HIP INJURIES: Imaging

Primary Care Approach To
Treating The Injured Athlete

Friday May 1, 2015

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Musculoskeletal Imaging

Disclosures

- No disclosures

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C. Pathology on imaging

Why Imaging?

- "In modern medical practice, the term Radiology encompasses the techniques used to ***investigate the architecture and physiological function of the human body."***
- ***To help identify the cause of pain, dysfunction, or disability***
- If you know where is the 'pain' and what is causing the 'pain', you will be able to better treat the 'pain'

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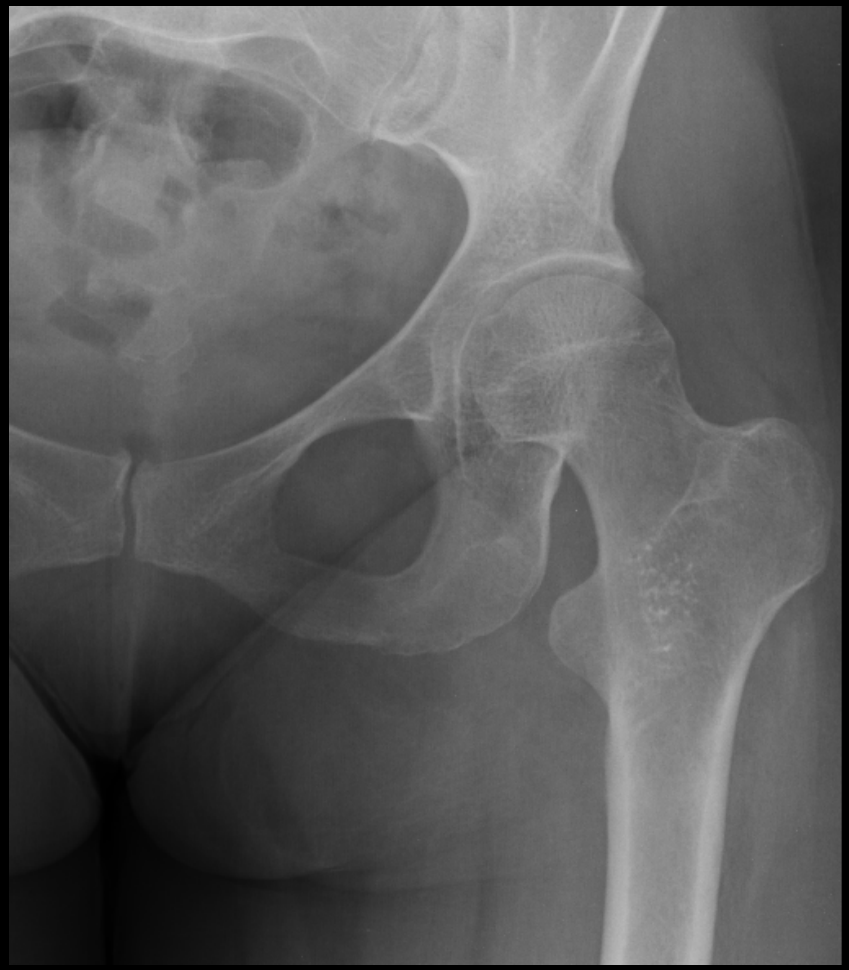
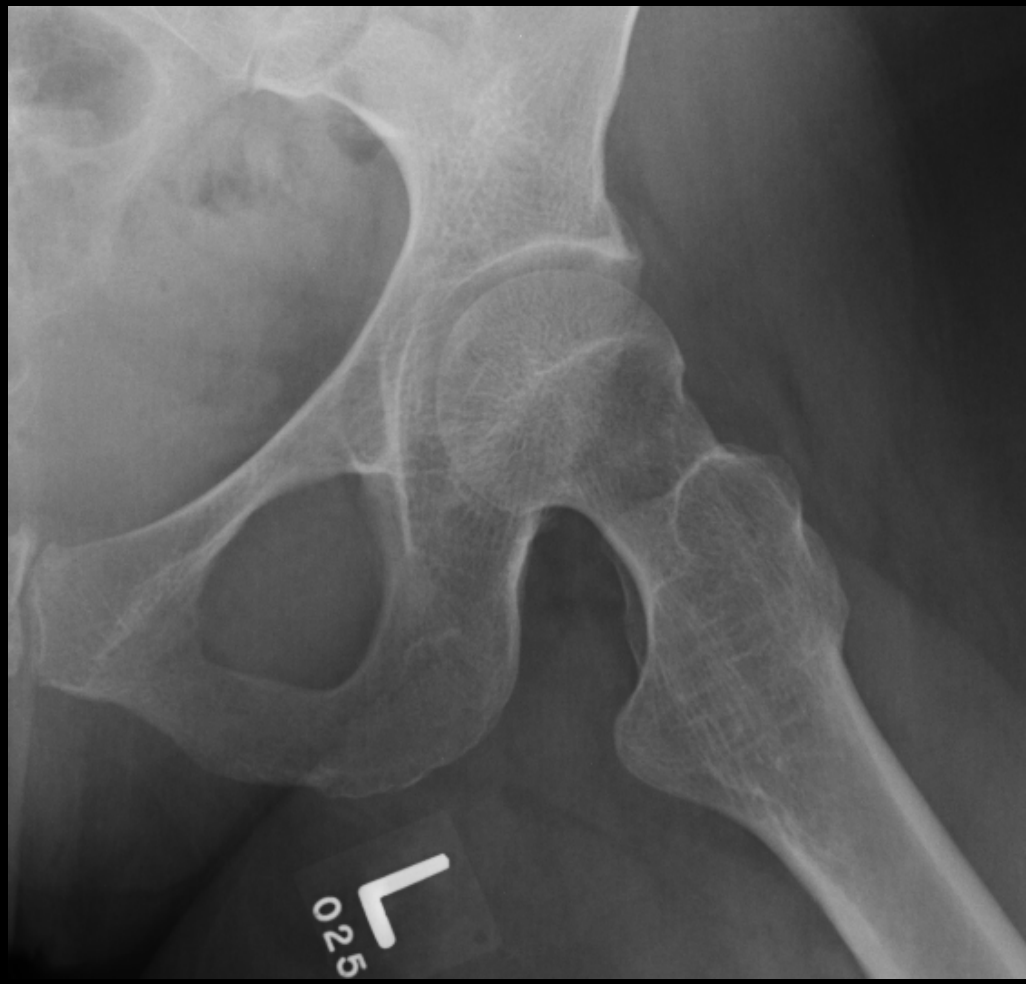
Modalities of Imaging

- XR
  - production of an x-ray beam to evaluate anatomy
  - portion of the x-ray beam, not absorbed by the body, used to expose x-ray film, producing the diagnostic image
  - bone and soft tissues require no special preparation for the evaluation
  - 2 dimensional image
  - ***detail of the bones***

Hip XR

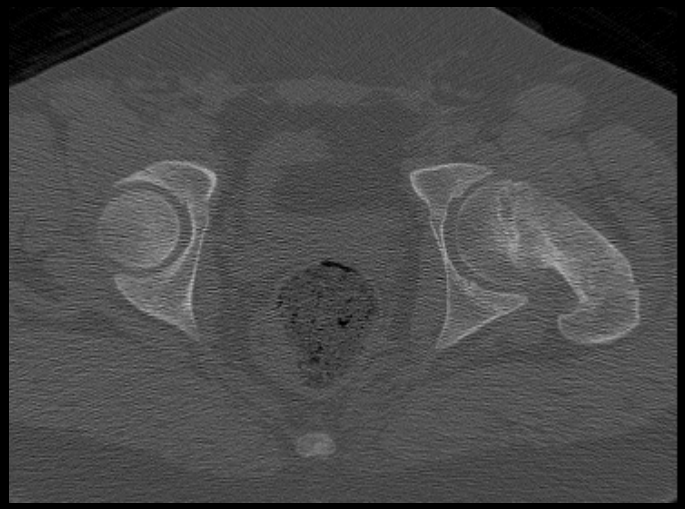


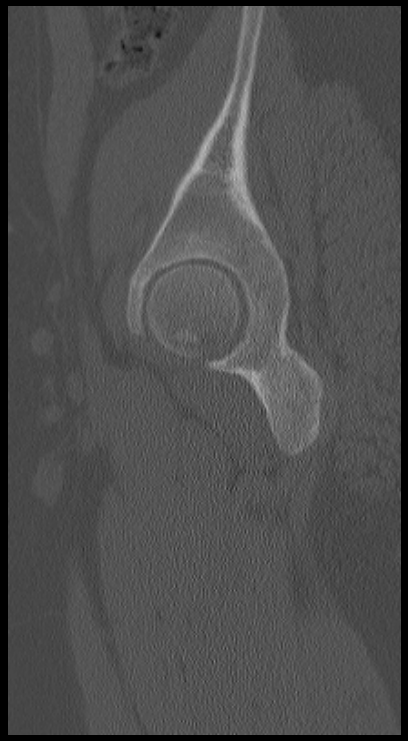


Modalities

- CT
  - production of an x-ray beam to evaluate anatomy
  - bone and soft tissues require no special preparation for the evaluation
  - organ and circulatory systems, may require contrast material to enhance the visualization of their shape, size, position, and functional status
  - 3 dimensional images of a cross-section of a part of the body
  - ***better detail of extra-articular and intra-articular bony architecture; also soft tissues***

Hip CT





Modalities

- US
  - ***high-frequency sound beam used to visualize the structures of interest***
  - sound beam directed into the body
  - resulting densities of body tissue reflected back, analyzed to produce the diagnostic image
  - ***Some detail of tendons, ligaments, organs, soft tissues***
  - NOT good for bones or lungs

Hip Ultrasound

http://www.ultrasoundcases.info/files/Jpg/7678.jpg

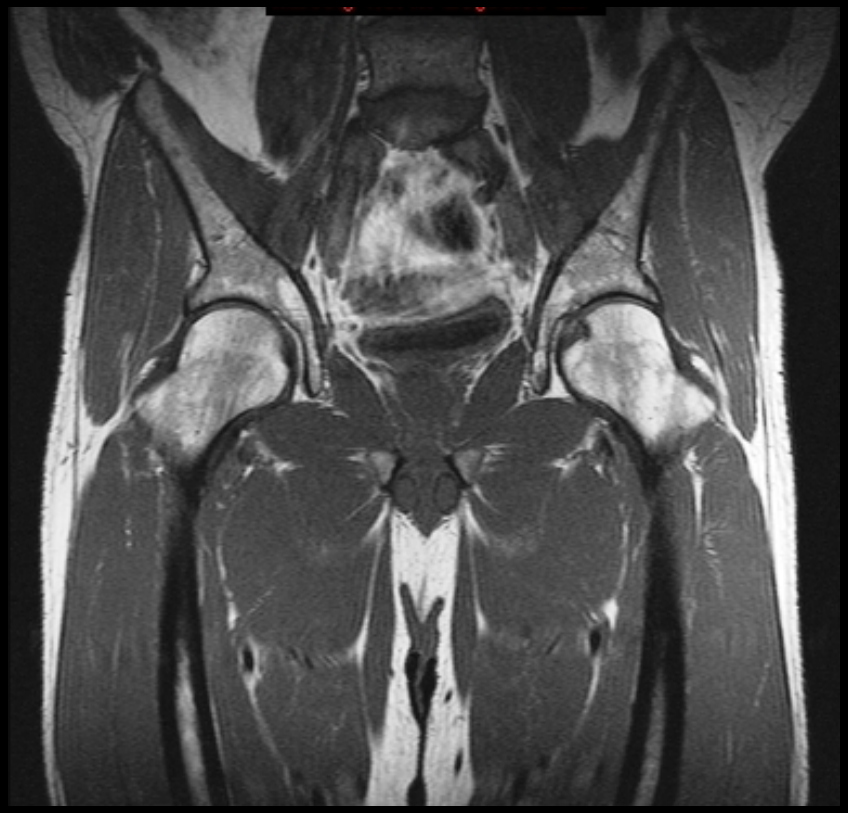
Modalities

- MRI
  - ***based on the magnetic behavior of H atoms in tissues when placed in a magnetic field and excited by radiofrequency pulses***
  - after excitation, H atoms return to normal state by emitting energy that is monitored
  - this energy characterized by relaxation times, which reflect the chemical and physical properties of tissues, creating an image
  - ***greatest for soft tissue detail and organ detail; including ligaments, tendons; also very good for bone***

MRI

- Depending on pulse sequence, tissues will show up as black, white, and everything in between (shades of gray)
  - T1, T2, Proton Density (PD)
- T1: fluid black, fat bright, muscle intermediate, tendons and ligaments dark, bone bright
- T2: fluid bright, fat bright or dark (FS), muscle intermediate or darker, tendons and ligaments dark, bone bright or dark (FS)

MRI pelvis protocol

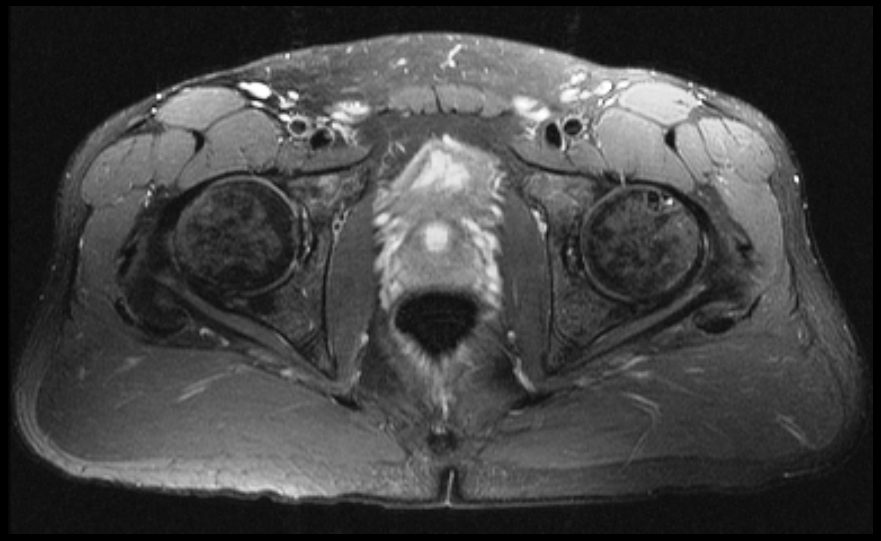


Coronal T1

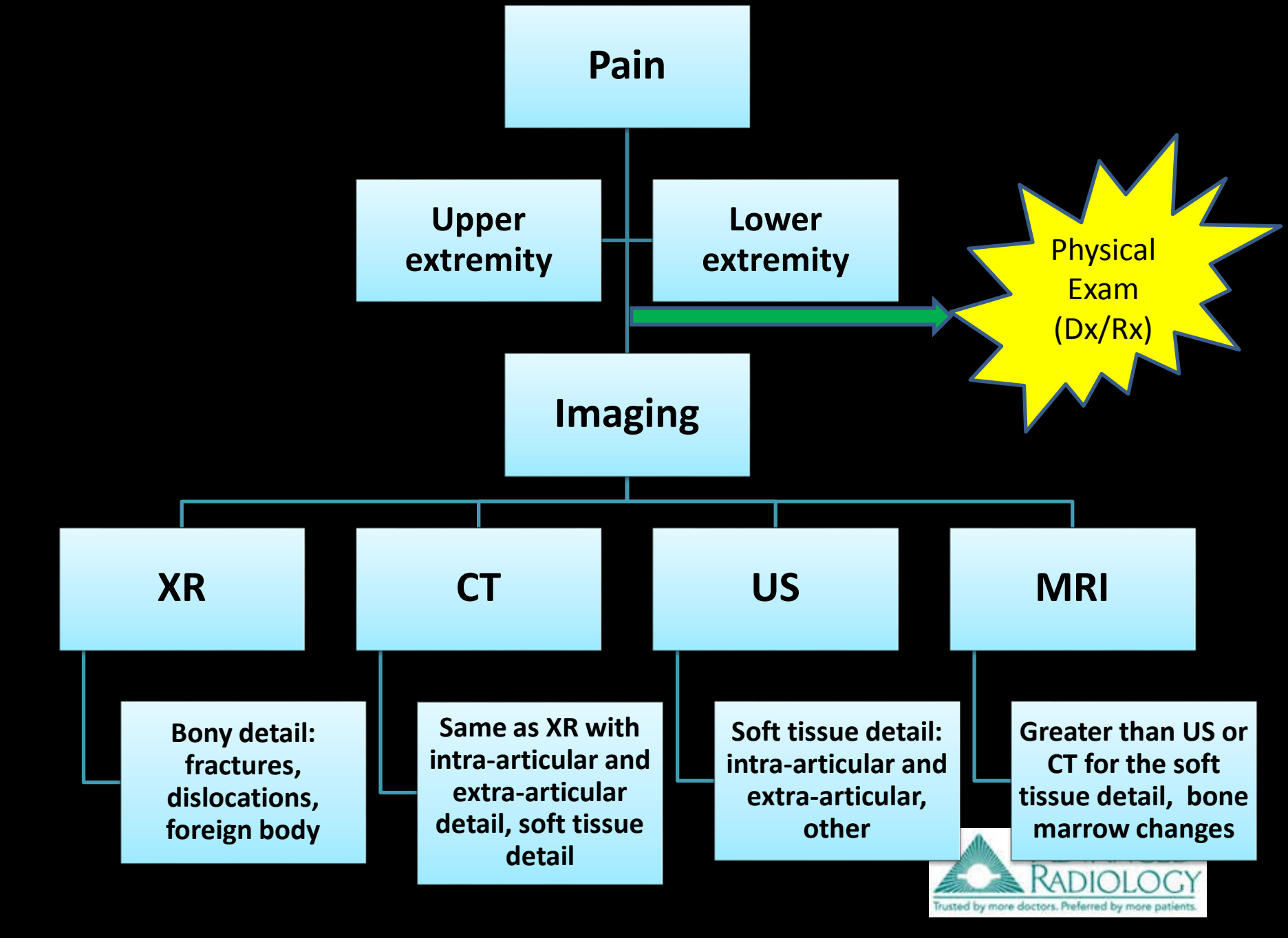
Coronal FS T2

MRI pelvis protocol

Axial T1



Axial FS T2


Pain
Upper extremity
Lower extremity
Physical Exam (Dx/Rx)
Imaging
XR
CT
US
MRI
Bony detail: fractures, dislocations, foreign body
Same as XR with intra-articular and extra-articular detail, soft tissue detail
Soft tissue detail: intra-articular and extra-articular, other
Greater than US or CT for the soft tissue detail, bone marrow changes
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Anatomy to evaluate/Indications for MRI of the hip

- Non-arthrogram
  - Everything!
    - Bones, Joint, Tendons, Other (tumors)
  - Bilateral hips or pelvis
    - Bilateral pain
    - Unknown pain source
  - Unilateral
    - Unilateral pain
    - Specific symptoms
- Arthrogram
  - Labrum
  - Cartilage
- All else can be commented on if visualized

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The hip

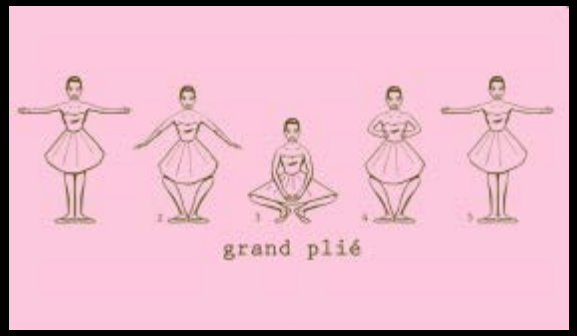
- Most stable articulation in the body
- Ball and socket joint, 2nd greatest ROM

The hip

The hip

Hip Functions

- Flexion
- Extension
- Abduction
- Adduction
- Internal/external rotation



Hip anatomy

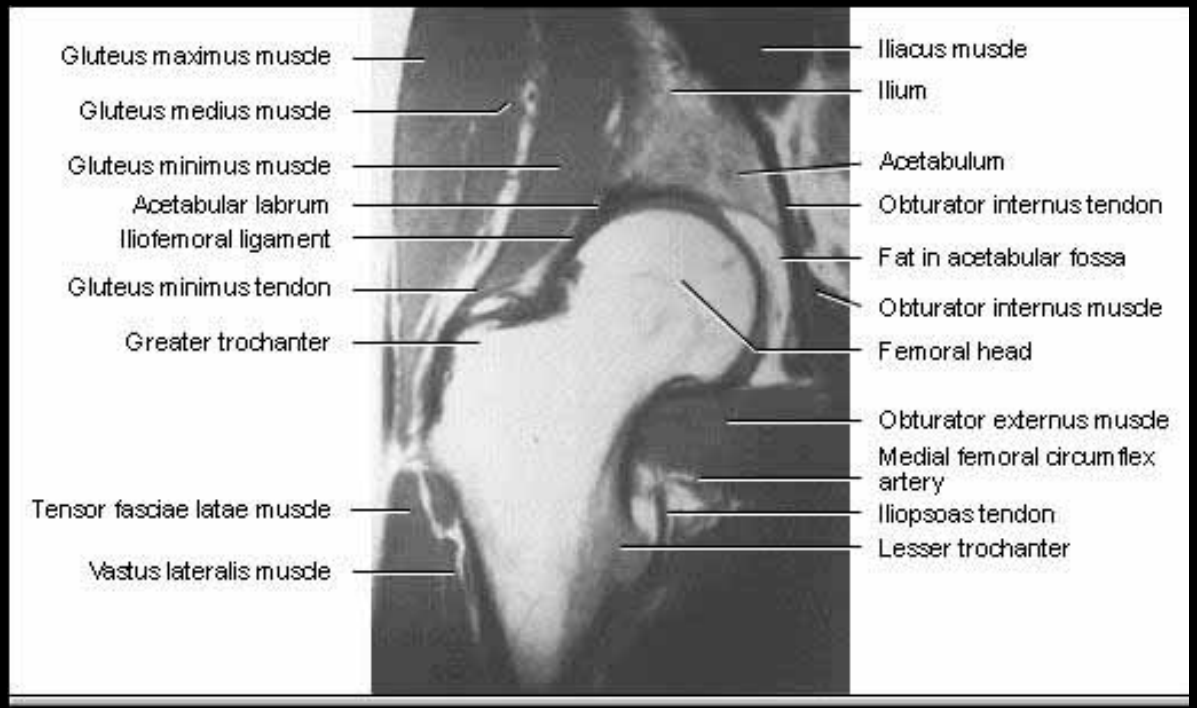
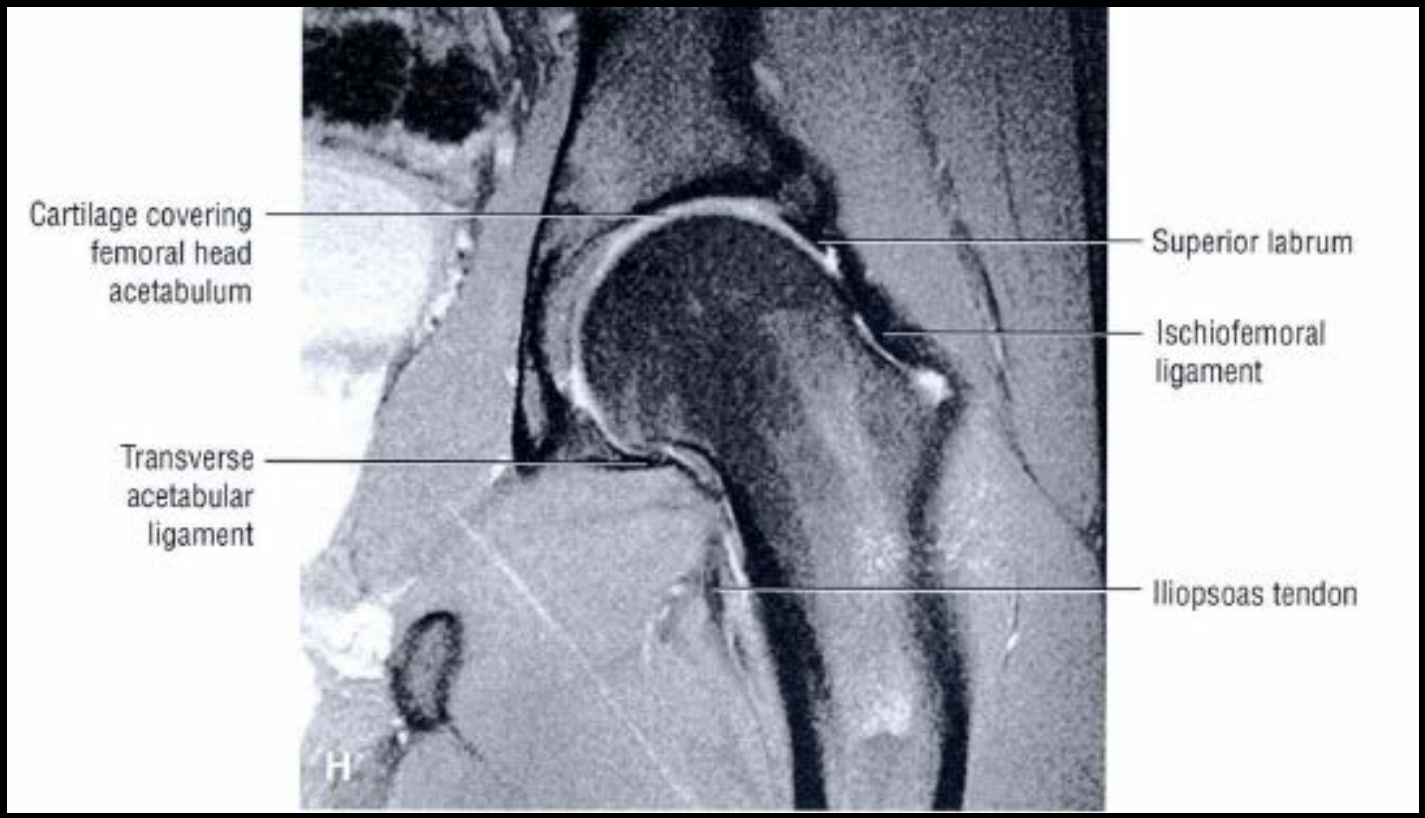


FIGURE 6-23H. Normal coronal MR anatomy. (**A**) Sagittal localizer used to graphically prescribe coronal T1-weighted image location from (**B**) anterior to (**L**) posterior.

From Magnetic Resonance Imaging in Orthopaedics and Sports Medicine
David W. Stoller MD, Lippincott-Raven 1996

www.hwbf.org

Hip anatomy



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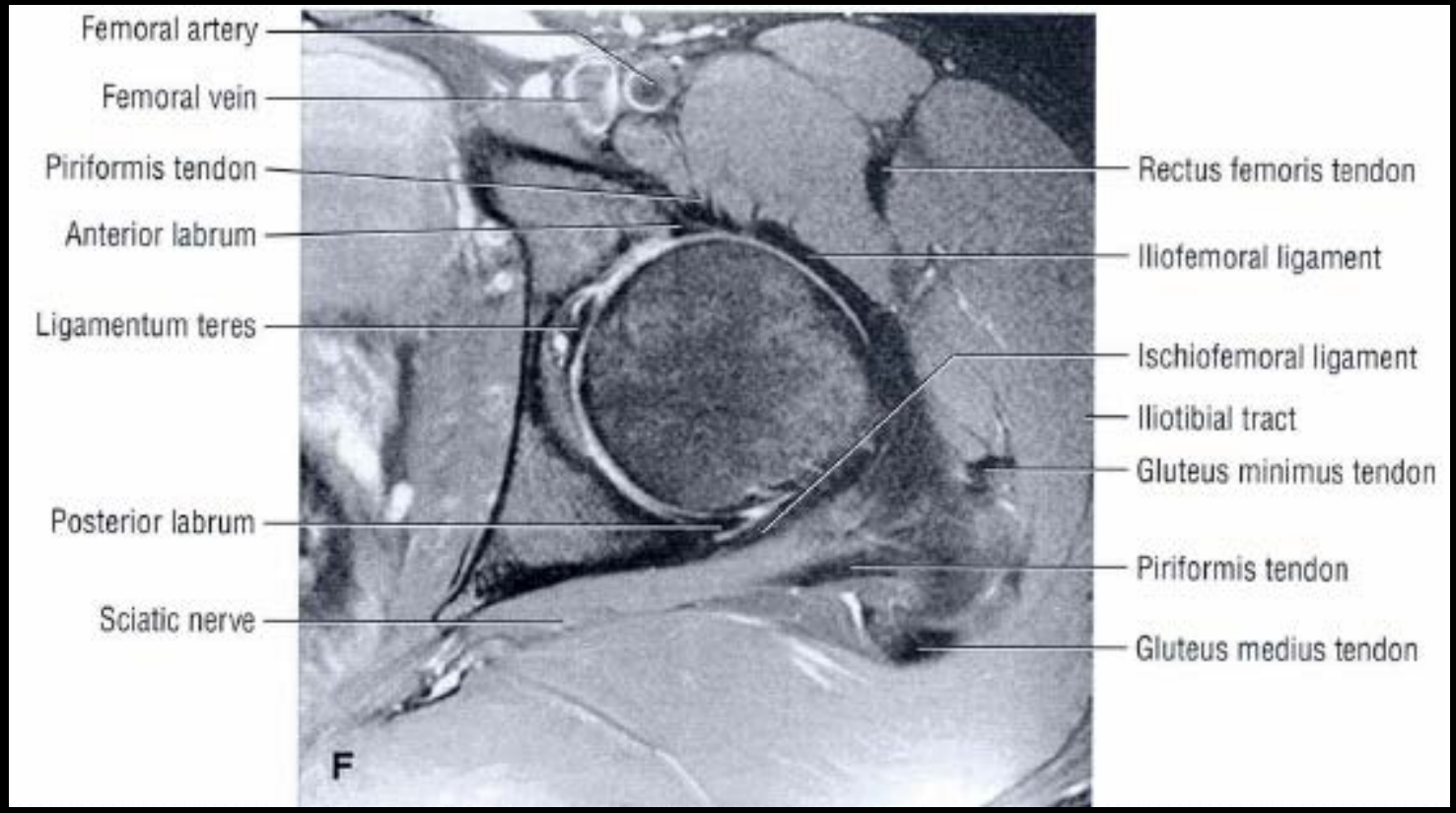

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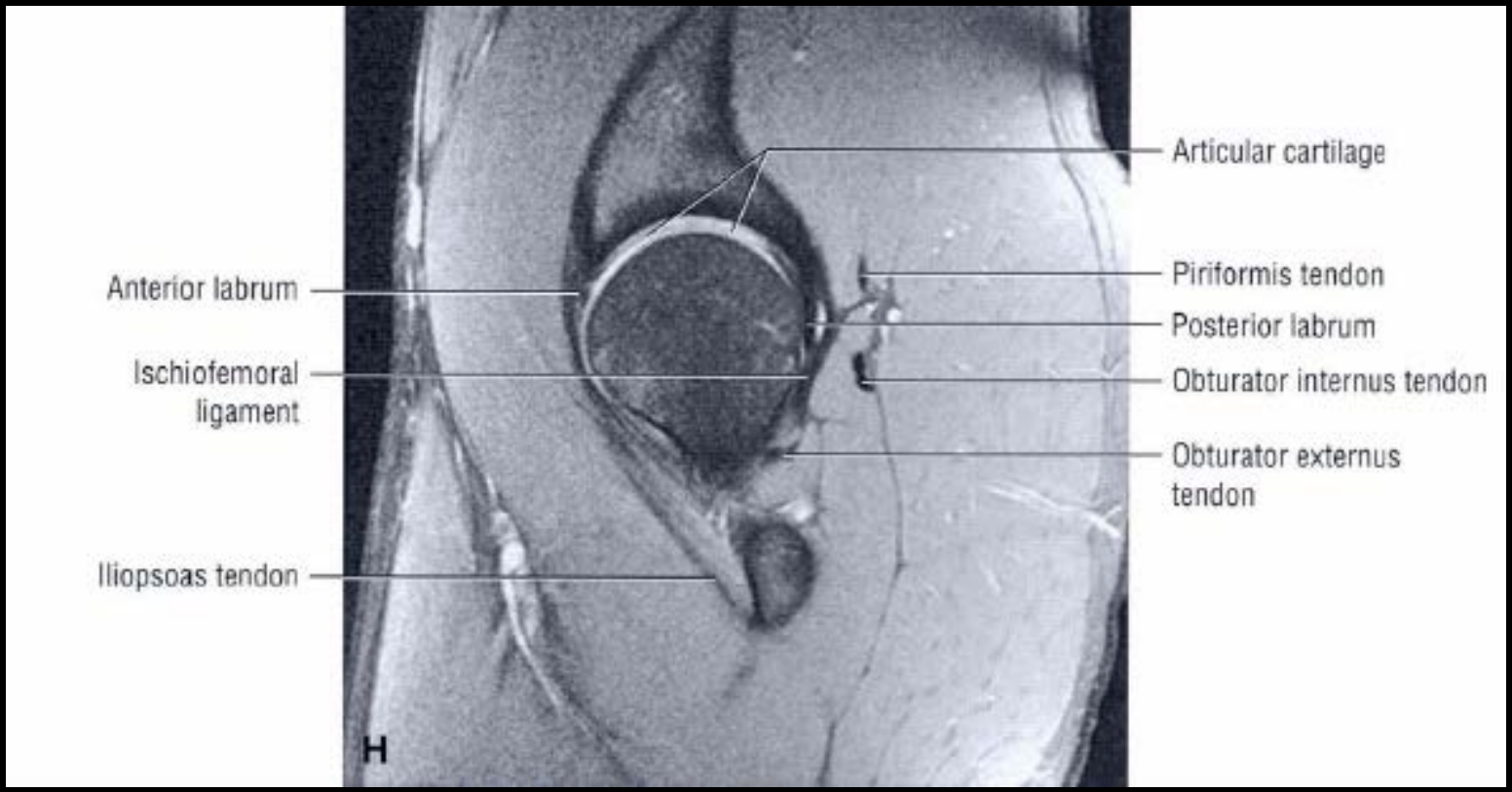
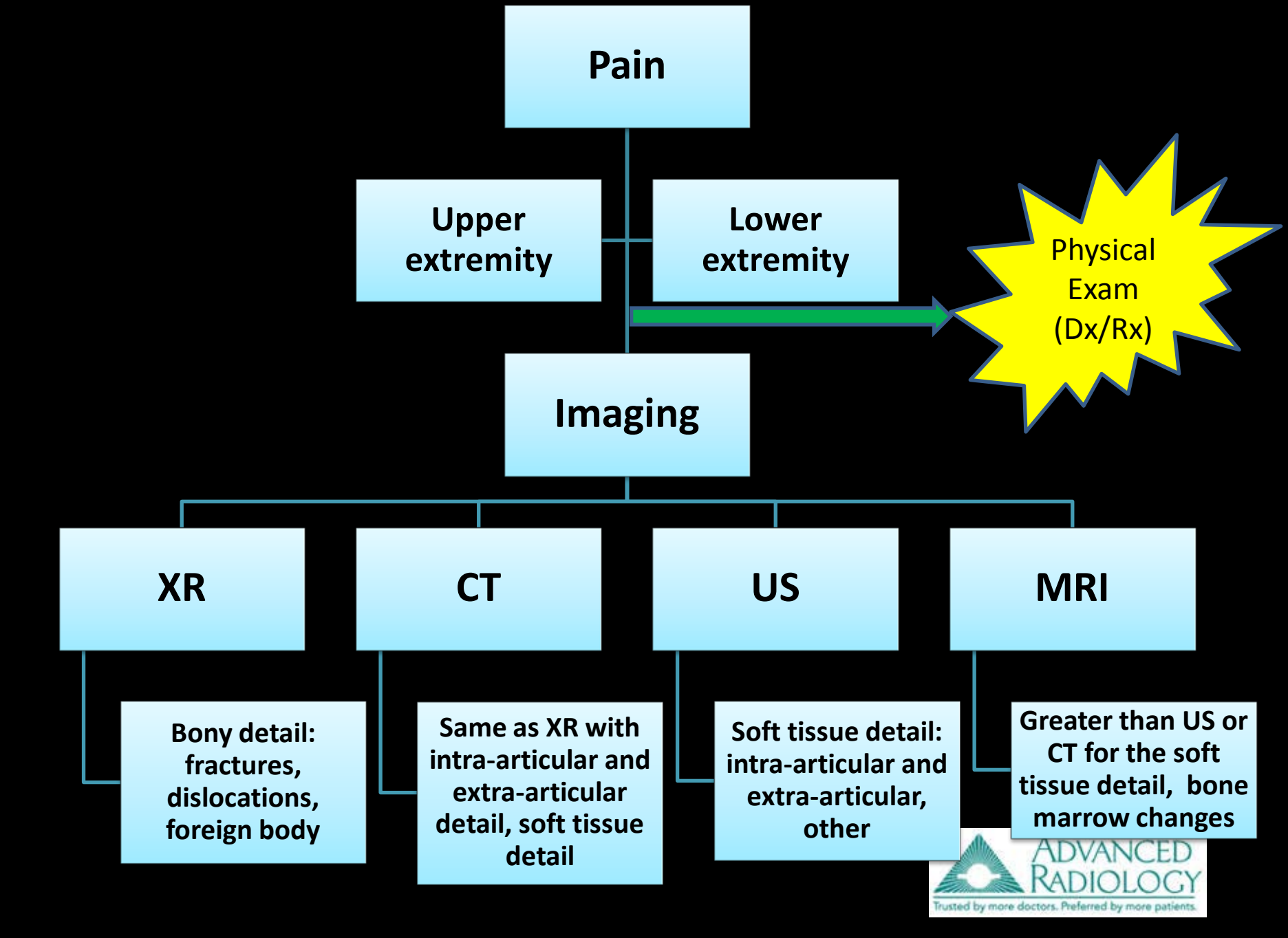


The hip

The hip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Pathology

- Fracture spectrum
- Tendon tear/Sports hernia
- Rectus femoris tendon avulsion
- Femoroacetabular Impingement
- Labral tear

Case A

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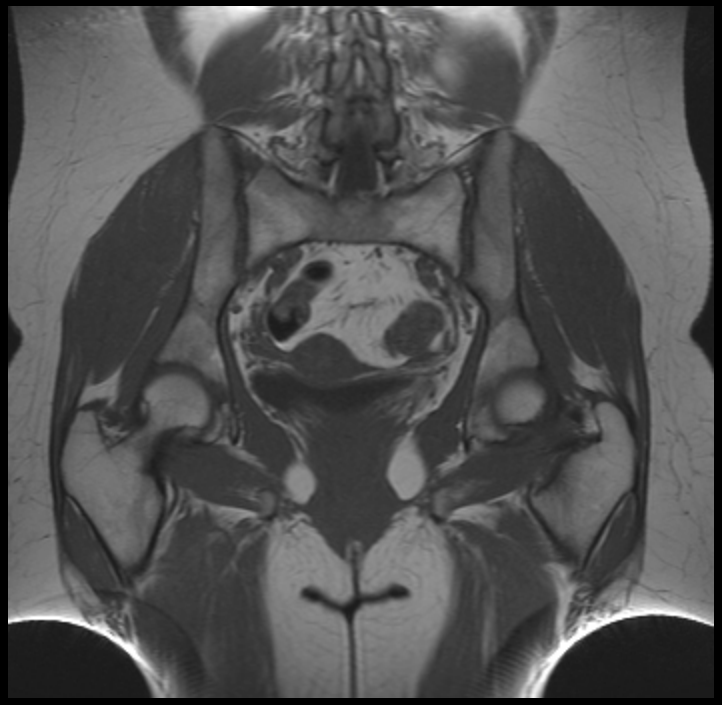
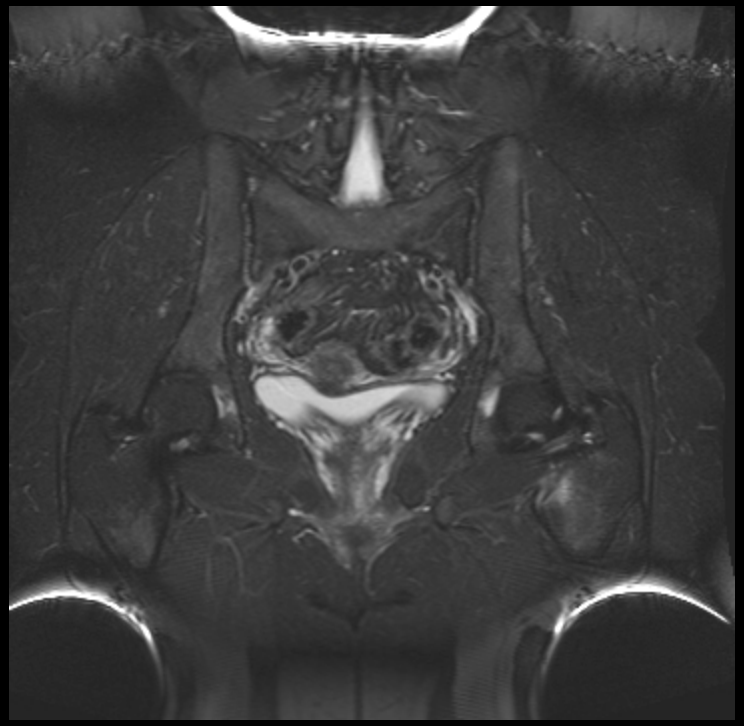
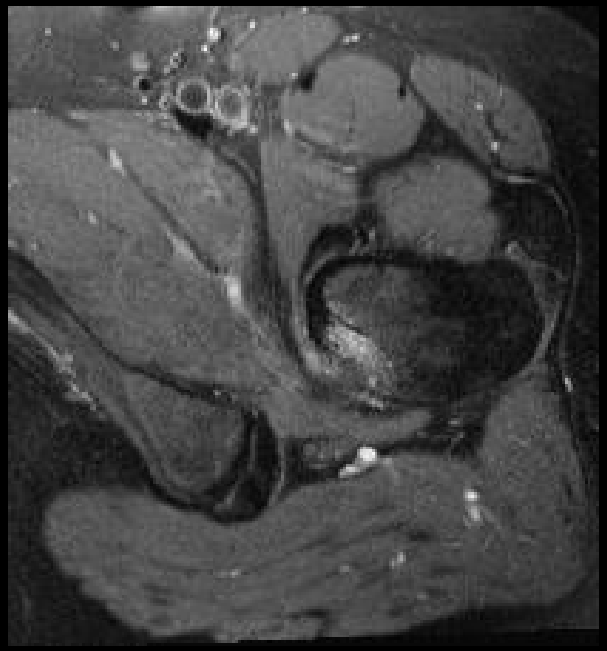
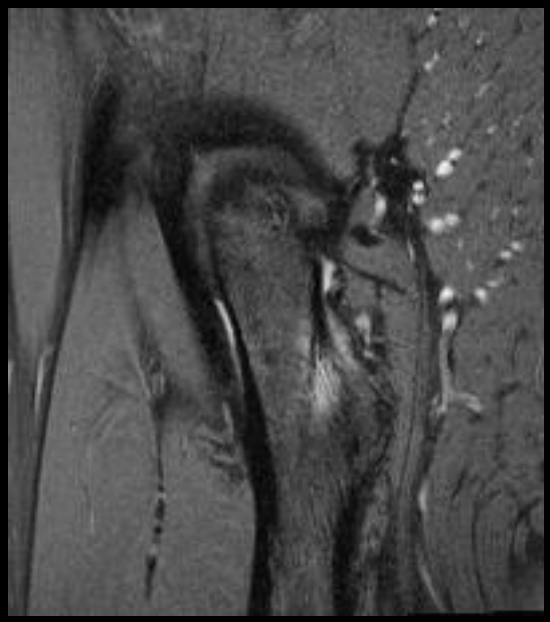
Stress reaction





Stress reaction

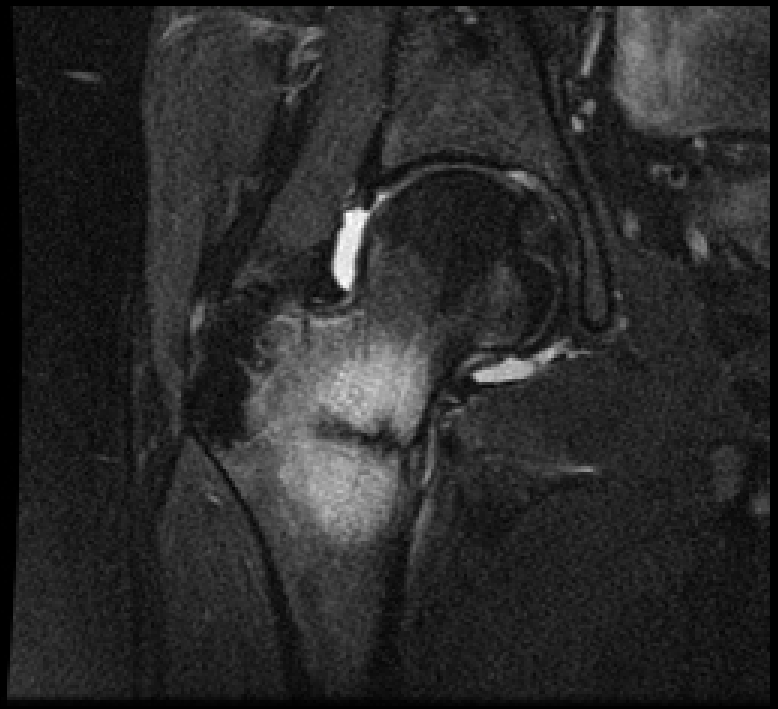




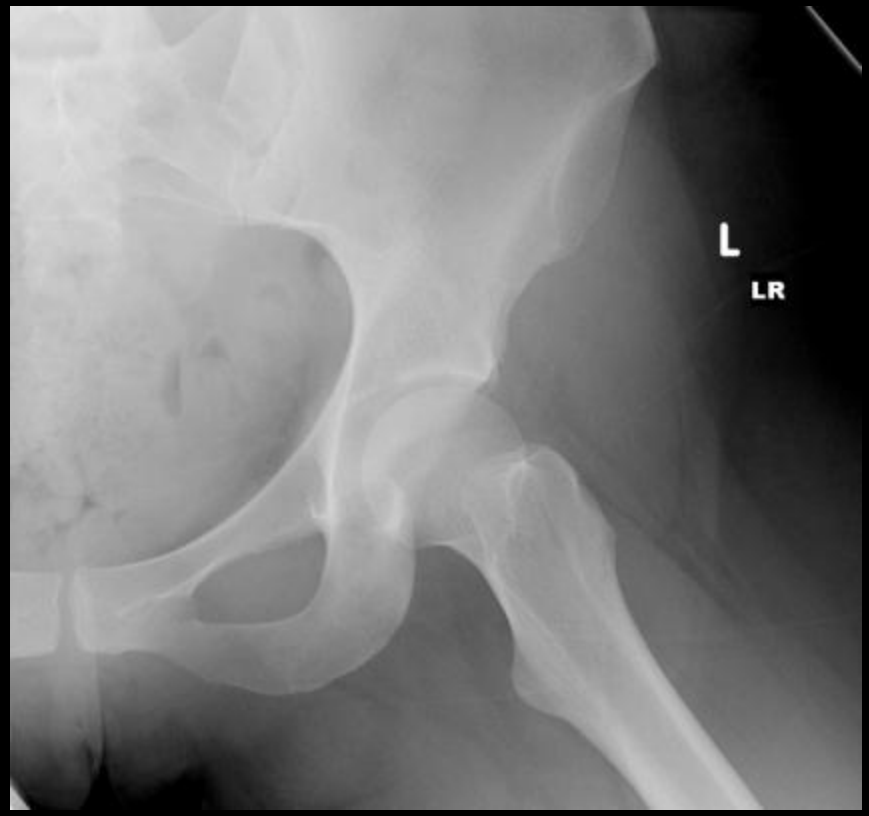
Case B

Case B

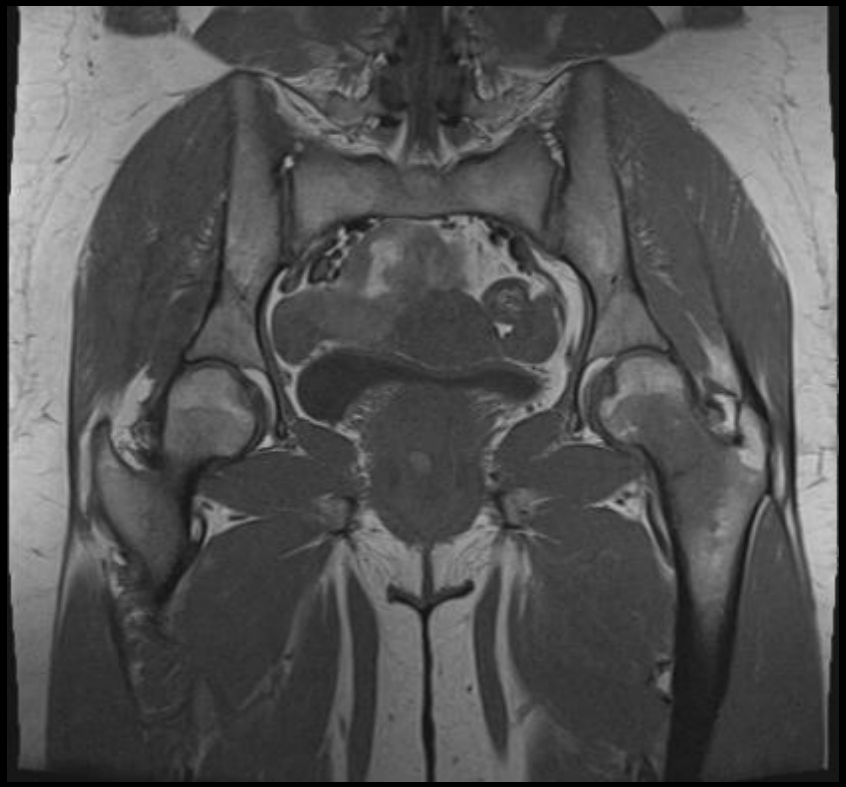
Stress fracture

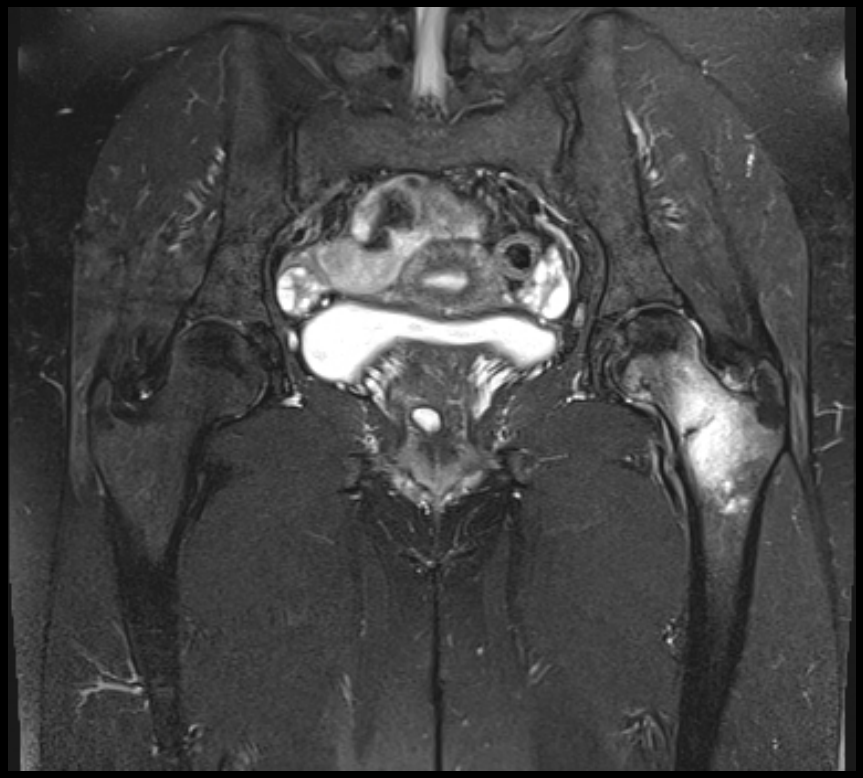


Case C

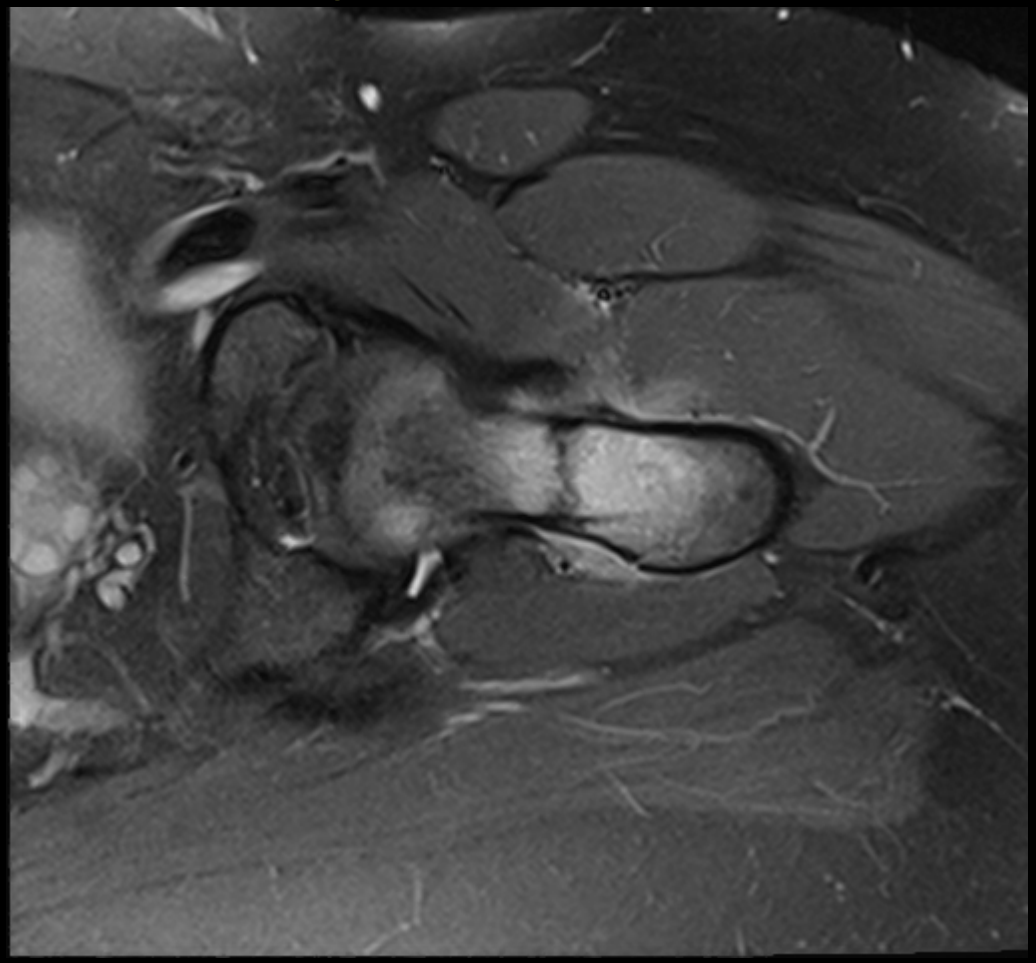


Nondisplaced fracture



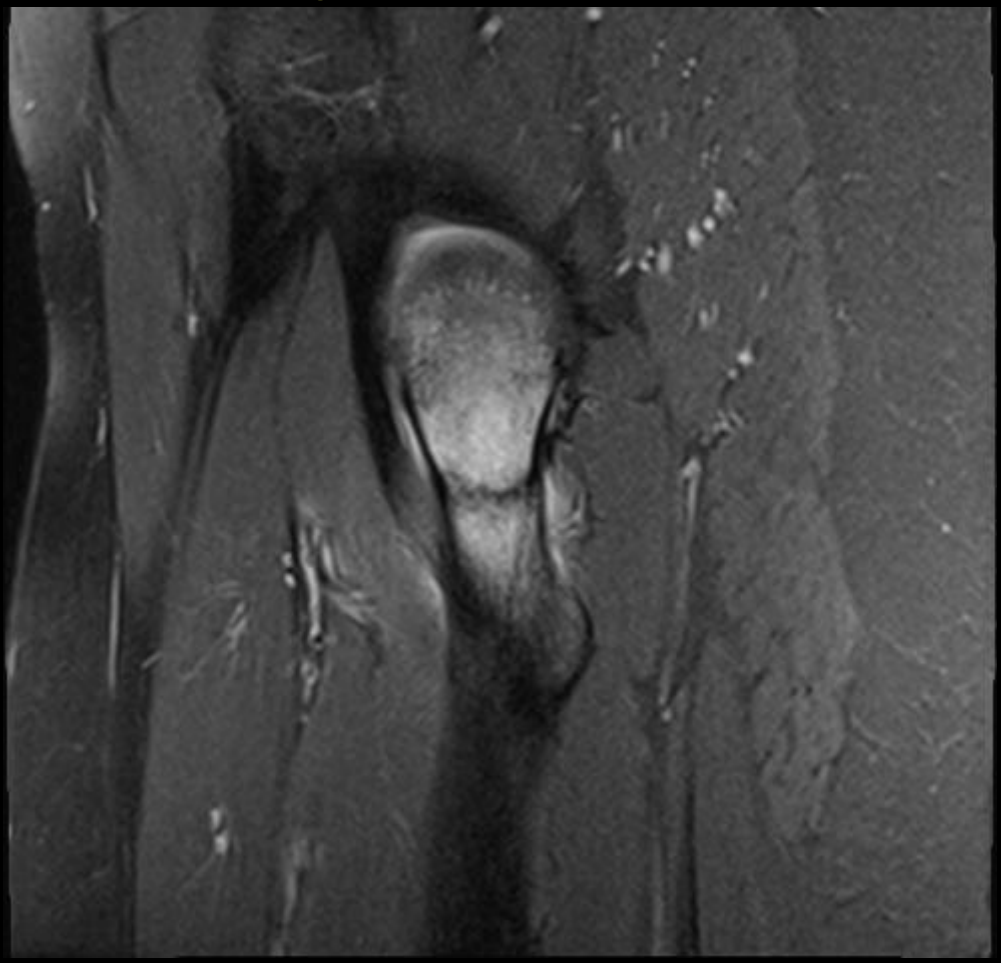


Nondisplaced fracture



Nondisplaced fracture

Nondisplaced fracture



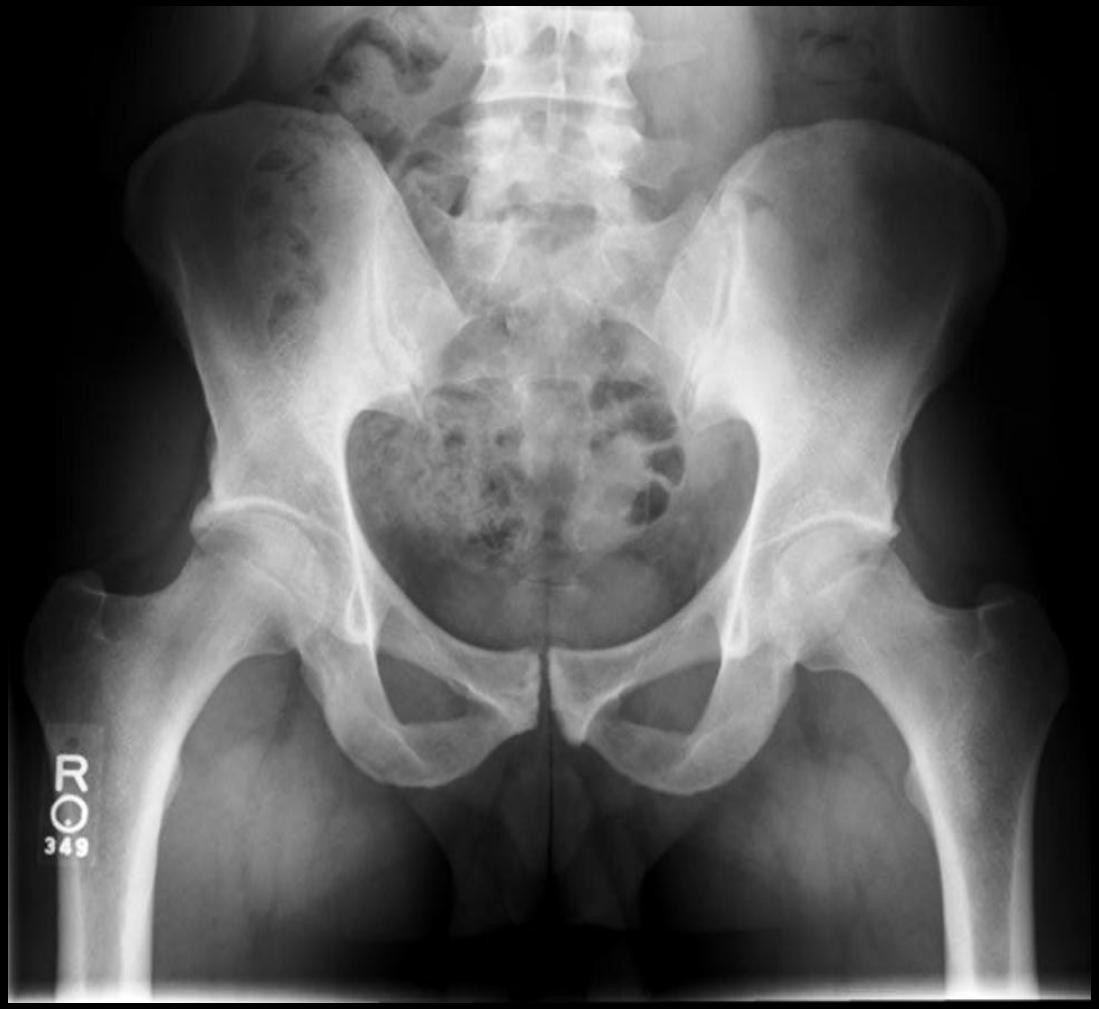
Fracture spectrum

- MRI findings
  - T1 linear low signal with surrounding low signal edema
  - T2 linear low signal with surrounding high signal edema
  - +/- cortical break, osseous fragments
  - Stress reaction is edema

Stress fracture

- Most commonly around pelvis and hip
- Stress fractures in athletes F>M
- 15% of runners sustain a stress fracture
- 5-10% of all stress fractures involve the femoral neck (usually basicervical)
- MRI exquisitely sensitive for detection (the most sensitive than all other modalities)
    - About 14% of femur and pelvic fractures are missed on CR
    - Kirby, AJR 2010;194:1054-1060.
- * Female Athlete Triad

Case D



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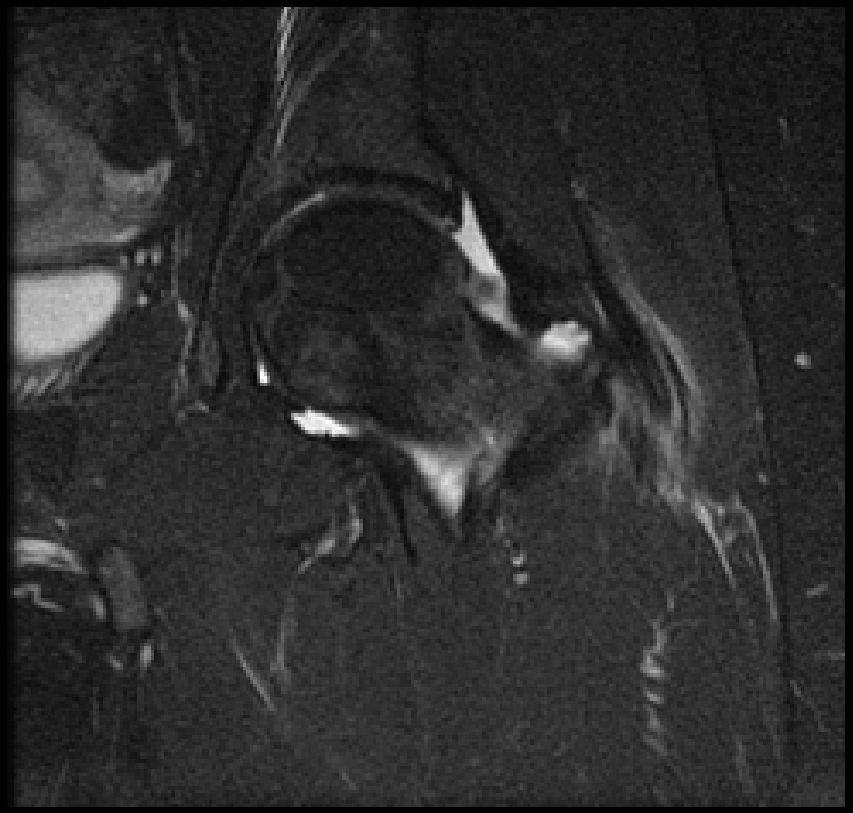
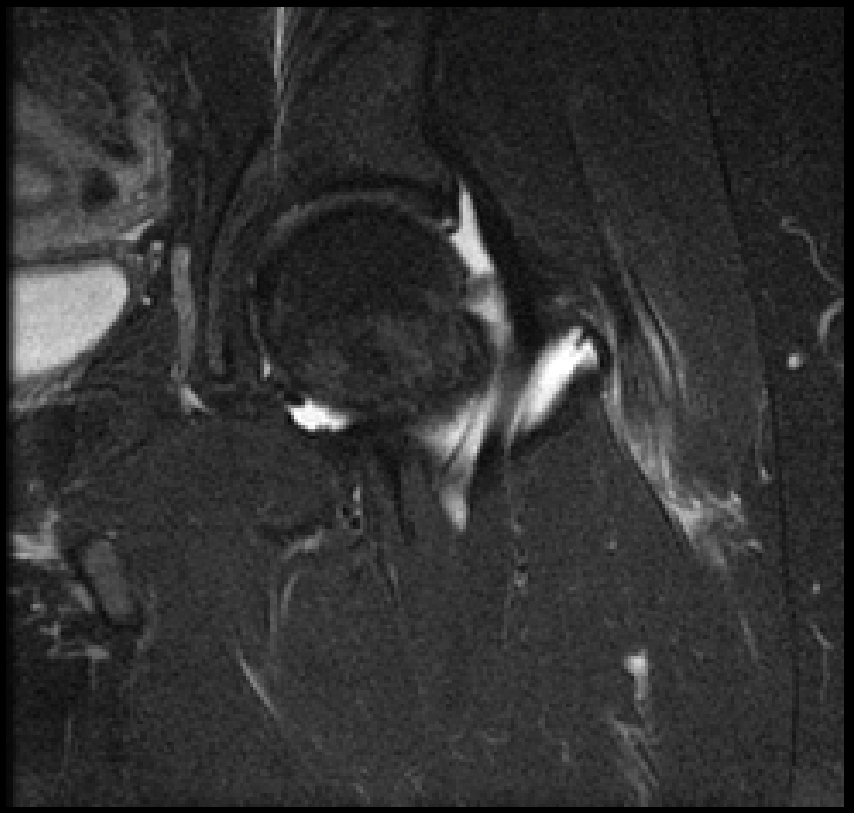
Tendon tear



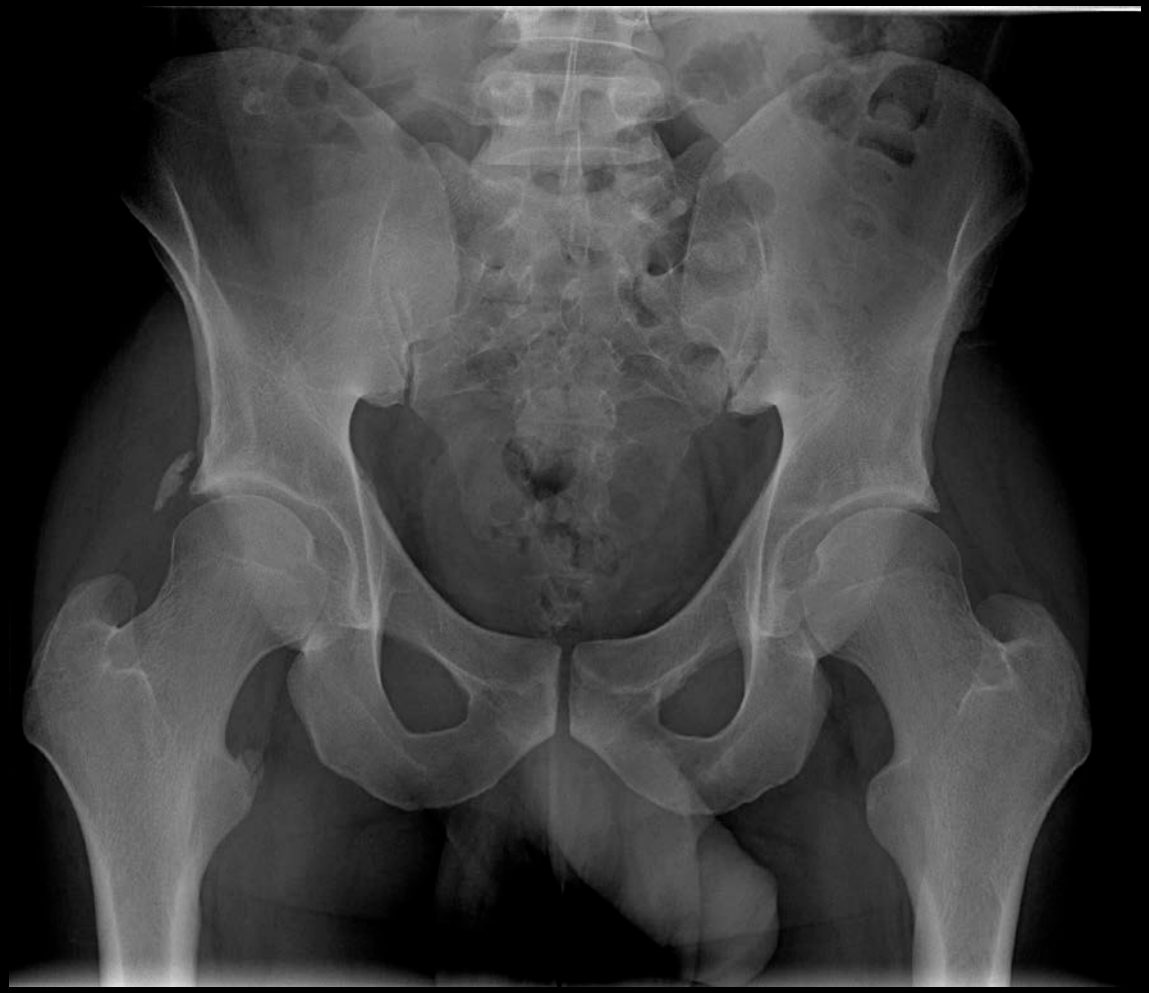


Tendon tear

- MRI findings
  - T1 isointense to muscle (low)
  - T2 high signal in tendon (edema)
  - Disruption of fibers (waviness, discontinuity)
  - Edema (high T2 signal) in adjacent muscle and bony attachment
  - For sports hernia also high T2 signal in the pubic symphysis

Sports hernia

Case E



AIIS avulsion

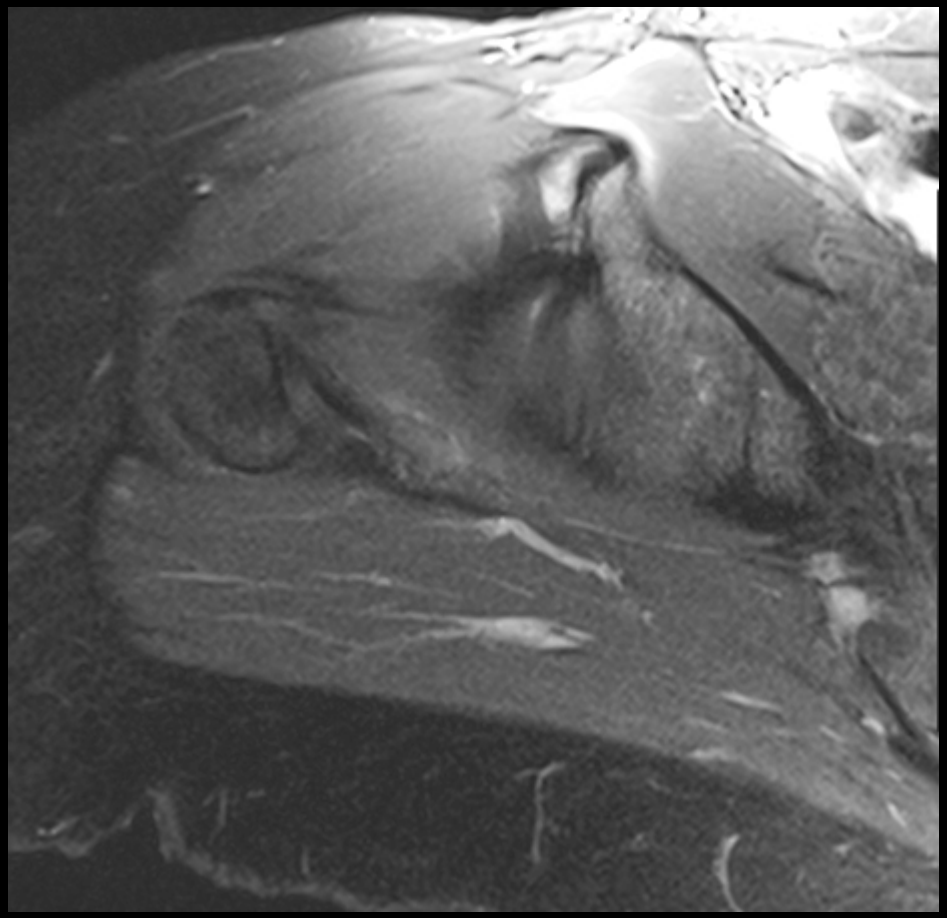
Tendon avulsion

- Bony avulsion usually clear on radiographs
- MRI findings
  - Similar tendon findings
  - Edema (high T2 signal) in adjacent muscle and bony attachment
  - Cortical break and adjacent bony fragment

AIIS tendon avulsion

AIIS tendon avulsion

AIIS tendon avulsion



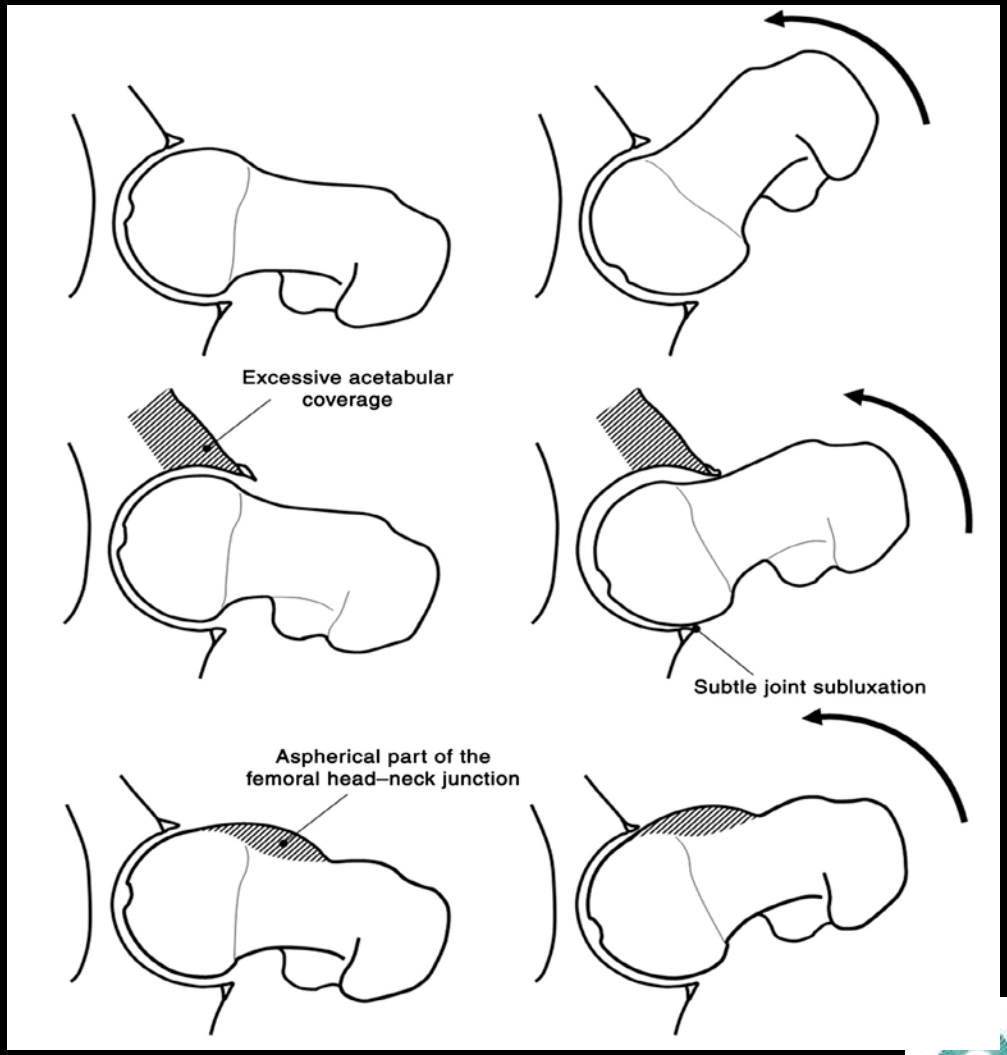
Femoroacetabular Impingement Syndrome

- Major cause of early osteoarthritis of the hip, especially in young and active patients, including labral abnormalities
- Early pathologic contact during hip joint motion between skeletal prominences of the acetabulum and the femur
- Limits physiologic hip range of motion, typically flexion and internal rotation
- Pain in the groin; +/- pain in the trochanteric region extending to the lateral thigh

Femoroacetabular Impingement Syndrome (FAI)

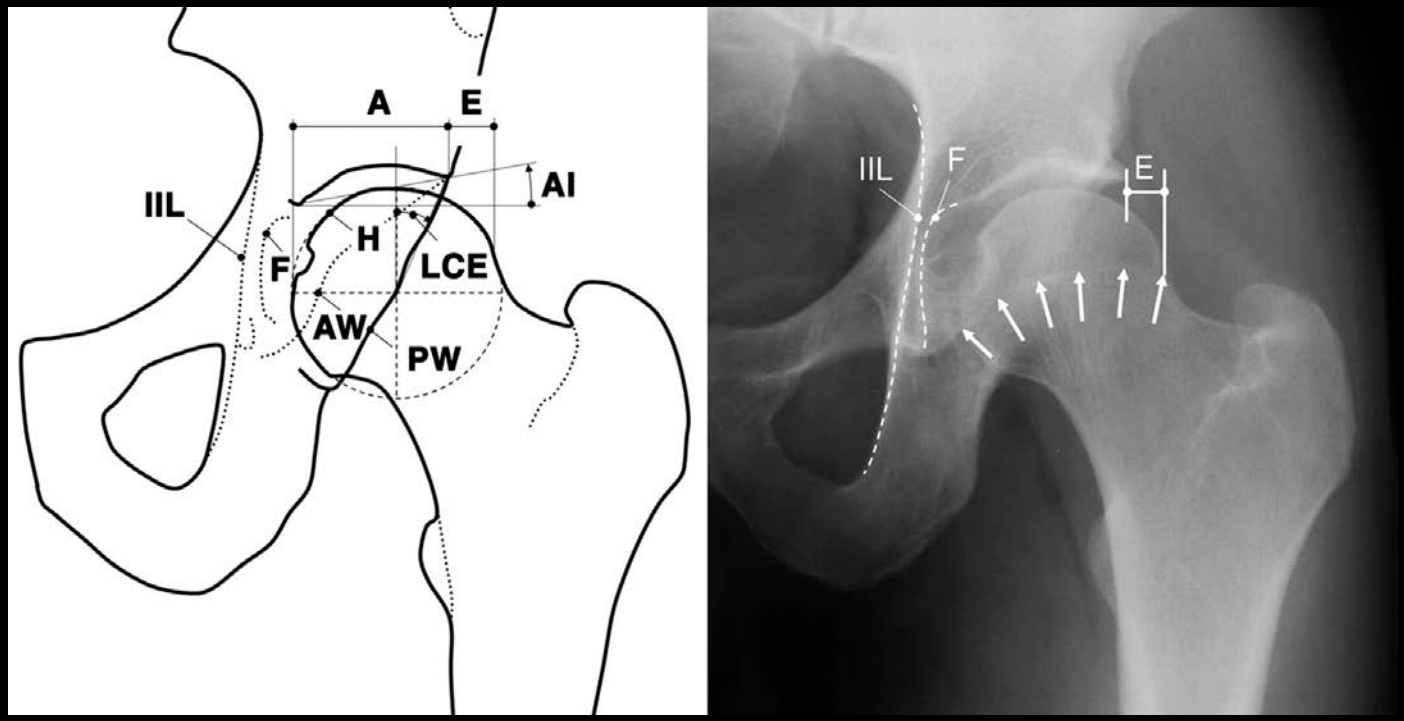
- 2 types of impingement
  - Pincer
    - acetabular cause of FAI
    - focal or general over coverage of femoral head
  - CAM
    - femoral cause of FAI
    - aspherical shape of femoral head, femoral head-neck bony excrescence (CAM lesion), coxa magna
- ***Best evaluation is first by radiographs***

FAI



Tannast, M. et al. Am. J. Roentgenol. 2007;188:1540-1552

FAI – Normal hip



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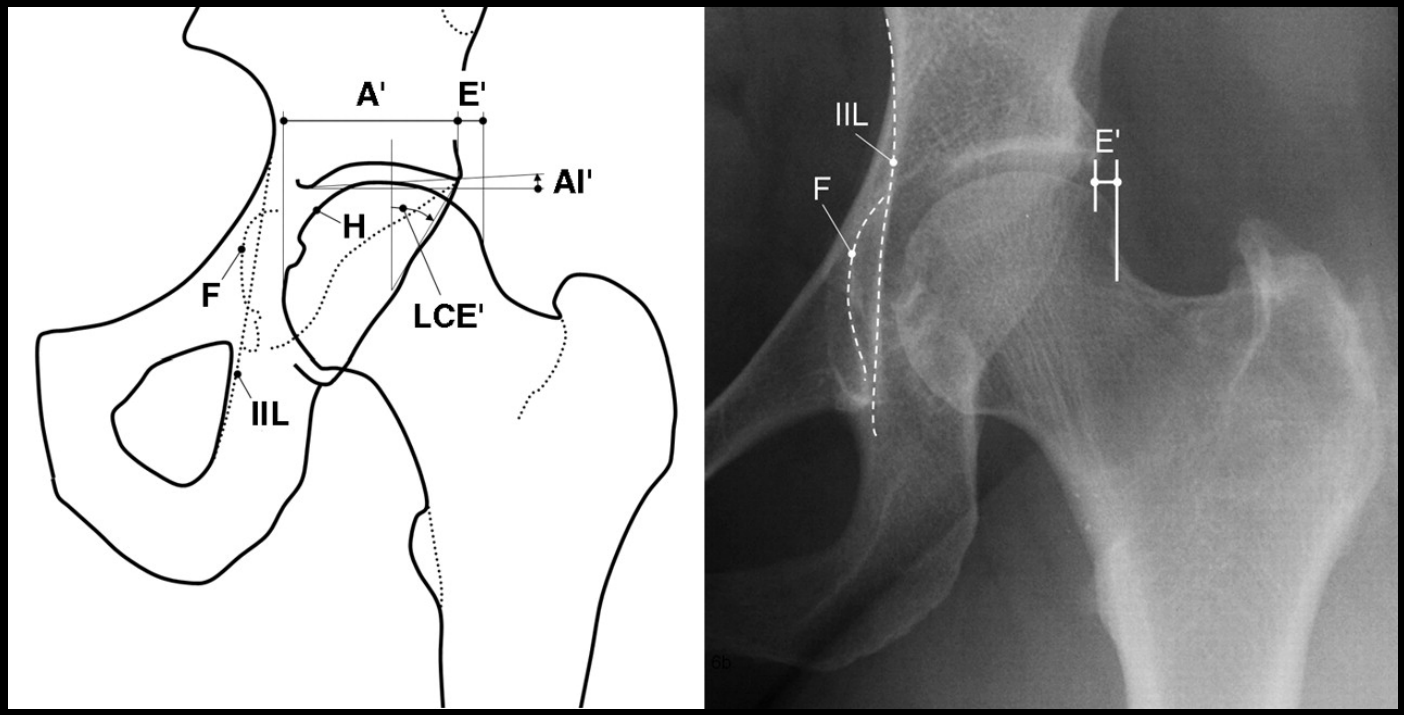
FAI – Pincer type



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AJR

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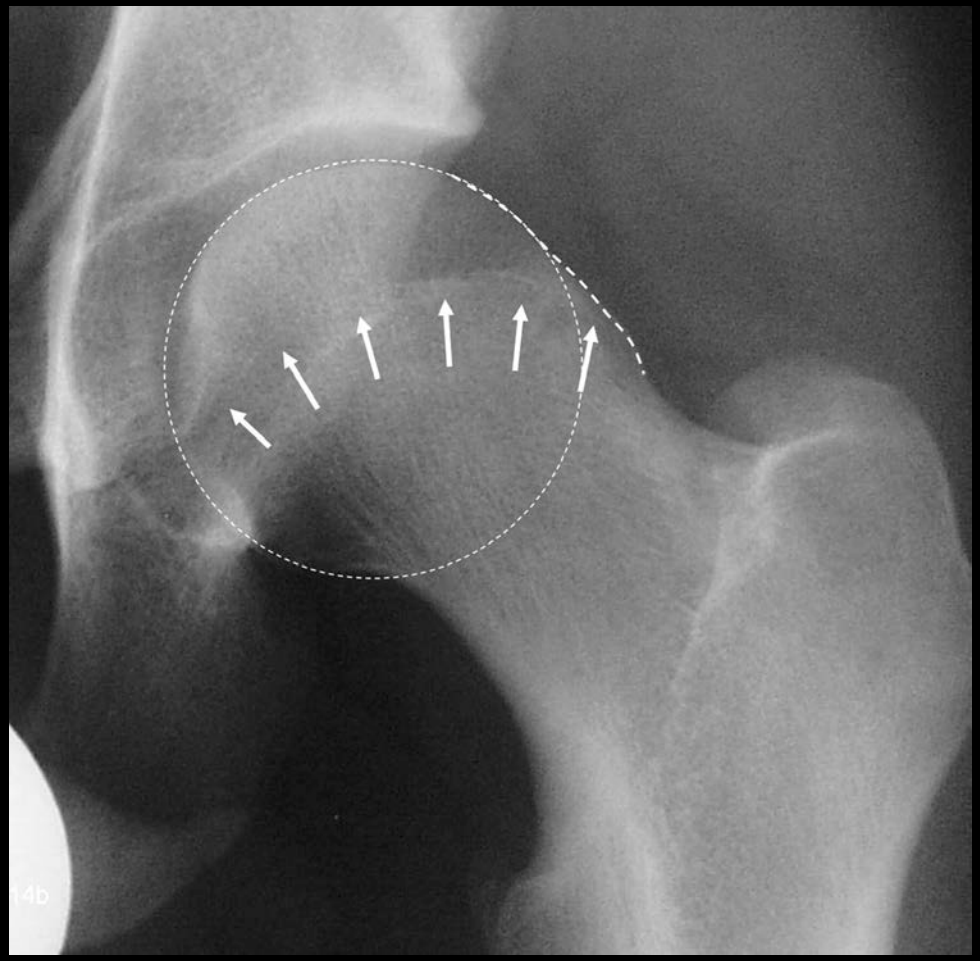
FAI – CAM type



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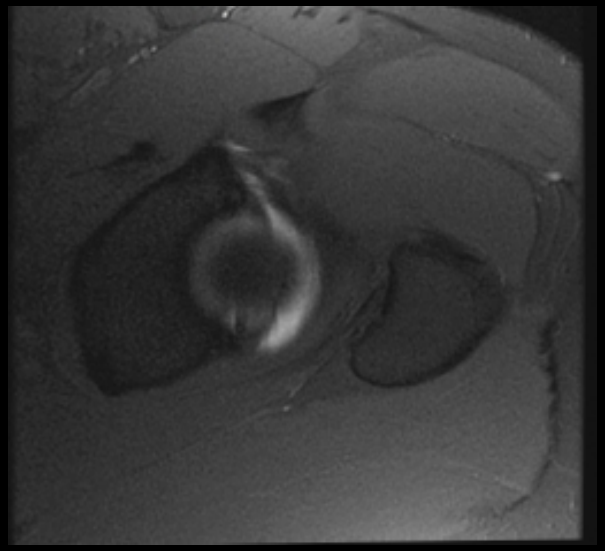
Labral tear

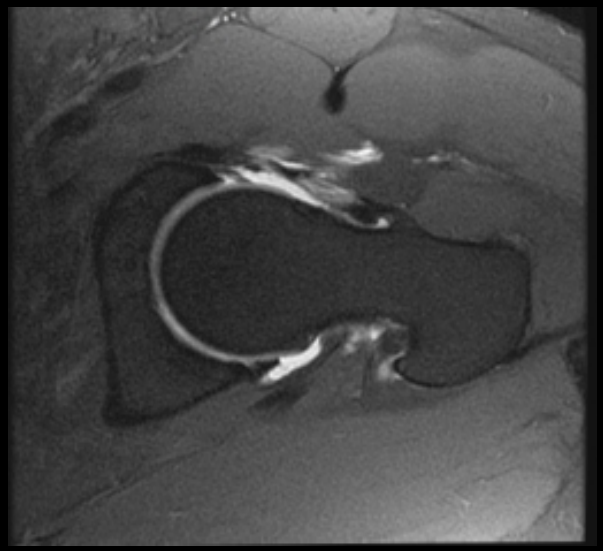
- MRI findings
  - Abnormal linear increased signal through the dark signal triangular labrum
  - Deformity or irregularity of the labrum
  - Detachment of the labrum
  - Associated paralabral cysts

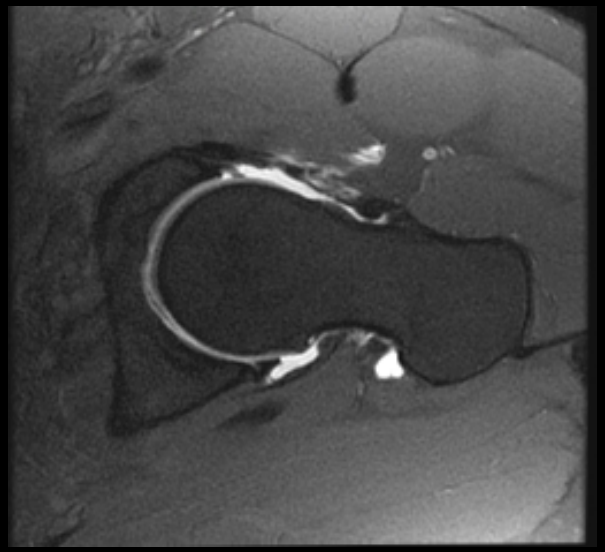
Labral tear

- Acute injury, chronic stress (FAI), DDH
- Pain and clicking
- MRI arthrography the best to evaluate labrum (and cartilage)

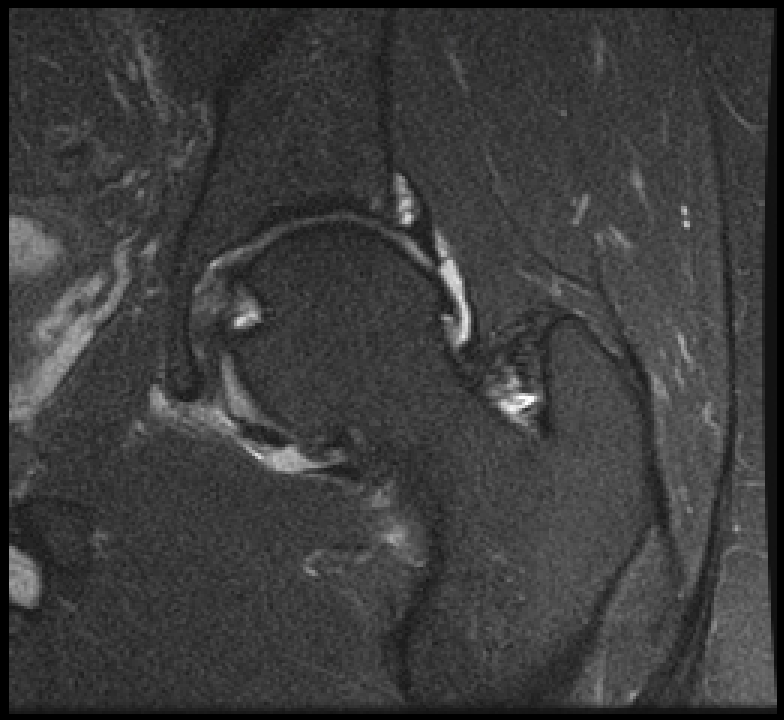
Labral tear



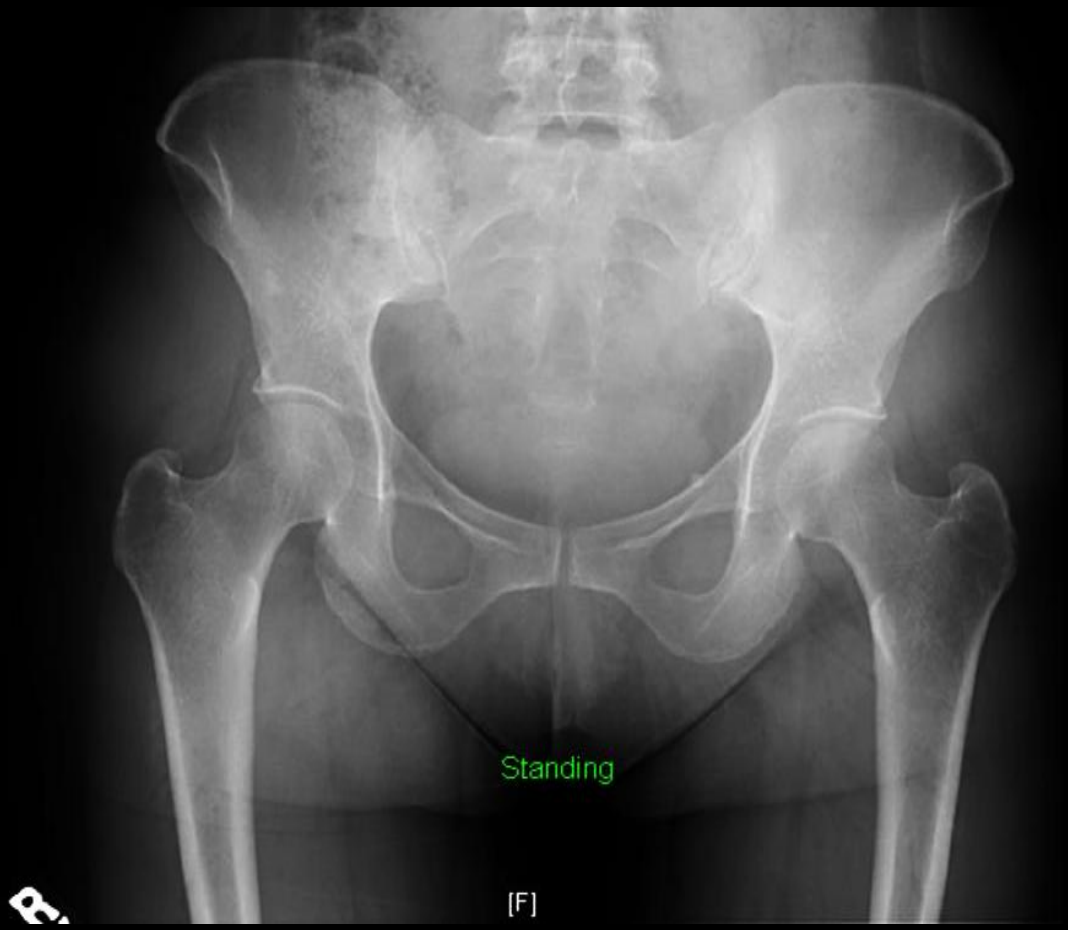




Labral tear



Case F



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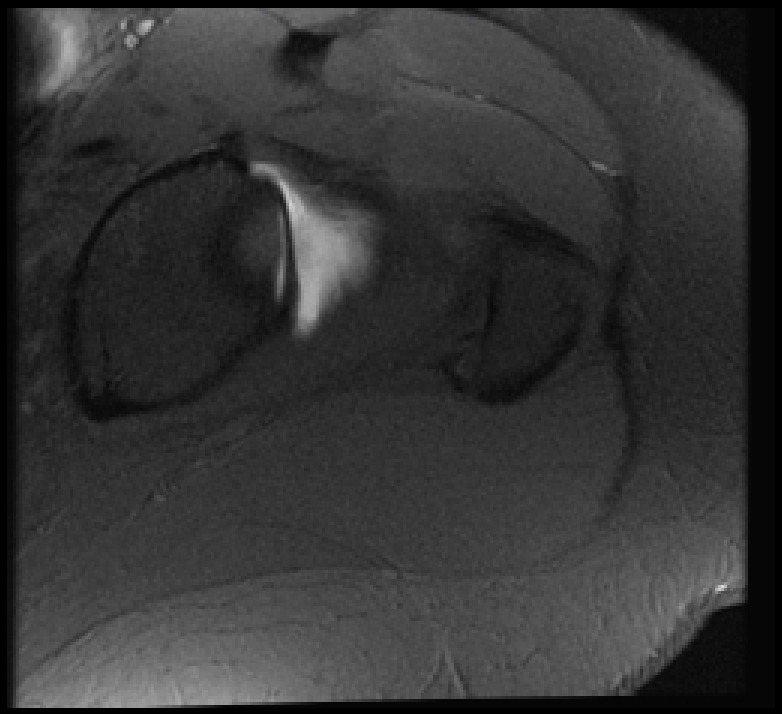

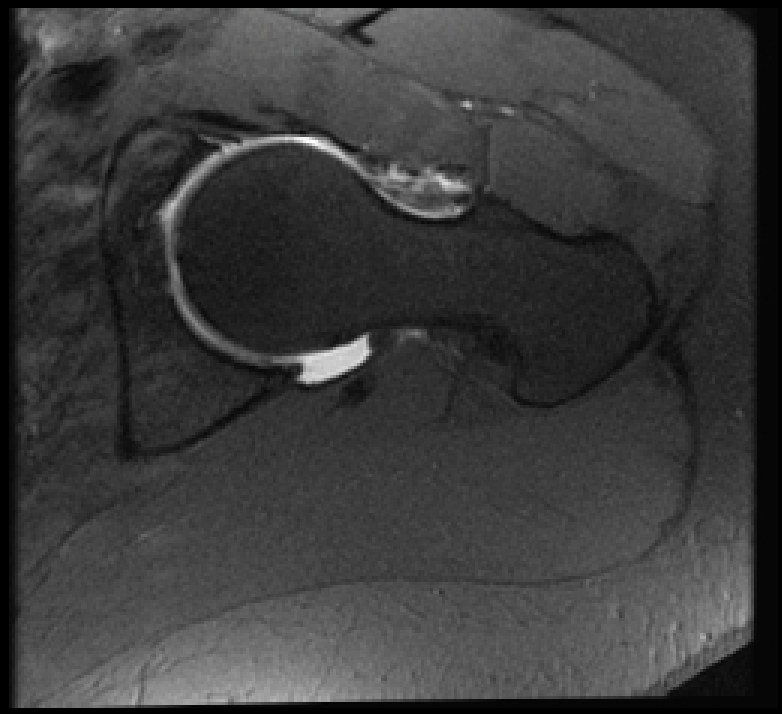

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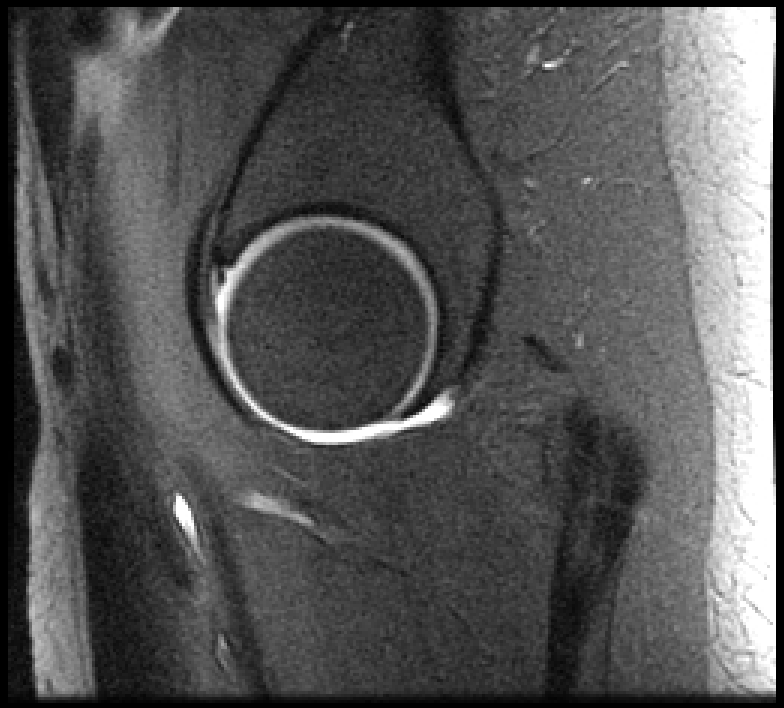

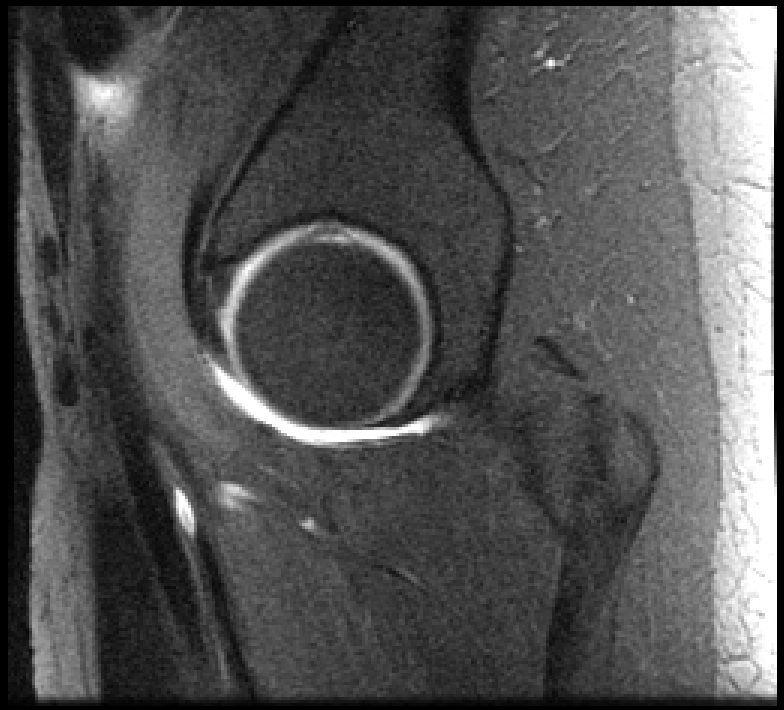

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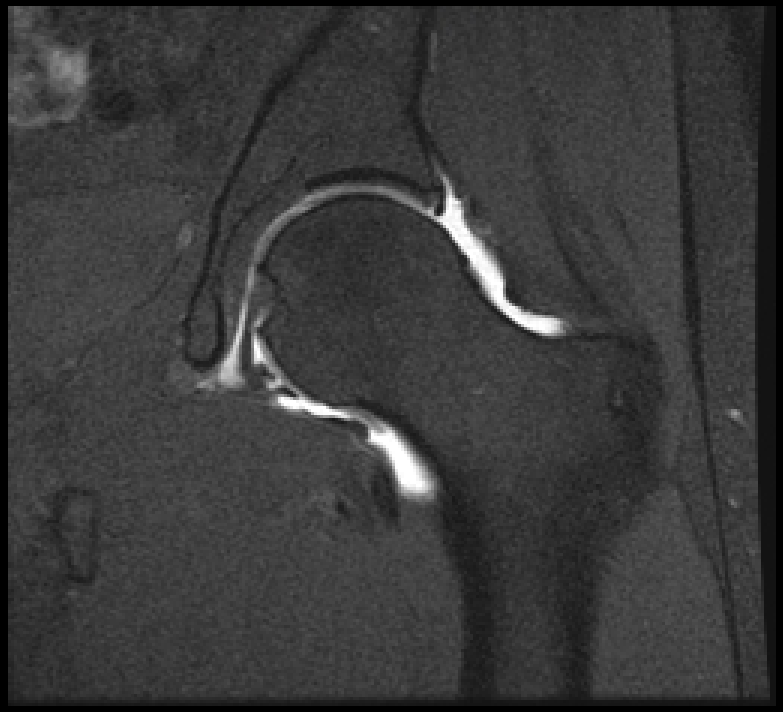
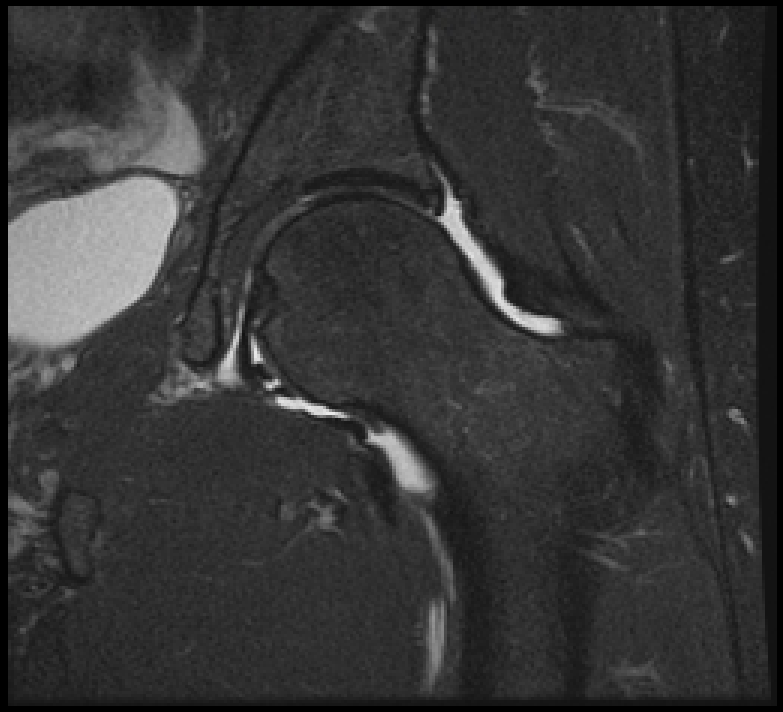
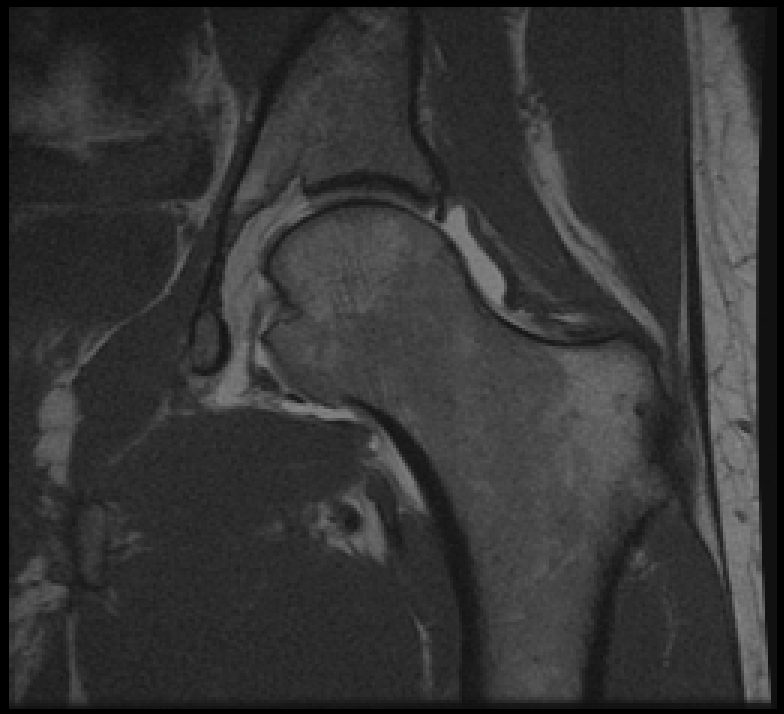
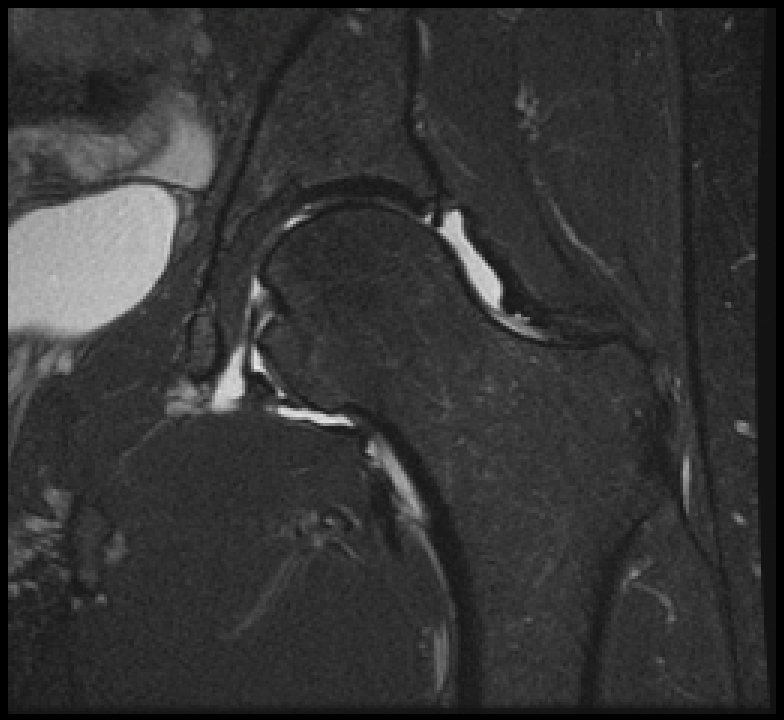




Labral tear





Conclusions

- Hip - complex joint with different anatomic structures causing pathology
- Imaging is the best way to evaluate pathology, including the hip joint
- In particular MRI is a great modality for all types of pathology

Thank you!

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References

- * All images taken from various websites have their references listed under the images . Other images with article references are from goldminer.arrs.org; under copyright laws. Some images also taken from the DUMC PACS.
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