

LOWER EXTREMITY TRAUMA

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No financial disclosures

Layout

- Hip and femur
- MR correlation of MSK injuries in ER – Knee
- Ankle subtle injuries

Hip and Femur

objectives

- Review radiographic and CT presentations of hip injuries
- Understand pathophysiology of hip injuries
 - High and low velocity
- Recognize clinical implications of hip and femur injuries

Hip pain

High energy injury

- Dislocation
- Femoral head fx
- Neck fx
 - Intertrochanteric fx
- Shaft fx

Low energy / repetitive injury

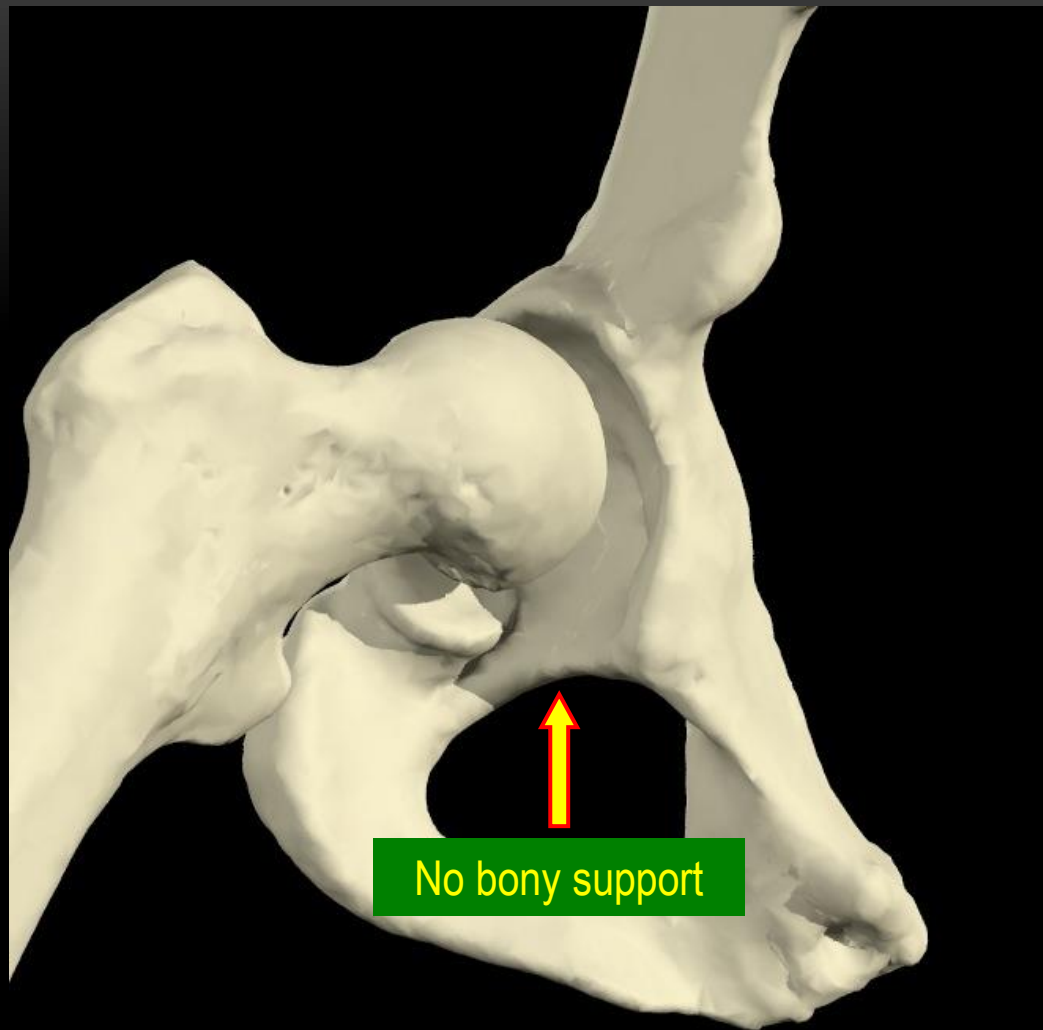
- Neck fx
- Shaft fx
- “peri” hip causes –
pubis fxs

Outline

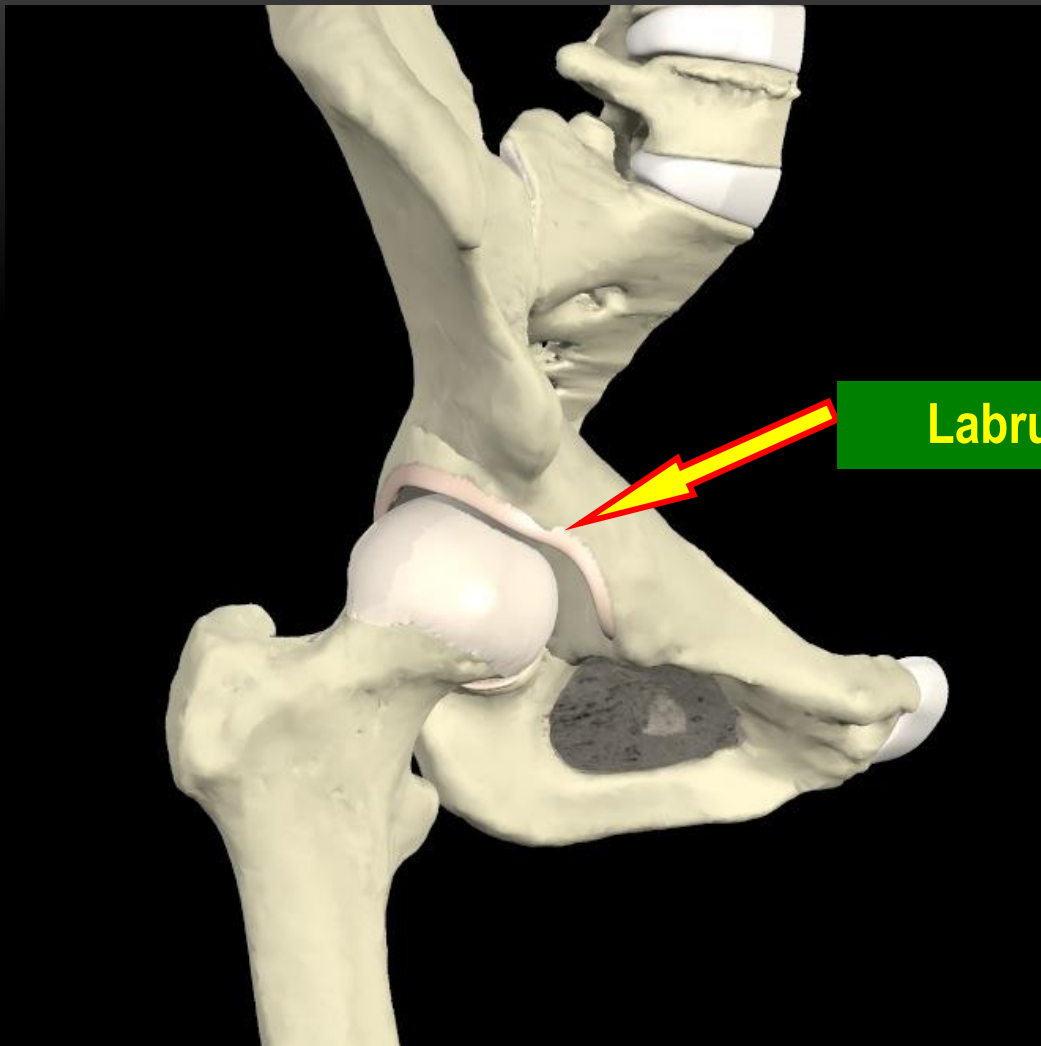
- Anatomy
 - Hip dislocations
 - Femur head fractures
 - Femur neck fractures
 - Peri – hip – Pubic rami
 - Atypical shaft fx
-
- **What the Clinician wants to know?**

Hip - Anatomy

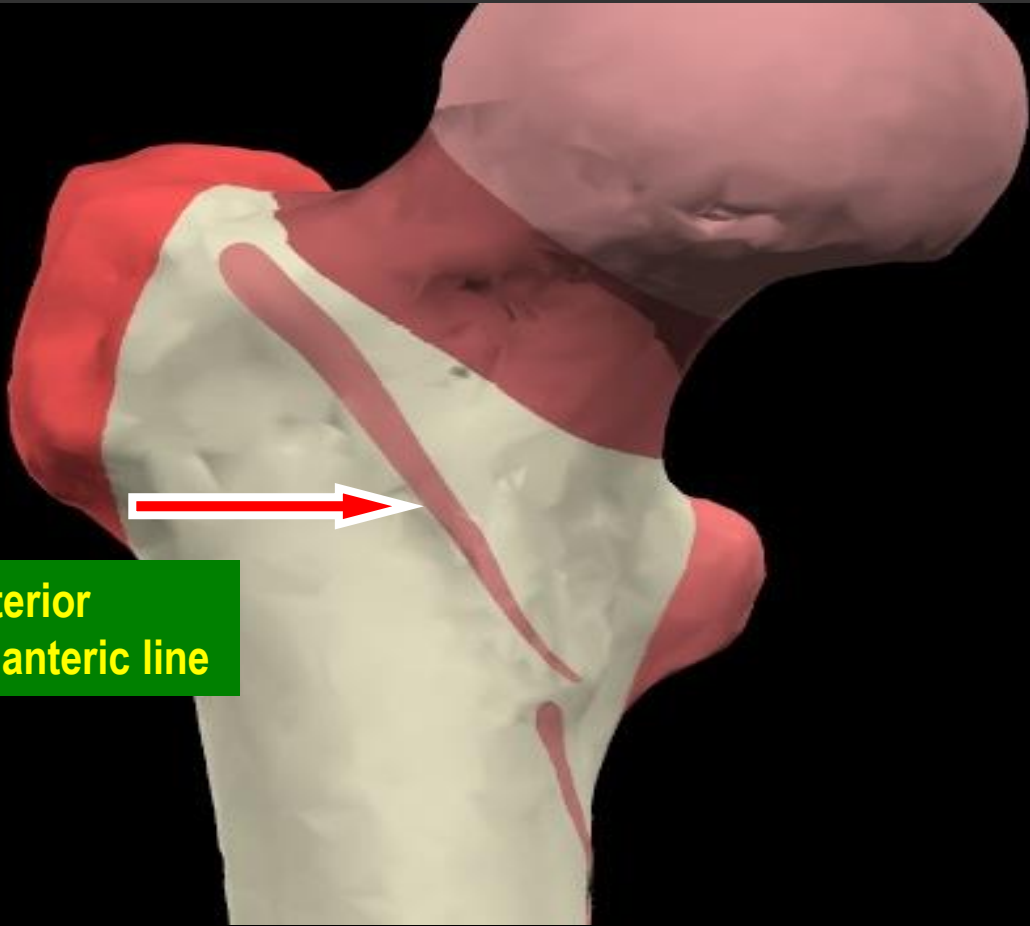
Images © Primal anatomy Inc – licensee
University of Texas Health Science Center at
Houston for educational use



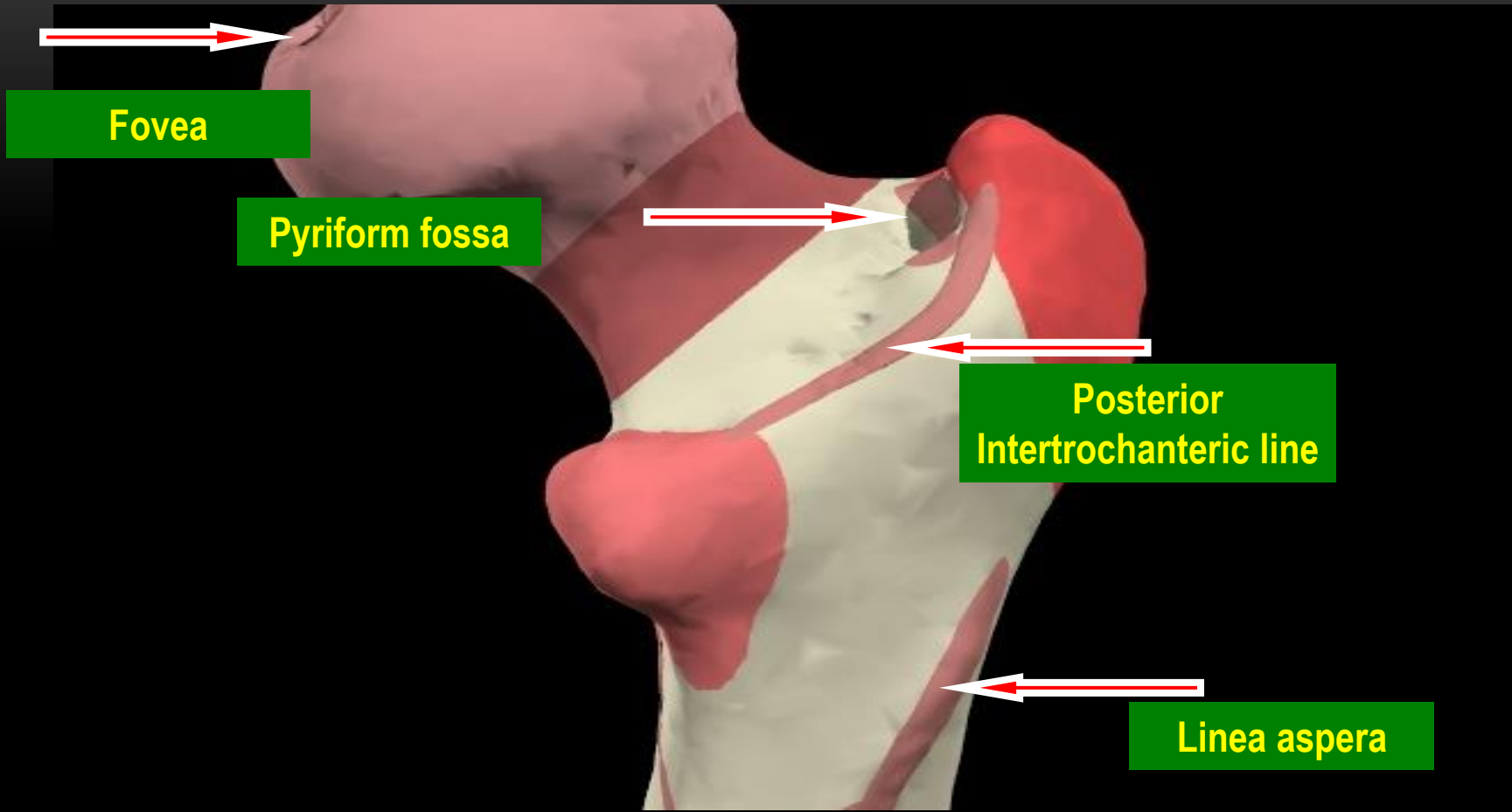
No bony support



Labrum



**Anterior
Intertrochanteric line**



Fovea

This diagram shows a lateral view of the proximal humerus. The humeral head is at the top left. The greater tuberosity is a large, rounded projection on the lateral side. The lesser tuberosity is a smaller projection on the medial side. The anatomical neck is the area just below the head. The surgical neck is the area below the anatomical neck. The greater and lesser trochanters are the large, rounded projections on the lateral and medial sides, respectively. The intertubercular sulcus is the groove between the greater and lesser tuberosities. The posterior intertubercular line is a line connecting the posterior aspects of the greater and lesser tuberosities. The linea aspera is a rough, longitudinal line on the posterior surface of the shaft. The piriform fossa is a small, oval-shaped depression on the medial side of the surgical neck. The fovea is a small, oval-shaped depression on the lateral side of the surgical neck.

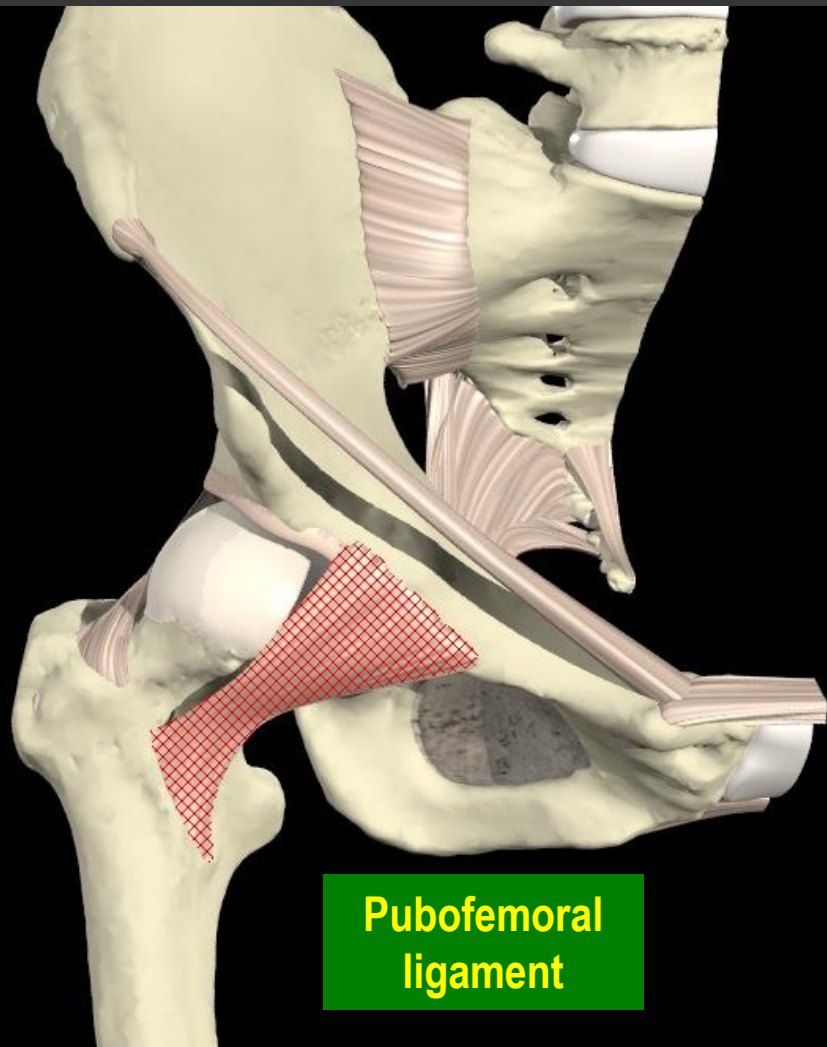
Piriform fossa

**Posterior
Intertrochanteric line**

Linea aspera

Ligaments of the hip

1. Pubofemoral
2. Ischiofemoral
3. Iliofemoral
4. Ligamentum Teres
5. Transverse ligament

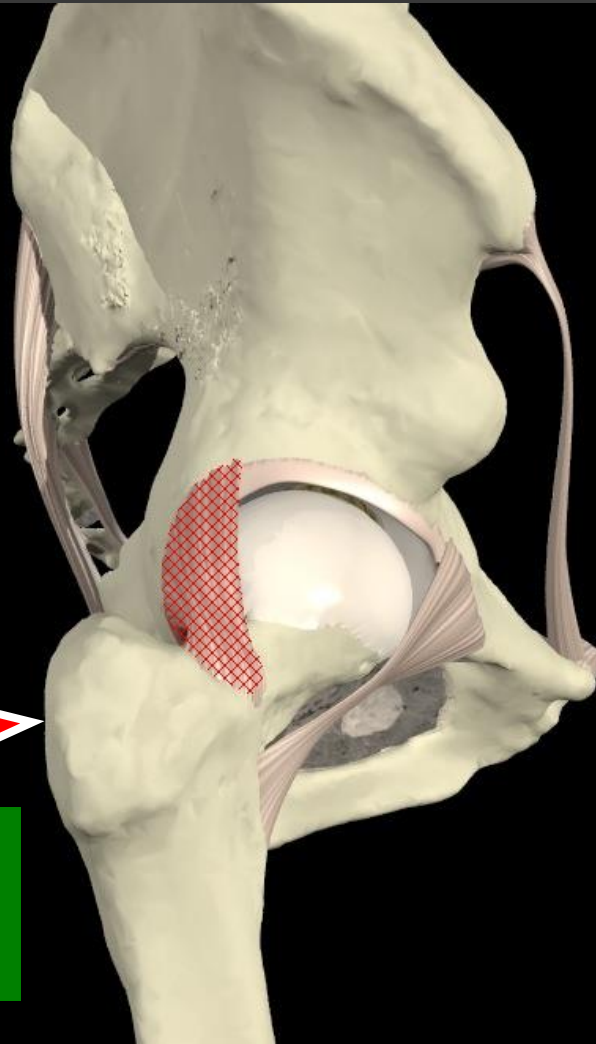


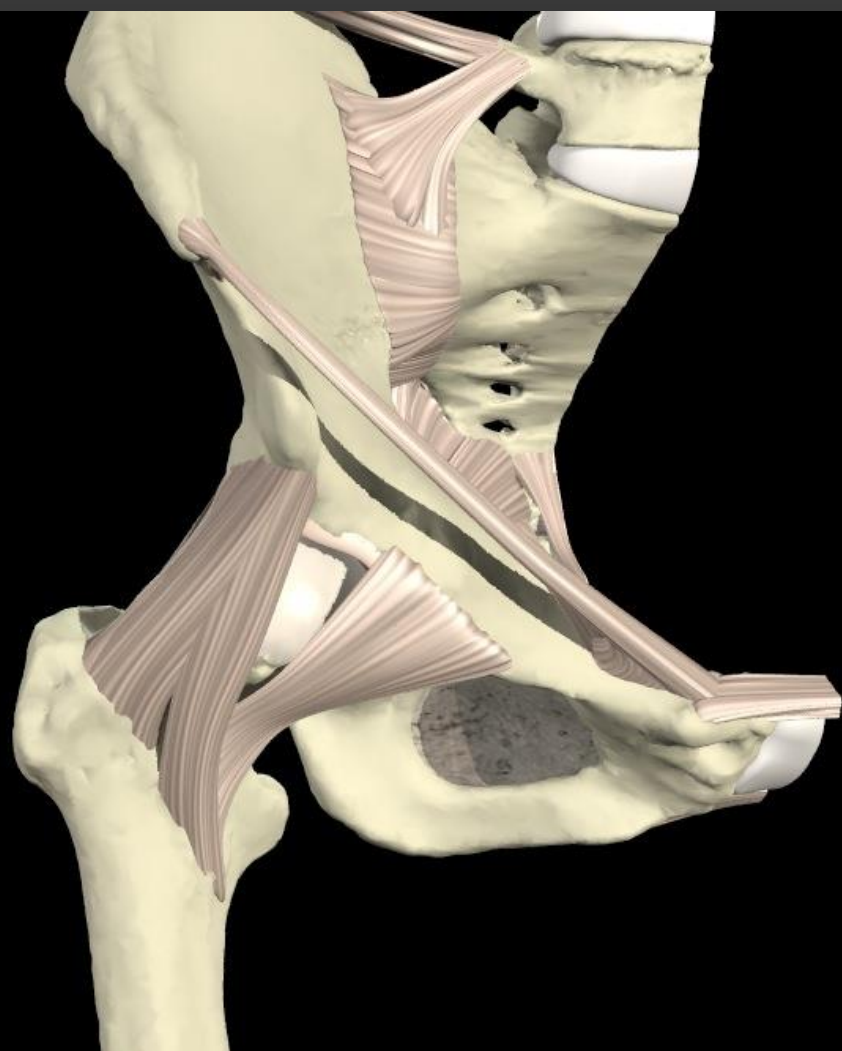
**Pubofemoral
ligament**

Ischiofemoral
ligament



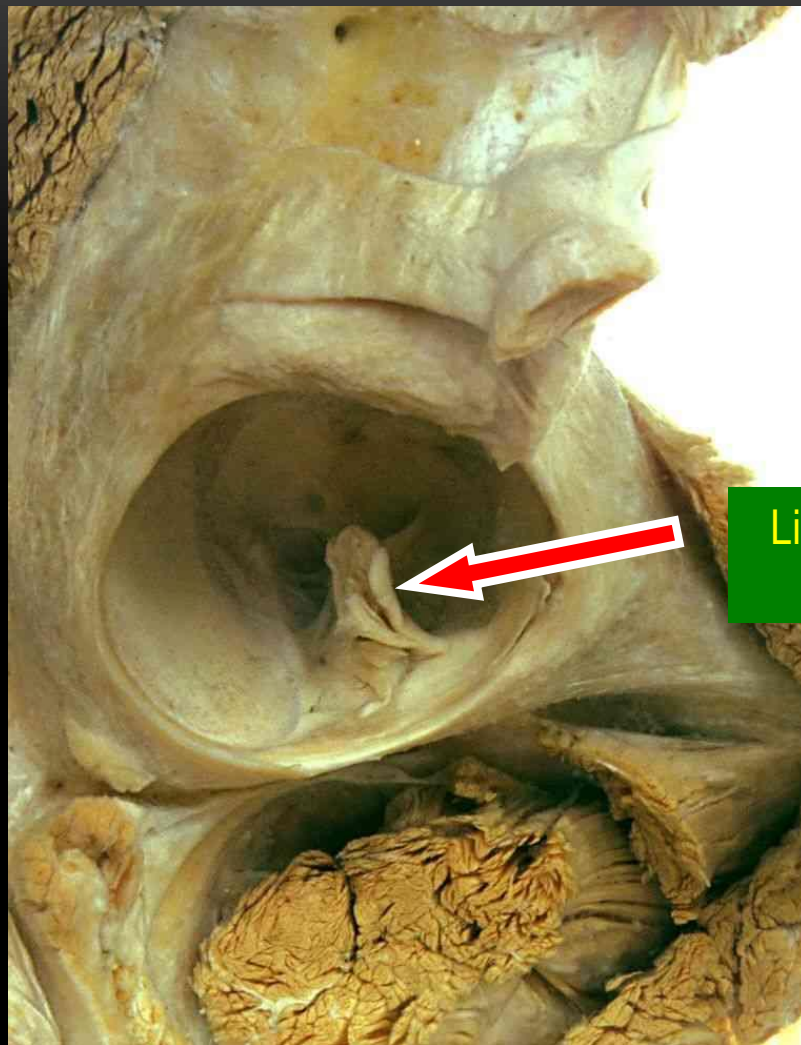
Greater
trochanter
posterior



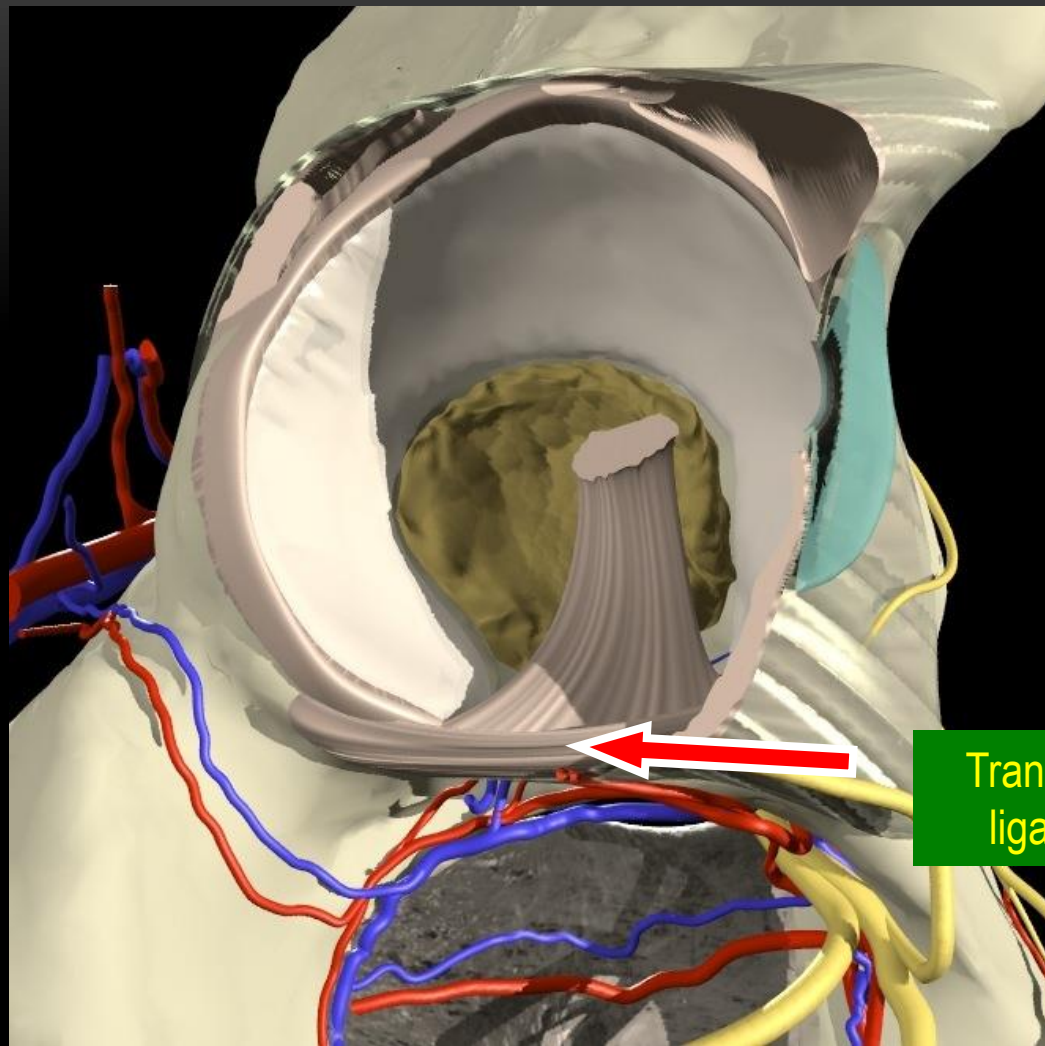




Iliofemoral
ligament



Ligamentum
teres



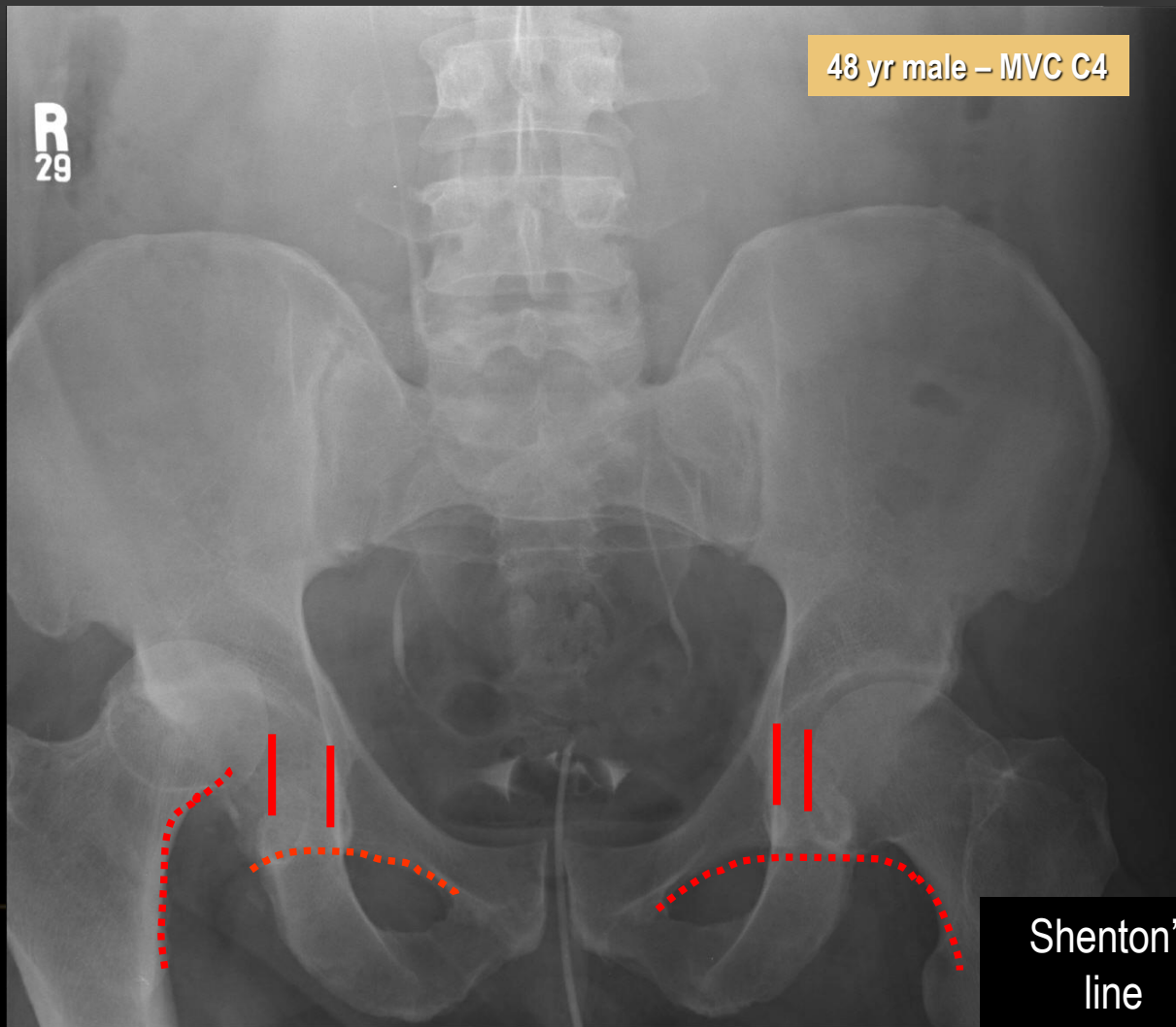
Transverse
ligament

Hip dislocation

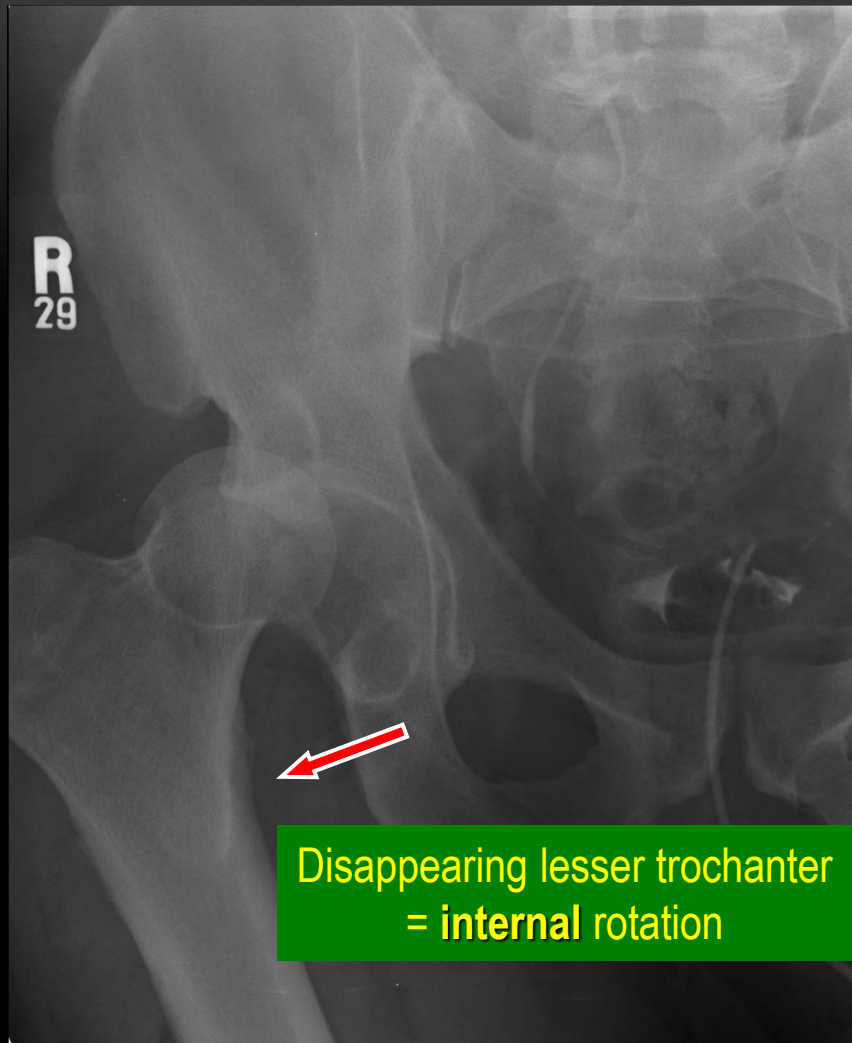
- Types of dislocation
 - Posterior
 - Commonest type – 80-90 %
 - Anterior
 - Rare less than 10 %
-

48 yr male – MVC C4

R
29

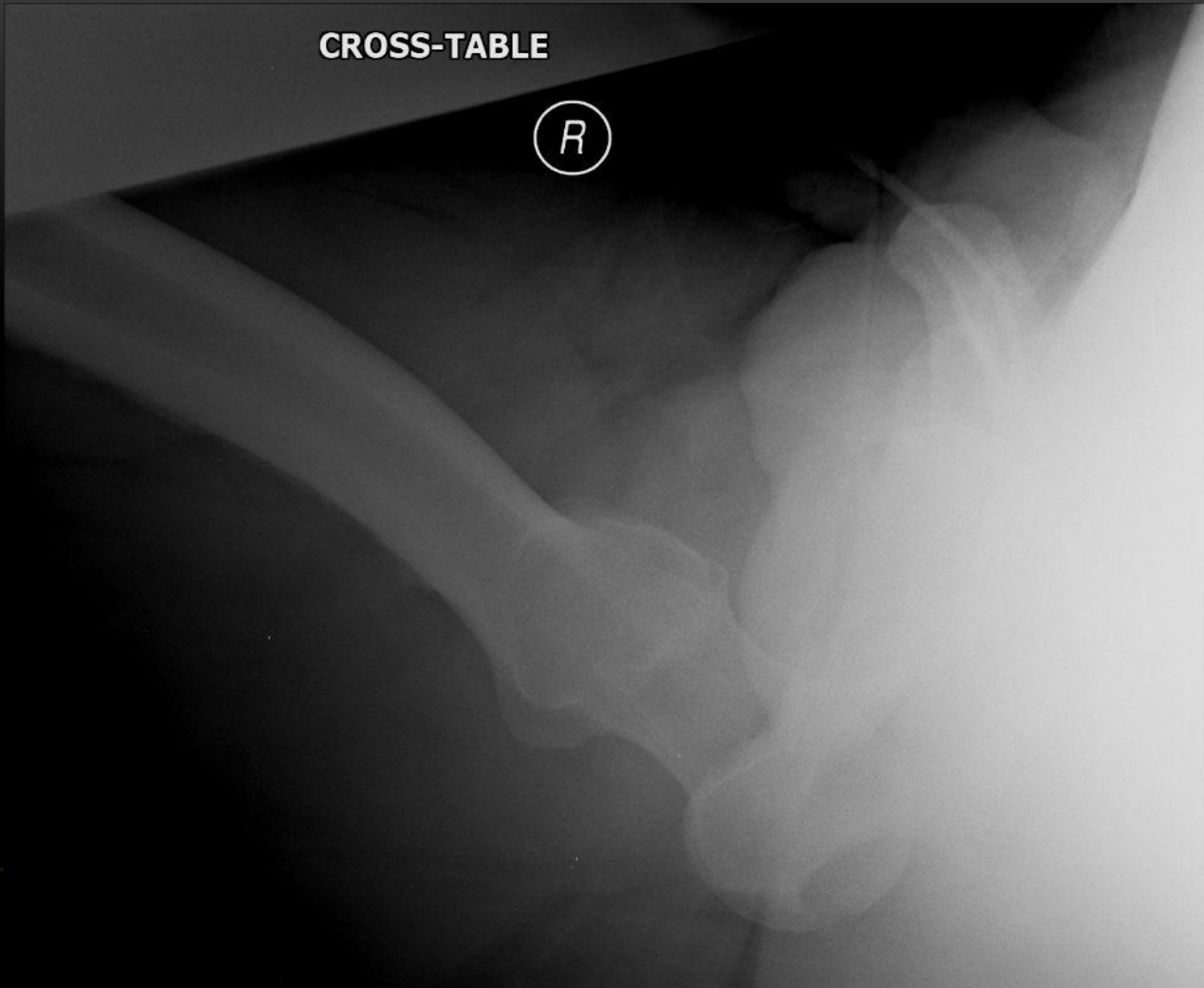


Shenton's
line



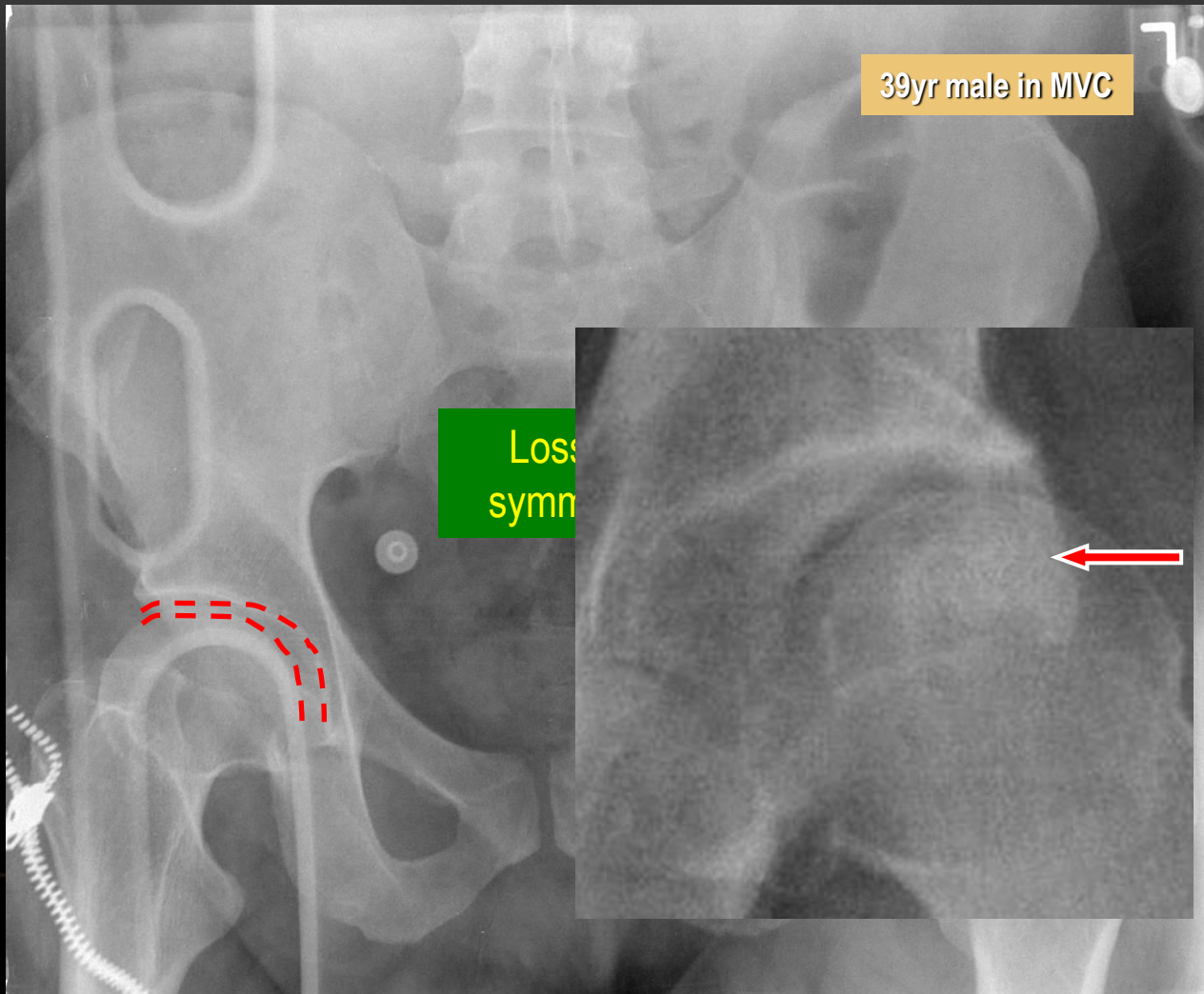
CROSS-TABLE

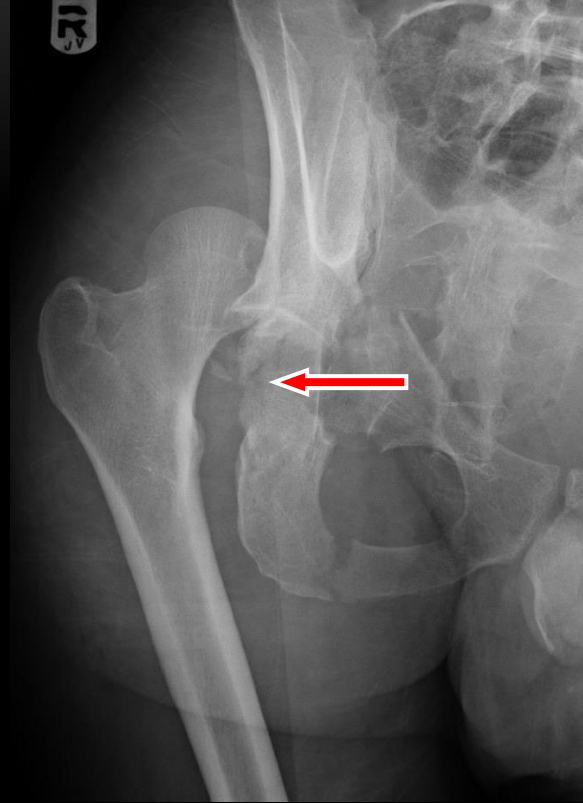
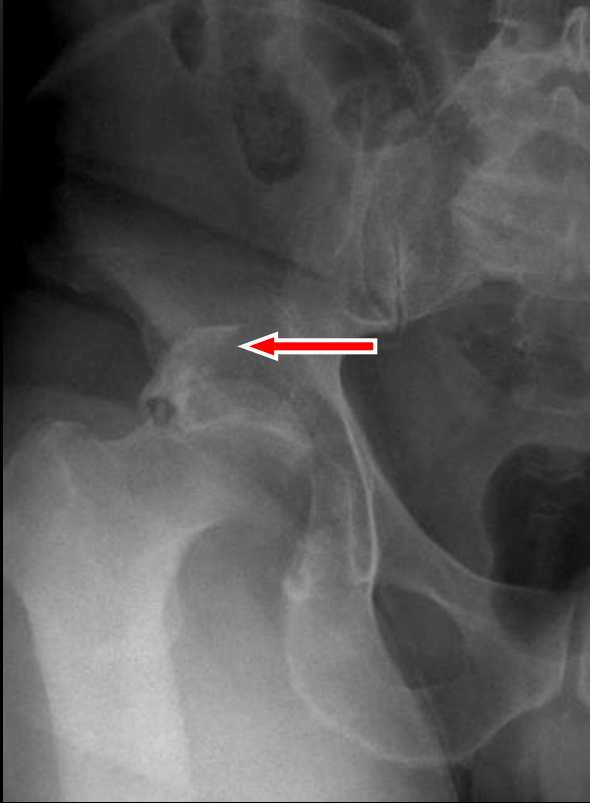
(R)

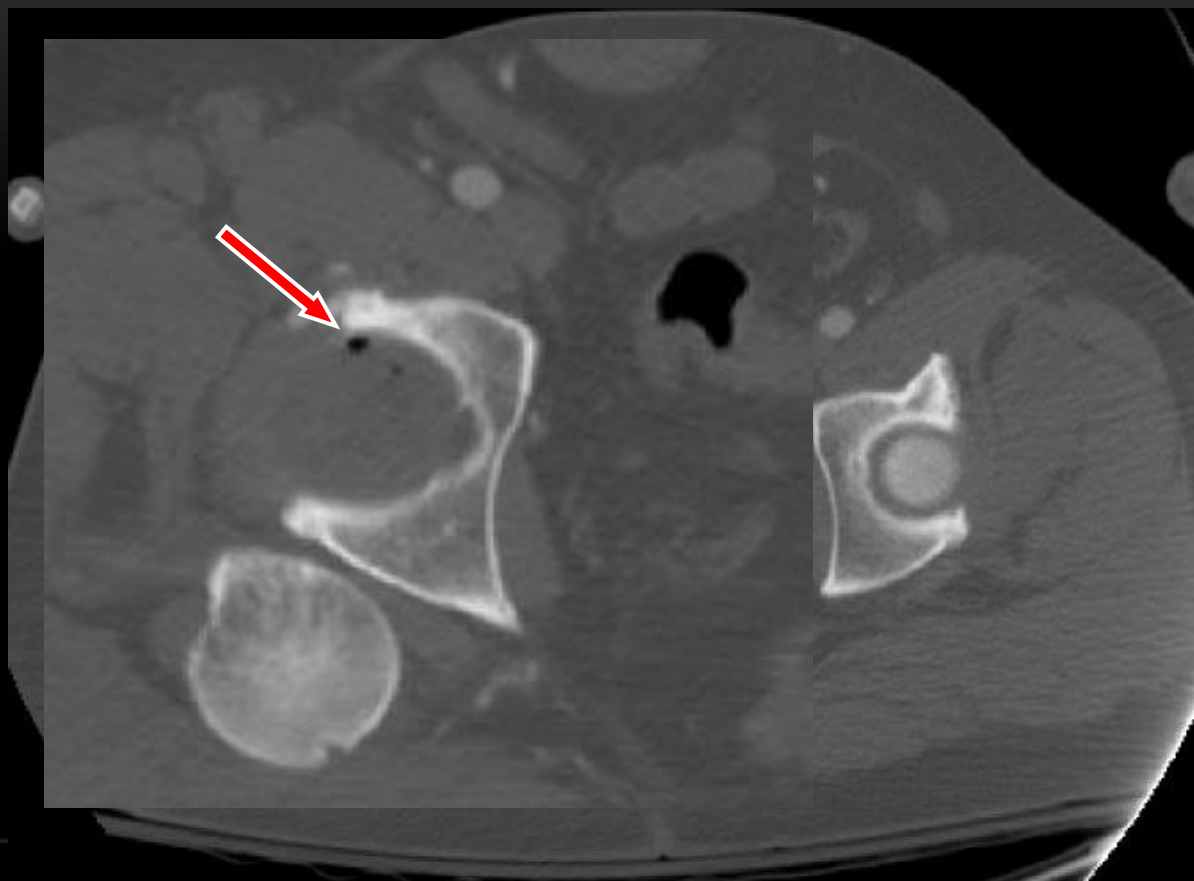


39yr male in MVC

Loss
symm







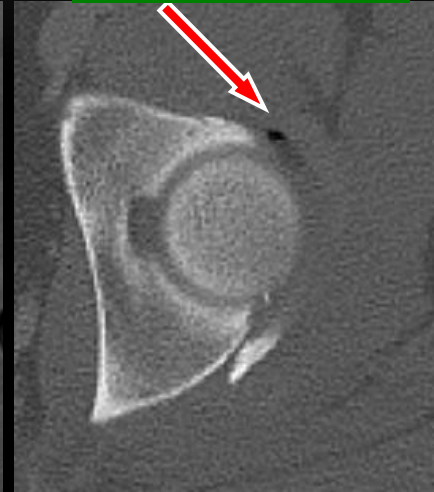
CT reveals all!



Foveal
avulsion
n



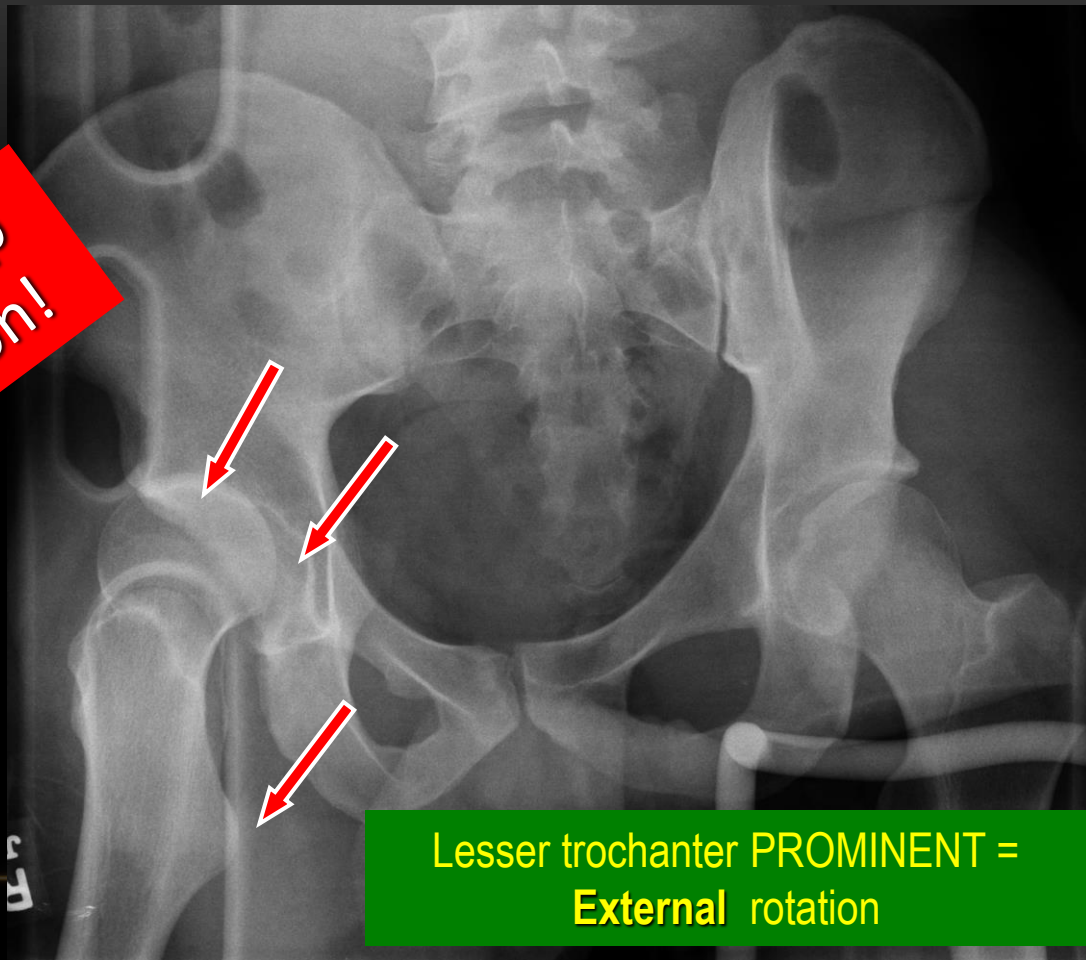
Intra-articular
fragments



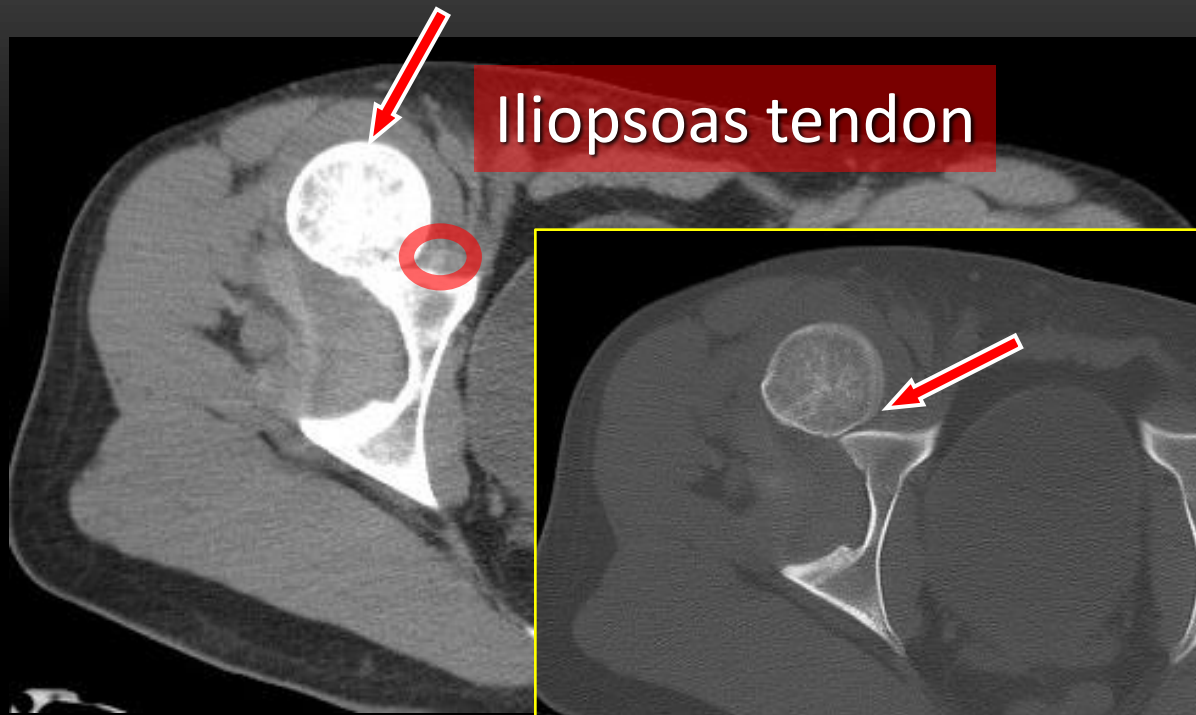
Vacuum = prior
dislocation

What about the rare type....
MVC – Hip pain

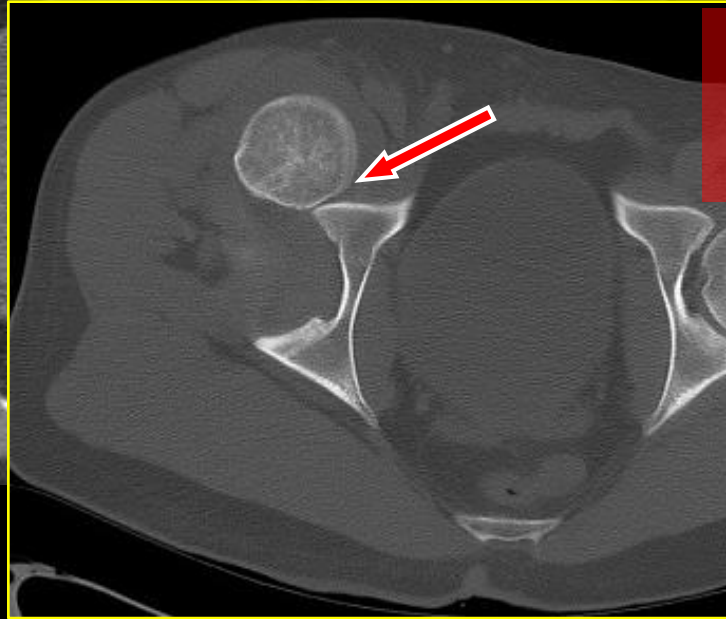
Anterior hip
dislocation!



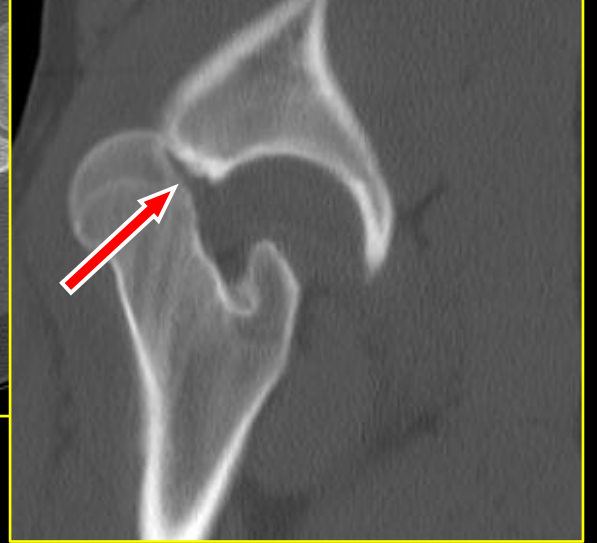
Lesser trochanter PROMINENT =
External rotation



Iliopsoas tendon

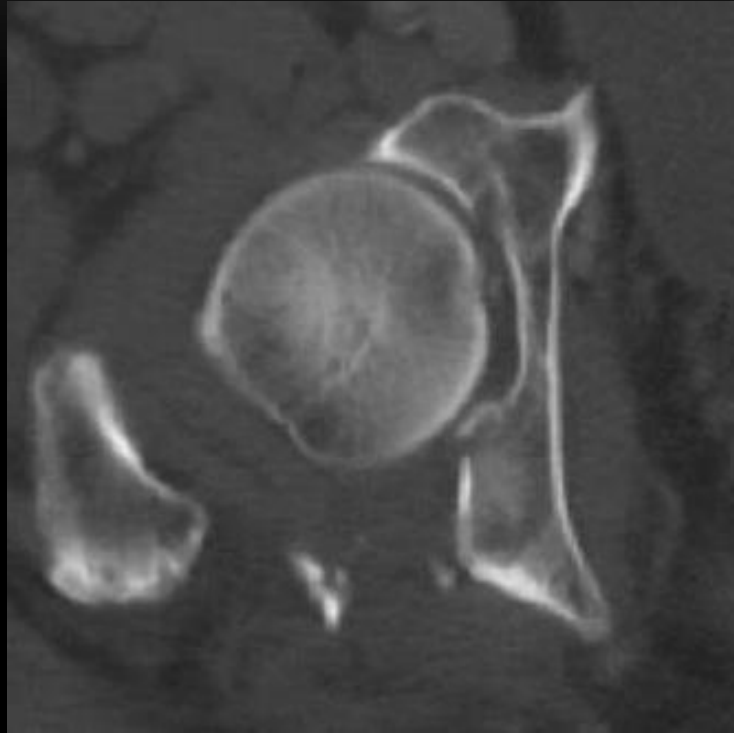


Impacted
anterior dislocation



What the clinician wants to know?

- Is it completely or partially reduced?
- Are there any intra-articular fragments?
- Any associated fractures?



Femoral head fractures

Types

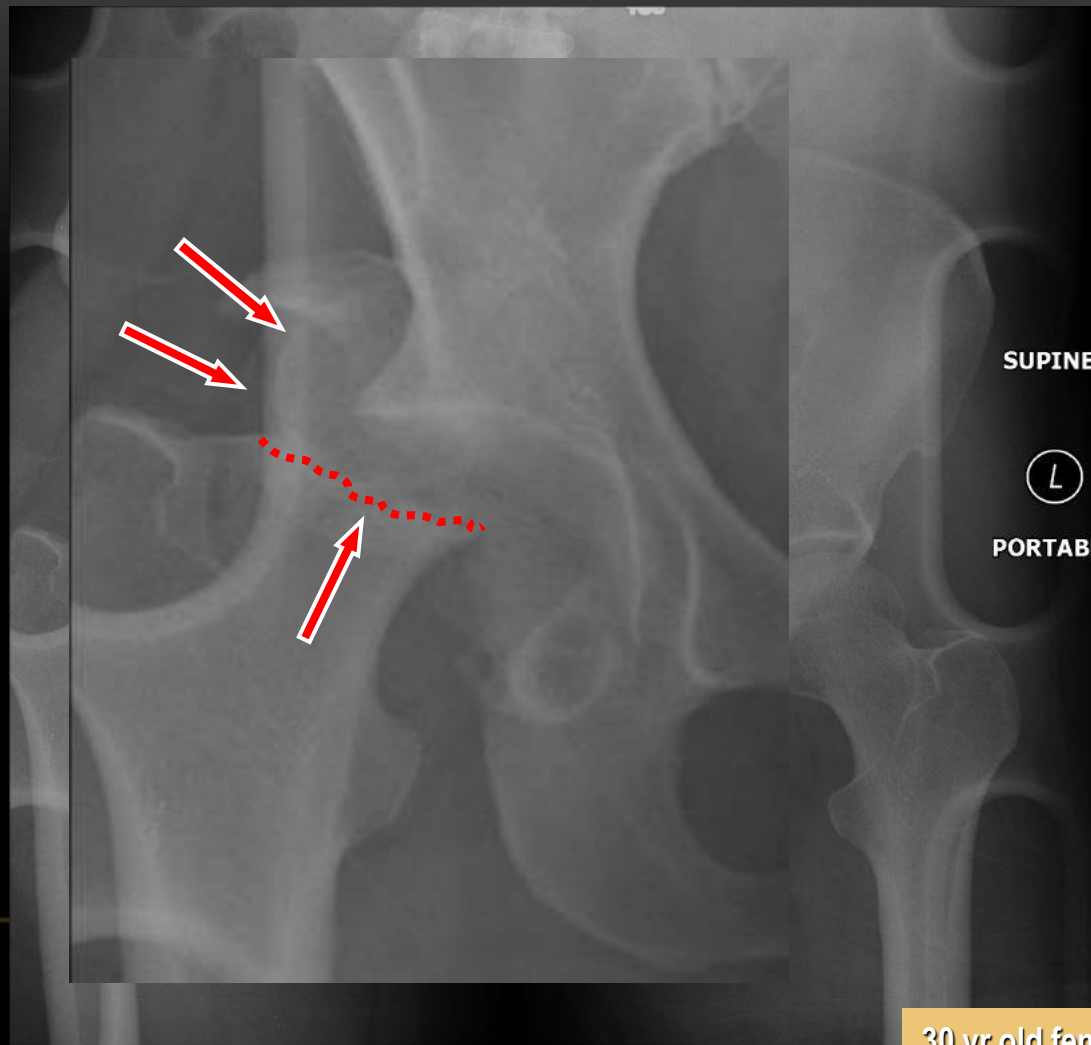
- Compression
- Shear

Associated fractures

- Acetabulum
- Neck of femur

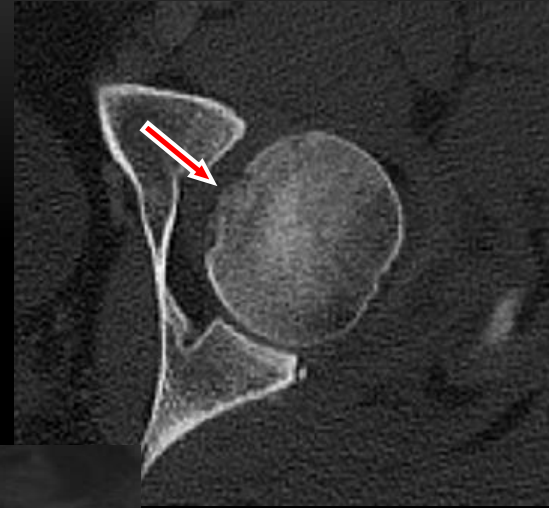
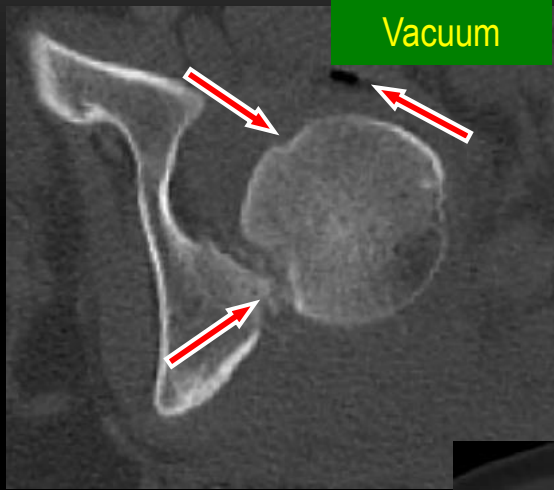


30 yr old female MVC

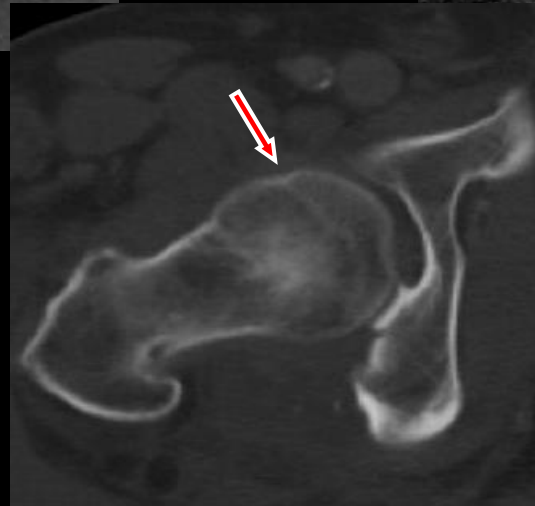


30 yr old female MVC

Compression type - CT



subchondral
injury

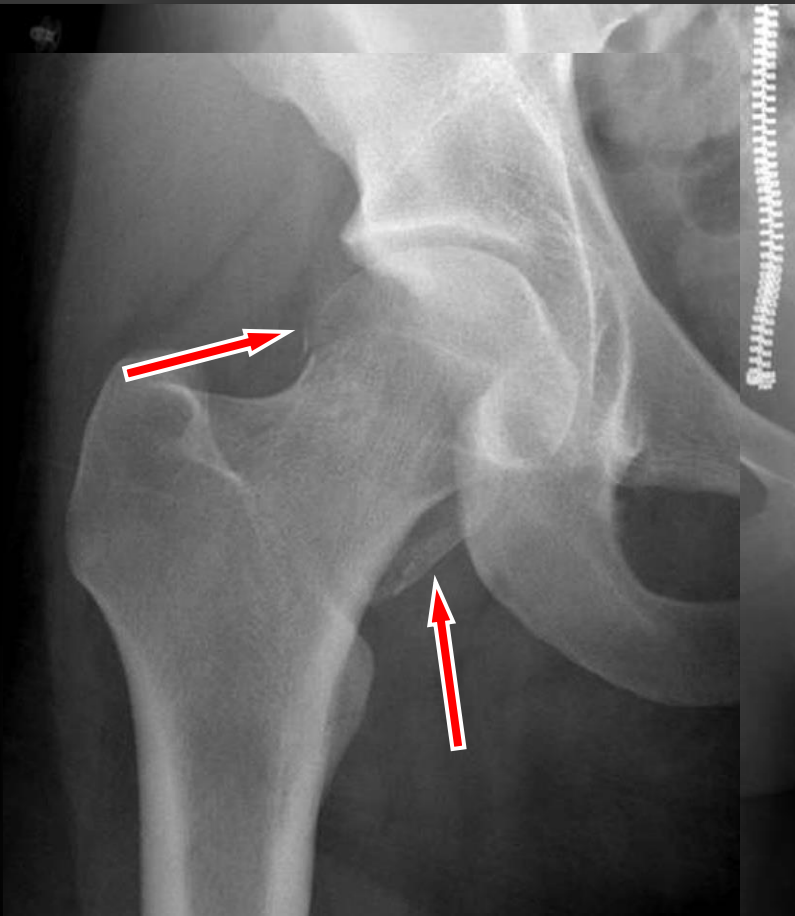




48 yr old male MVC

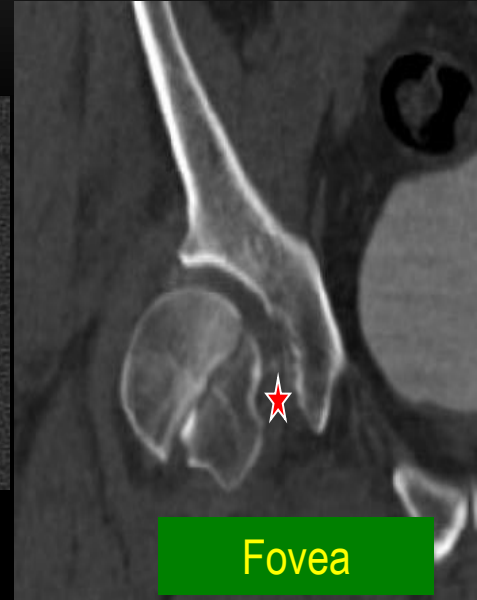






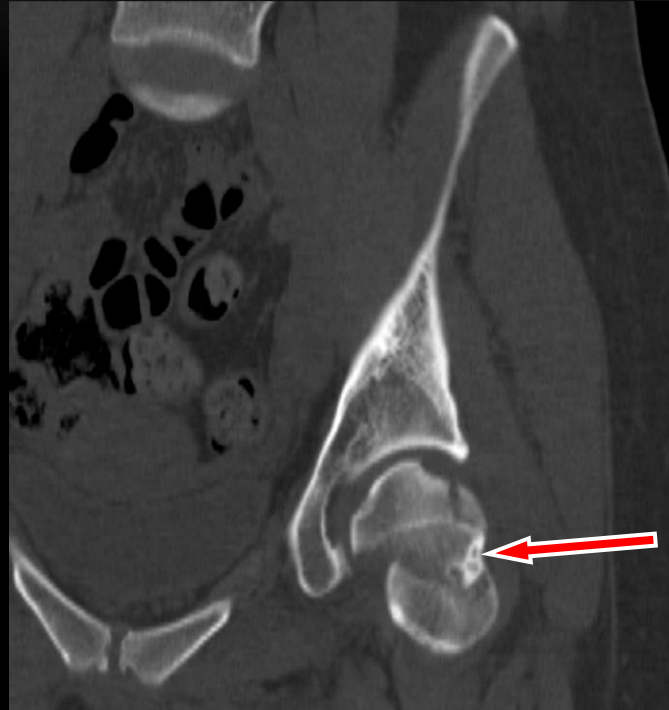
48 yr old male MVC

Shear type - CT



What the clinician wants to know?

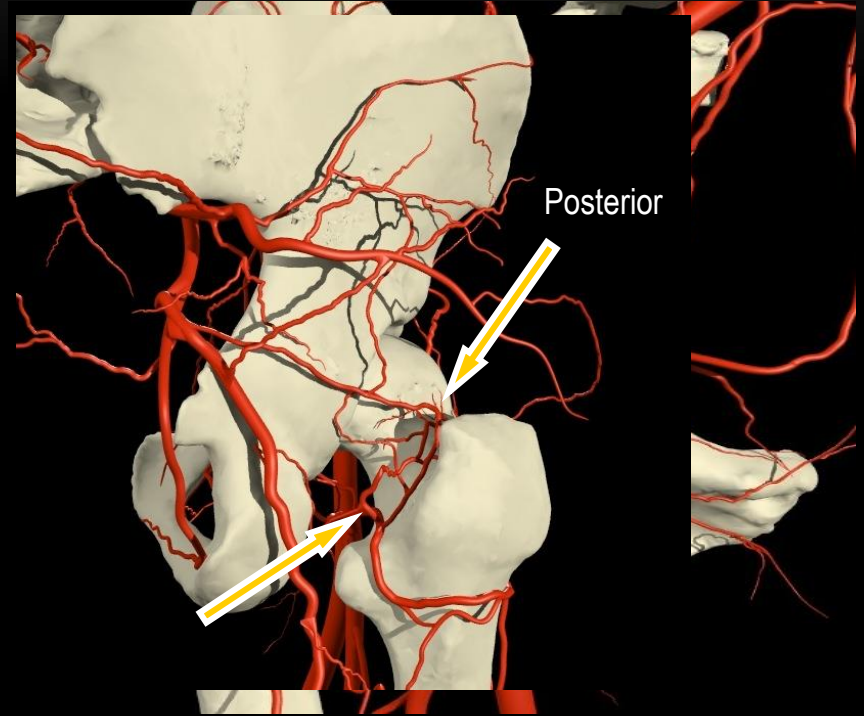
- Compression or Shear ?
- Shear
 - **Relationship to fovea –
weight bearing surface**
(Pipkin classification)
- Associated fractures

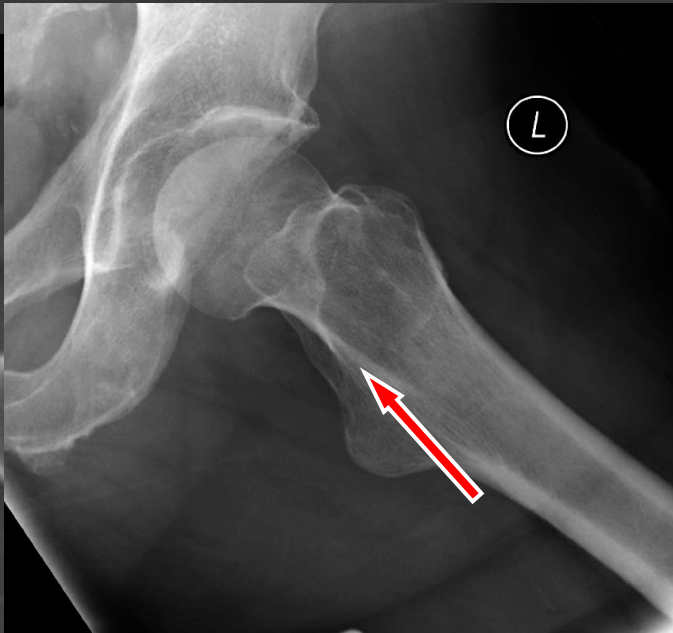


Neck of femur

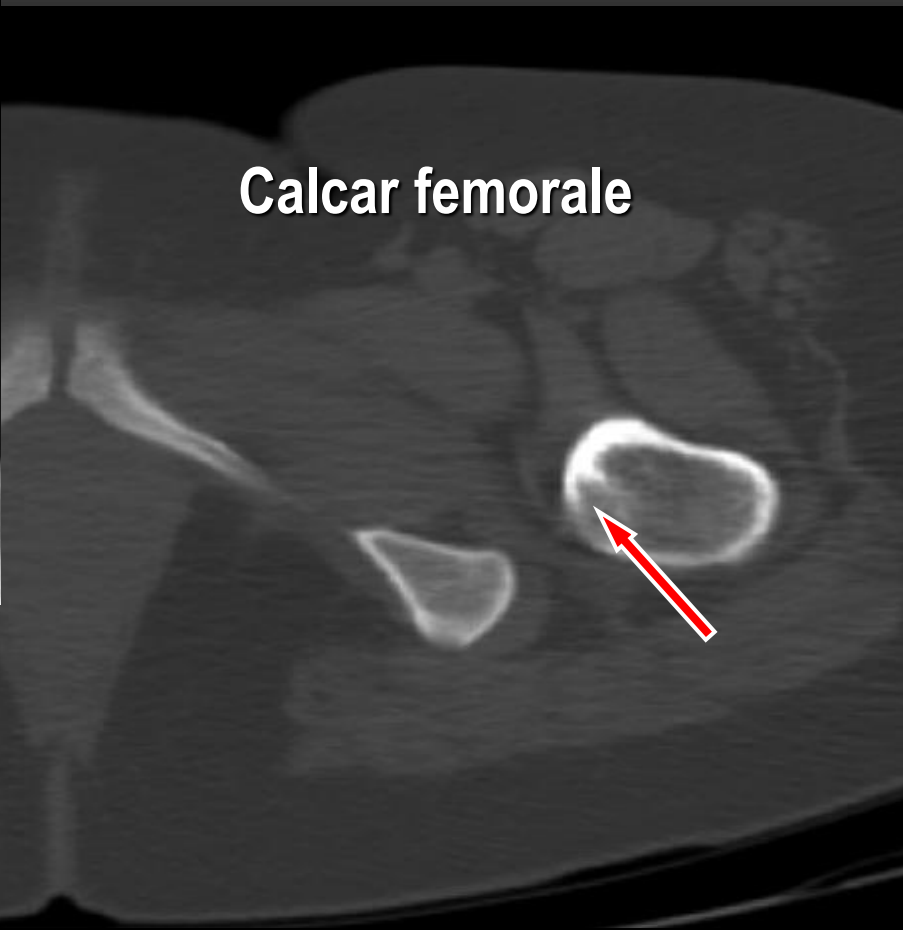
Relevant anatomy

- Circumflex vessels – majority of blood supply
- Foveal artery – about 10% contribution
- Extra capsular fractures do **not** compromise femoral head vascularity





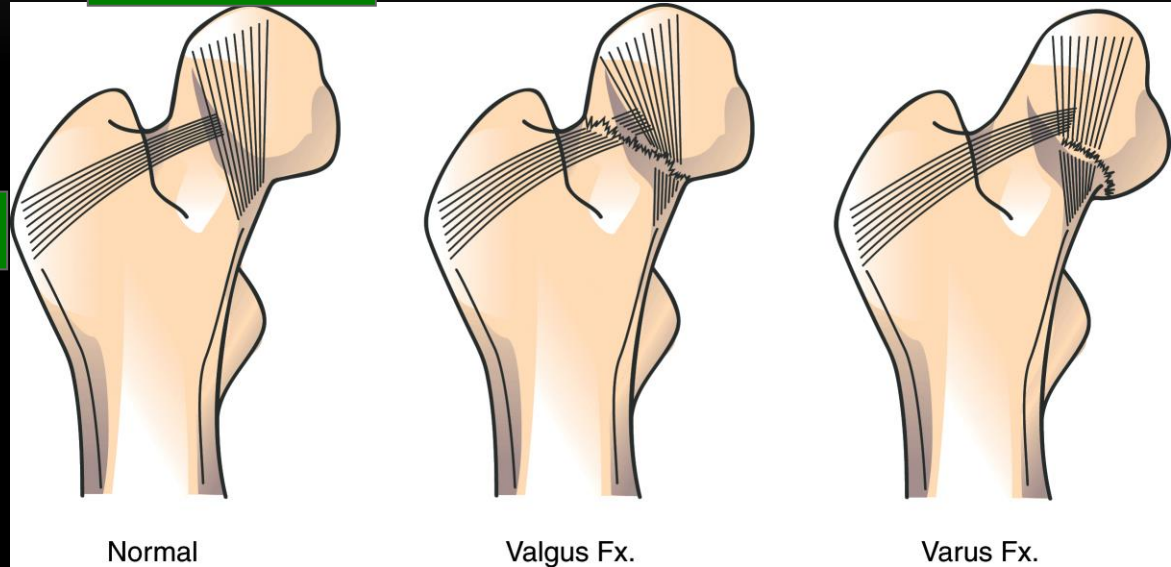
Calcar femorale



Trabecular pattern – The key!

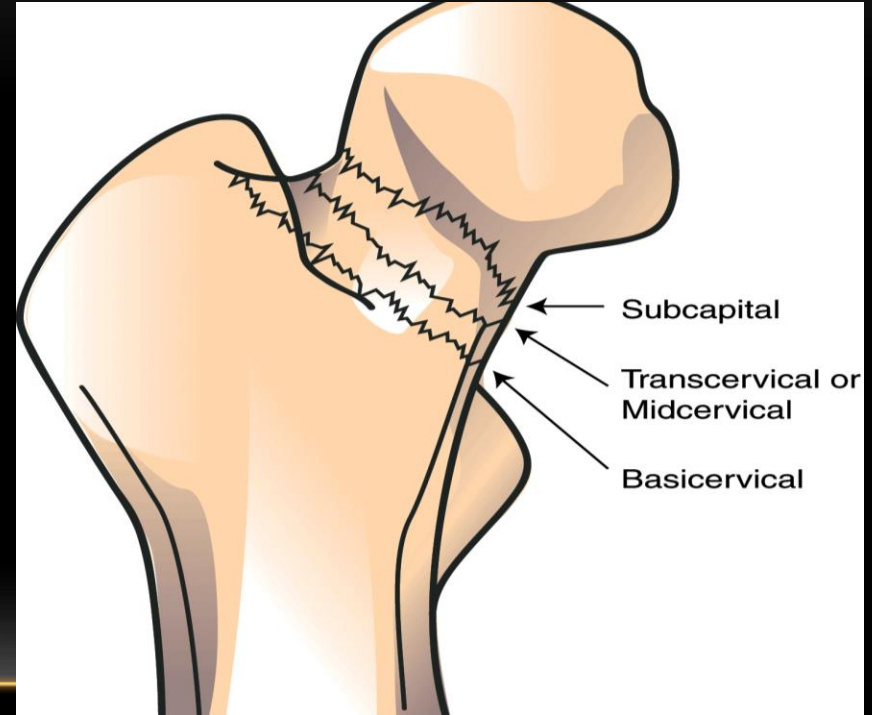
Compressive

Tensile

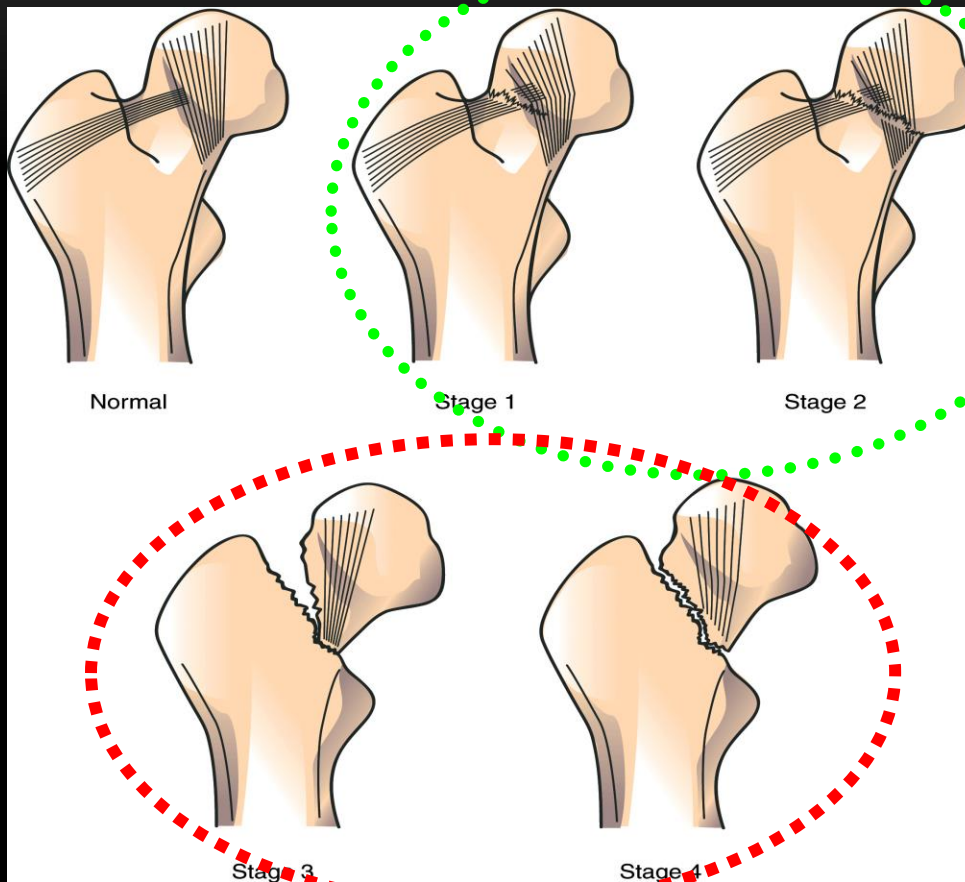


Types of NOF fractures

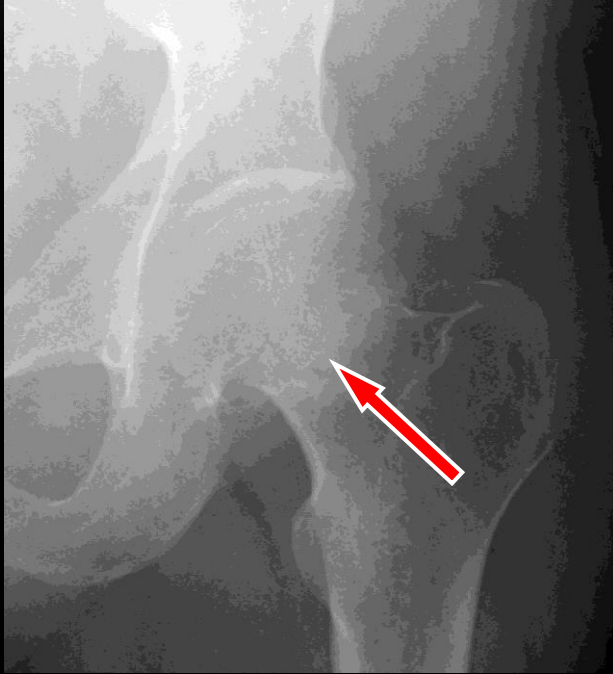
- Most common is subcapital
- Basicervical and midcervical are usually complete fractures
- Pediculars more commonly basicervical



Garden classification



Garden classification

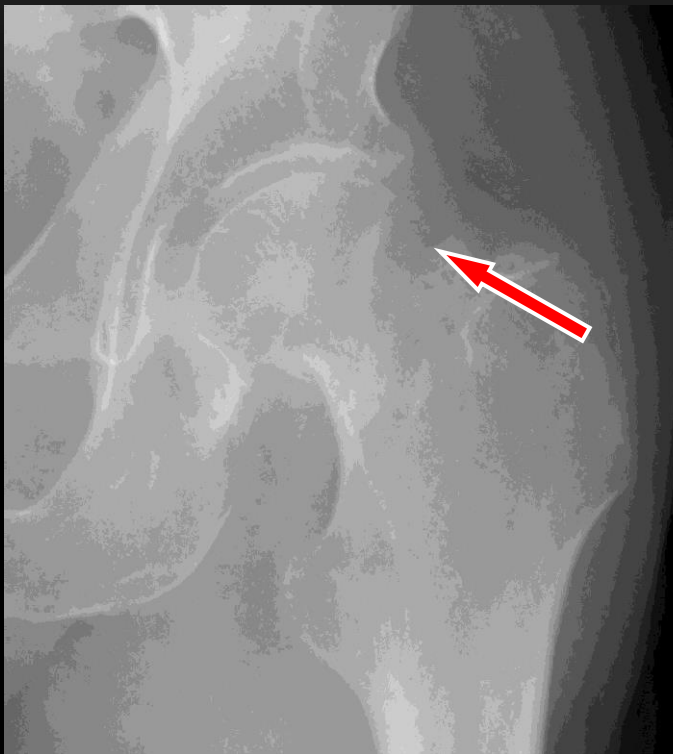


Type 1

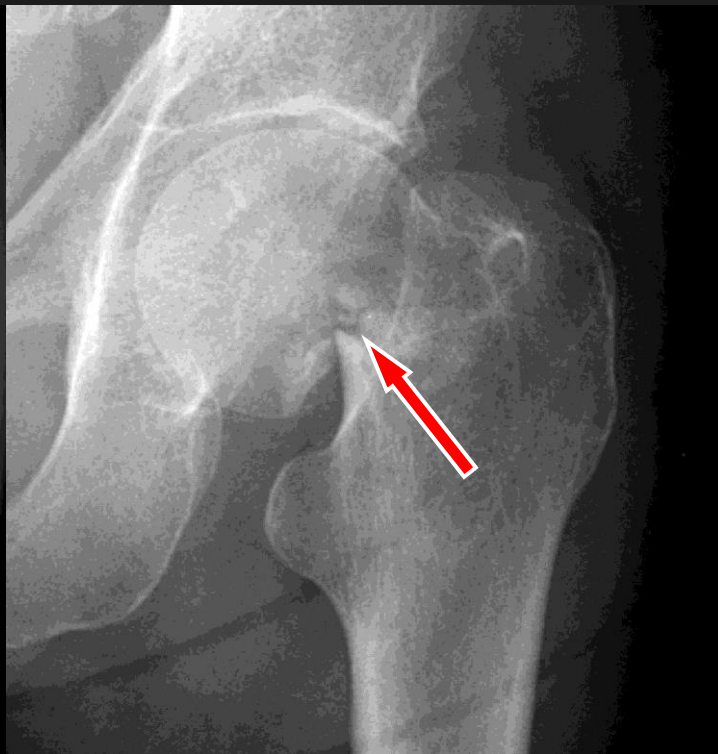


Type 2

Garden classification



Type 3

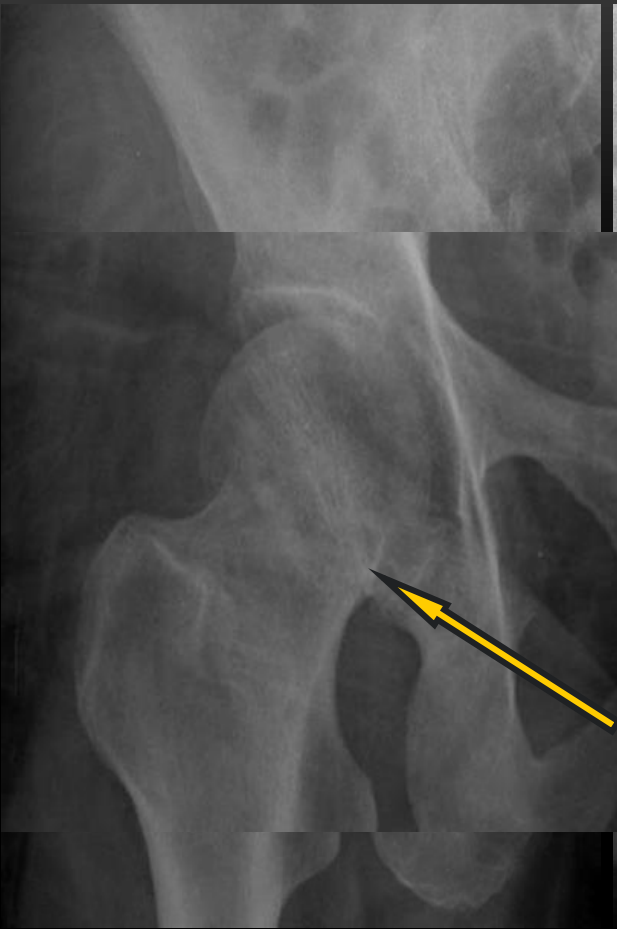


Type 4

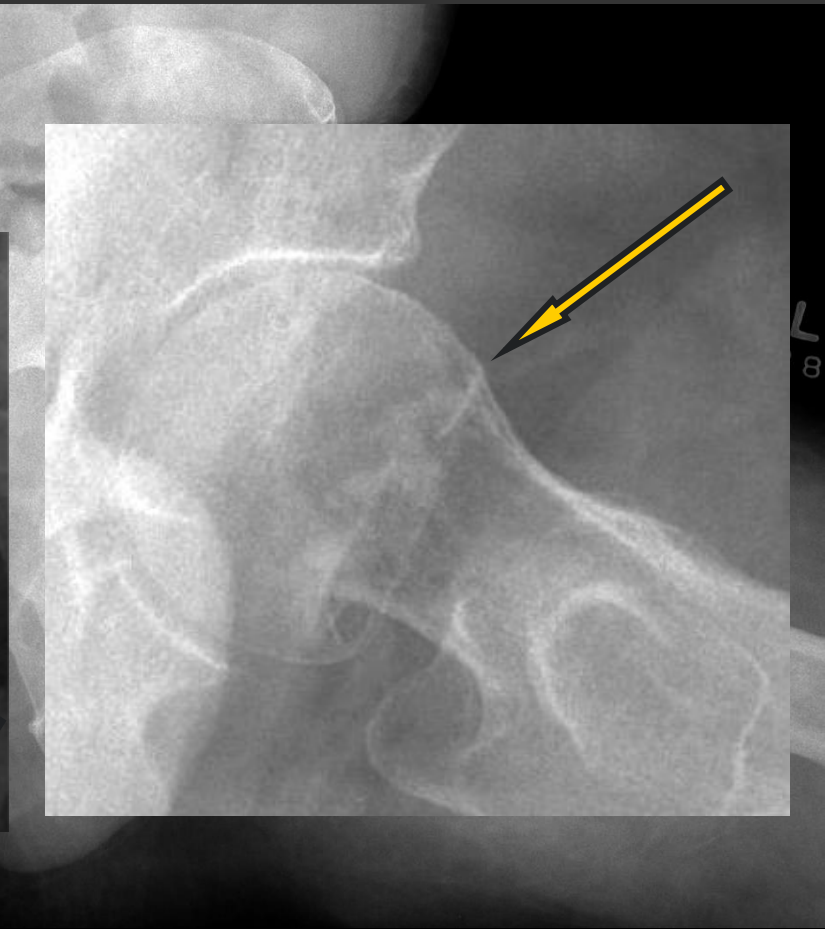


23 yr male - MVC

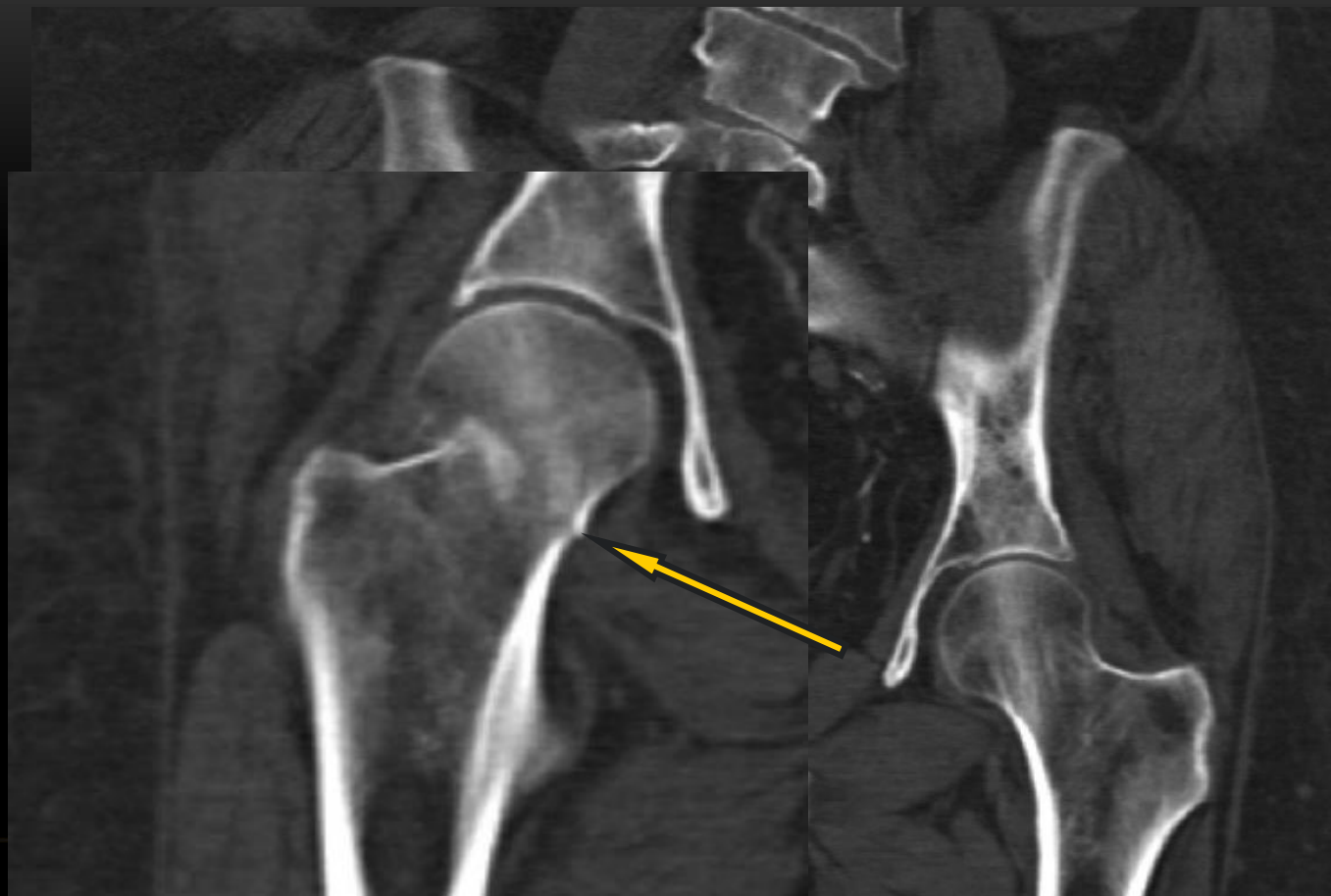


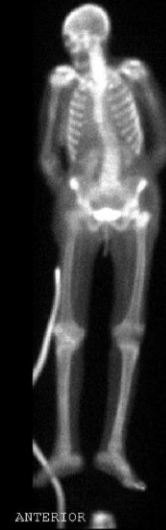
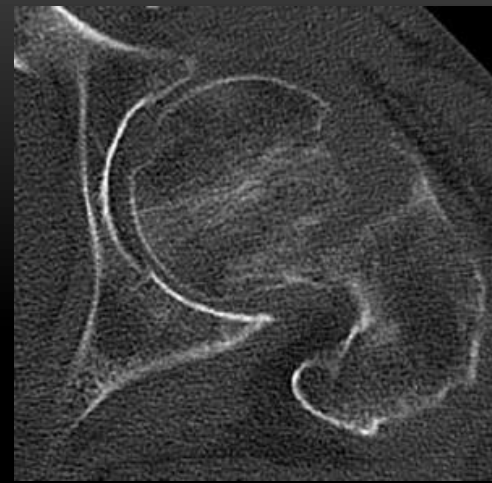


23 yr male - MVC



46 yr female - MVC

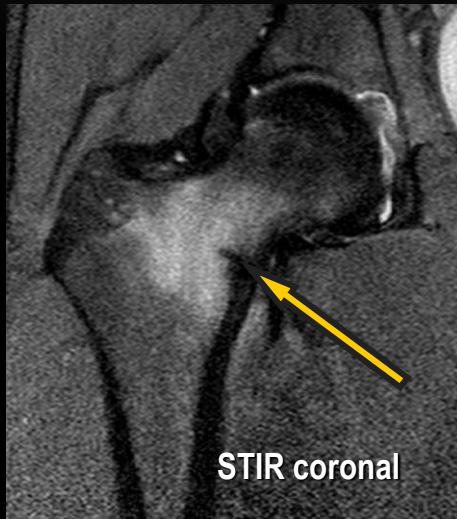




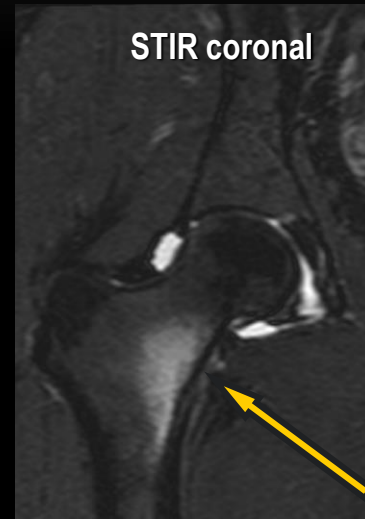
81yr female fall – H/O lung ca

MRI

Neck of femur stress reaction



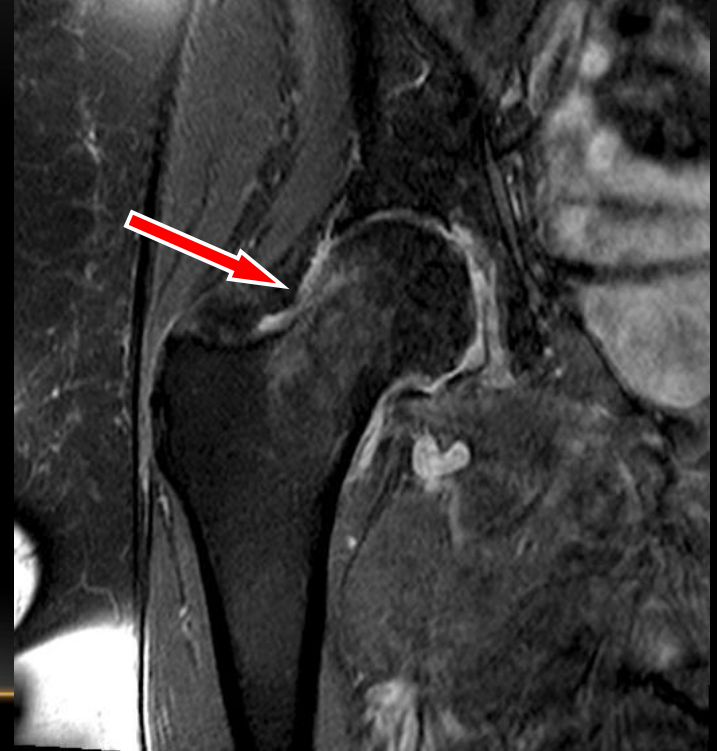
19yr male gymnast



25yr female
Pain for 4weeks

So what is clinically relevant in NOF fxs?

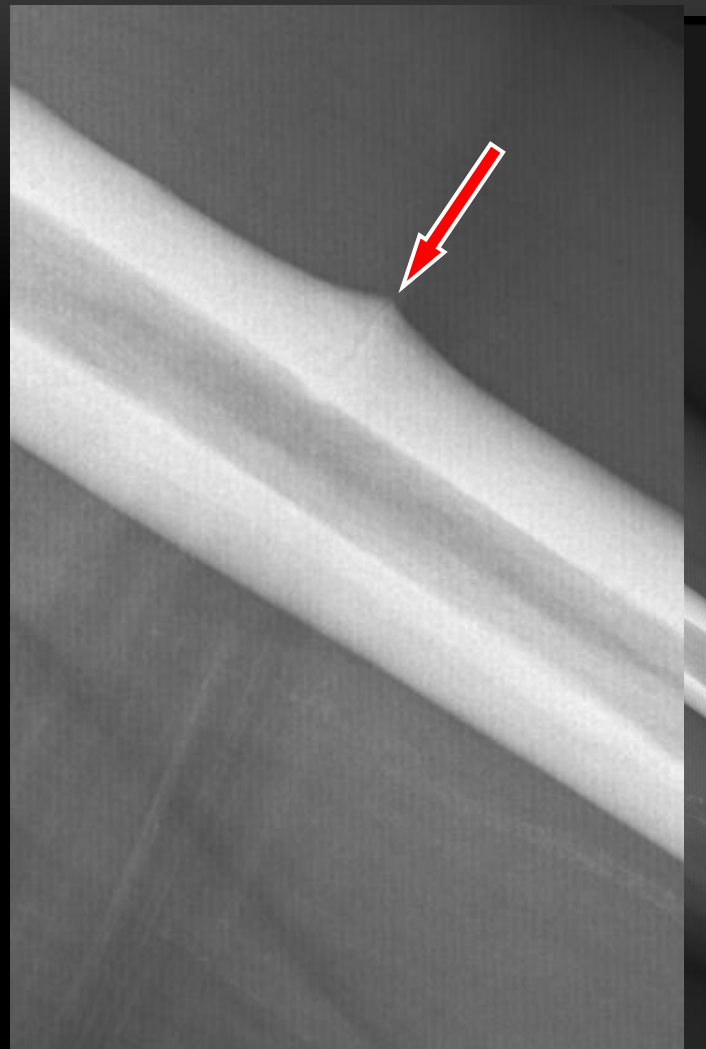
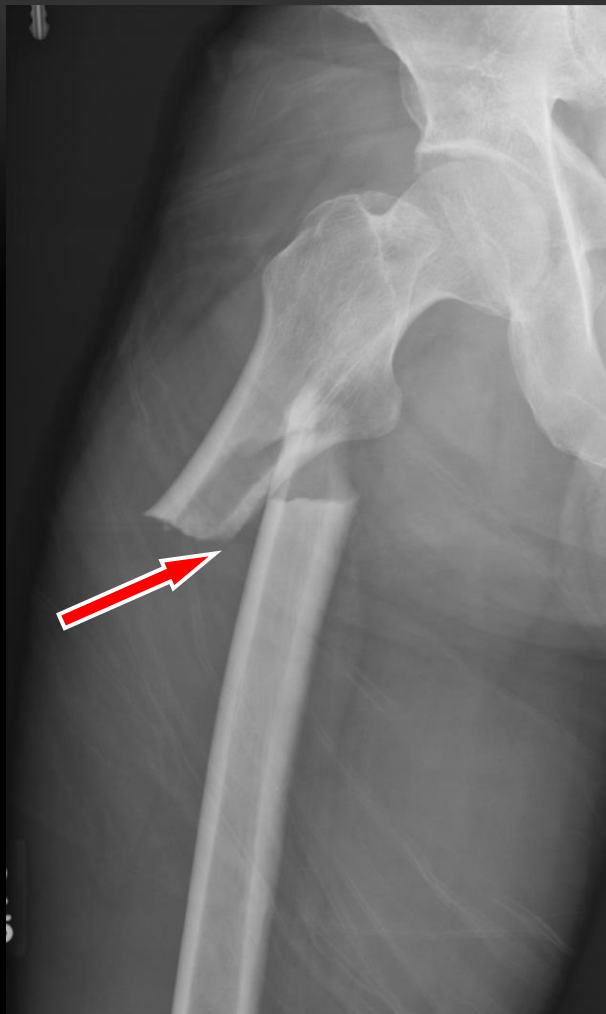
- Location – subcapital / basicervical / Calcar
- Complete / incomplete / displacement
- Varus type – lateral cortex involvement
- Occult - **MRI**



Moving a bit more distal

Bilateral dull ache in the hips – 2 months





Bisphosphonate related femoral fracture

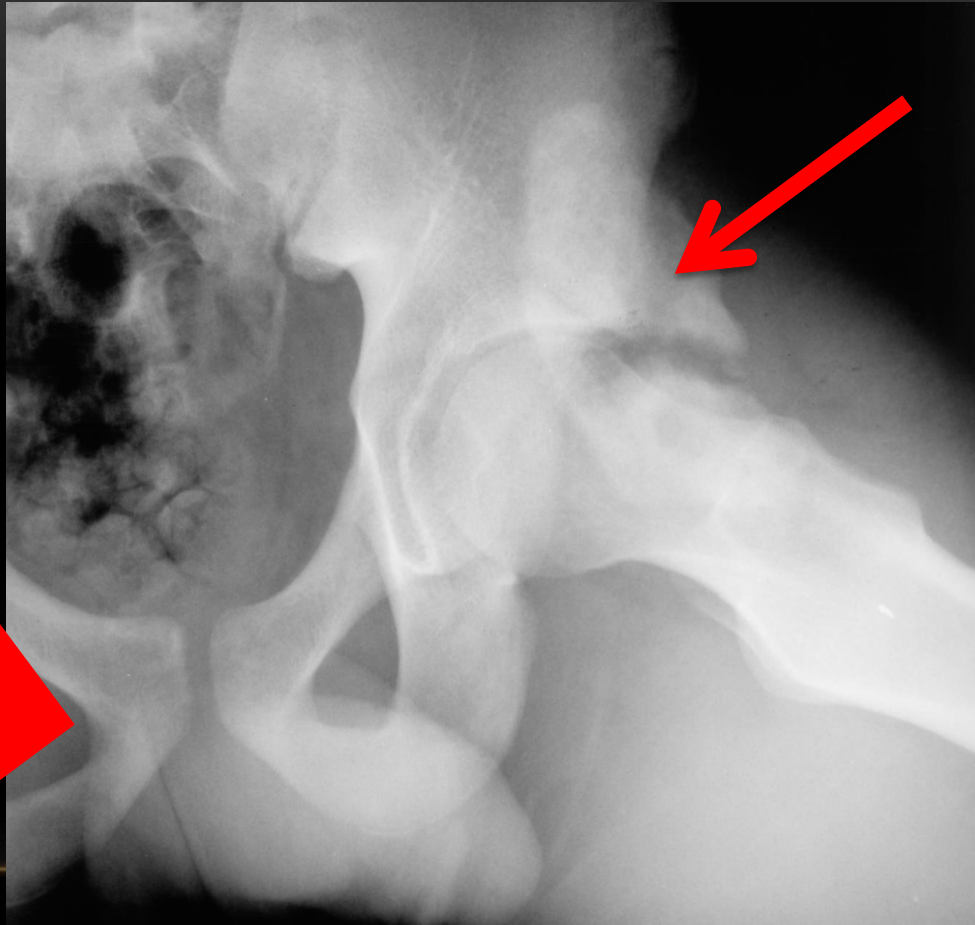
- Typically history of bisphosphonate use for >2 years
- Typically bilateral
- Classic location
 - Cortical beaking lateral cortex - subtrochanter femur
 - Progresses stress fracture → complete fracture
- Intramedullary nailing – prophylactic
- Teriparatide



Lets' move a bit away from the femur

25 year old ... trip and fall 3+ weeks ago
Hip pain....

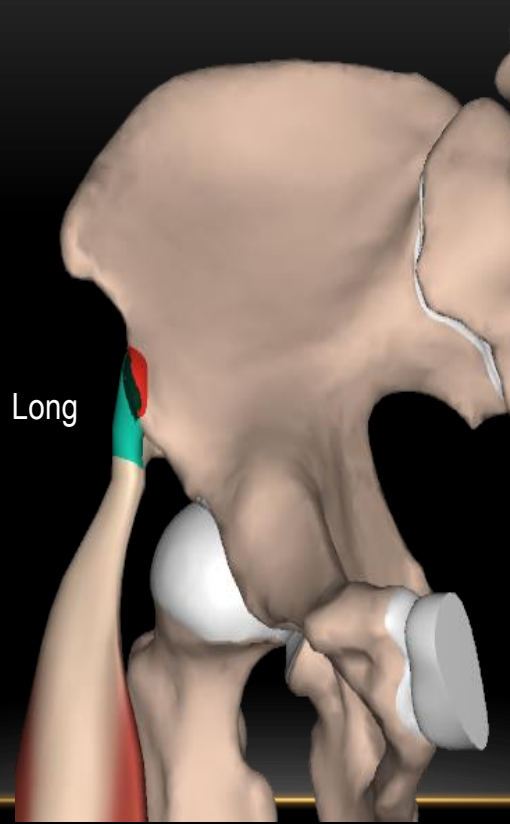
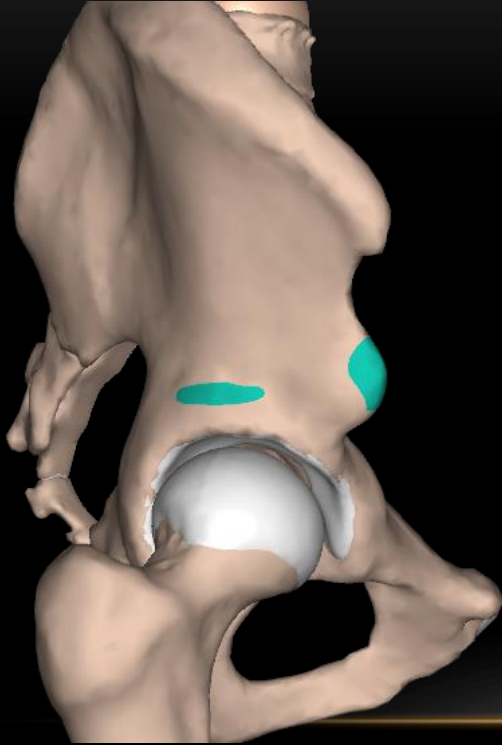
Rectus
femoris
avulsion



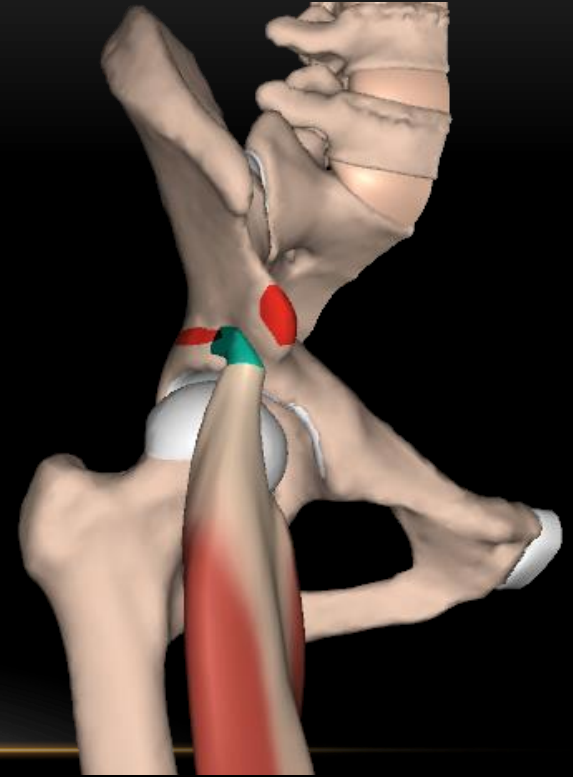


Rectus
femoris
avulsion

Rectus femoris attachments



Long / Straight head



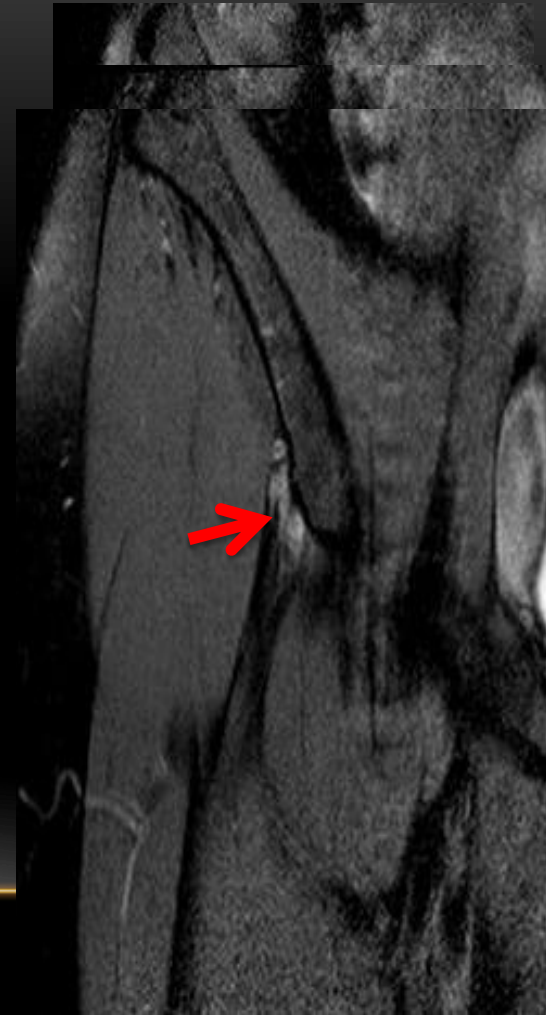
Reflected head

Rectus femoris tear

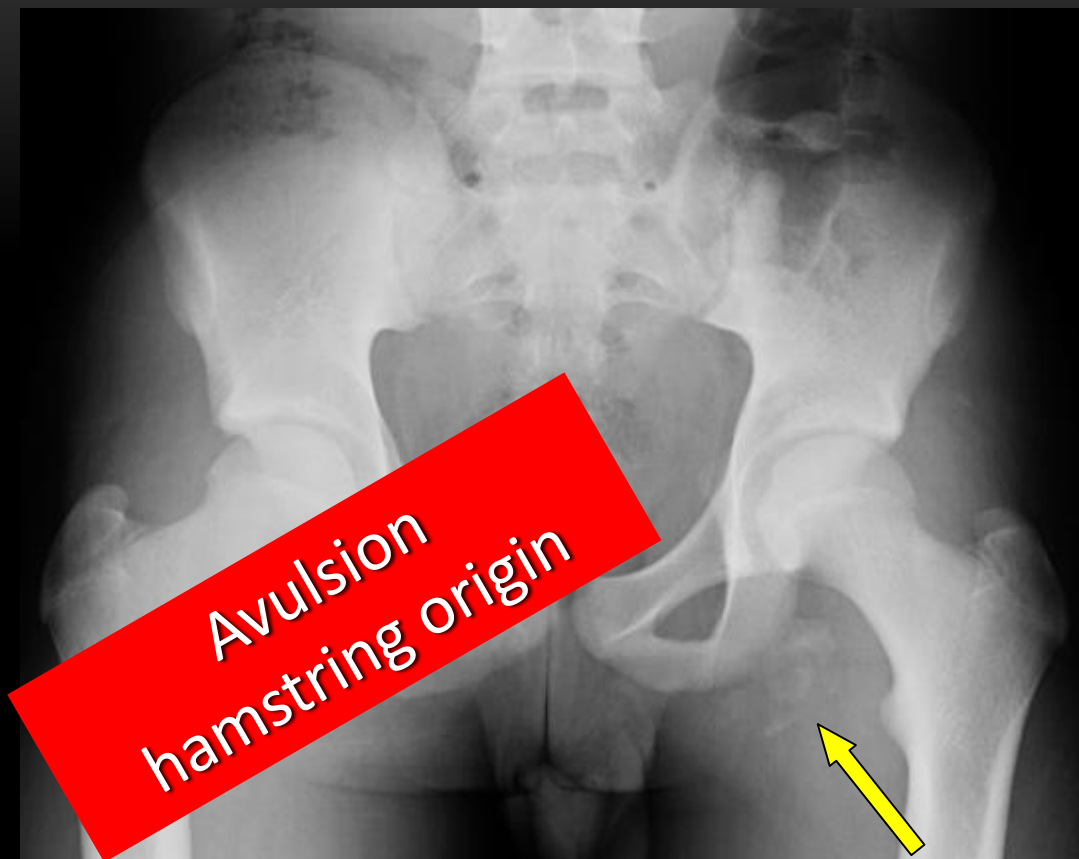
- Acute / chronic
- Partial or complete
- Bony fragment – if so how far displaced



- Rest /conservative
- Surgical fix



Fall from horse .. Hip pain...





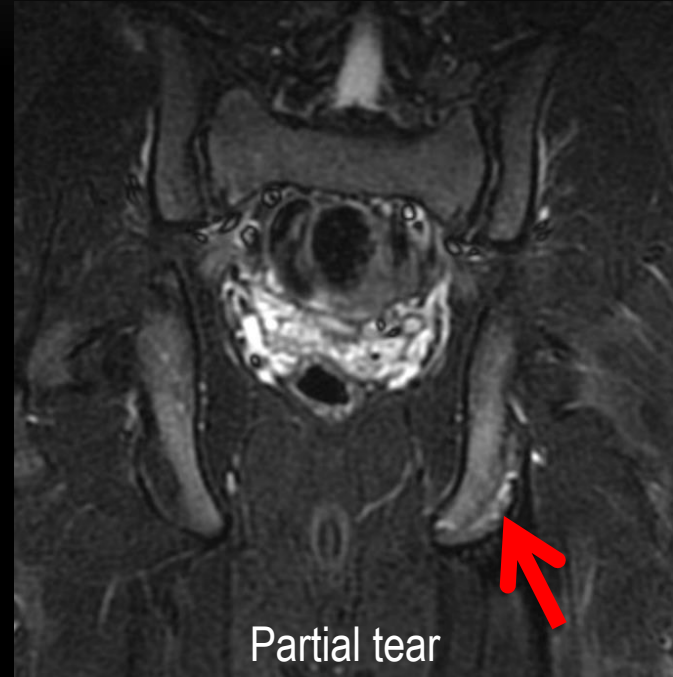
Complete avulsion
hamstring origin

Hamstring avulsion... What is relevant

- Partial or complete
- Bony fragment +/-
- Distance of retraction



- If more than 2cm displaced – consider surgery



Summary

- Anatomy
- Femoral head injuries
- Vascularity of femoral neck
- Stress reaction / fracture
- Avulsion injuries
- Soft tissue injuries

Please focus on the
clinical relevance of
the injury

MR correlation of knee injuries in the ER

Introduction

- Knee injury is common in both high velocity and in low velocity impact
- ER radiologists have an excellent ability to evaluate knee injuries using plain radiography and CT
- BUT there is limited exposure to MSK MRI in the ER setting

Objectives

- Review MRI appearances of knee injuries presenting in the ER
- Raise awareness of associated injuries
- Improve clinical understanding and diagnostic confidence

Layout

- Anatomy – Normal

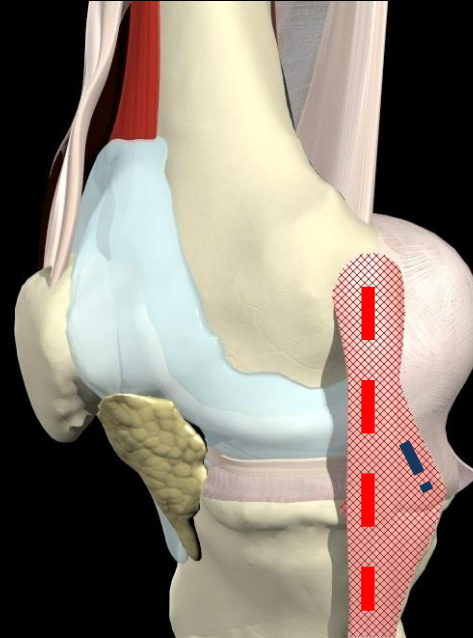
- X-ray
- MRI
- Clinical relevance

Medial knee

Medial side pain



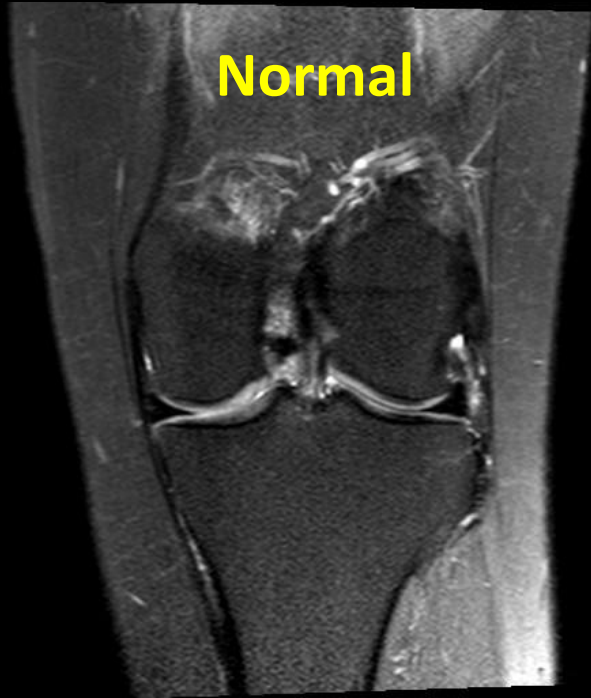
Medial collateral ligament



Post Oblique

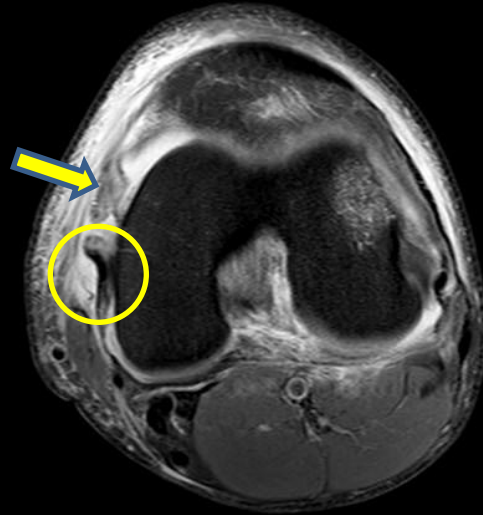
Anterior
Longitudinal

Medial collateral – high grade 2 sprain



Medial collateral – high grade 2 sprain

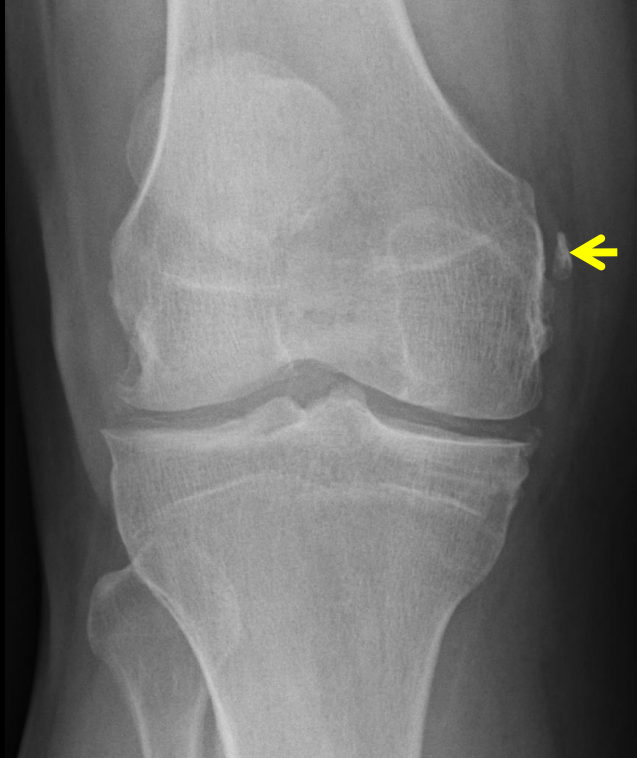
Normal



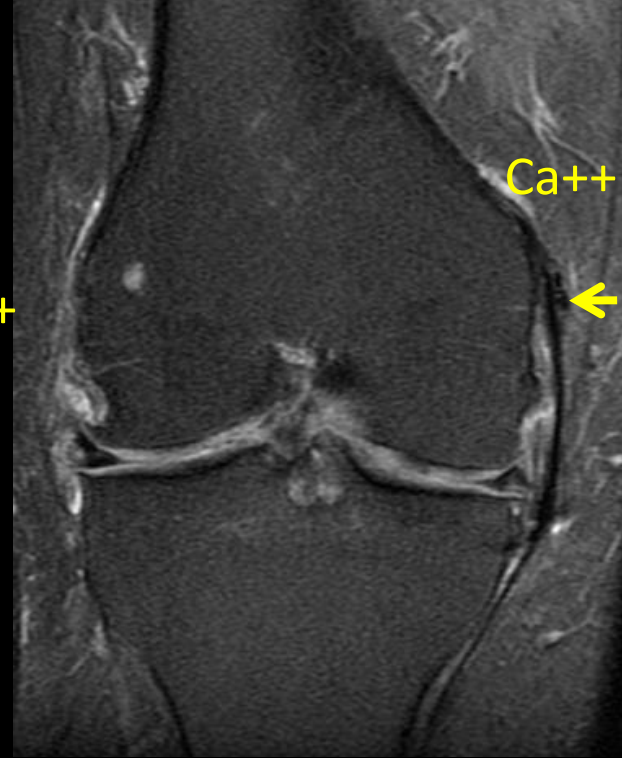
MCL injury – Clinical stuff....

- Valgus force
- Partial or full thickness tear
- Isolated tears – good outcome with conservative
- Associated injuries
 - ACL

Pellegrini-Stieda Lesion

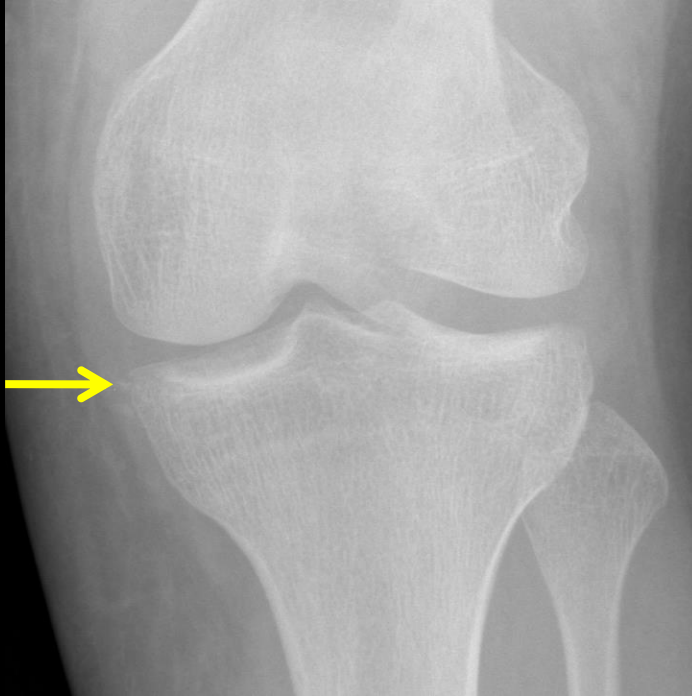


Ca++



Look for PCL injuries

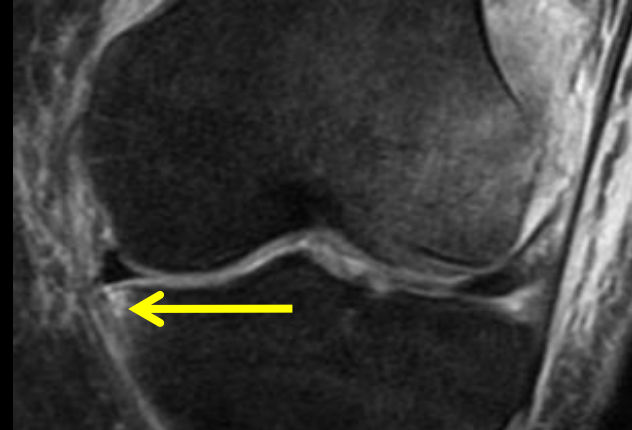
Reverse Segond Fracture



association with PCL and
medial meniscal tears

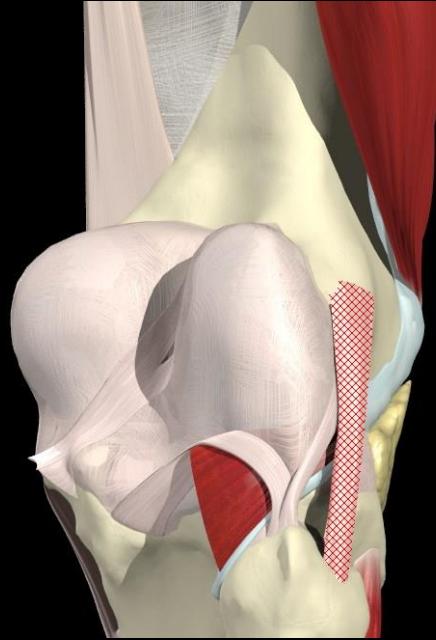


medial meniscocapsular ligament

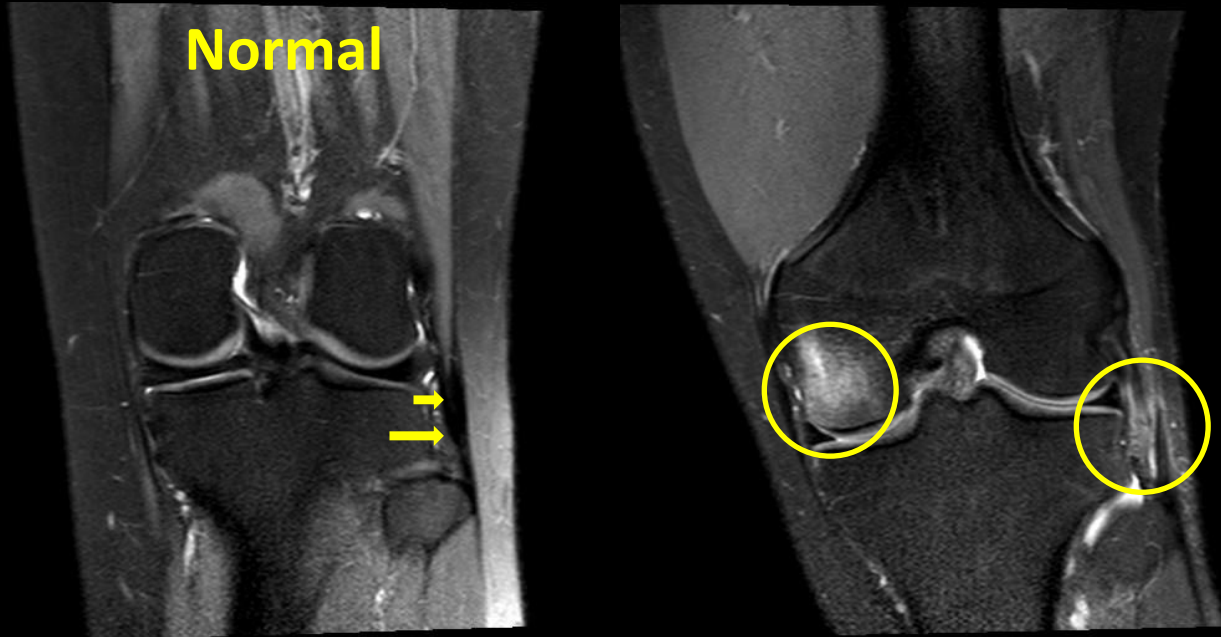


Lateral knee

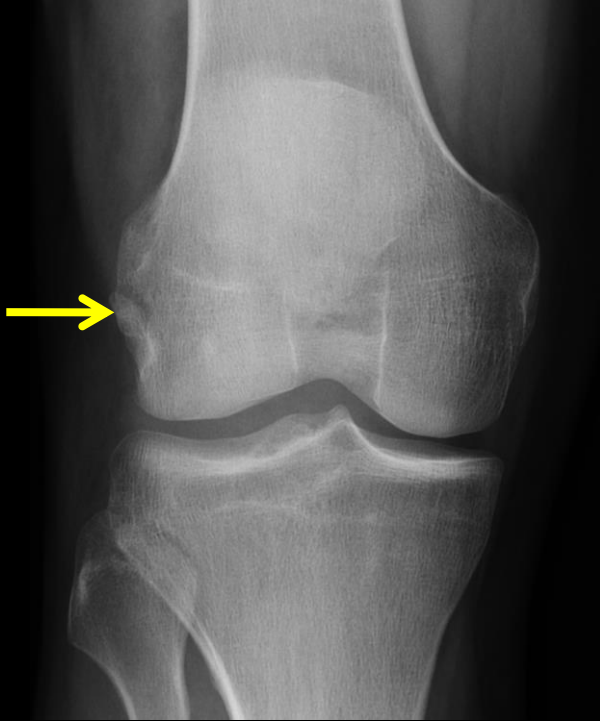
Lateral collateral ligament



Football tackle – pain lateral aspect - Lateral collateral ligament injury



Lateral Collateral Ligament

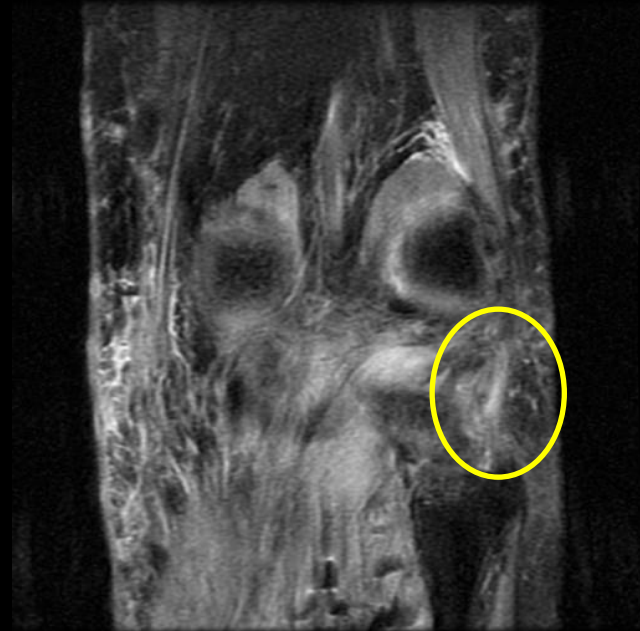


Proximal ligament tears are rare

MCC varus injury

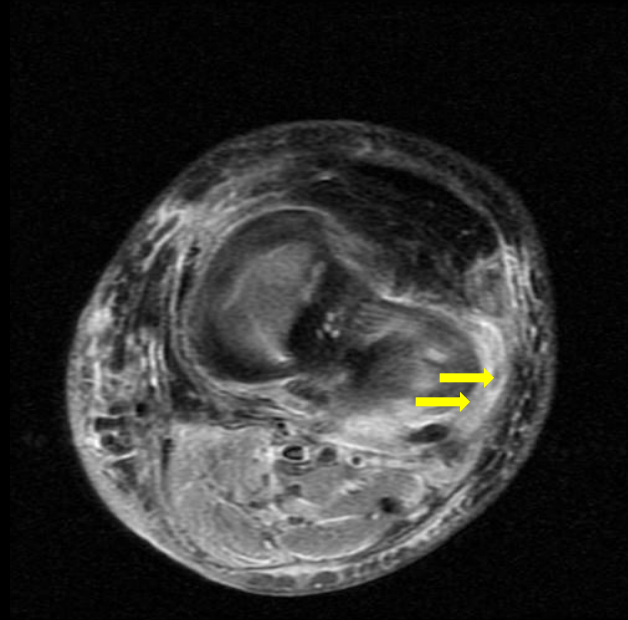
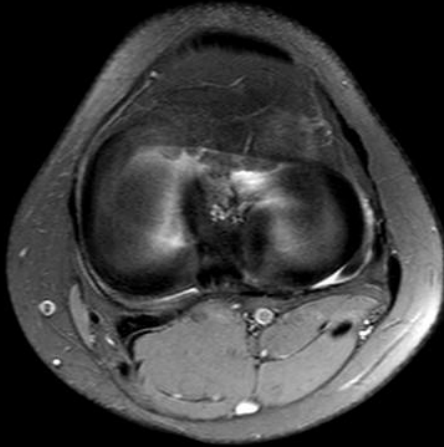


MCC varus injury-Lateral collateral ligament injury



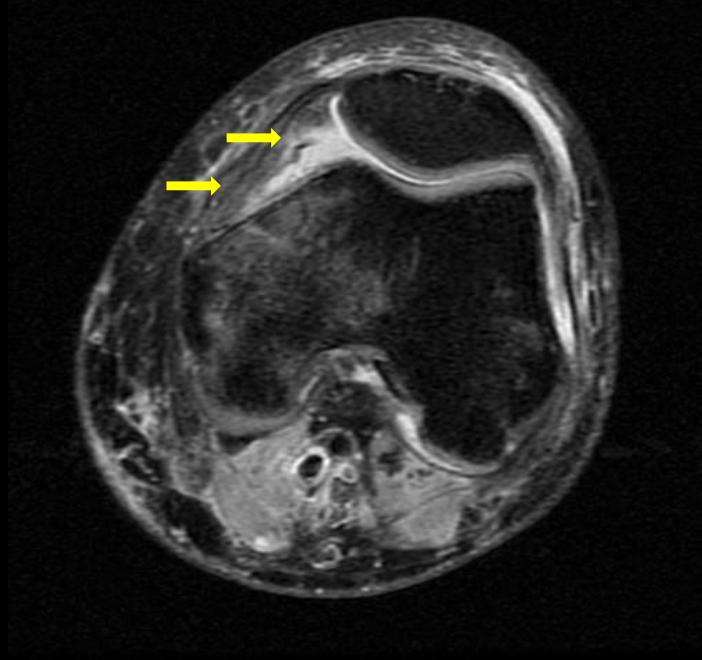
Lateral collateral ligament – grade 3 tear

Normal



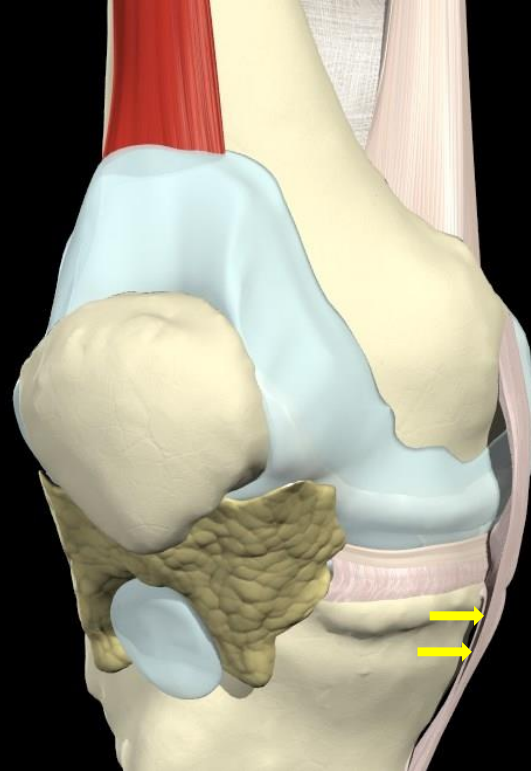


Varus, lateral collateral ligament– associated injuries





Varus, lateral collateral ligament– associated injuries



Meniscotibial ligament

LCL injury – Clinical stuff....

- Varus , external rotation
- Rarely isolate LCL tear
- Look for “**Posterolateral corner**” structures
- Management based on other associated injuries

Posterolateral knee

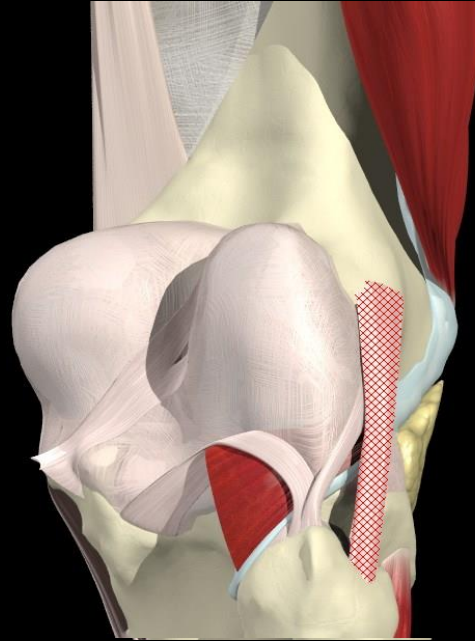
18 yr old ATV injury



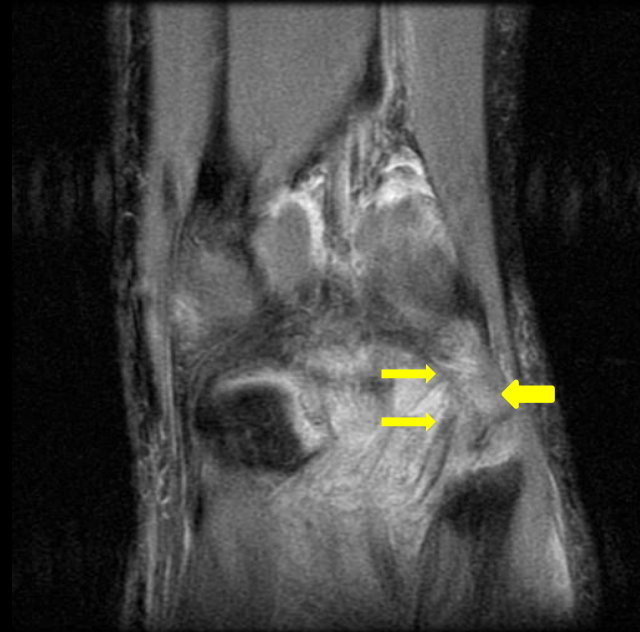
Arcuate sign

Posterolateral corner

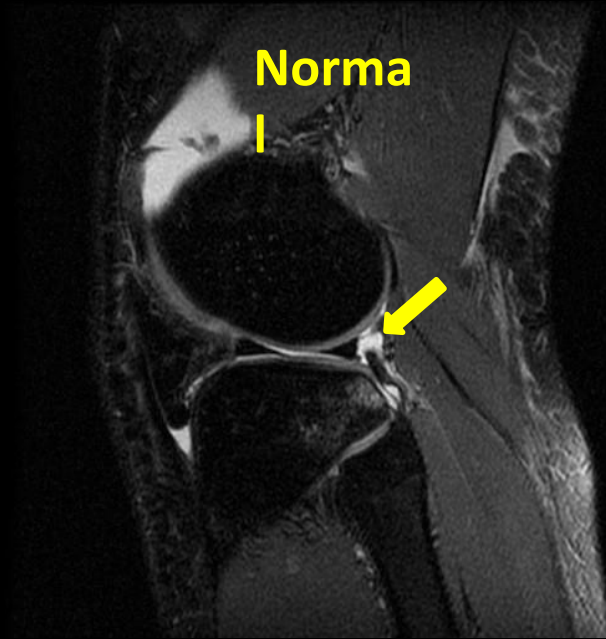
- Arcuate ligament
- Popliteal tendon
- Popliteofibular ligament
- Lateral collateral ligament
- Posterolateral joint capsule
- Fabellofibular ligament



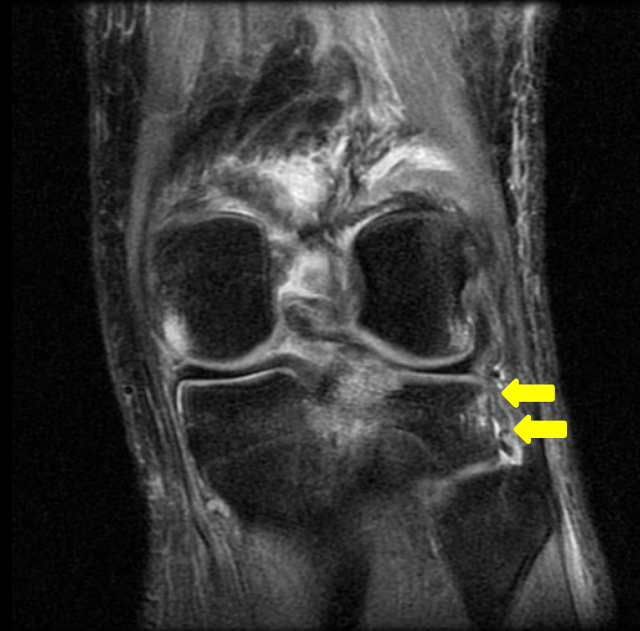
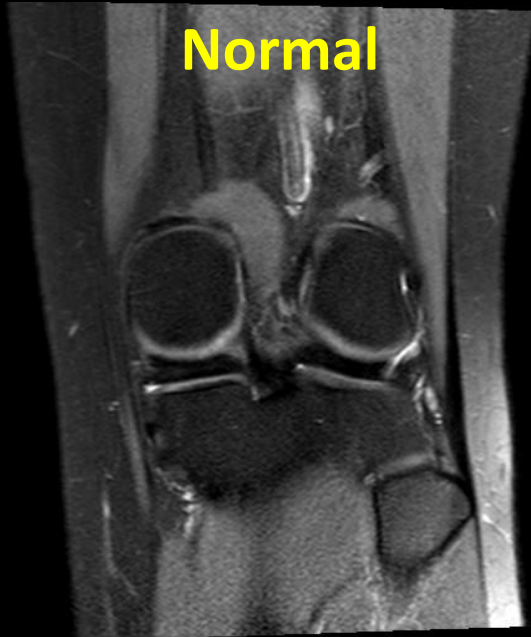
Posterolateral corner – popliteus sprain, arcuate ligament tear



Posterolateral corner – arcuate lig tear



Posterolateral corner – popliteofibular ligament injury



Posterolateral corner – popliteus & lateral capsule sprain

Normal

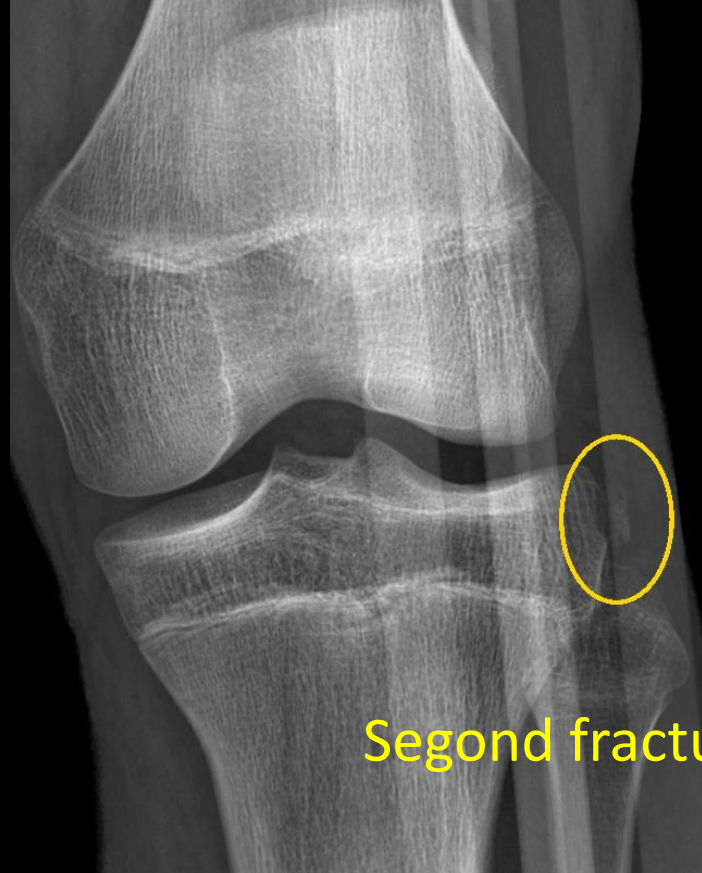


Posterolateral corner- why should we worry?

- Instability
- Buckling in hyperextension
- **Can be missed at initial clinical presentation**
- Surgical repair warranted

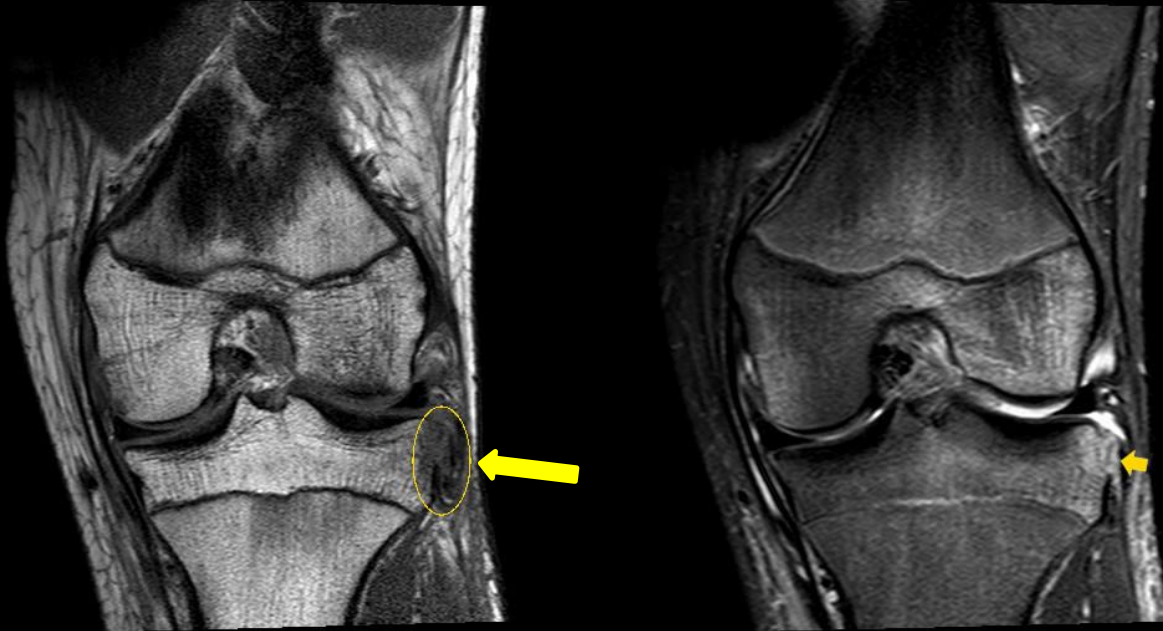
Still around the lateral knee...

Fender injury



Second fracture

Second fracture



Second fracture – lateral capsular injury

Normal



Second fracture – associated ACL inj



Second fracture – Clinical stuff...

- Dashboard injury – internal rotation +varus
- Lateral Capsular avulsion
- Associated injuries
 - ACL
 - Meniscus

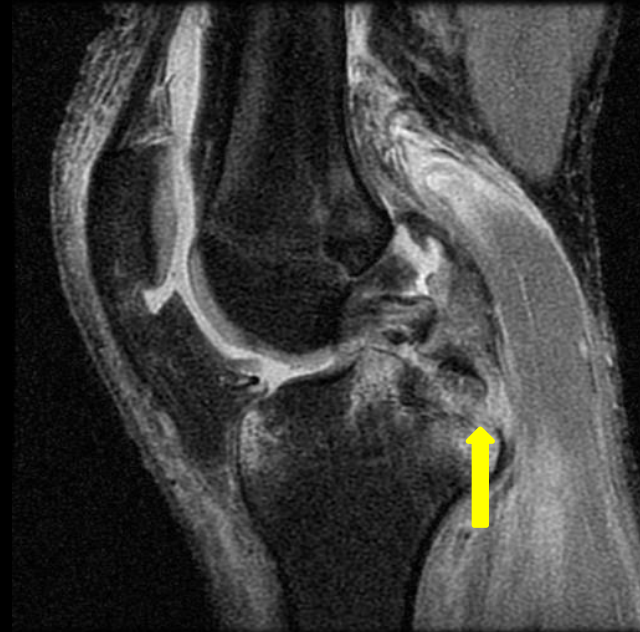


Posterior Cruciate ligament

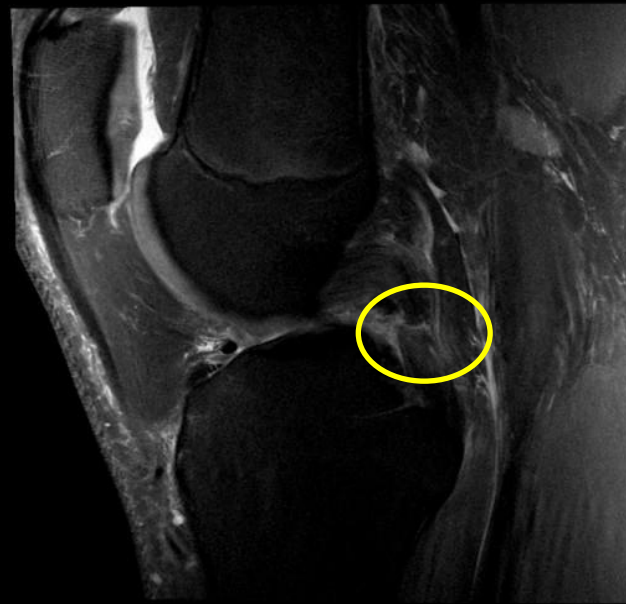
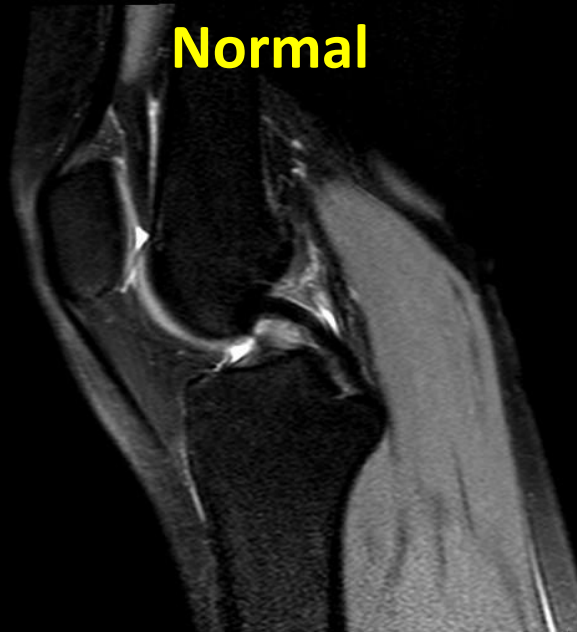
ATV injury



PCL tear + avulsion



Rugby tackle - PCL

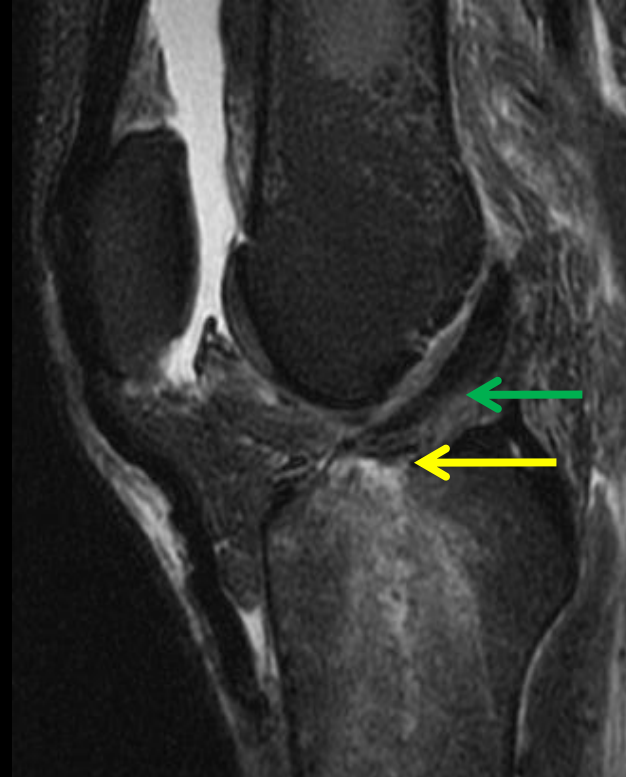
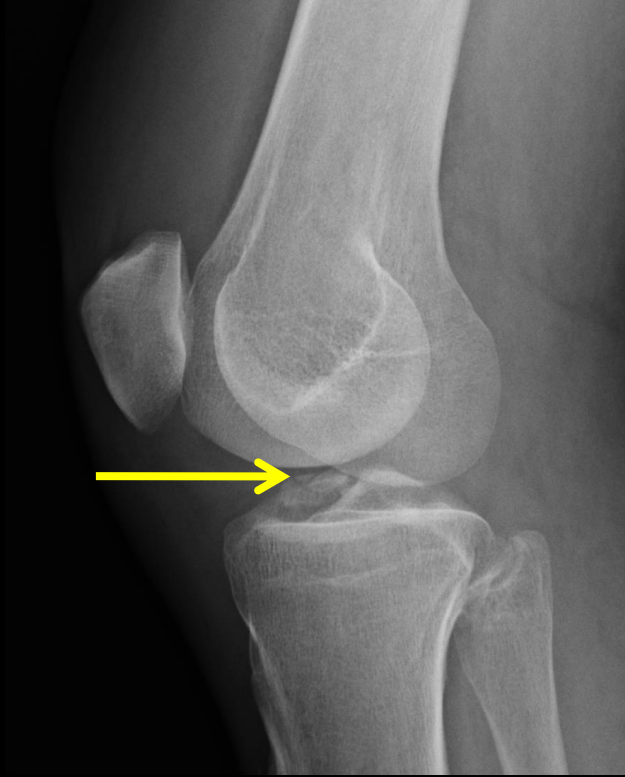


PCL injuries – Clinical stuff....

- Direct posterior translation of tibia
- Associated with Posterolateral corner injuries and posterior capsule injuries
- Can be treated conservatively if isolated injury

Anterior Cruciate ligament

Anterior Cruciate Ligament



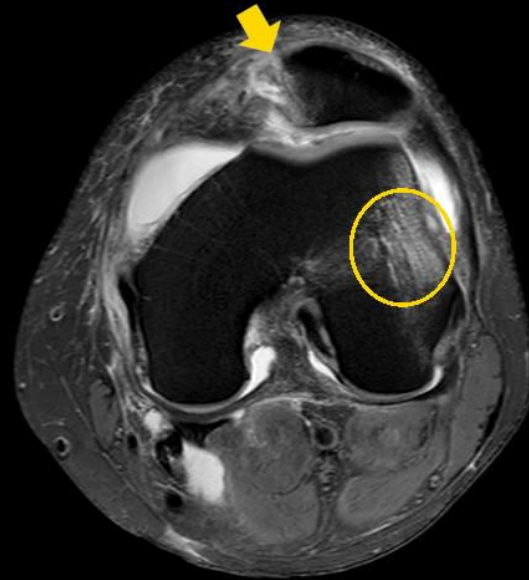
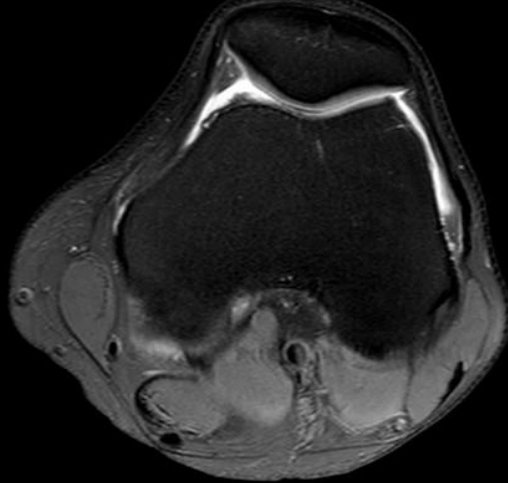
Anterior knee

Patella dislocation

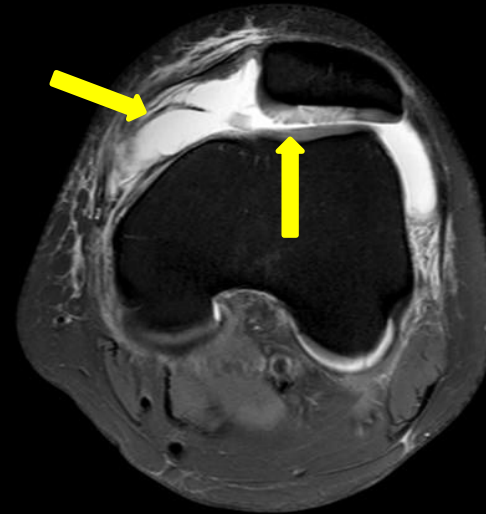
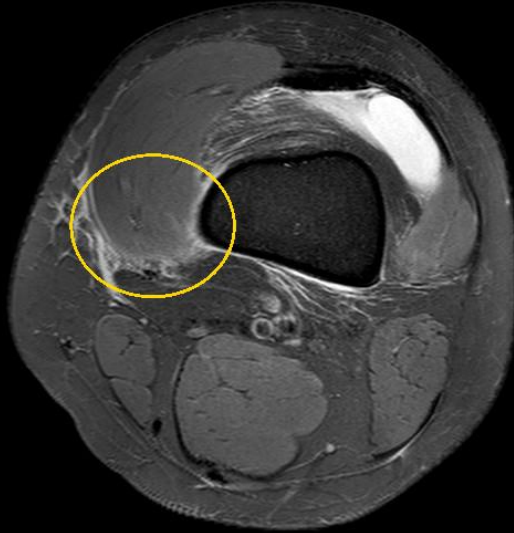


Medial retinaculum injury + “Kissing contusions”

Normal



Dislocation patella – Vastus medialis obliquus sprain & cartilage injury

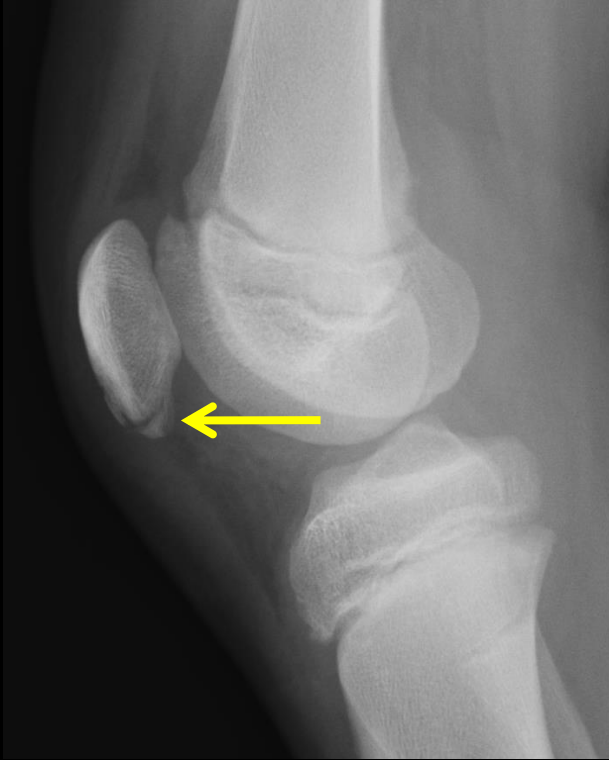


Medial
retinaculum/patellofemoral
ligament injury

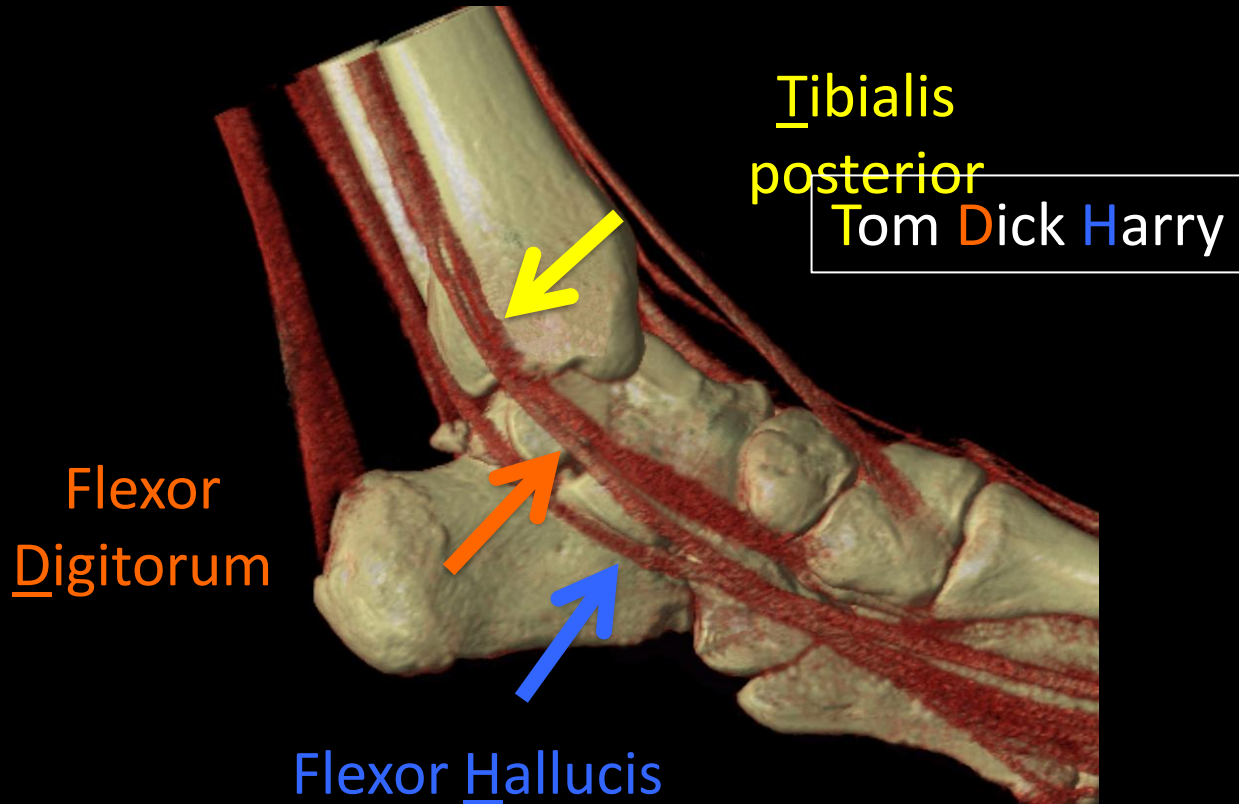
Patella dislocation – clinical stuff...

- Look for cartilage injury
- Medial patellofemoral ligament / retinacular injury may require surgery
- Evaluate trochlear groove & Vastus medialis obliquus

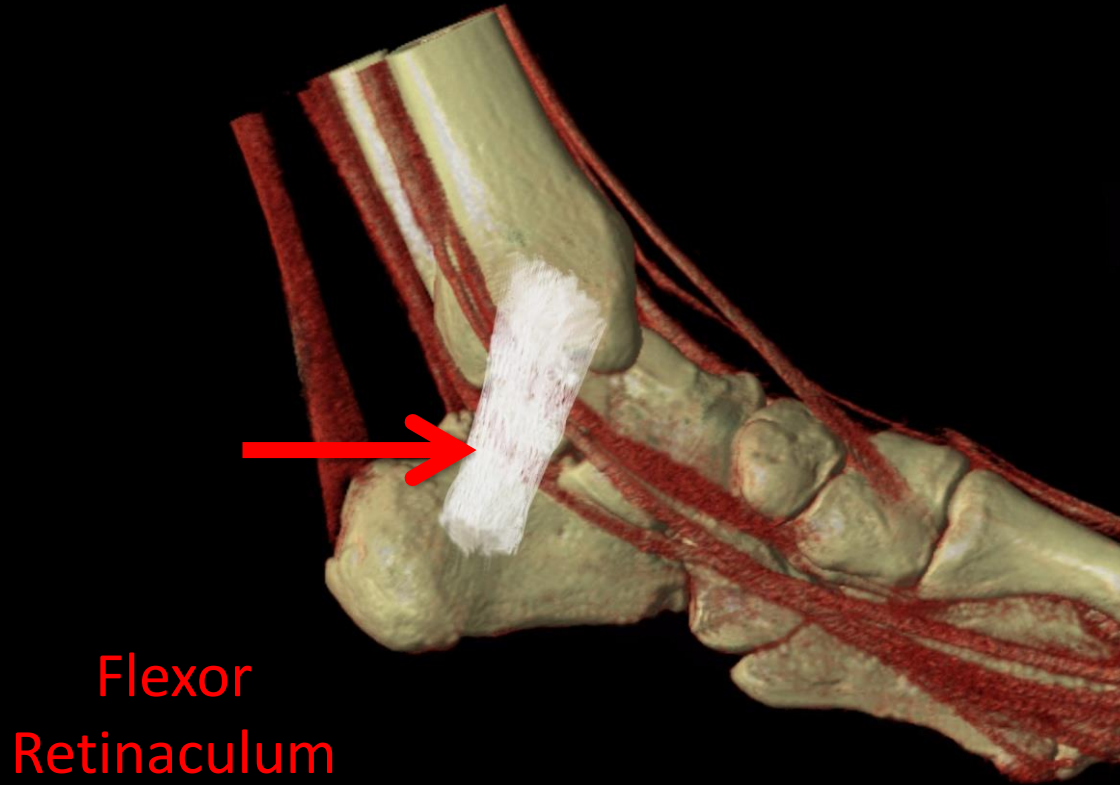
Patellar Tendon – sleeve avulsion



Anatomy medial

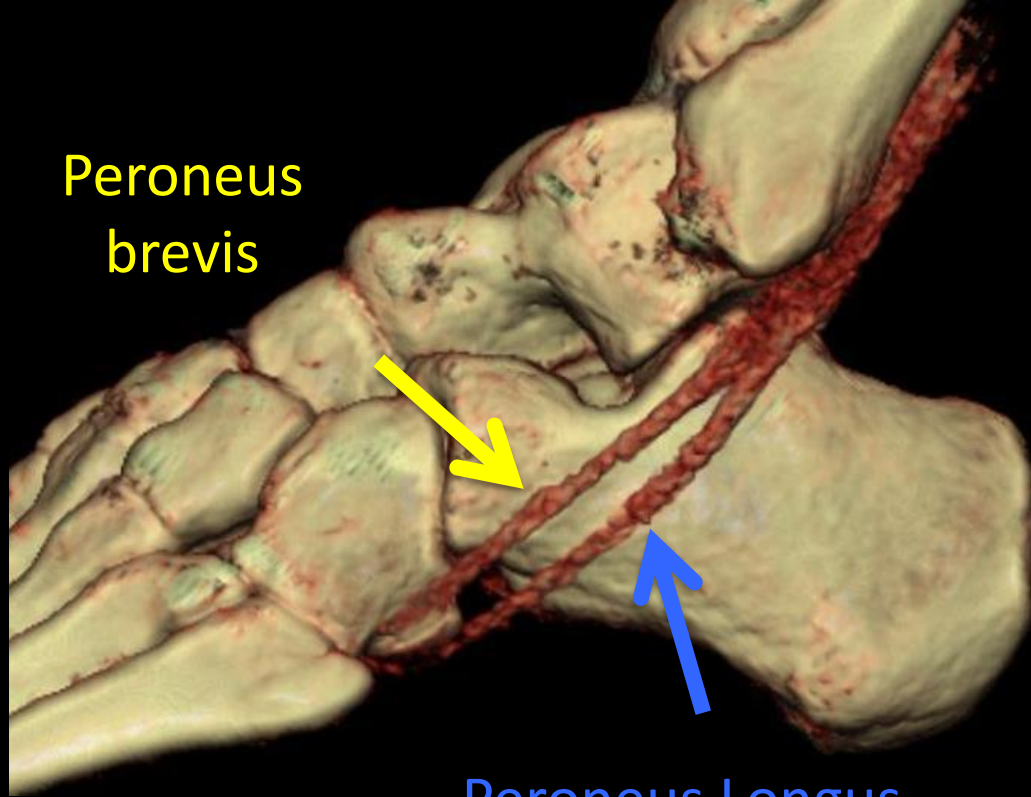


Anatomy medial



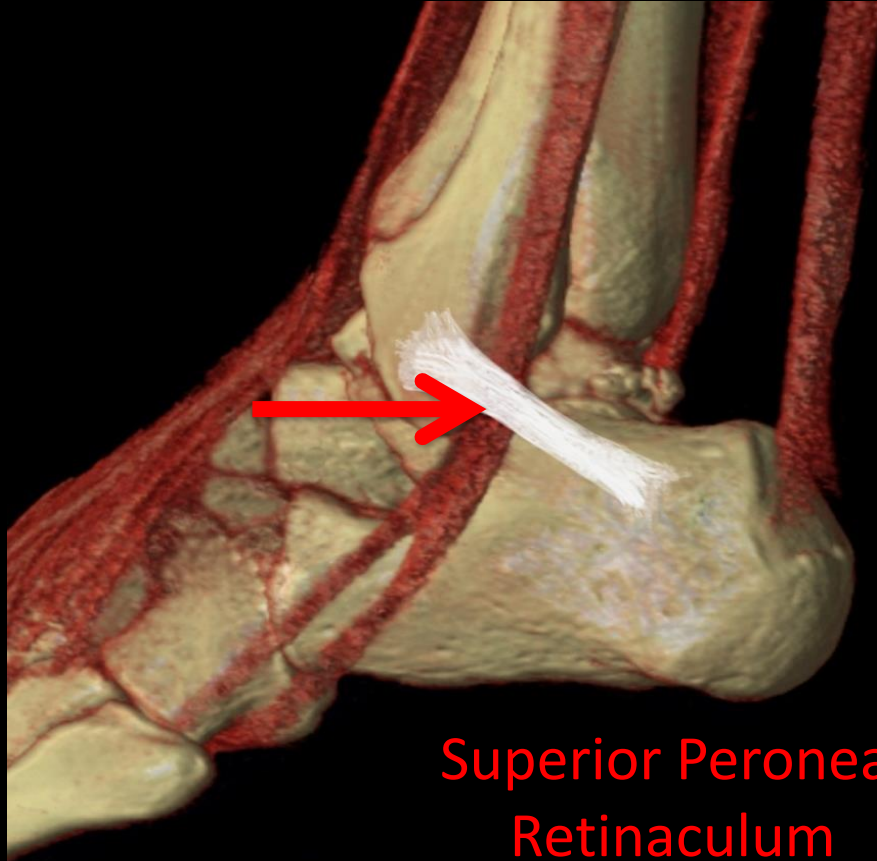
Anatomy lateral

Peroneus
brevis



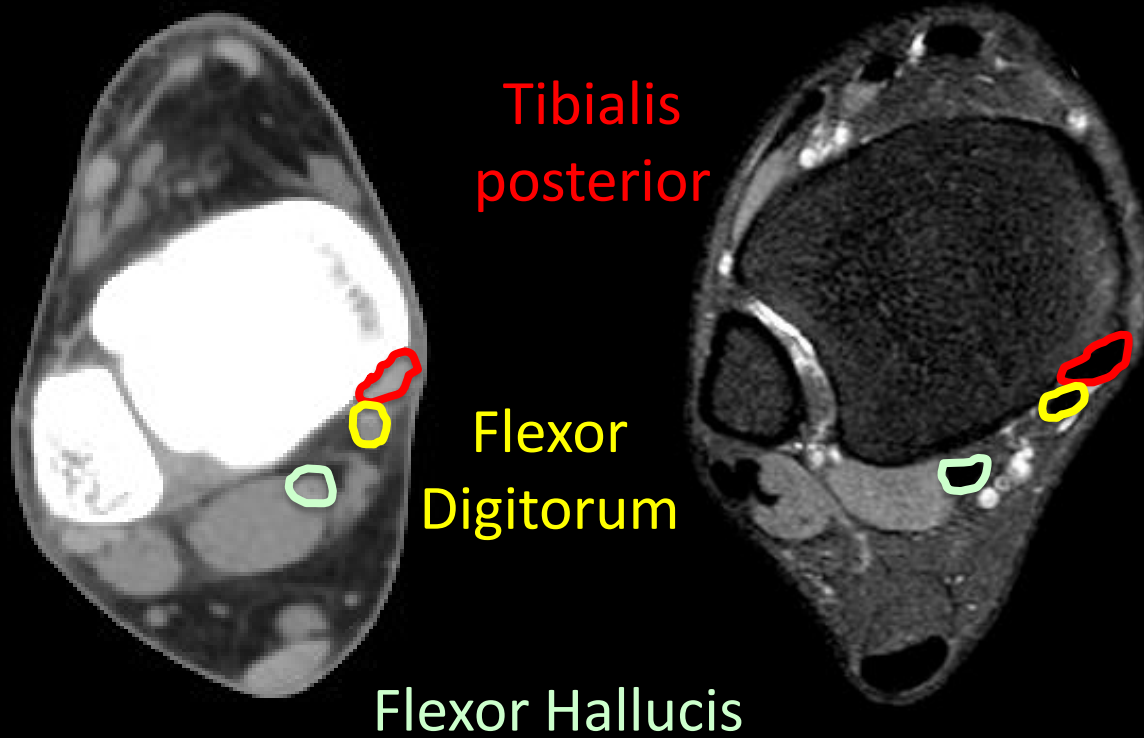
Peroneus Longus

Anatomy lateral

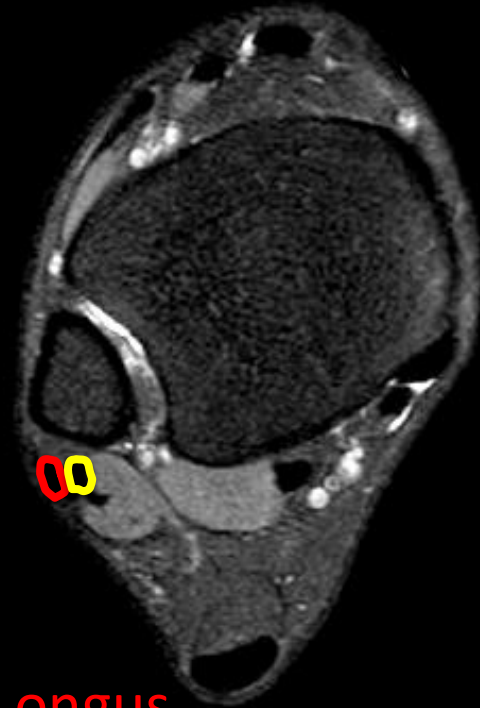


Superior Peroneal
Retinaculum

Anatomy medial tendons



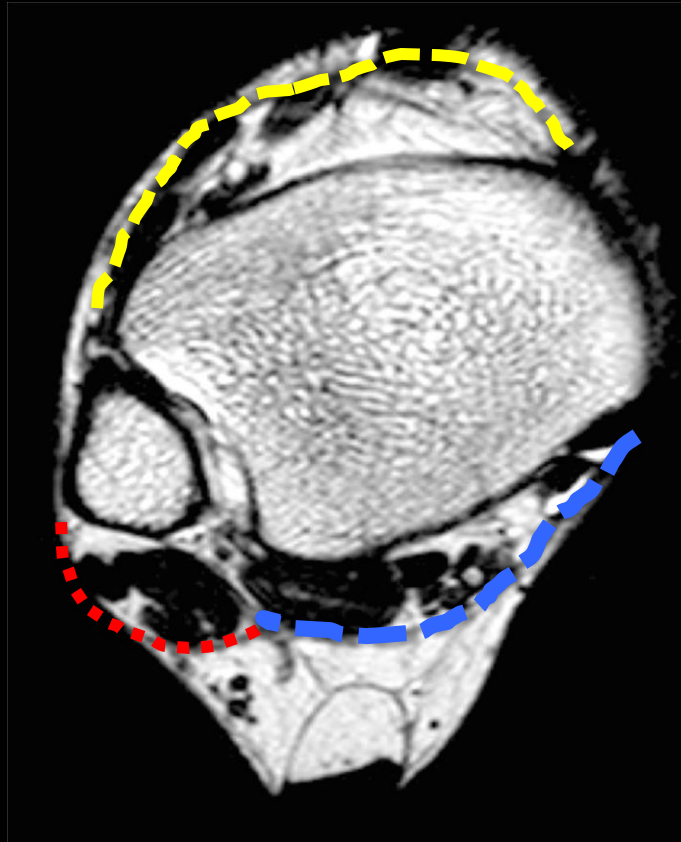
Anatomy lateral tendons



Peroneus Longus

Peroneus
brevis

Anatomy retinaculum



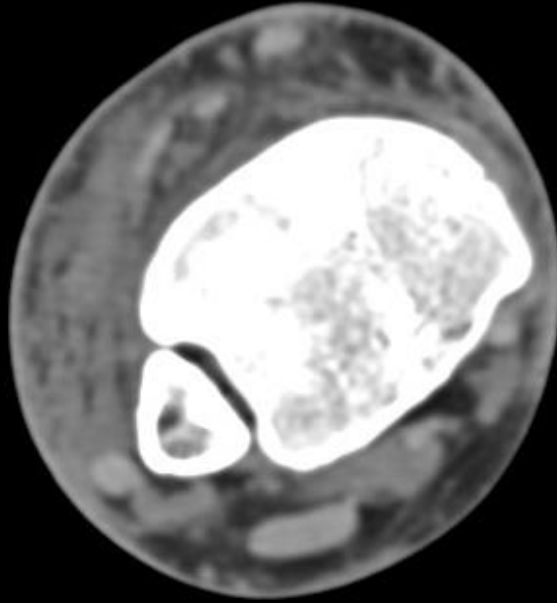
Extensor
retinaculum

Flexor
retinaculum

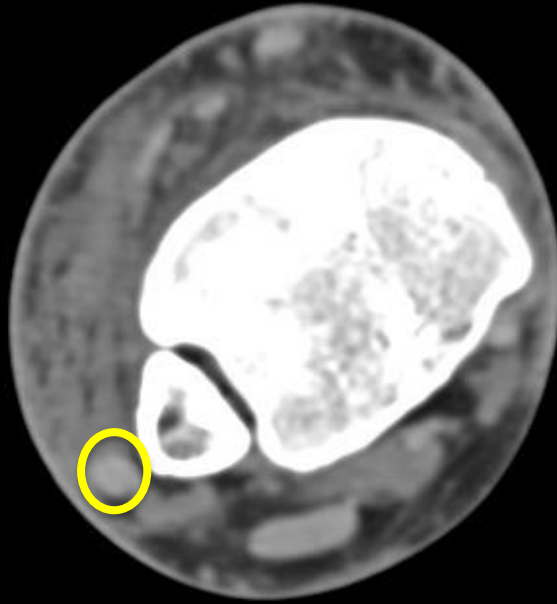
Superior peroneal
retinaculum

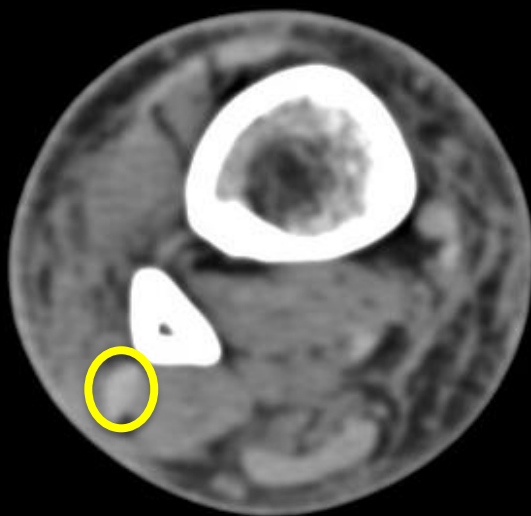
Cases !

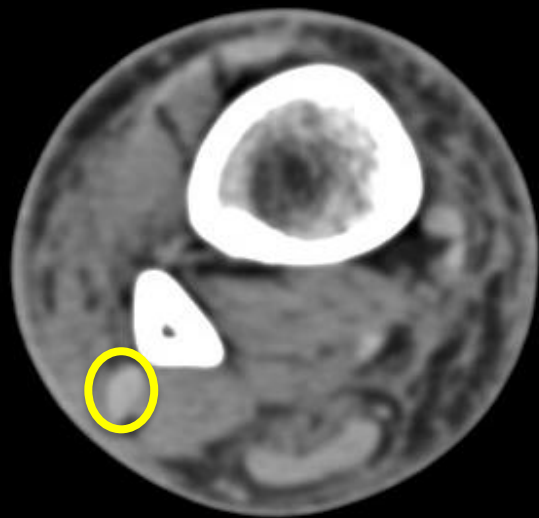
pain

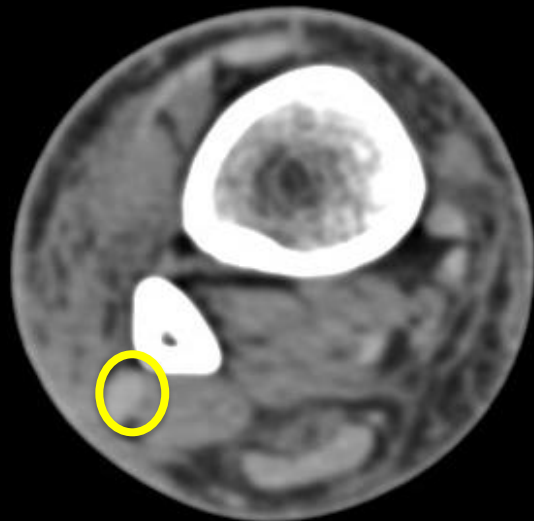


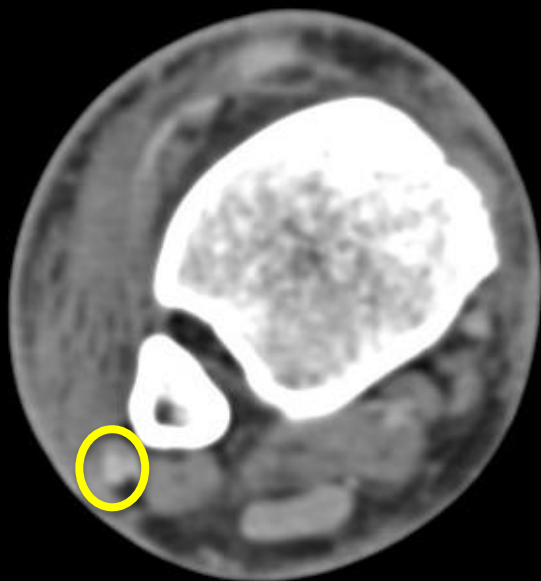
More images

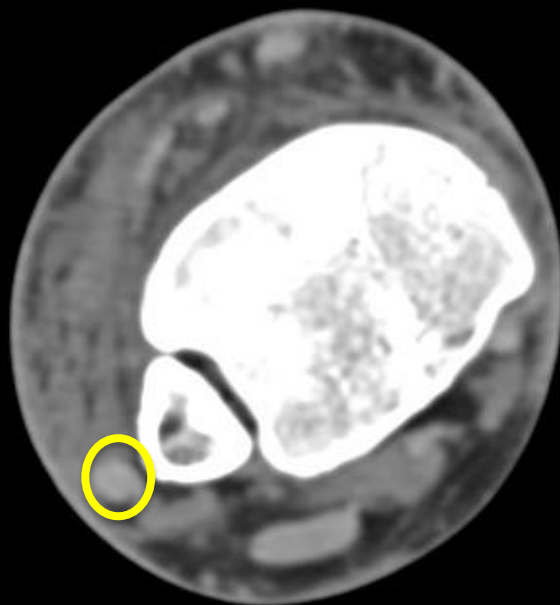






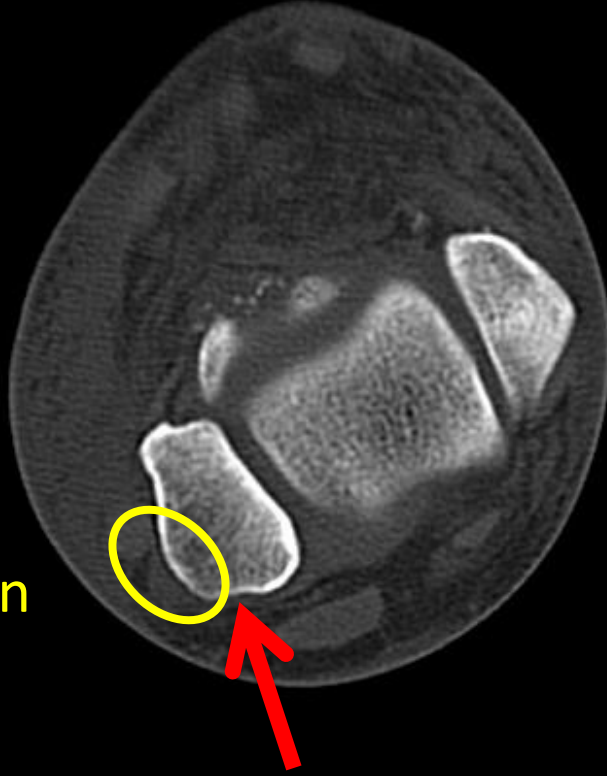






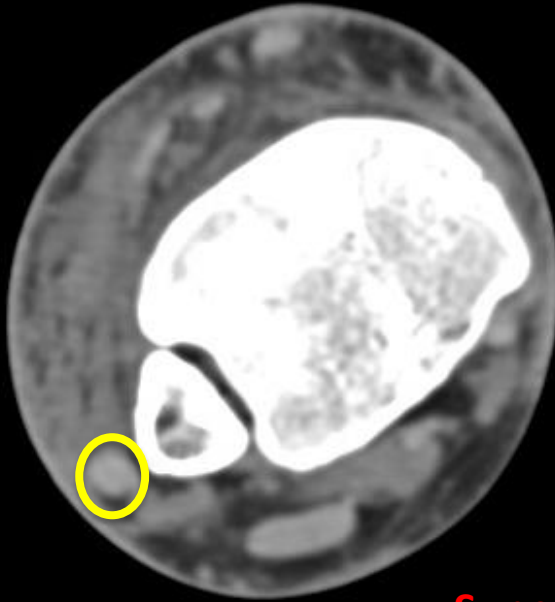
NO avulsion

Retro-fibular groove





Subluxation of peroneal

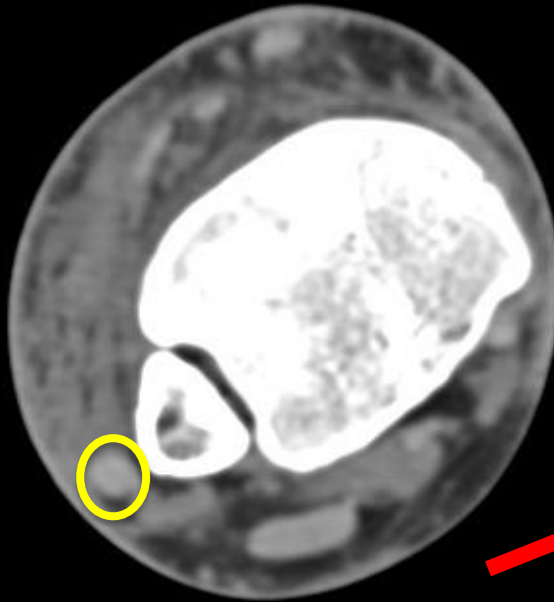


**Superior Peroneal
Retinaculum**



Normal

Subluxation of peroneal



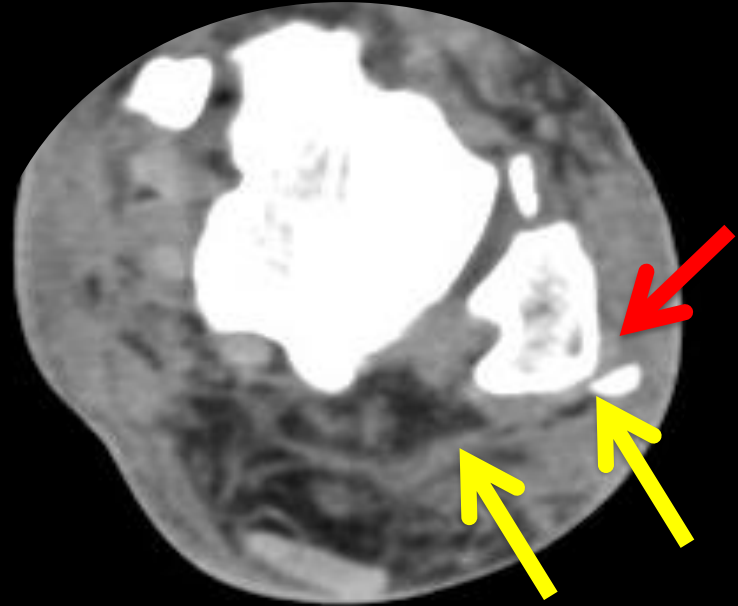
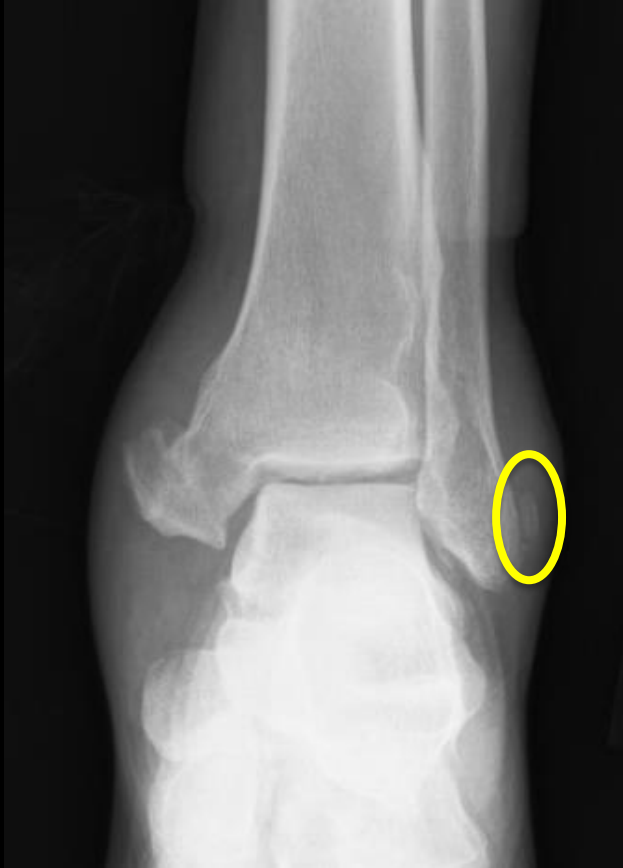
Peroneal tendons stay b'cos

- Superior peroneal retinaculum
- Retro-fibular groove
- Fibrocartilage

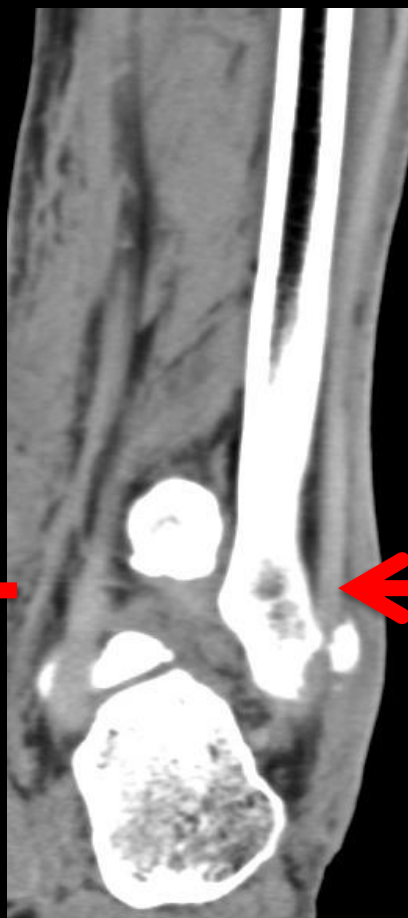


Normal Fibrocartilage

Lateral symptoms



Superior Peroneal
retinacular avulsion fx +
split Peroneus





Superior Peroneal
retinacular avulsion
fx + split Peroneus



H

L

R

F

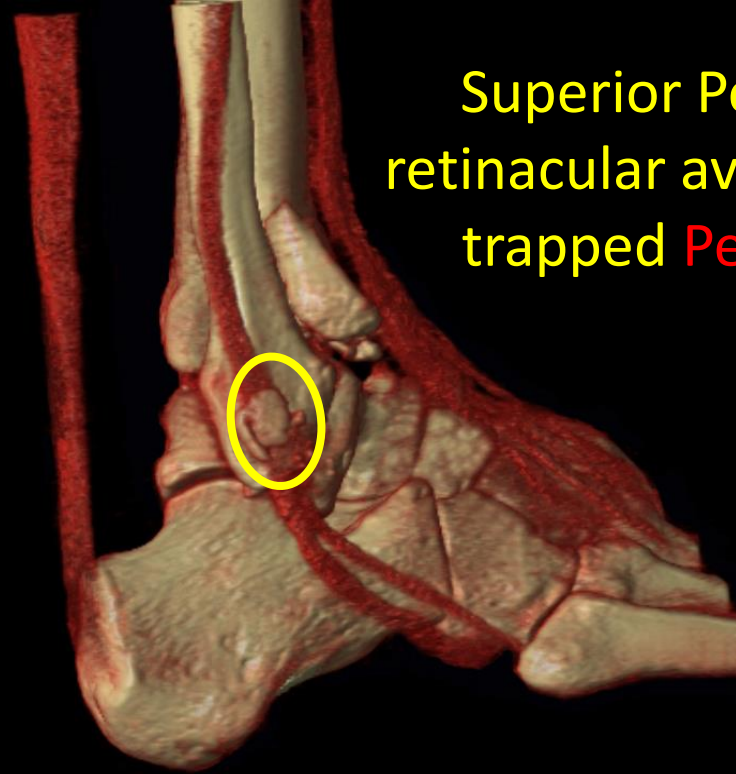
5mm/div



5mm/div

Lateral symptoms

2nd case



Superior Peroneal
retinacular avulsion fx +
trapped **Peroneus**

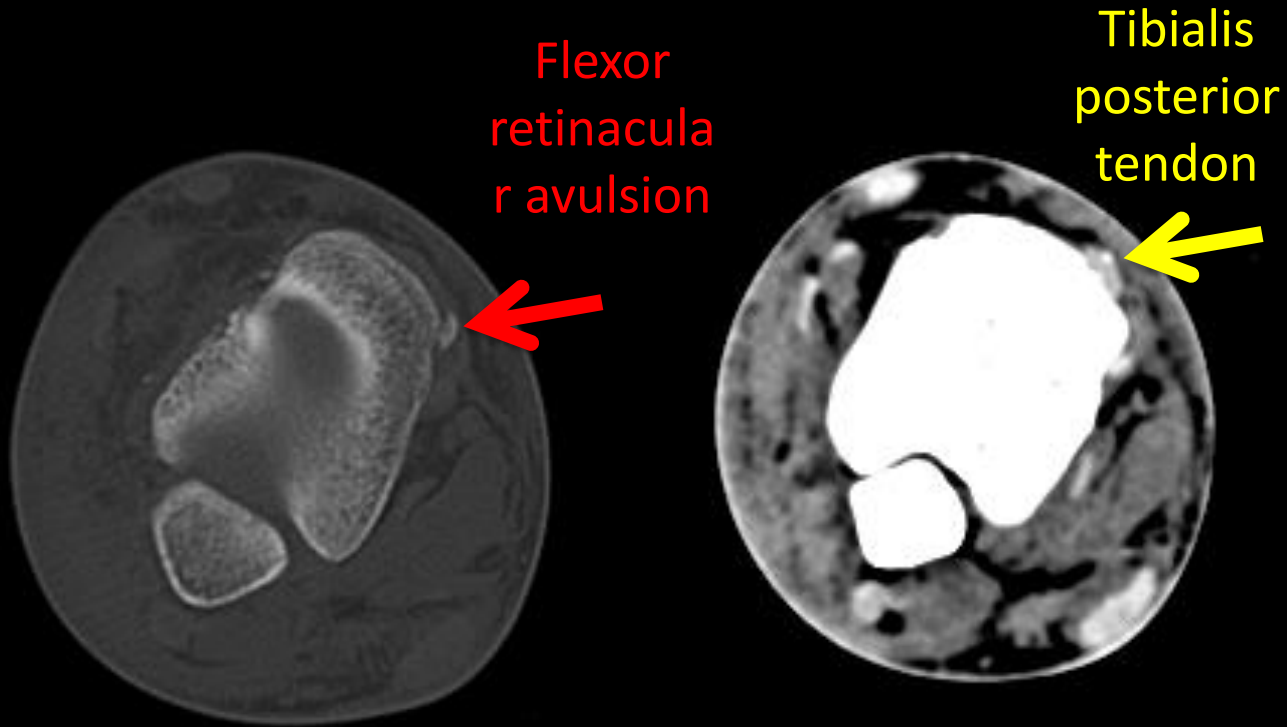
Medial sided pain in er



Medial sided pain in er

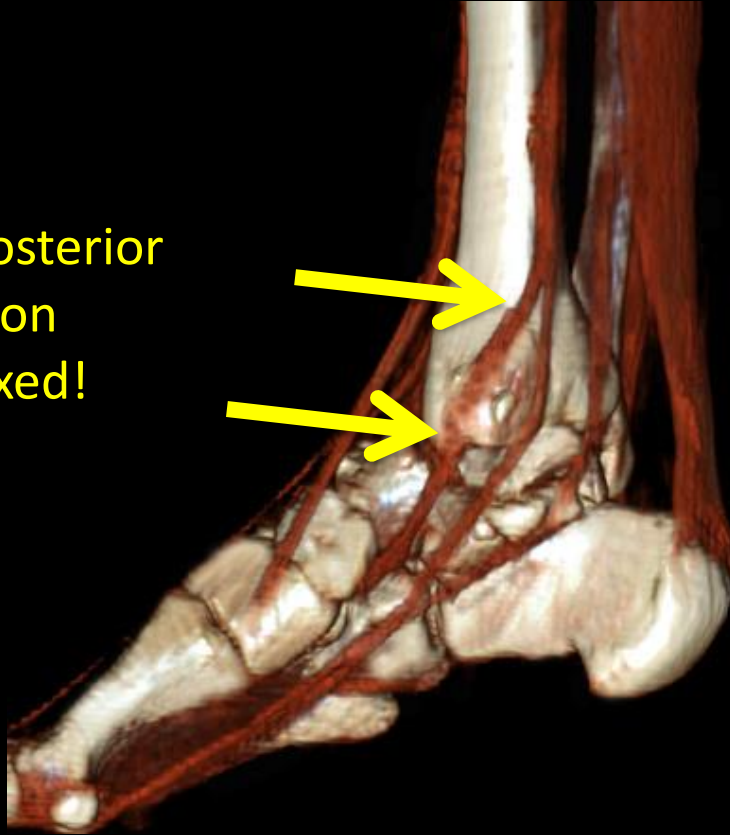


Flexor retinacular avulsion



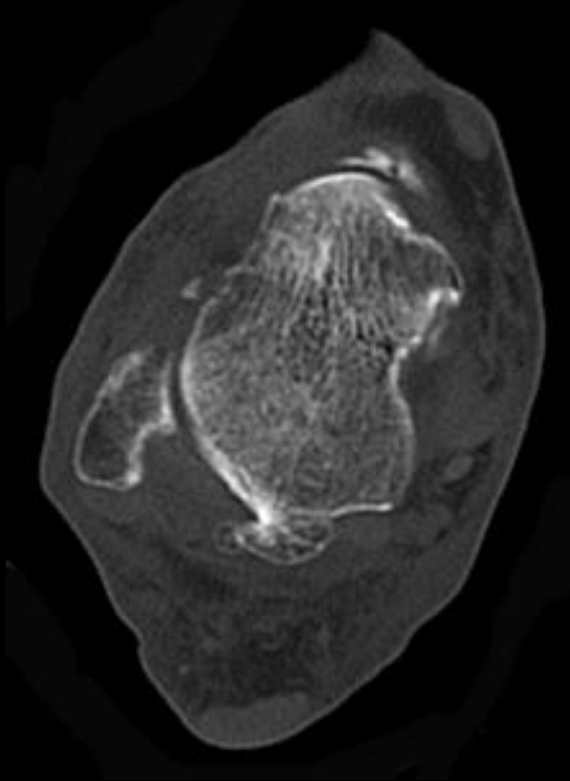
FLEXOR RETINACULAR AVULSION

Tibialis Posterior
tendon
Subluxed!

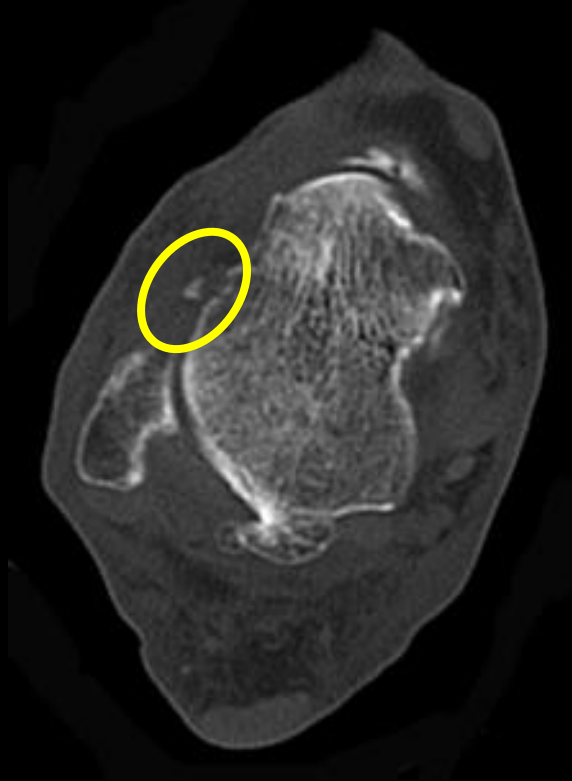


Lets look at some more injuries

What are you worried about that
could lead to instability?

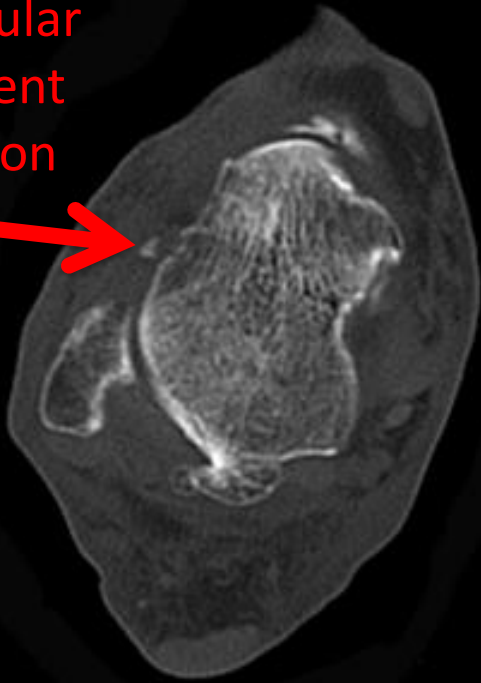


What are you worried about that could lead to instability?

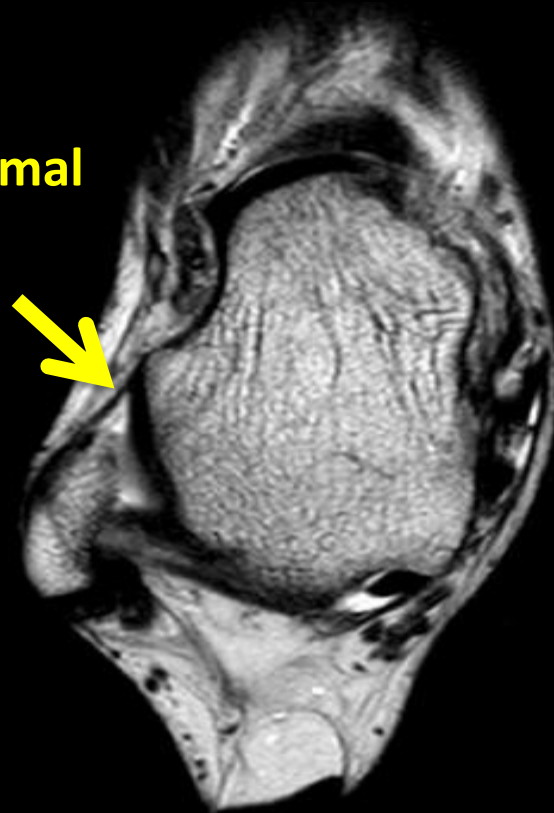


Atfl avulsion

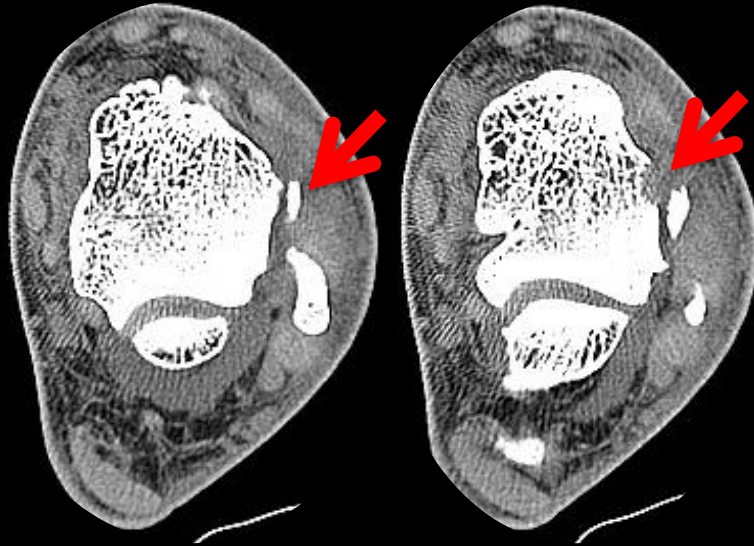
Anterior
Talofibular
Ligament
Avulsion



Normal



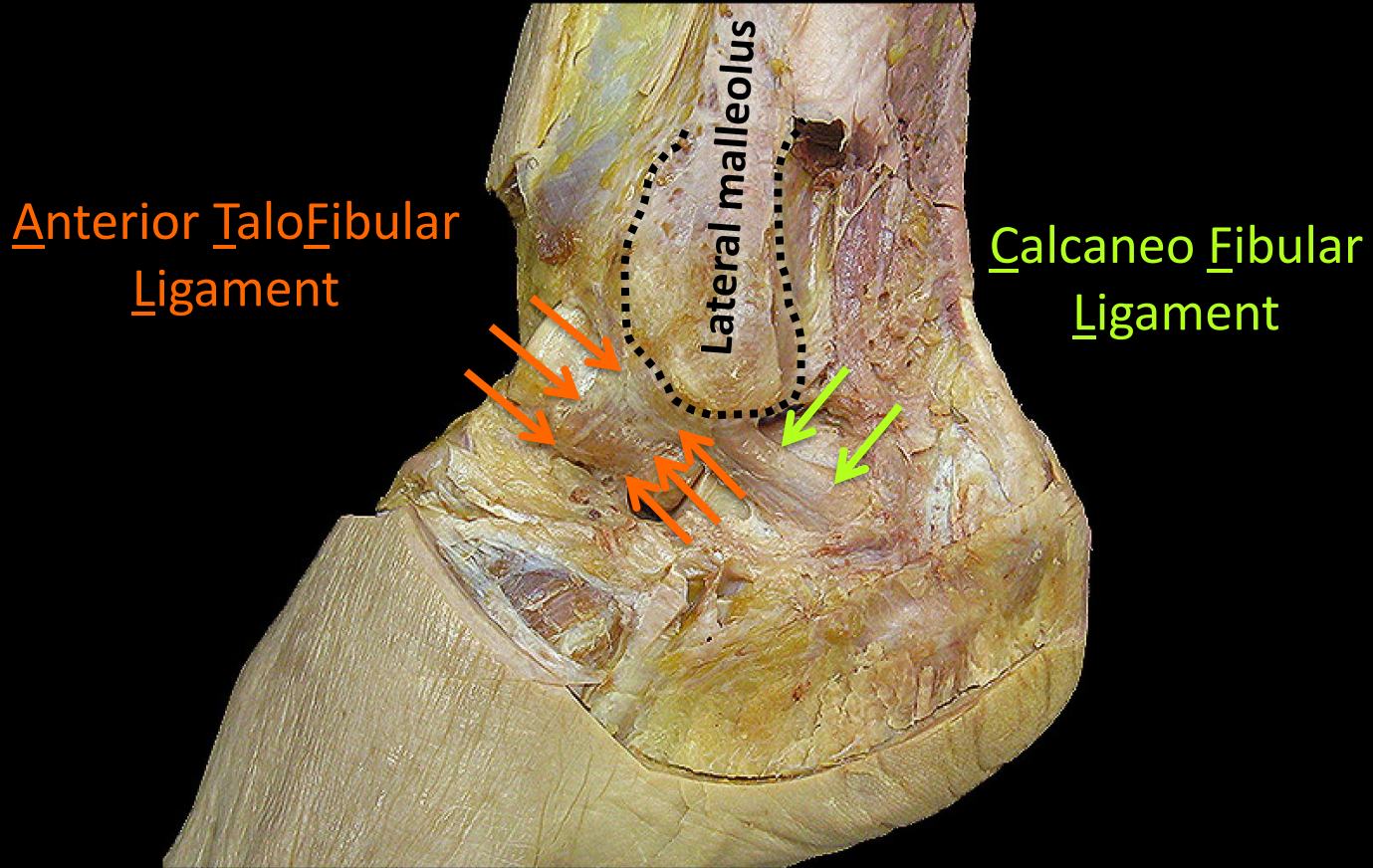
Cycling injury



ATFL avulsion



Anatomy – atfl & cfl



CalcaneoFibular Ligament Avulsion

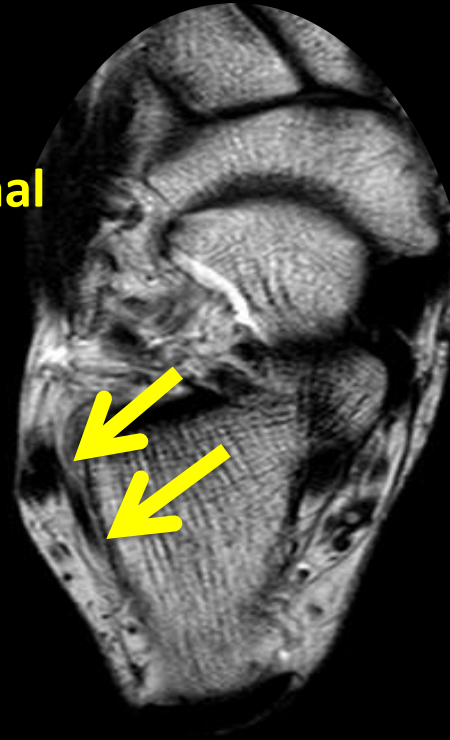
Posterior
lateral pain



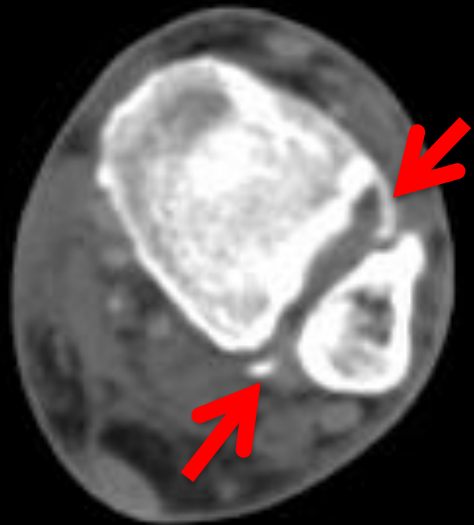
CalcaneoFibular Ligament Avulsion



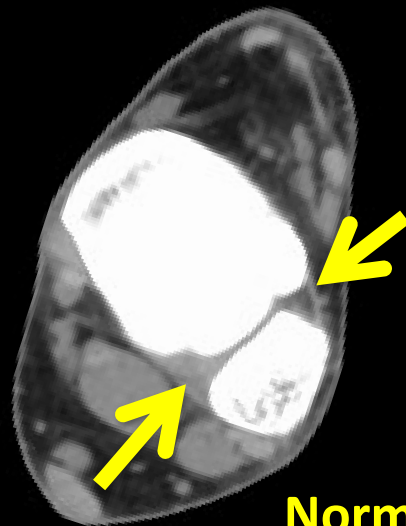
Normal



Some more avulsions

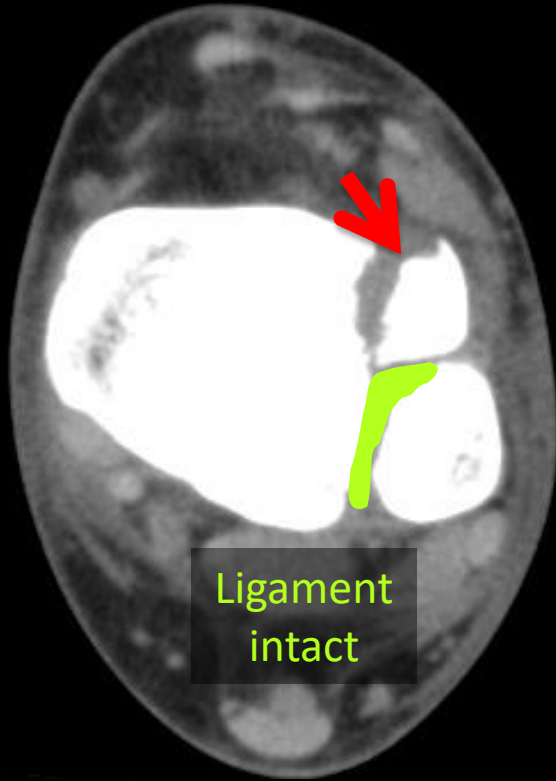


Distal Tib Fib
avulsion



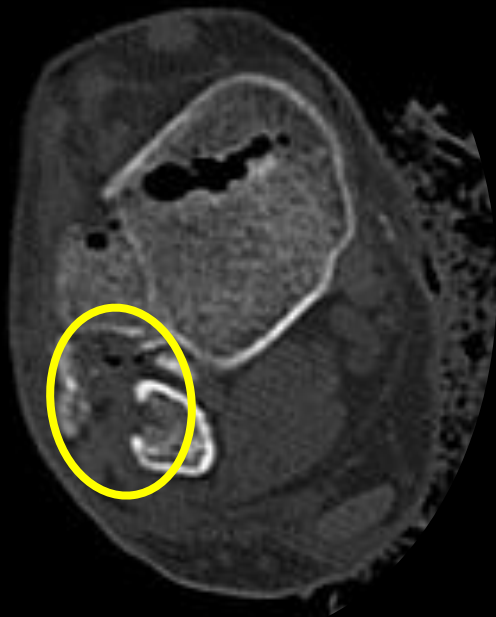
Normal
Distal Tib Fib
Ligament

14 yr old Gymnastics injury

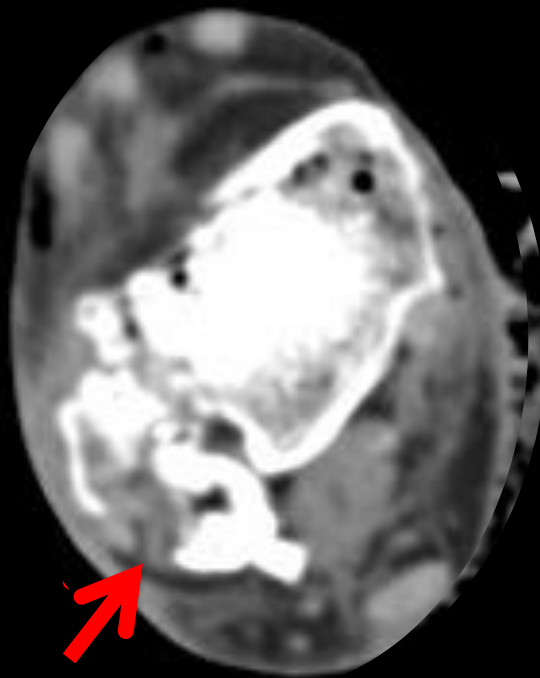


Juvenile Tillaux
fracture

What about tendons?!

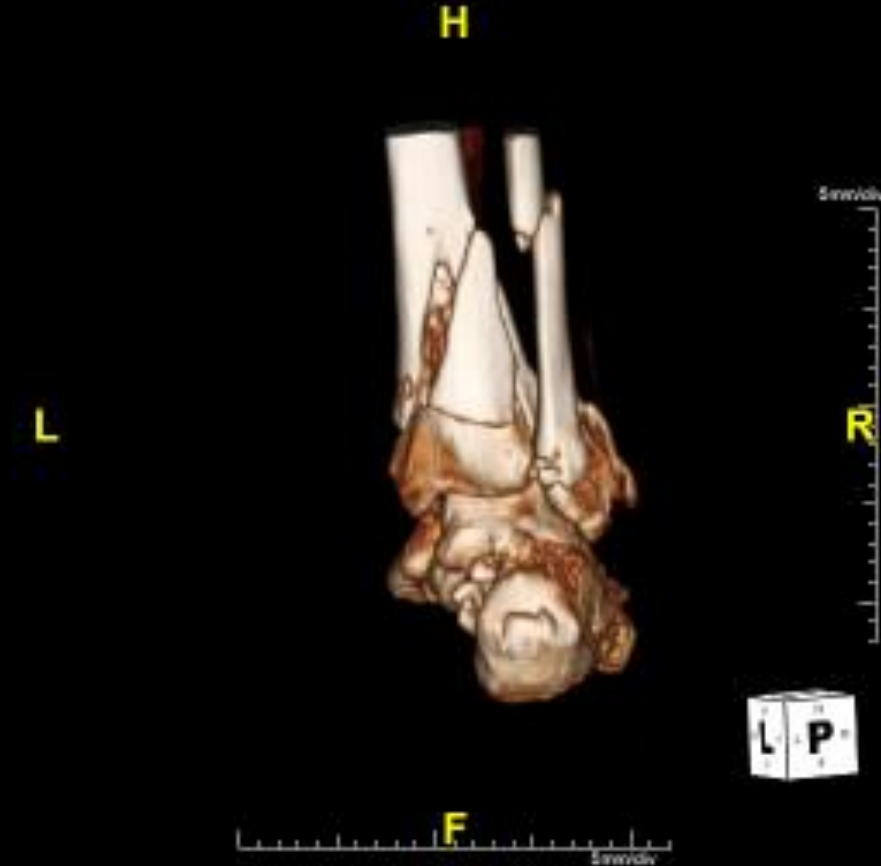


Open
wound
MCC

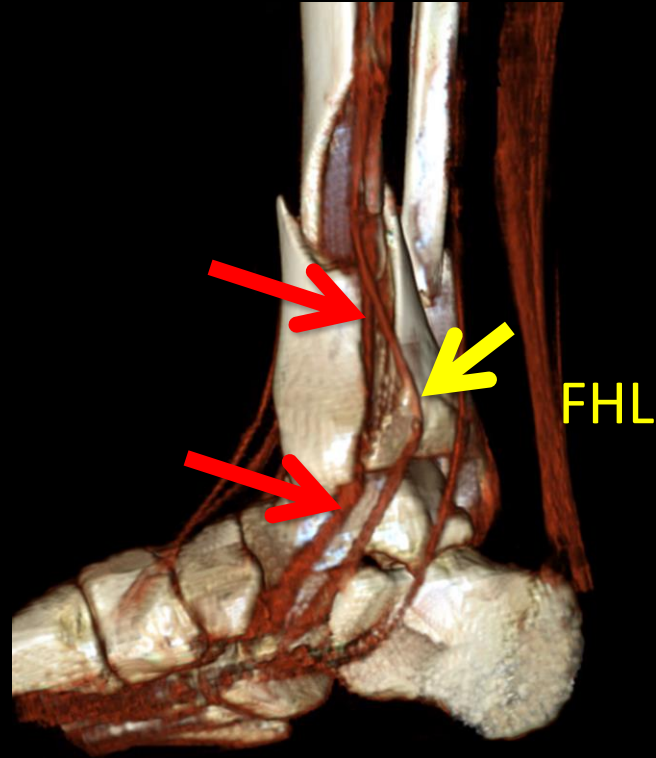
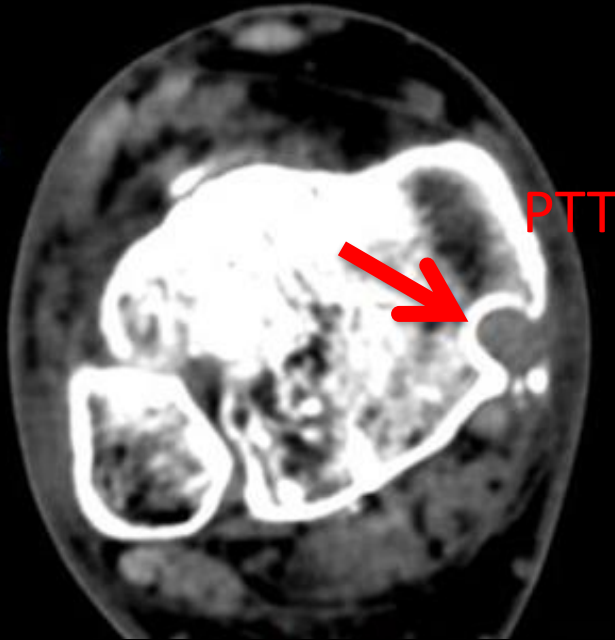


Trapped PL & PB
tendons

Trapped Peroneus Longus & Brevis



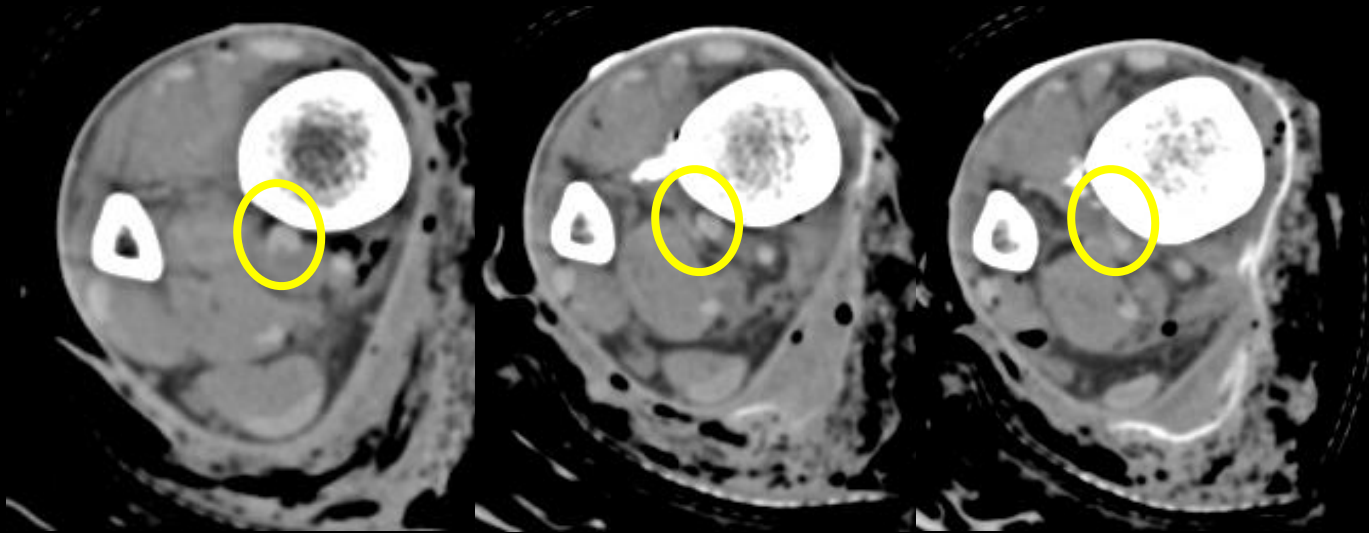
Medial tendons in trouble!



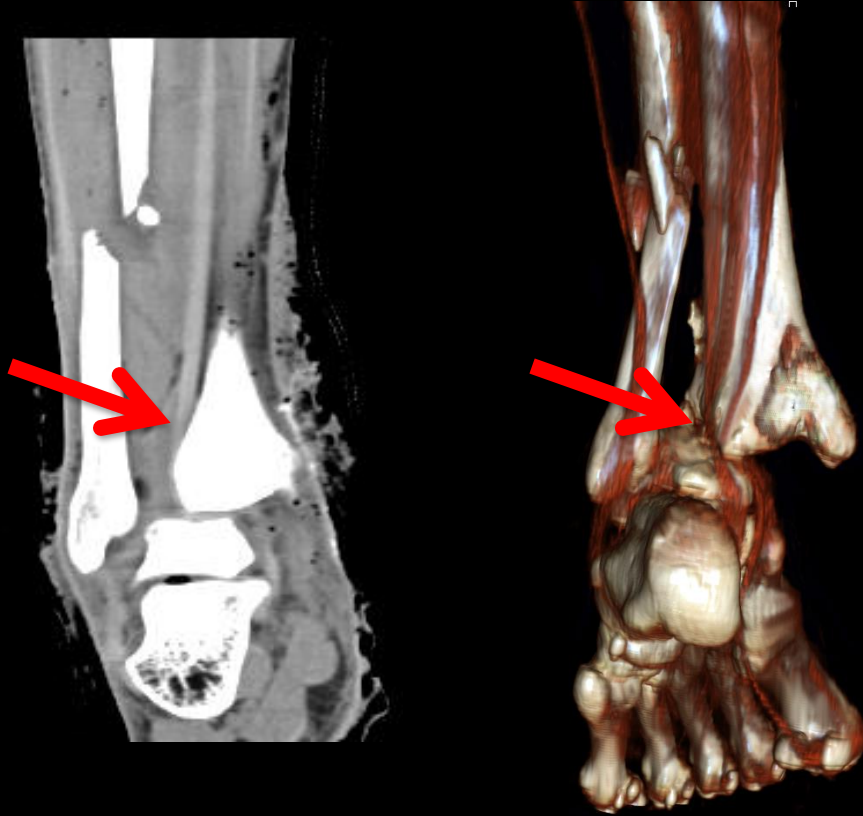
NON REDUCING ANKLE !



THE VANISHING Tibialis post tendon!

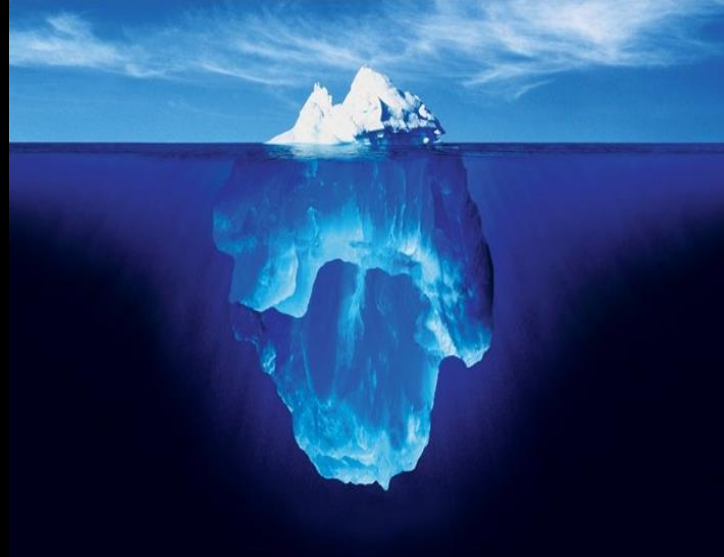


THE VANISHING Tibialis post tendon!



Summary...

- “Small” avulsion / chip fractures are just the tip of the iceberg for significant soft tissue injuries
- Associated soft tissue injuries may warrant surgery





Thank you for your attention!

