Orthopaedics from a radiology perspective
(or a radiology perspective from a ex-orthopaedist?)

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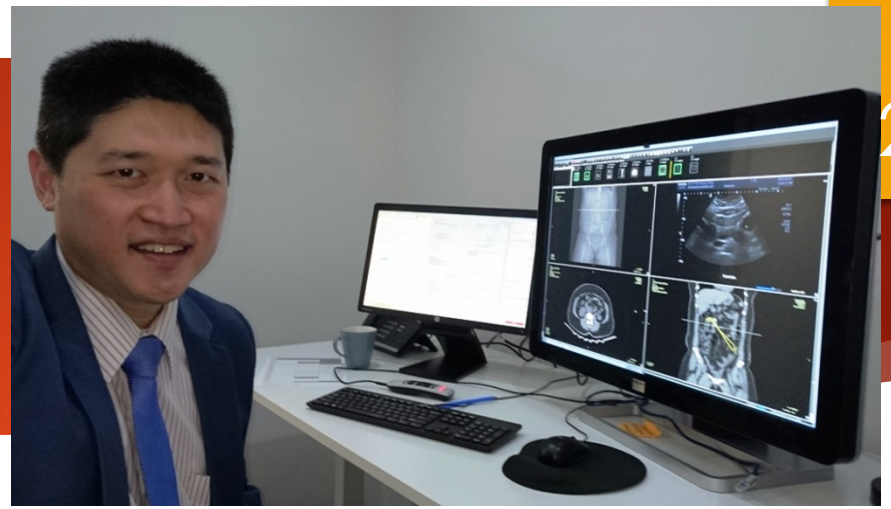
WEBINAR PRESENTATION FOR ÖSSUR AUSTRALIA

10 APRIL 2019

A little bit about me….



- Internship 2001
- Surgical HMO & training 2002-2004
- Orthopaedic registrar 2005-2007
- Research Fellow 2008
- Orthopaedic trainee 2009-2010
- Radiology trainee 2011-2015
- Radiologist 2016-
- Retired by…. ???

Current work

- St Vincent's Hospital Melbourne
- North West BreastScreen (Melbourne Health)
- Monash BreastScreen (Moorabbin)
- Everlight (teleradiology)
- Barwon Medical Imaging (Geelong Hospital)
- Western Hospital Footscray
- Capital Radiology (Somerville)

My tools and Acknowledgements

- Fracture assessment principles
  - cases

- **Radiography (X-Ray)**
- Ultrasound
- Computed Tomography (CT)
- Magnetic Resonance (MR)
- Nuclear Medicine
- DEXA

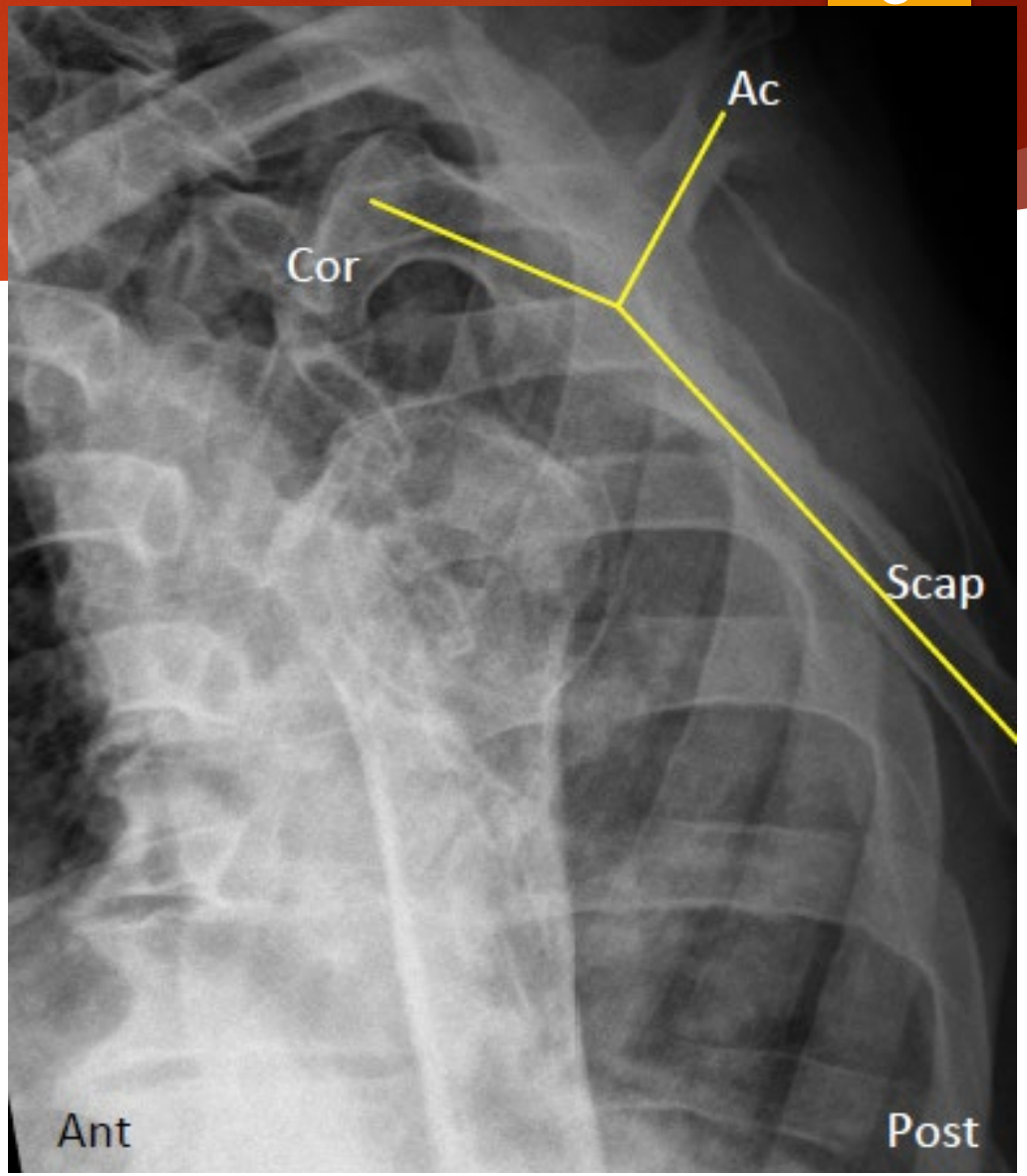
- Melbourne Medical School MD course notes
- *Medical Imaging* teaching modules
- SkelRAD 2016 presentation
  - Jon A. Jacobson "Radiography of Subtle and Important Fractures"
- www.aotrauma.aofoundation.org
- www.orthobullets.com/
- www.wheelessonline.com/
- www.radiopaedia.org/

Fractures

- Alignment abnormality
- Break in cortex
- Break in trabecular lines

- **Principles of fracture management**
  - Restoration of anatomy: length, alignment, rotation
  - Stable fracture fixation: allows for fracture healing, prevention of loss of anatomy
  - Preservation of blood supply (soft tissue protection): periosteum, muscle, vessels
  - Early mobilisation of limb and patient
    - Limb – prevent joint stiffness, muscle atrophy, contracture formation
    - Patient – pneumonia, deep venous thrombosis (DVT)/pulmonary embolus, pressure sores, hospital acquired infections
- **Management**
  - Operative versus "conservative" (non-operative)
  - Considerations: weight bearing status, wound management, antibiotics, anticoagulation, smoking

Two projections



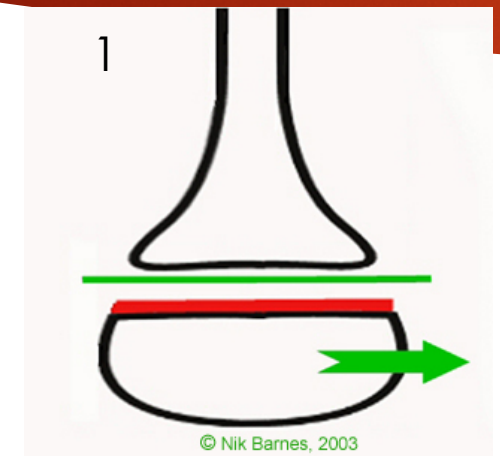
Two projections

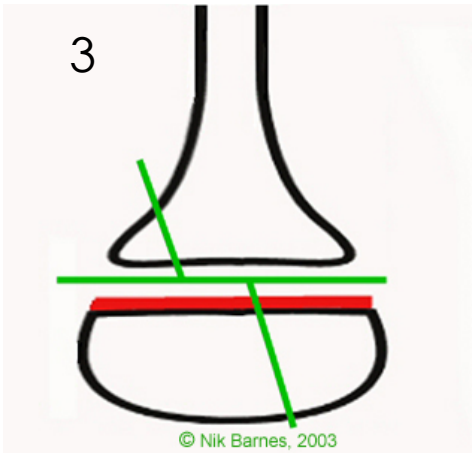
Two projections

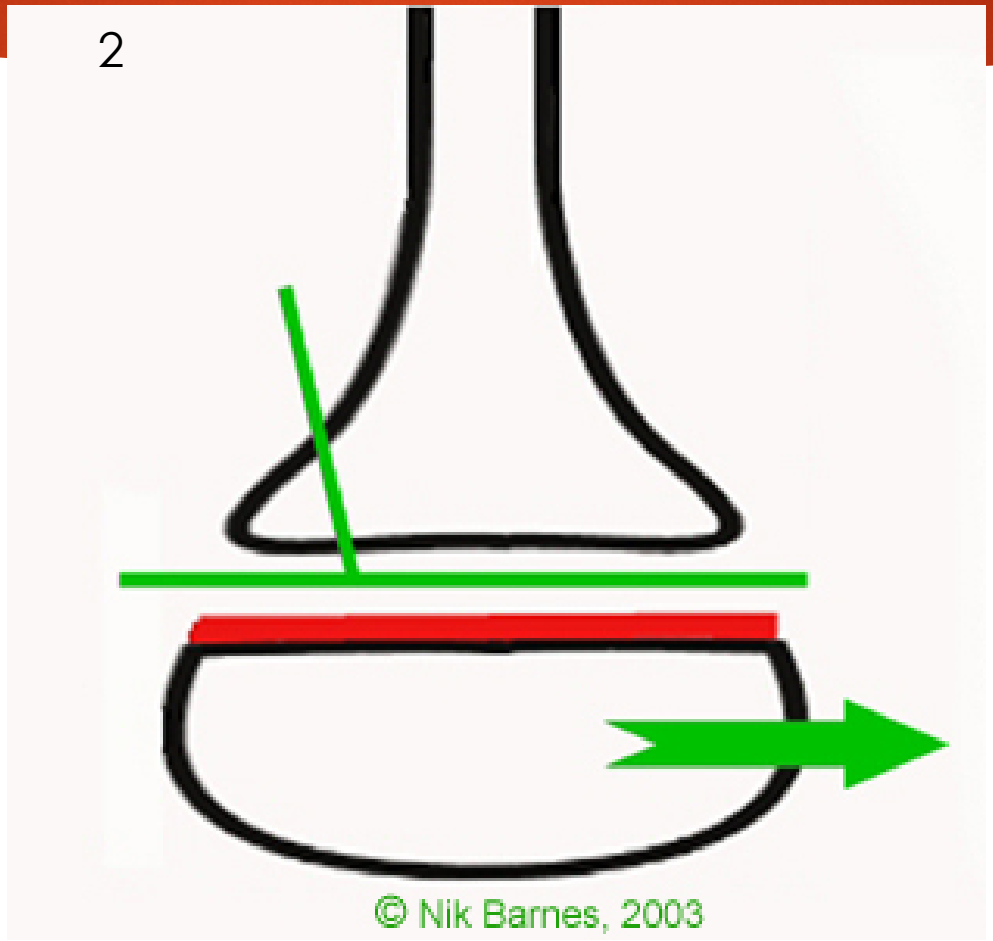
Special projections

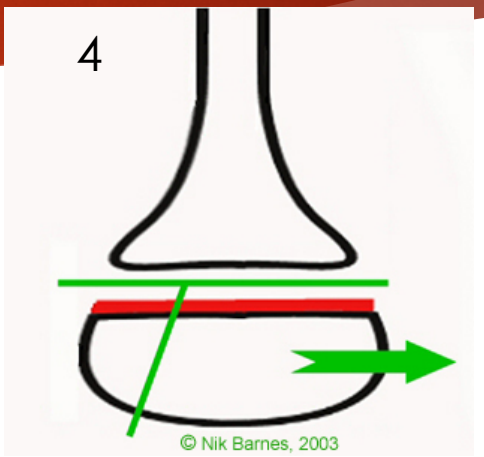
Stress fracture

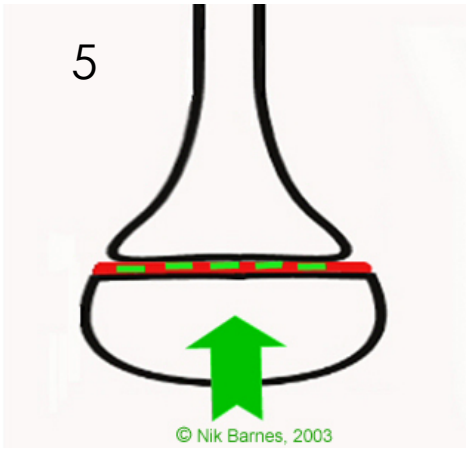
An example of classification systems: Salter-Harris injuries











Salter-Harris injuries

Table 4
Malvern classification system in detail

Type	Pathology	Location	Incidence (%)	Mechanism	Imaging Studies
1	Accessory ossicles				
1A	Os supratalare	Accessory bone on dorsal aspect of talar neck	0.2 to 2.4	Developmental variation; congenital	Lateral or oblique foot XR; sagittal foot MRI
1B	Os supranaviculare	Accessory bone on dorsal aspect of navicular, sometimes found intra-articularly at TNJ, close to midpoint	1.0 to 3.5	Developmental variation; congenital; can fuse with underlying bone	Lateral or oblique foot XR; sagittal foot MRI
2	Talar dorsal head and neck fracture				
2A	Talar dorsal head and neck avulsion fracture	Dorsal margin of talar head and neck; related to soft tissue insertions of dorsal talonavicular ligament, deep anteroinferior tibiotalar ligament, anterior ankle capsule; loose fragments seen in soft tissue; potential for concomitant navicular avulsion fracture	0.5 to 2; most common avulsion at anterosuperior neck at anterior ankle capsule	Twisting (or abd/add) force applied to foot (plantarflexed position) causing injury to TNJ capsule (common in middle-age high heel-wearing females); hyperplantarflexion (anterosuperior neck at attachment site of ankle capsule)	Lateral or oblique foot XR; ankle XR
2B	Talar dorsal head and neck cortical fracture	Dorsal margin of talar head and neck, close to or with possible extension to TNJ; related to soft tissue insertions of dorsal talonavicular ligament, deep anterior tibiotalar ligament, anterior ankle capsule; larger size, with appreciated cortical discontinuity	Unknown; reported on case series basis	Twisting (or abd/add) force applied to foot (plantarflexed position) causing injury to TNJ capsule (common in middle-age high heel-wearing females); hyperplantarflexion (anterosuperior neck at attachment site of ankle capsule)	Lateral or oblique foot XR; CT

3	Talar neck fracture				
3A	Talar neck stress fracture	Talar neck, paralleling TNJ in cancellous region of bone	0.047 (military population)	Insufficiency and fatigue	Lateral foot XR; bone scan; MRI
3B	Talar neck fracture, nondisplaced (defined as Hawkins 1; Marti type 1)	Talar neck, vertical in orientation; fracture is isolated and nondisplaced, without subluxation	Talar neck fractures constitute 50% of all talar fractures; isolated Hawkins type 1 account for 5 to 20	Forced dorsiflexion; MVA; FFH	Lateral foot XR; MRI or CT
4	Talar head fracture				
4A	Nondisplaced talar head fracture	Talar head articular surface at TNJ	Account for 2.6 to 10 of all talar injuries; reported to be least common of all talar fractures	Hyperdorsiflexion; compressive load through sustentaculum of calcaneus; axial compressive force through talar head from navicular in plantarflexed foot causes 2 fracture patterns: (1) articular crush with communition and (2) shear fracture; articular crush seen in area of middle facet	Oblique or Canale and Kelly foot XR; ankle mortise XR; CT; live fluoroscopic TNJ stress or plain film anteroposterior XRs (fully inverted and everted) to determine joint and fragment stability
4B	Displaced talar head fracture	Talar head articular surface at TNJ	Account for 2.6 to 10 of all talar injuries; reported to be least common of all talar fractures	Hyperdorsiflexion; compressive load through sustentaculum of calcaneus; axial compressive force through talar head from navicular in plantarflexed foot causes 2 fracture patterns: (1) articular crush with communition and (2) shear fracture; articular crush seen in area of middle facet	Oblique or Canale and Kelly foot XR; ankle mortise XR; CT; live fluoroscopic TNJ stress or plain film anteroposterior XRs (fully inverted and everted) to determine joint and fragment stability
5	Talar head OCL	OCL adjacent to SCB plate at TNJ articulation	Rare	Acute versus chronic repetitive trauma; nonunion of OCL fragment or SCB	Lateral foot XRs; MRI

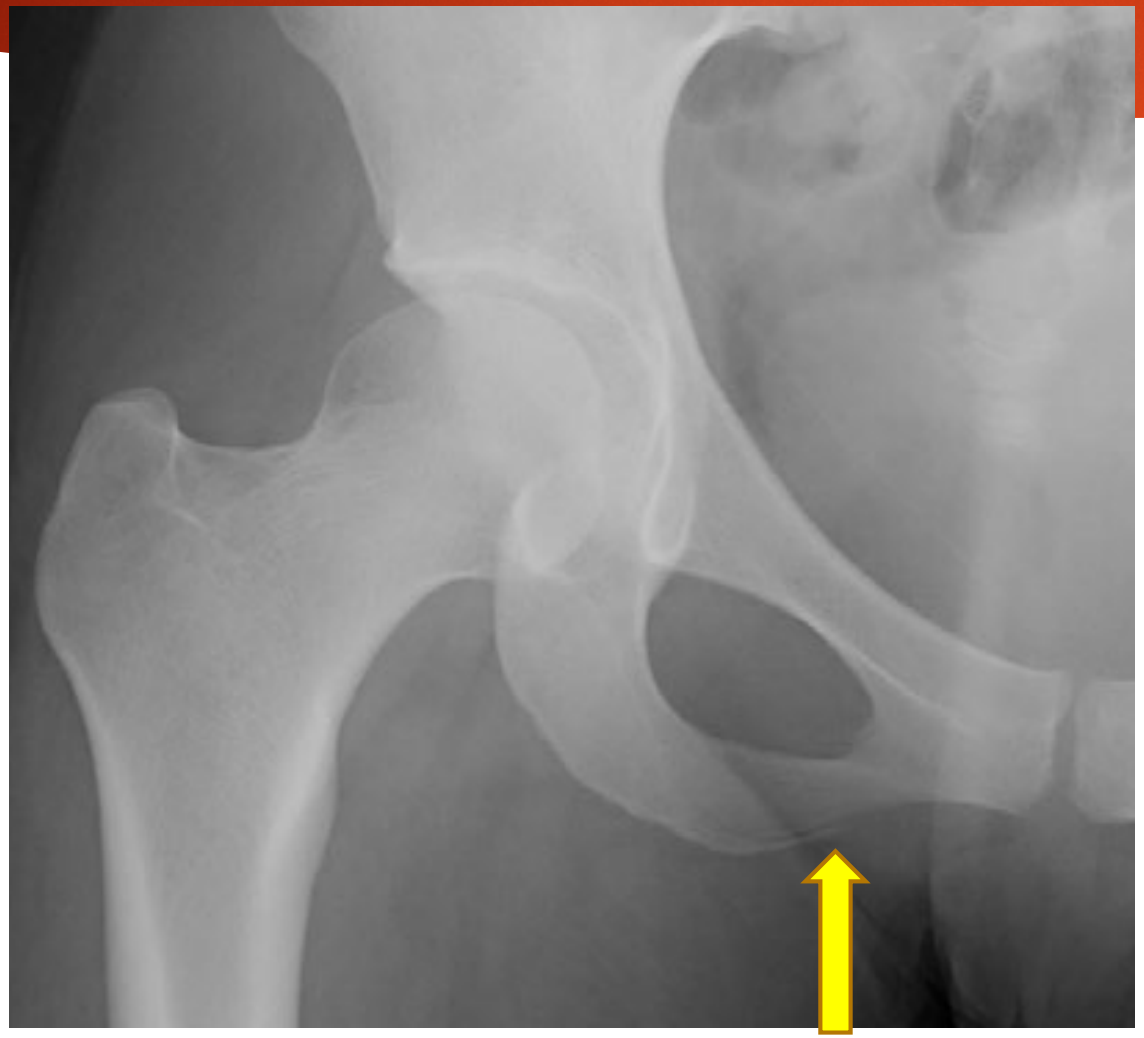
Abbreviations: abd, abduction; add, adduction; CT, computed tomography; FFH, fall from height; MRI, magnetic resonance imaging; MVA, motor vehicle accident; OCL, osteochondral lesion; SCB, subchondral bone; TNJ, talonavicular joint; XR, radiograph.

Treatment options stratified by Malvern classification system

Type	Pathology	Treatment
1	Accessory ossicles	
1A	Os supratalare	WB in CAM boot if symptomatic; excision if symptomatic or recalcitrant
1B	Os supranaviculare	WB in CAM boot if symptomatic; excision if symptomatic or recalcitrant
2	Talar dorsal head and neck fracture	
2A	Talar dorsal head and neck avulsion fracture	Most will be stable, warranting no specific management
2B	Talar dorsal head and neck cortical fracture	CR with WB in CAM boot for 2 to 6 wk; excision if symptomatic; if deemed unstable, ORIF with KWs or mini-rail for 6 wk with NWB, advancement to WB after fixation removal
3	Talar neck fracture	
3A	Talar neck stress fracture	Activity modification for 2 to 4 wk; case report detailed treatment with NWB in SLC for 3 wk
3B	Talar neck fracture, nondisplaced	NWB in CAM/SLC for 6 to 8 wk, followed by WB in CAM for another 4 to 8 wk; conservative treatment reserved for true nondisplaced neck fractures
4	Talar head fracture	CR versus ORIF, depending on instability, comminution, and articular nature; stress test of TNJ to evaluate for same
4A	Nondisplaced talar head fracture	NWB for 4 to 8 wk in CAM/SLC with radiographic evidence of healing noted at ~6 to 8 wk
4B	Displaced talar head fracture	ORIF with NWB for 6 to 12 wk in SLC; published data recommend excision of fragments if <50% of articular surface and attempted reduction if >50% of articular surface; anatomic reduction key to reduce likelihood of TNJ osteoarthritis or AVN; fusion should be considered for severe comminution
5	Talar head OCL	Short period of rest with anti-inflammatory medication and activity modification; operative treatment reserved for persistently painful lesions or if OCL fragment separates from SCB

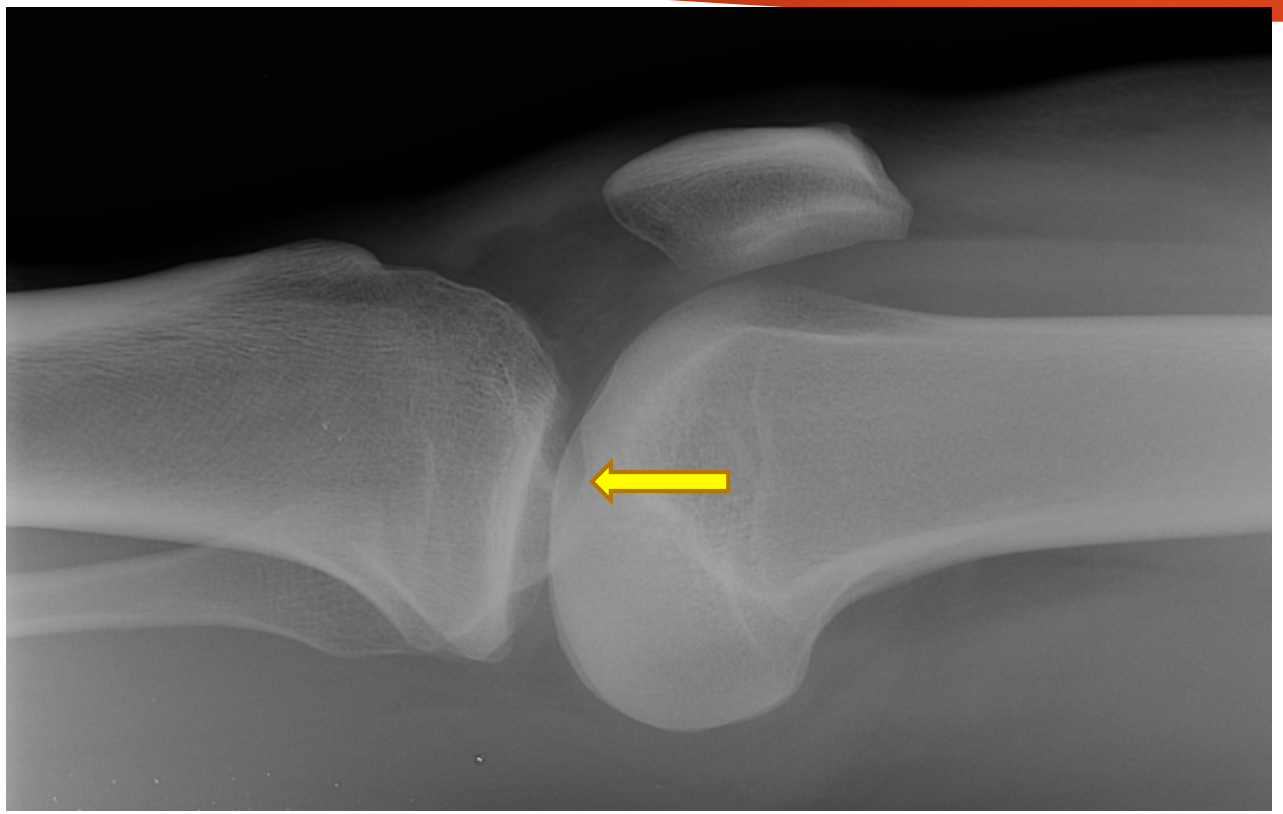
Abbreviations: AVN, avascular necrosis; CAM, controlled ankle motion; CR, closed reduction; KWs, Kirschner wires; NWB, non-weightbearing; ORIF, open reduction and internal fixation; SCB, subchondral bone; SLC, short leg cast; TNJ, talonavicular joint; WB, weightbearing.

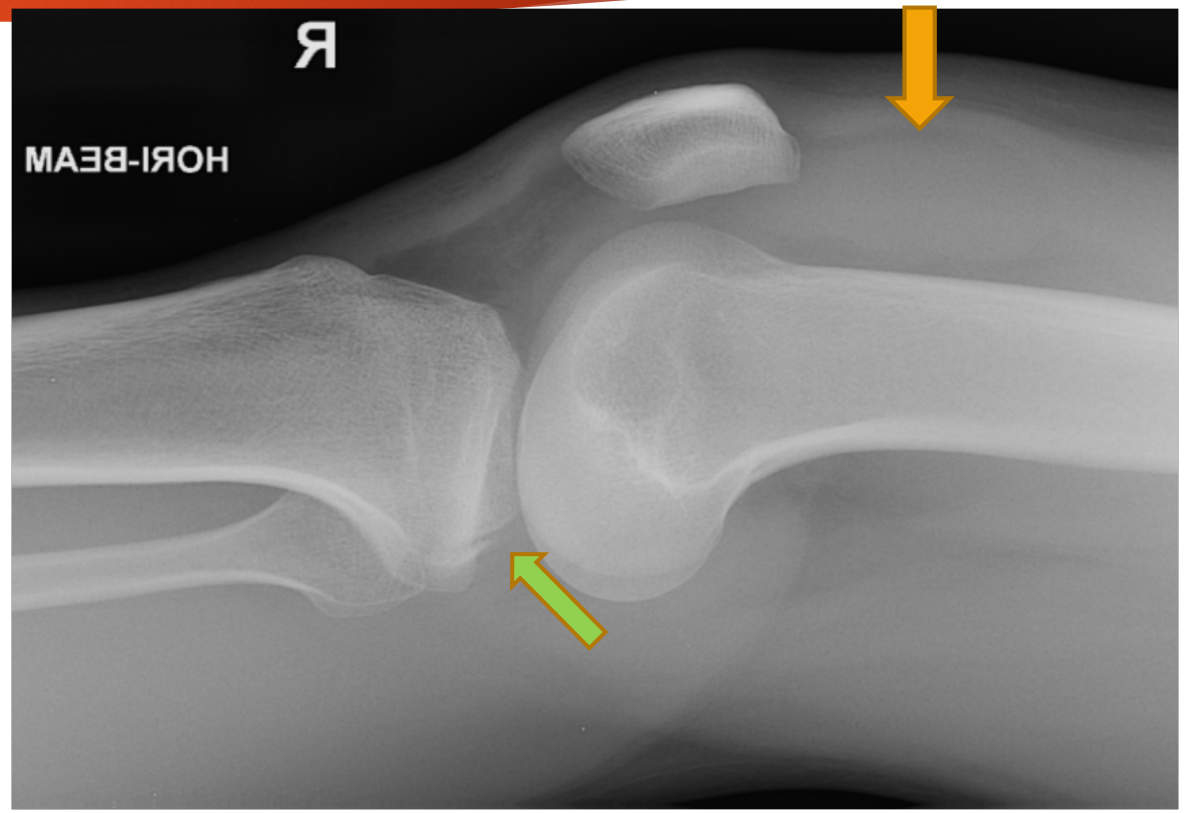
Fracture mimics



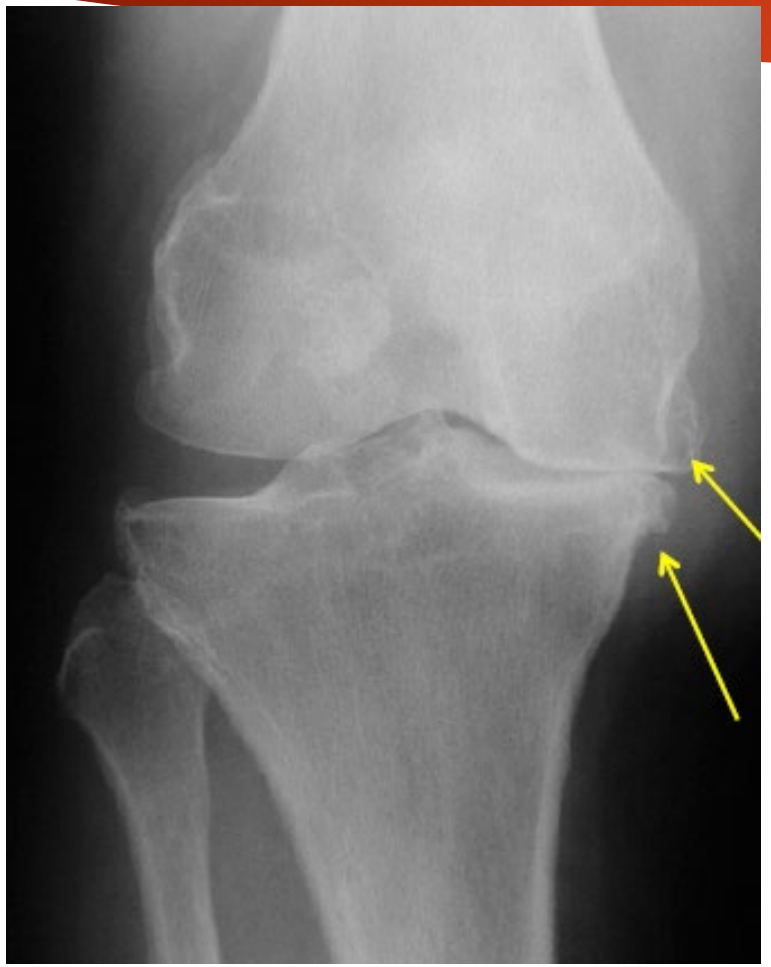
Joint effusion

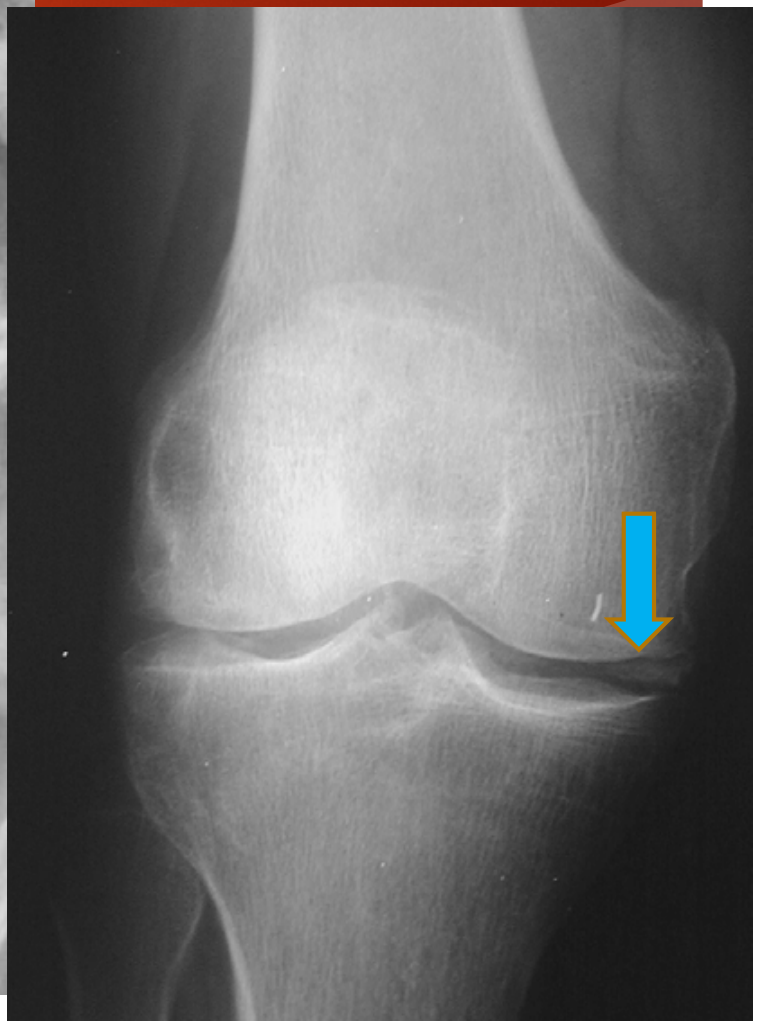
Joint effusion – why?





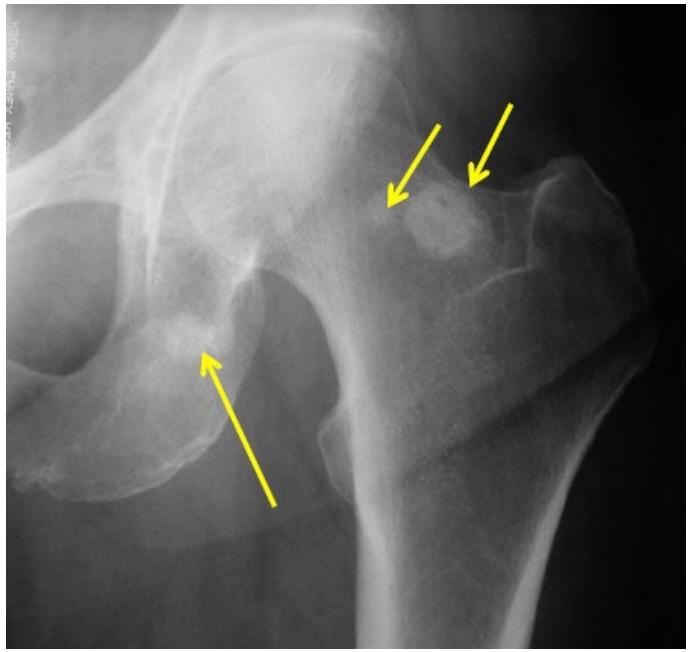
Osteophytes

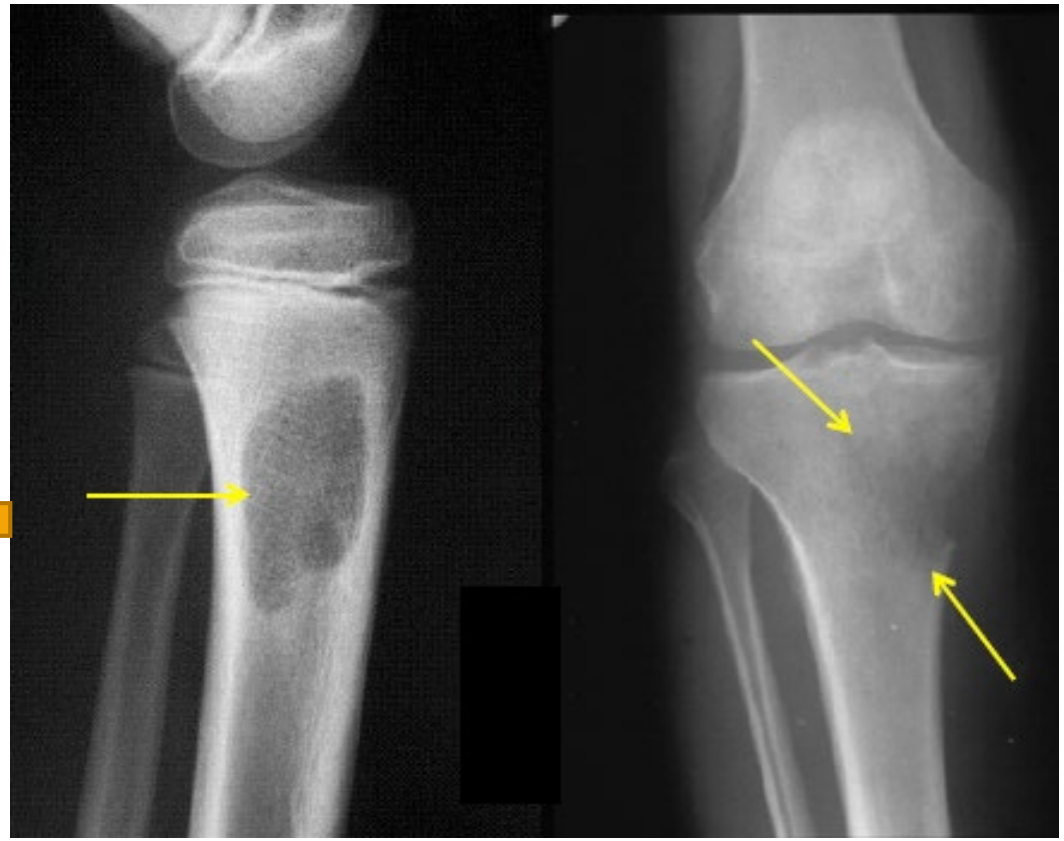




Suspicious lesions

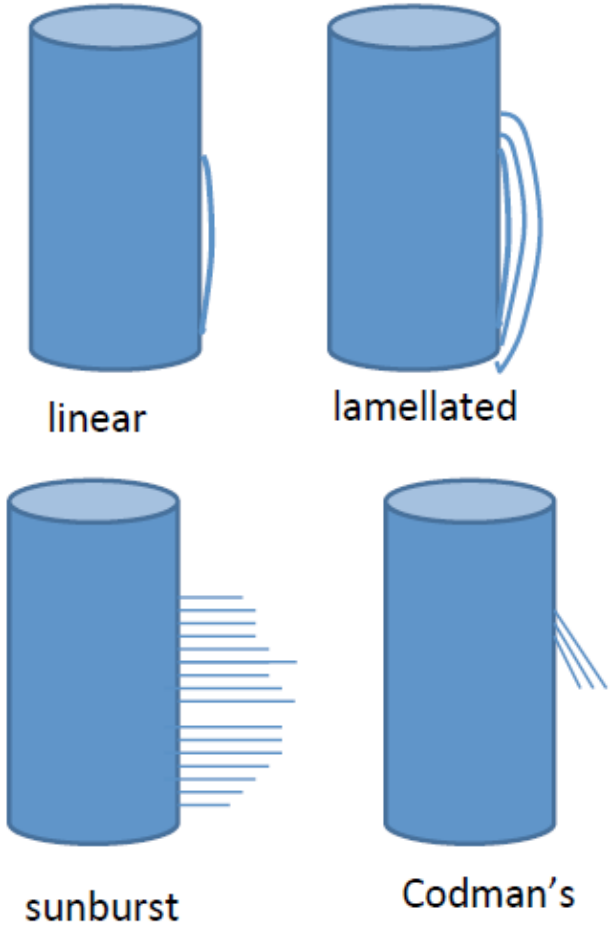
- radiolucent vs radio-opaque
  - What makes something too dark?
  - What makes something too white?

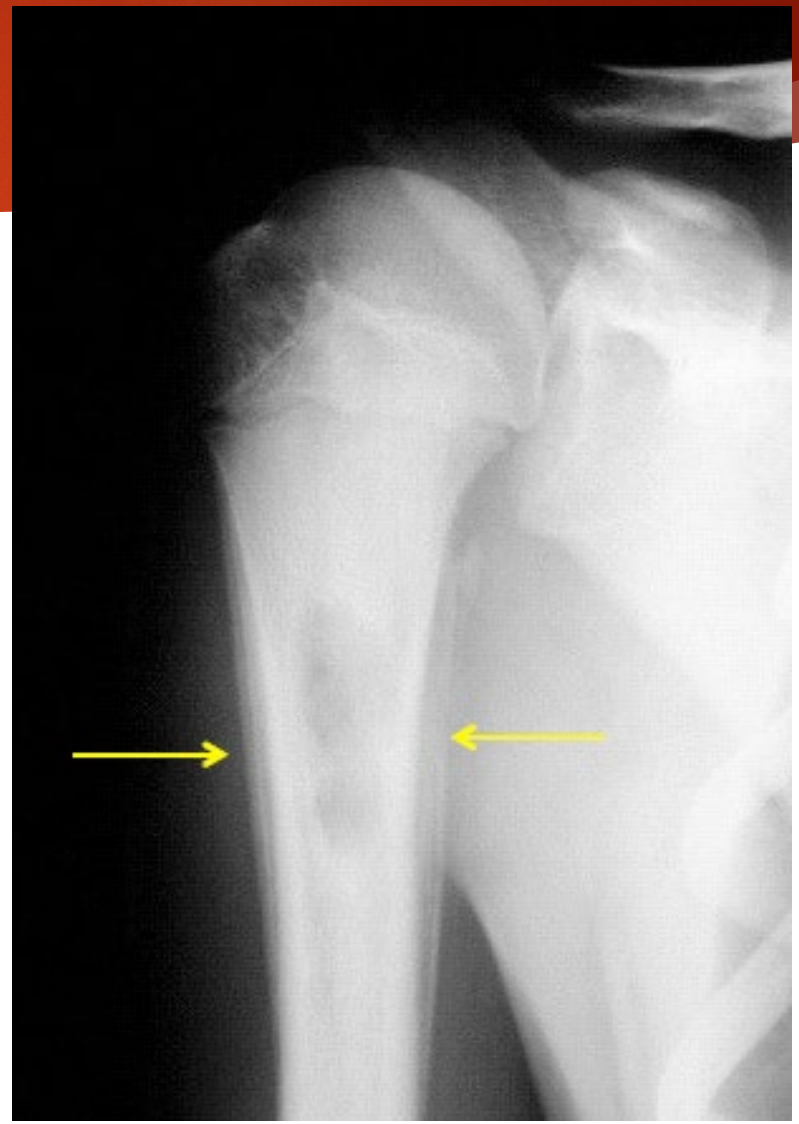




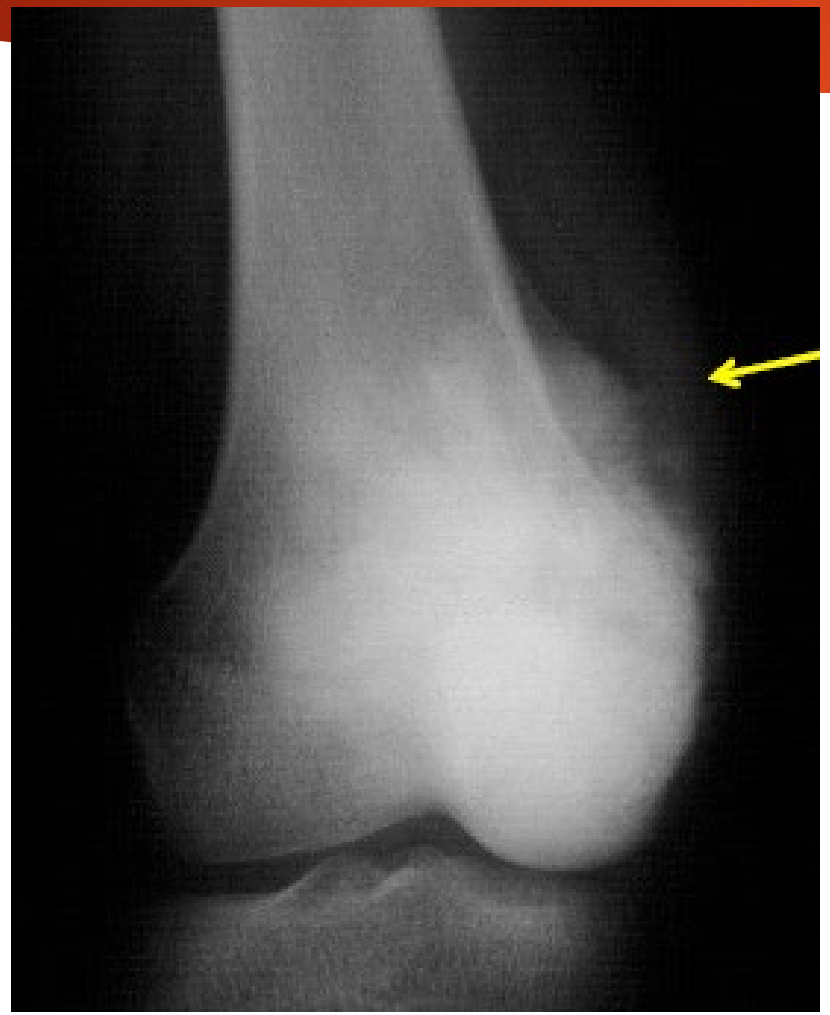
Suspicious lesions

Periosteal reaction





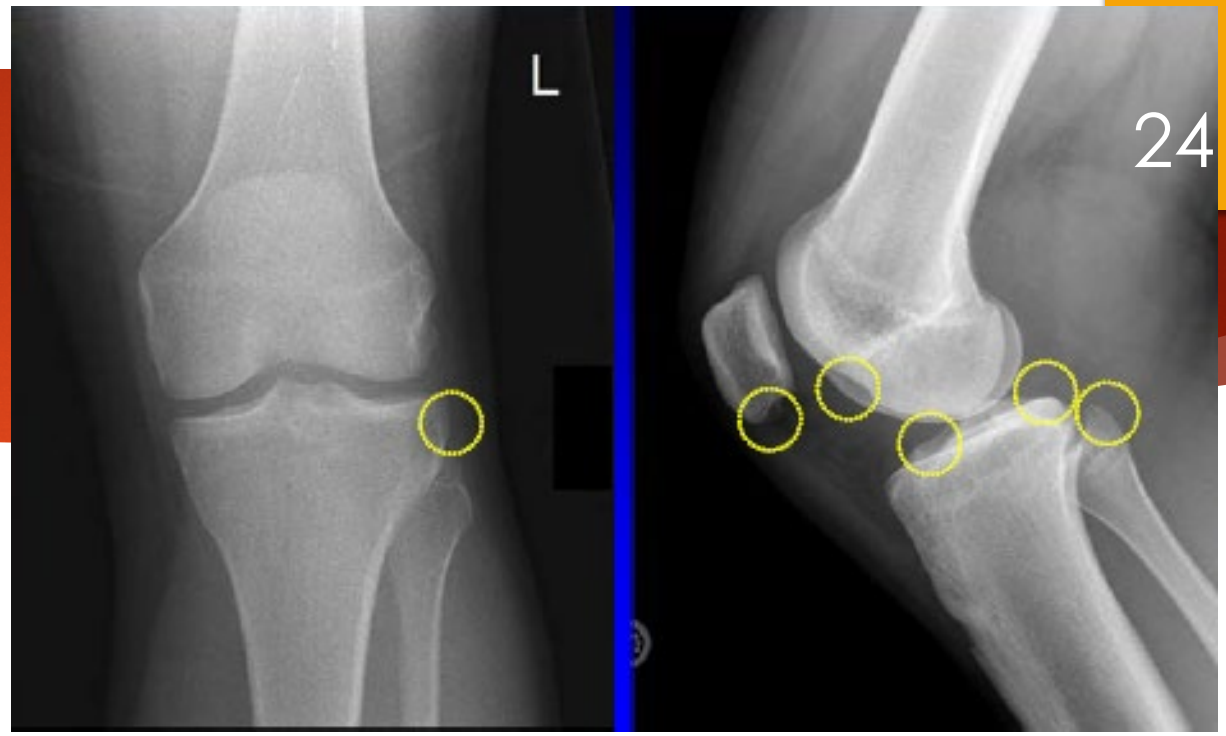
Periosteal reaction

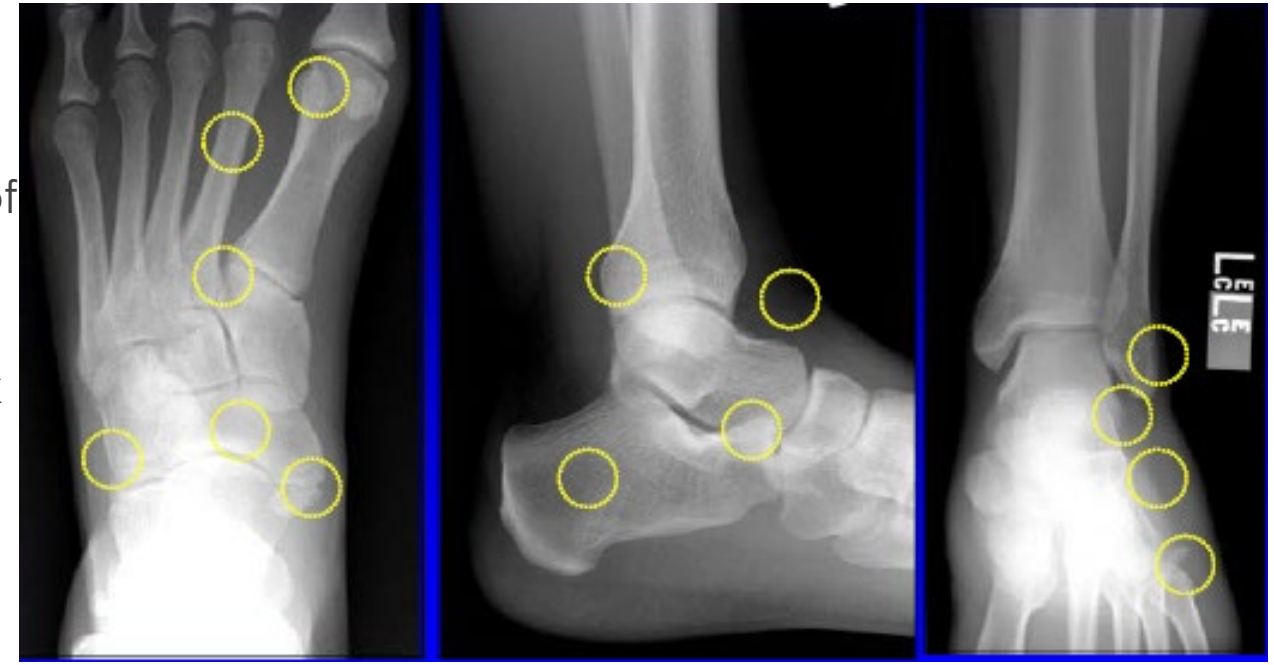


Exostosis vs endosteal lesion vs soft tissue calcification

My tips

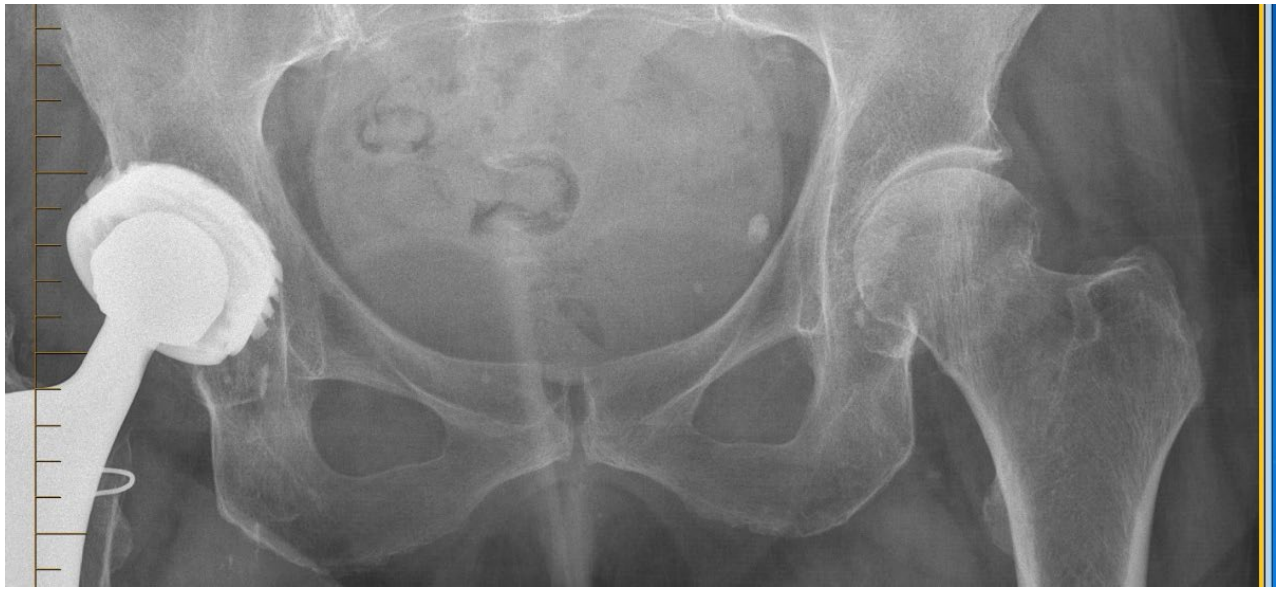
- Respect radiation!!
- Two projections!
- Know where common fractures occur
- Look for subtle or important fractures (examples coming up)
- Know specific avulsion fractures (what sof tissue structures attached to this bone?)
- Consider other imaging modalities for further investigation if ongoing pain (look for occult fracture or other pathology)



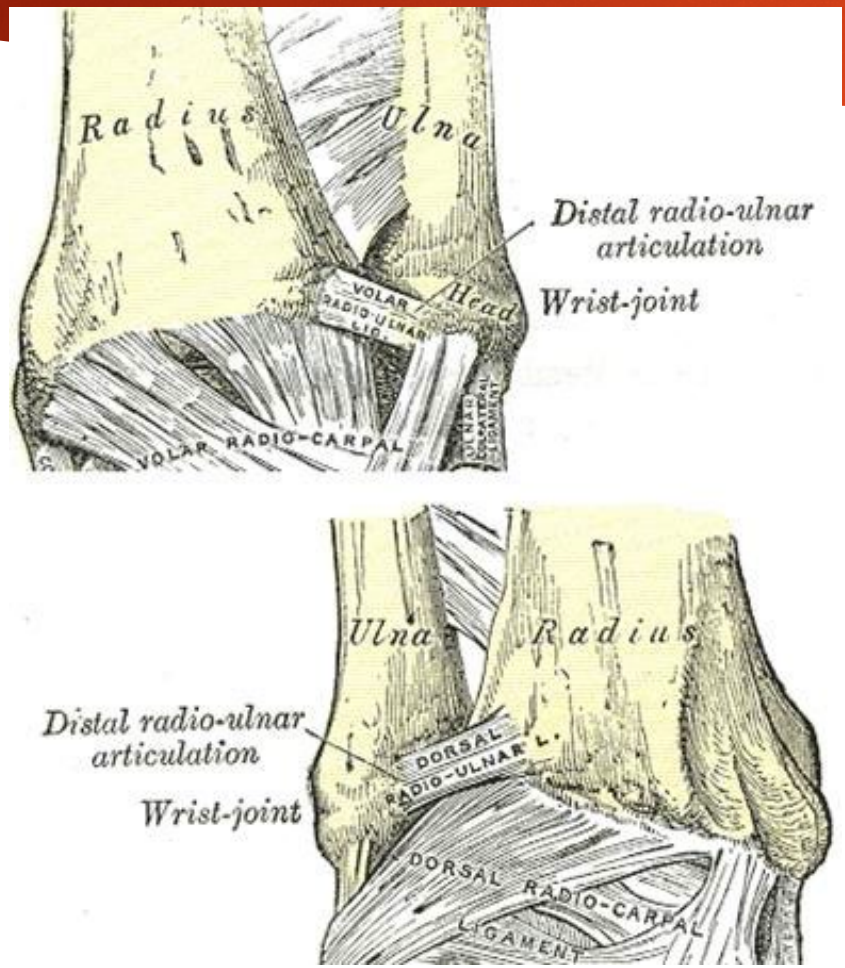


FRACTURES RADIOLOGSTS CANNOT MISS

- Neck of femur
- Scaphoid & triquetral
- Galeazzi & Monteggia
- Lisfranc



Galeazzi fractures



http://www.orthobullets.com/trauma/1029/galeazzi-fractures

http://www.orthobullets.com/trauma/1029/galeazzi-fractures

Monteggia fractures

Non operative

- Closed reduction
- More common in children
- Casting with forearm supination

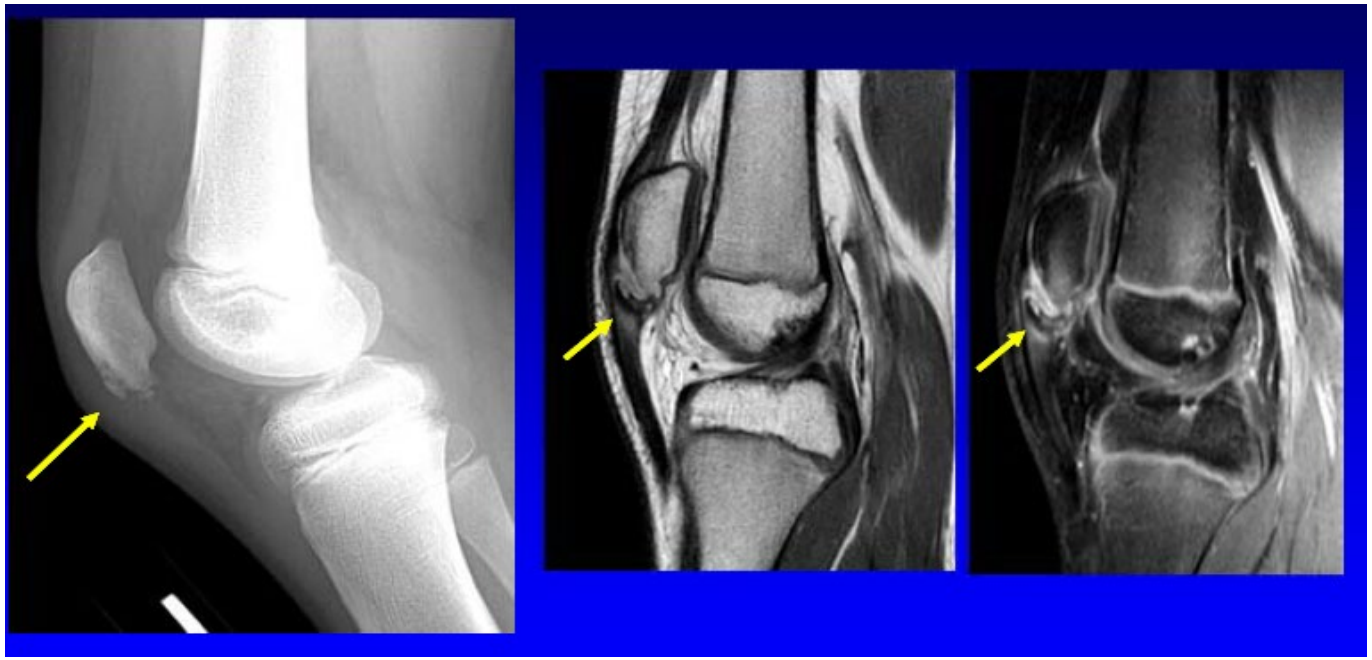
Operative

- ORIF ulnar +/- open radial head reduction
- Comminuted ulna
- Unable to reduce radius

http://www.orthobullets.com/trauma/1024/monteggia-fractures

Two cases to watch out for….

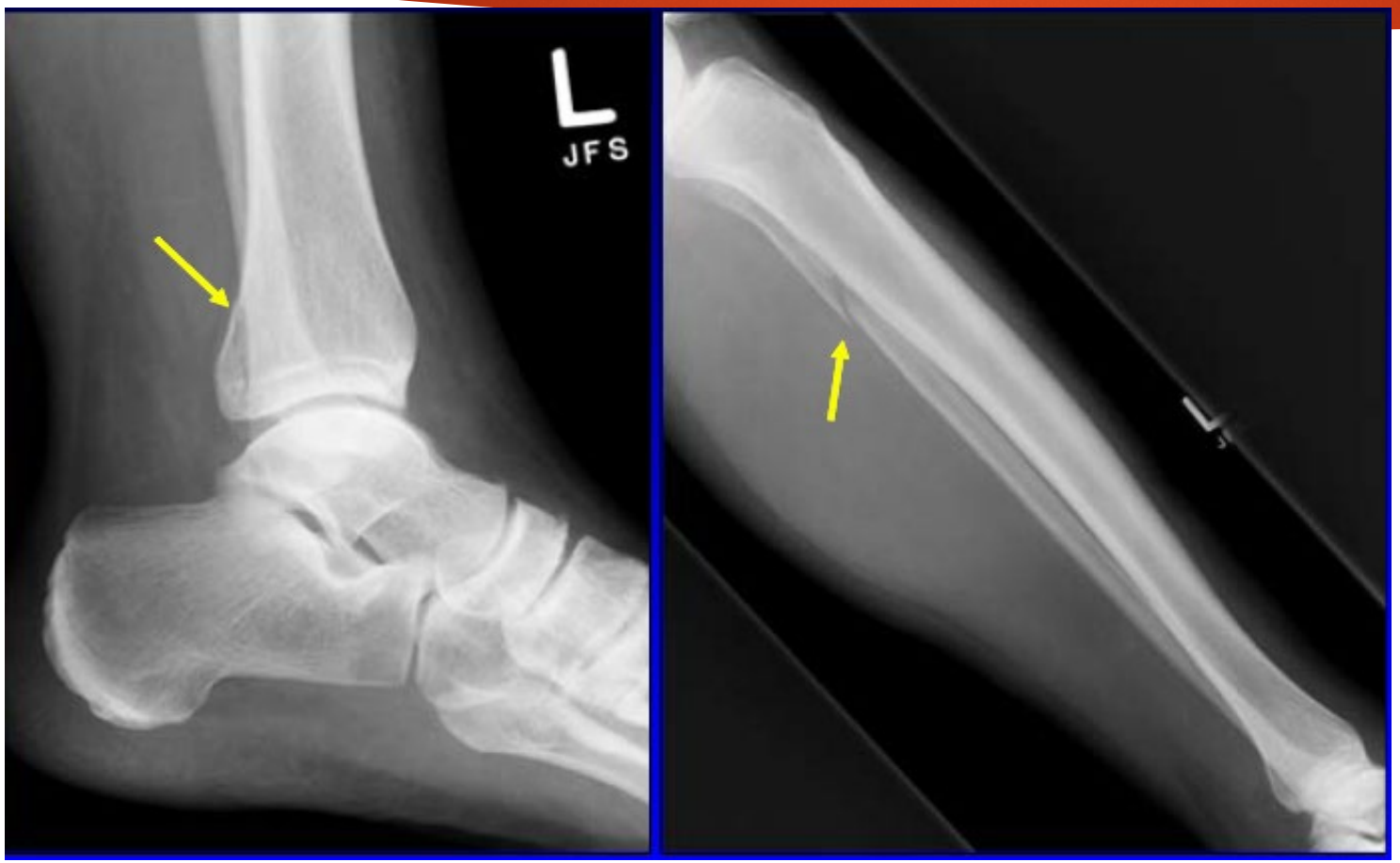
Patellar Sleeve Fracture



- Hyperextension injury: children
- Inferior patella: small bone fragments
- Cartilage avulsion: under-estimataed
- Patella alta may be present
- MRI displays full extent of injury

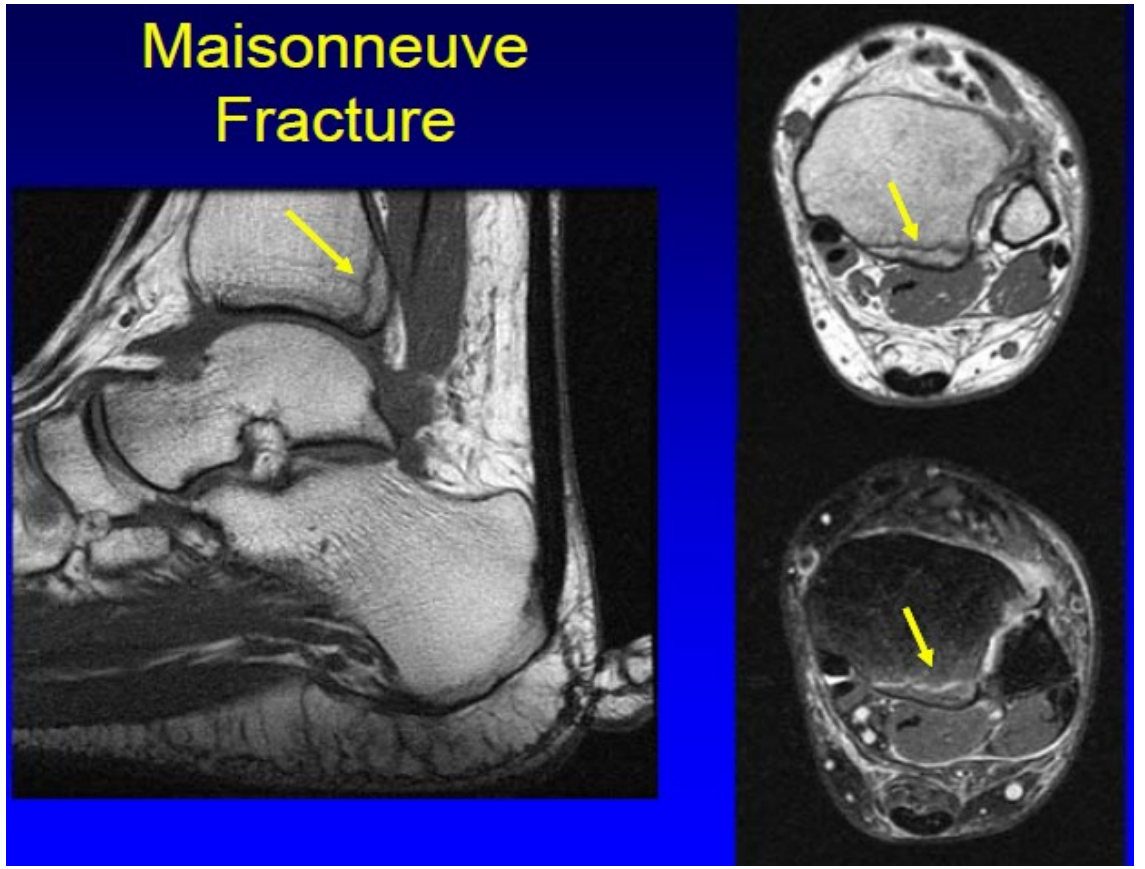
Bates DG et al. Radiology 1994; 193:825

ANKLE: Maisonneuve fracture



- High fibula fracture
  - Ankle injury
  - Interosseous membrane injury
- Fibula fracture may not be obvious
- Isolated posterior or medial malleolus fracture: look for fibular fracture if ankle XR shows isolated posterior or medial malleolar fracture

Maisonneuve



Thank you

- Respect radiation (without being radiophobic)
  - the ‘golden age’ of radiology
- Two (or more) projections
- Classification systems make communication easier!