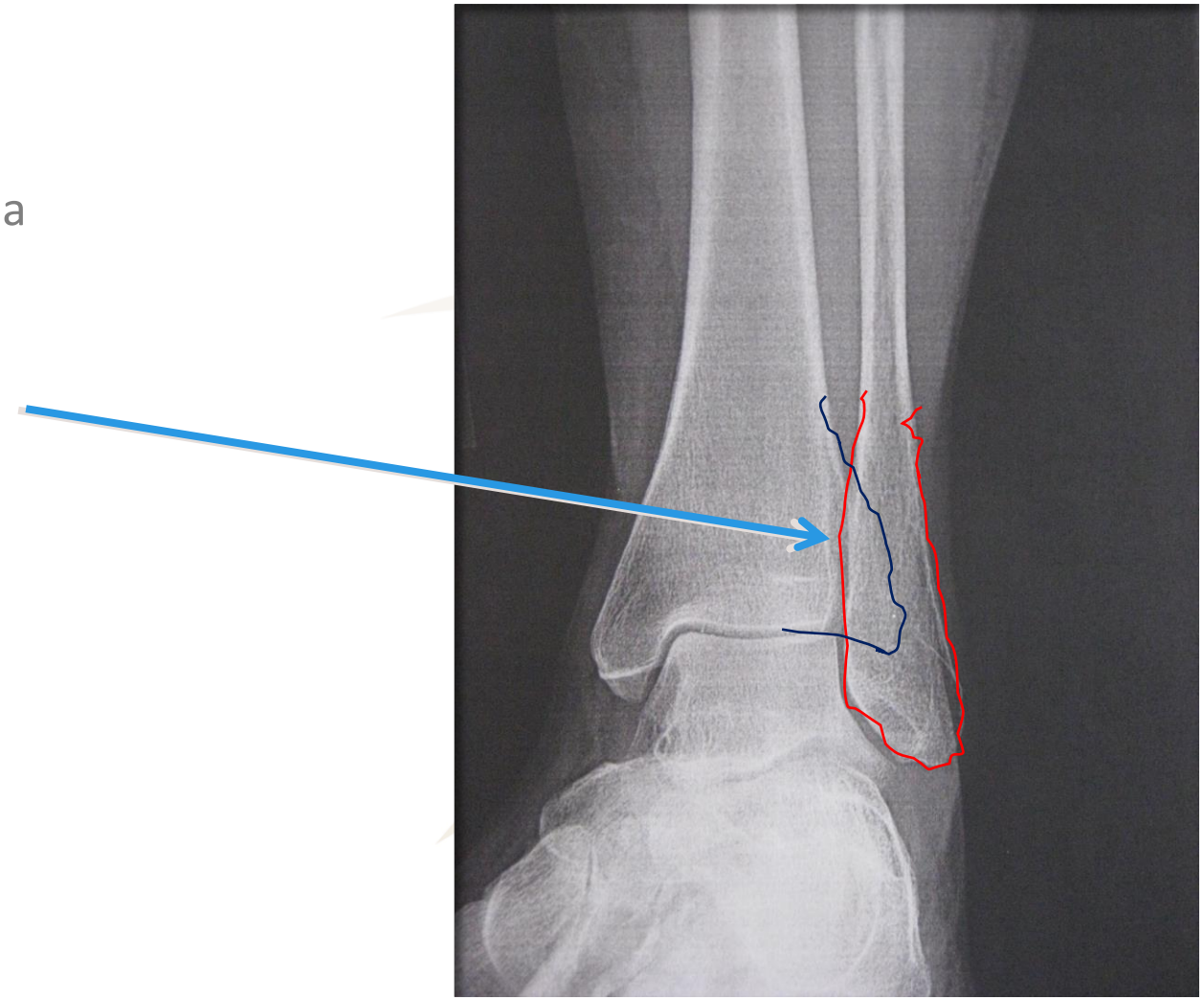
Ankle Radiographs

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



Ankle Radiographs

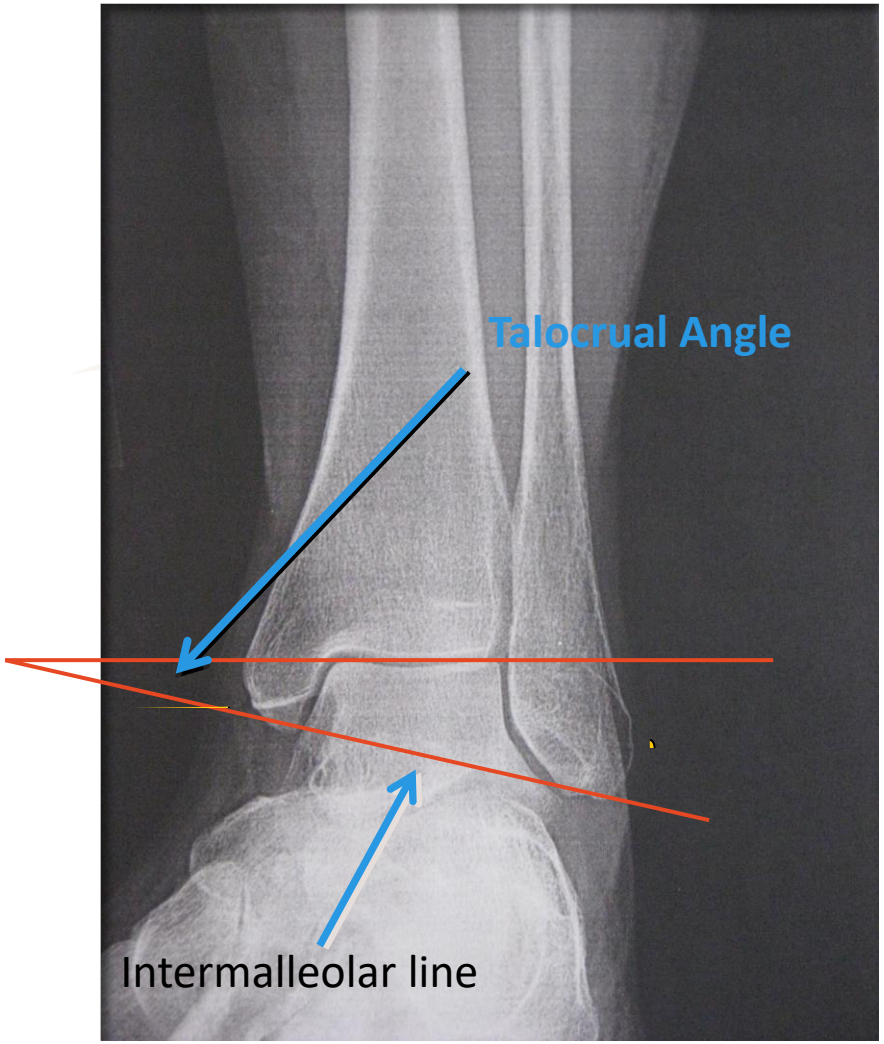
- Tibiofibular overlap
  - Normal range >10 mm between tibia & fibula
  - Fibular notch



Ankle Radiographs

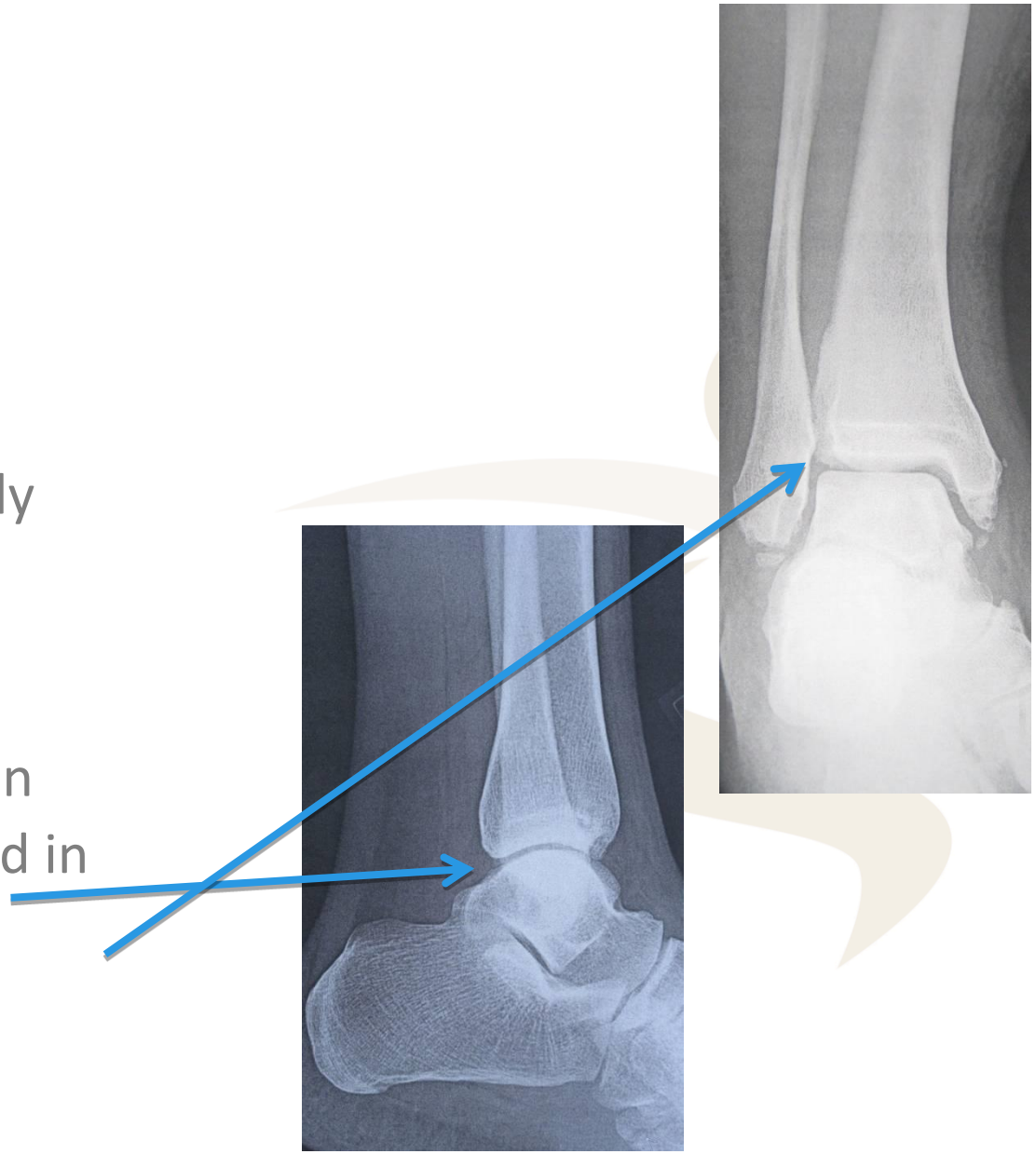
Talocrual Angle

- 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



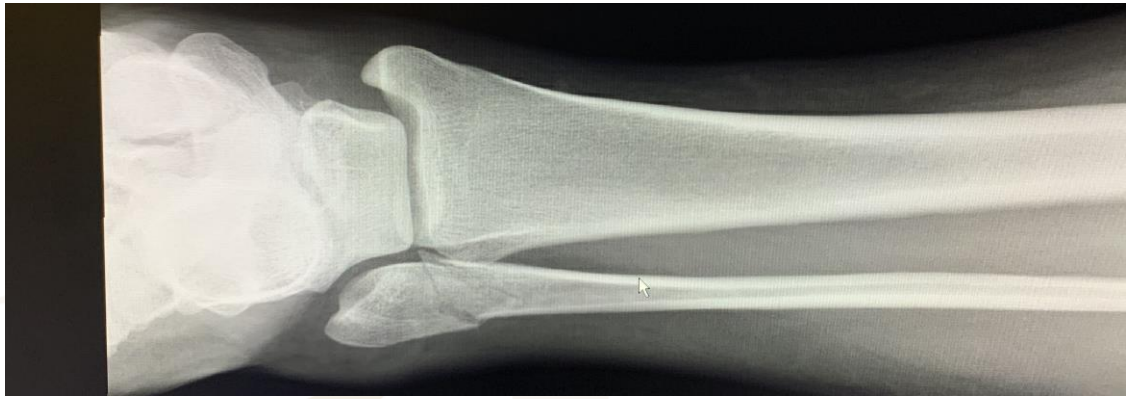
Ankle Radiographs

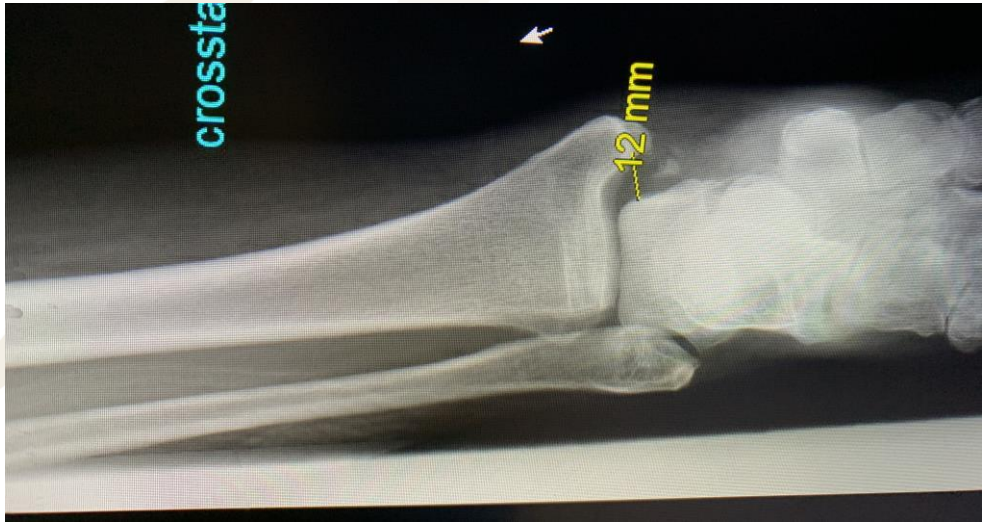
- Radiographs
  - AP Lateral and Mortise views
    - Mortise view: ankle internally rotated 15 degrees
    - Check medial Clear space
    - Normal mortise configuration
    - Talar dome fits under Plafond in ALL views



Gravity Stress View Ankle

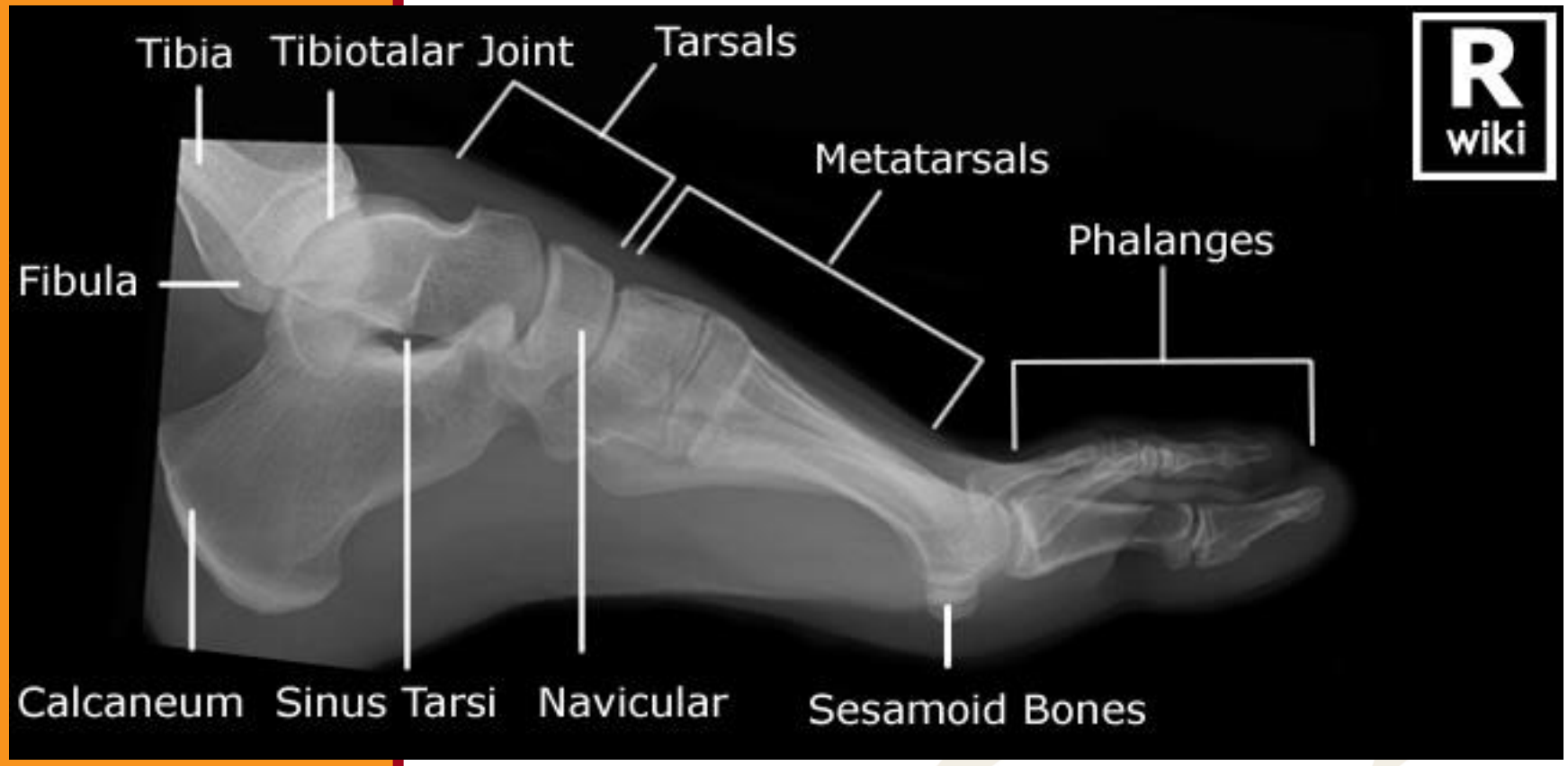
- MCS >4mm on gravity stress view
- unstable ankle in supination-external rotation injury
- Deltoid ligament injury
- Positive findings related to need for surgical stabilization ankle fx [Weber B]





Foot Radiographs

Images courtesy Michael J. Fuller-WikiRadology



Images courtesy Michael J. Fuller-WikiRadology

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

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

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

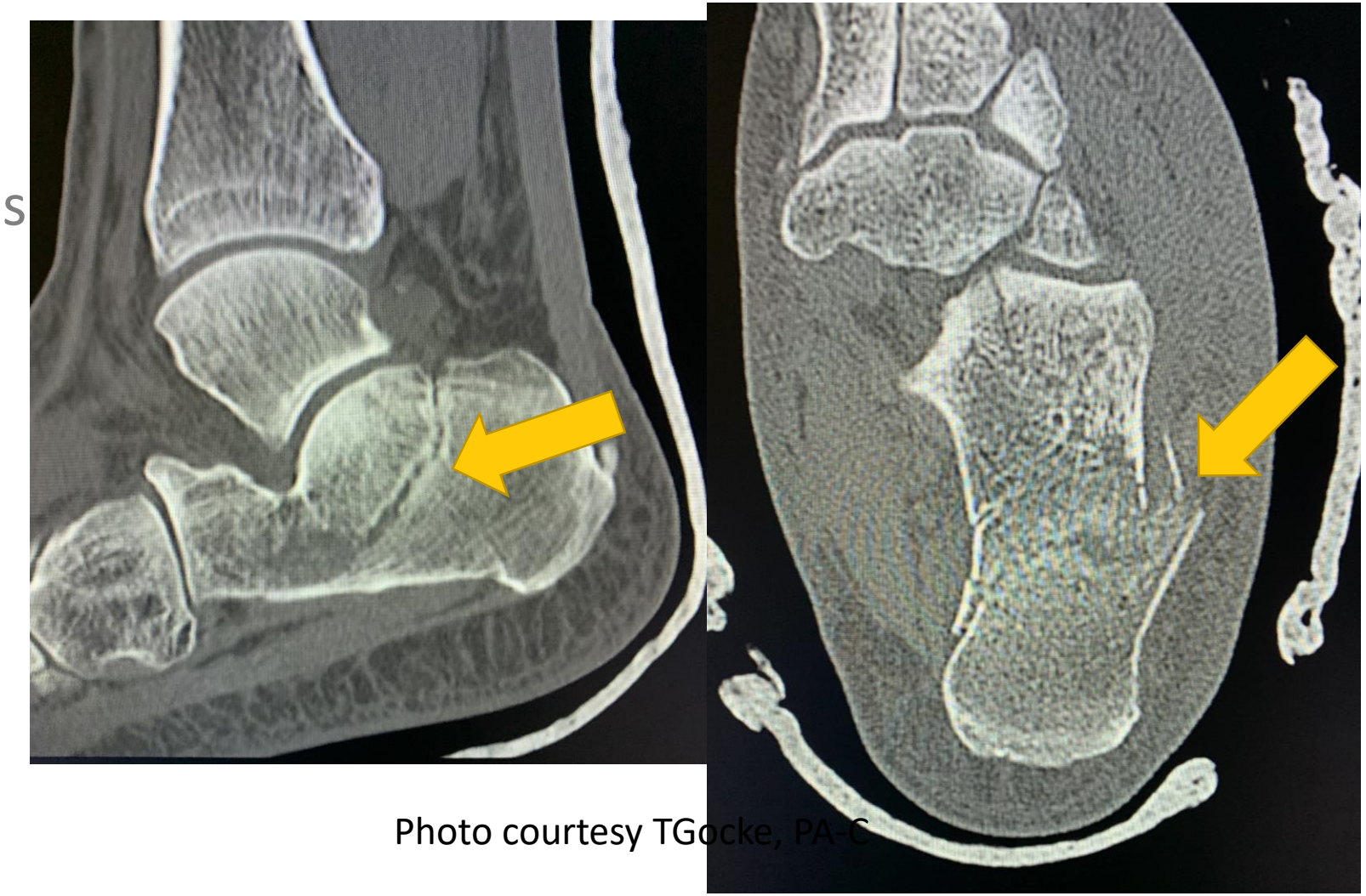


Photo courtesy TGocke, PA-C

Take home points

- KNOW WHAT NORMAL LOOKS LIKE
- At least 2 views of every joint/bone you x-ray (PA & Lateral)
- Elbow- look for Radiocapitellar line, anterior Humeral line & Fat pad sign
- Wrist: Radius lines and Gilula's arch's, look for wide Scapholunate & Scphoid Fx
- Ankle – look for Mortise widening
- Foot – Make sure the cuneiforms and the Metatarsals line up

THANK YOU

www.orthoedu.com

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