

# RADIOLOGY 1: THE NOT-SO- FUNNY BONES

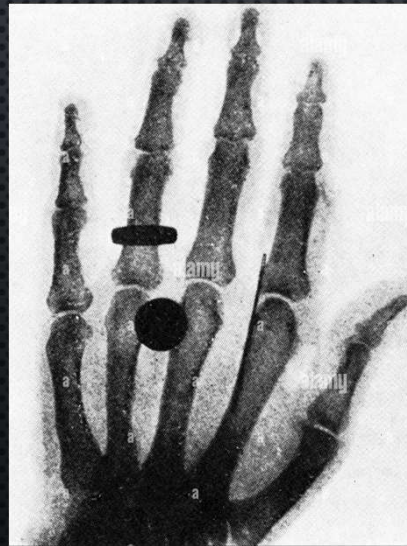
BROOKE BECKETT, MD  
ASSOCIATE PROFESSOR  
DIAGNOSTIC RADIOLOGY  
OHSU

NO RELEVANT DISCLOSURES

## OBJECTIVES:

- 1) DETERMINE APPROPRIATE RADIOGRAPHIC VIEWS FOR BONES AND JOINTS
- 2) DESCRIBE FRACTURE PATTERNS ON ROUTINE RADIOGRAPHY
- 3) UNDERSTAND THE BASICS OF ARTHRITIS IMAGING AND DIAGNOSIS
- 4) DISCUSS AGGRESSIVE VS. NON-AGGRESSIVE BONE TUMORS AND TUMOR-LIKE CONDITIONS

# RADIOGRAPHS – THE ACCIDENTAL DISCOVERY



- WILHELM RÖNTGEN (1845-1923)
- DISCOVERED X-RAYS WHEN EXPERIMENTING WITH A CATHODE RAY TUBE IN 1895
- CALLED THEM “X” RAYS BC HE DIDN’T KNOW WHAT THEY WERE!
- WON NOBEL PRIZE FOR PHYSICS IN 1901

# TISSUE APPEARANCE ON RADIOGRAPHS

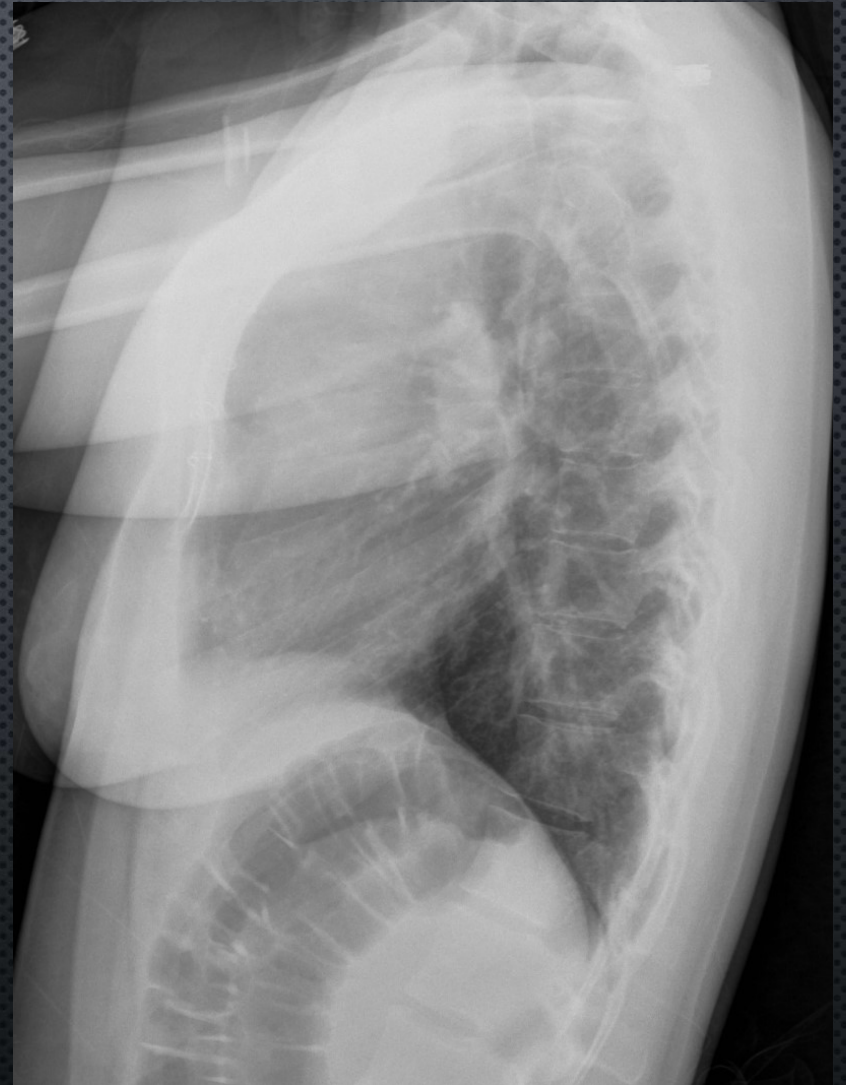
**Air**

**Fat**

**Water/tissue**

**Bone**

**Metal**



Tissue boundaries are seen only when the densities are *different* between the tissues



Gunshot wound to the upper arm

# MY PLUG FOR THE LOWLY RADIOGRAPH 😊

- MANTRA: ALWAYS, ALWAYS GET A RADIOGRAPH FIRST. ALWAYS.
  - RADIOGRAPHS ARE THE WORKHORSE OF MSK RADIOLOGY
  - EXQUISITE BONY DETAIL, WHETHER FOR TRAUMA, TUMORS, INFECTIONS
  - JOINT SPACES, ALIGNMENT
  - SOFT TISSUES
- BONUS = CHEAP, LITTLE RADIATION, AVAILABLE



Google images



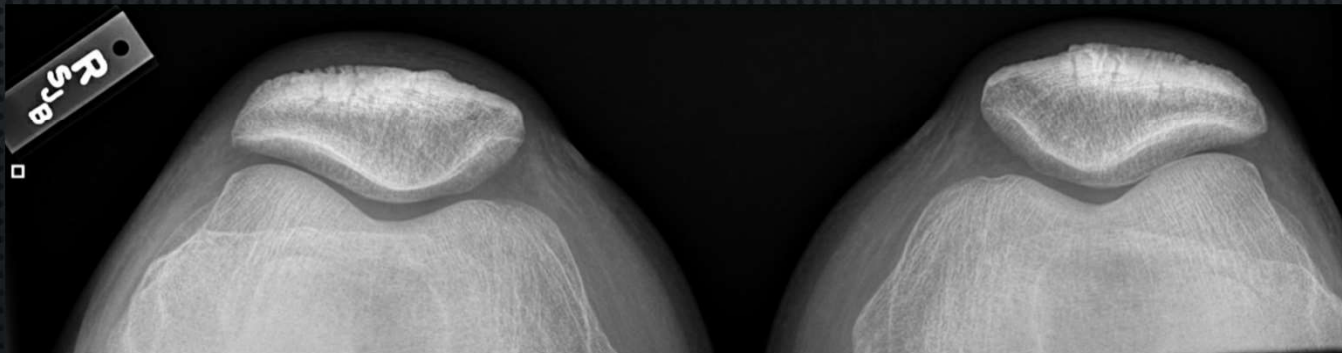
# STANDARD VIEWS

- DIFFERENT FOR EACH BONE OR JOINT
- IN GENERAL:
  - 3 VIEWS OF A JOINT (KNEE, SHOULDER, ANKLE, WRIST)
    - EXCEPTION IS HIP – 2 VIEWS WITH AP PELVIS BEST
  - 2 VIEWS OF LONG BONES (FEMUR, HUMERUS, FOREARM)
  - 3 VIEWS CERVICAL SPINE
  - 2 VIEWS THORACIC, LUMBAR SPINE
  - PELVIS – MANY POSSIBLE VIEWS

















# FRACTURES

- DESCRIBE:
  - LOCATION
  - ORIENTATION
  - SIMPLE OR COMMINUTED
  - DISPLACEMENT
  - ANGULATION
  - INTRAARTICULAR EXTENSION









# JOINTS

- OSTEOARTHRITIS
- INFLAMMATORY ARTHRITIS
- INFECTION

# Hands/Feet

Are there erosions?



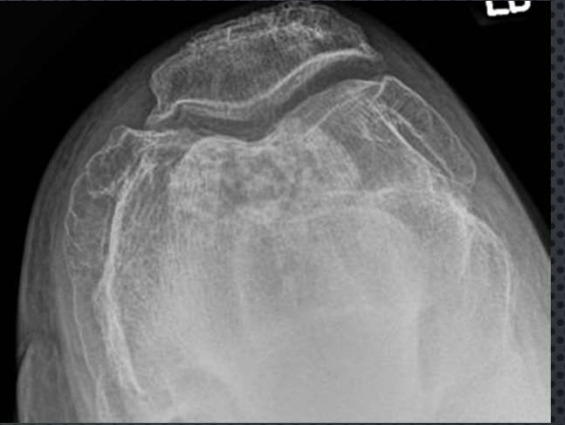
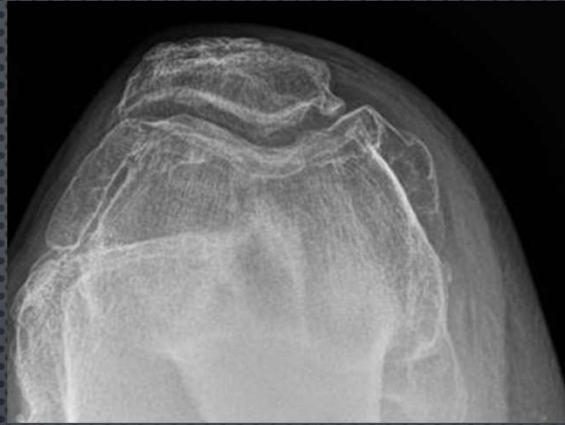
**\*IP ankylosis\***

EOA

PSA



Osteoarthritis









Rheumatoid arthritis





Psoriatic arthritis

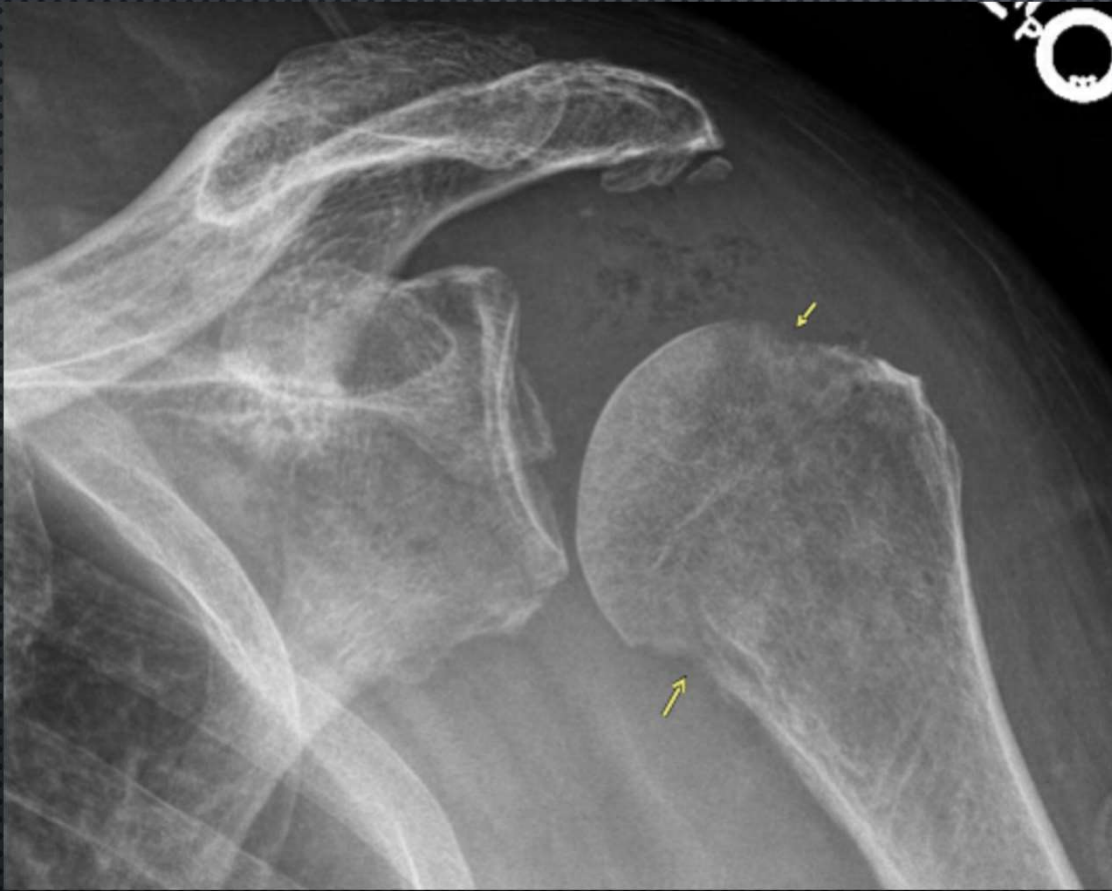


Psoriatic arthritis

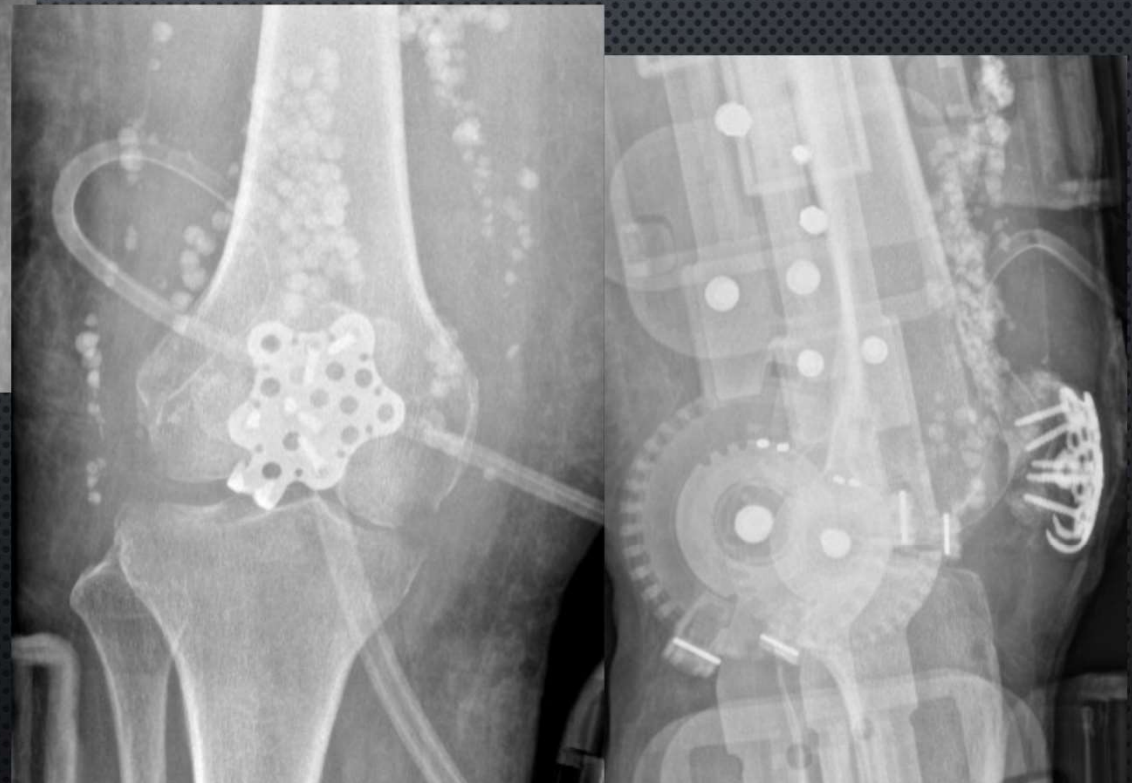




Ankylosing spondylitis



Septic arthritis/osteomyelitis



Septic arthritis/osteo





More infected toes!

# BONE TUMOR BASICS

## KEY POINT:

- BONE TUMORS ARE CHARACTERIZED RADIOGRAPHICALLY
- THEY ARE STAGED BY MRI
- RADIOGRAPHIC DESCRIPTORS THAT HELP DETERMINE WHETHER A LESION IS NON-AGGRESSIVE VS. AGGRESSIVE AS WELL AS DDX:
  - LOCATION
  - ZONE OF TRANSITION (NARROW, WIDE)
  - PATTERN OF DESTRUCTION (GEOGRAPHIC, MOTH-EATEN, PERMEATIVE)
  - MATRIX (CHONDROID, OSSEOUS, FIBROUS)
  - PERIOSTEAL REACTION (SOLID, INTERRUPTED, LAMELLATED)
  - CORTICAL DESTRUCTION (+/- VISIBLE ST MASS)
  - (PATIENT AGE)



Liposclerosing myxofibrous tumor

Benign fibro-osseous lesion





Enchondroma



Osteosarcoma or Ewing Sarcoma

Osteosarcoma



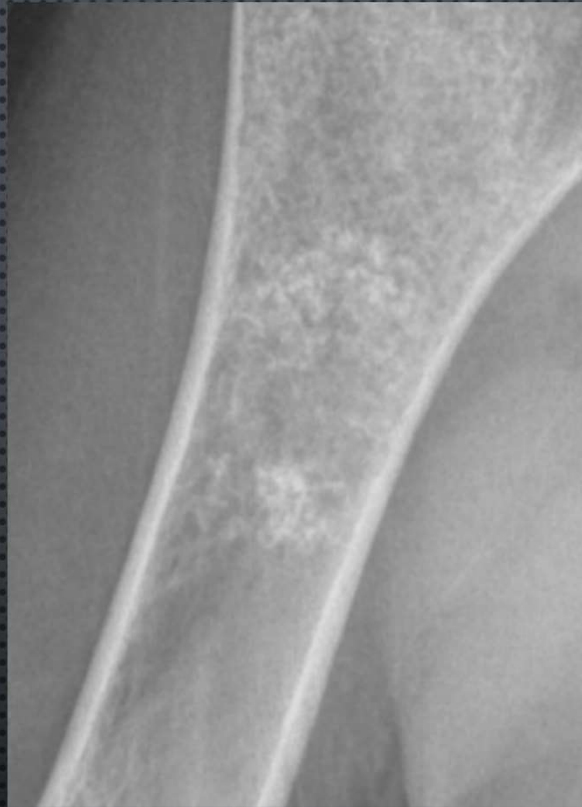
Giant cell tumor



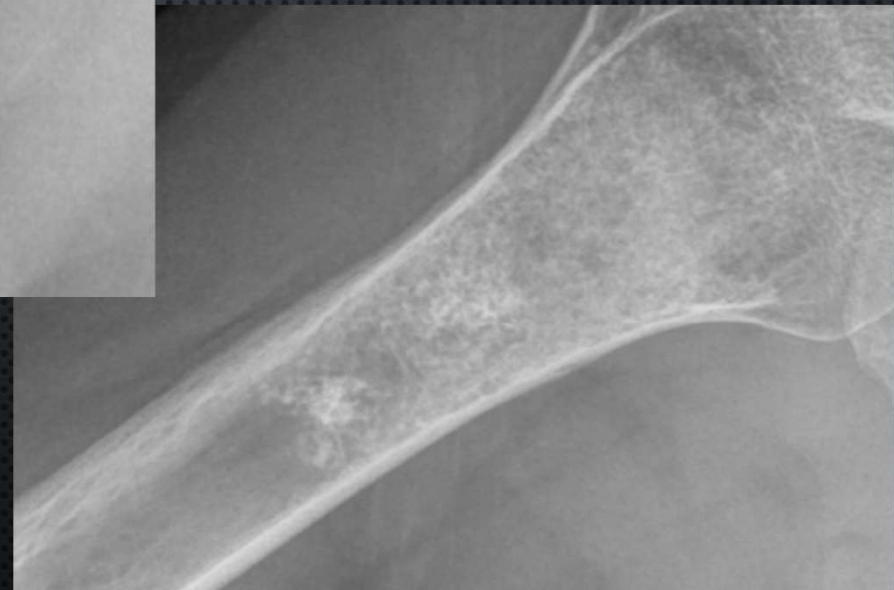


Fibrous dysplasia





Low-grade chondroid lesion



# MY PLUG FOR THE LOWLY RADIOGRAPH 😊

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  - EXQUISITE BONY DETAIL, WHETHER FOR TRAUMA, TUMORS, INFECTIONS
  - JOINT SPACES, ALIGNMENT
  - SOFT TISSUES
- BONUS = CHEAP, LITTLE RADIATION, AVAILABLE



THANK YOU!

# RADIOLOGY 2: THE TENDON-CY TO TEAR

BROOKE BECKETT, MD

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DIAGNOSTIC RADIOLOGY

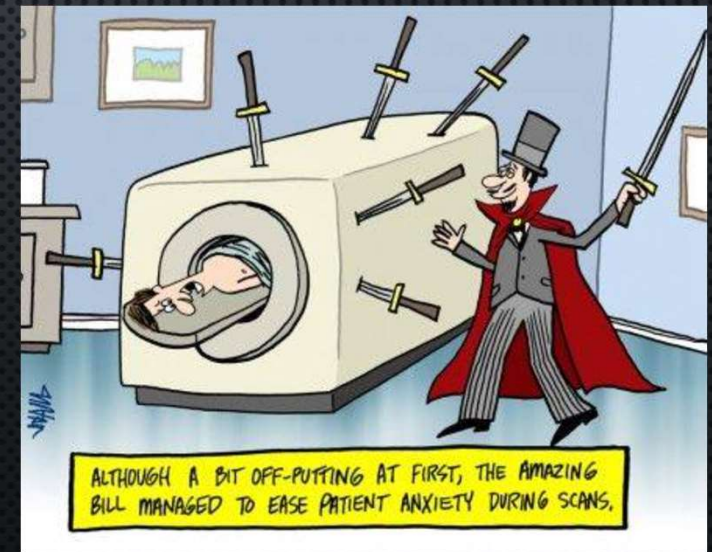
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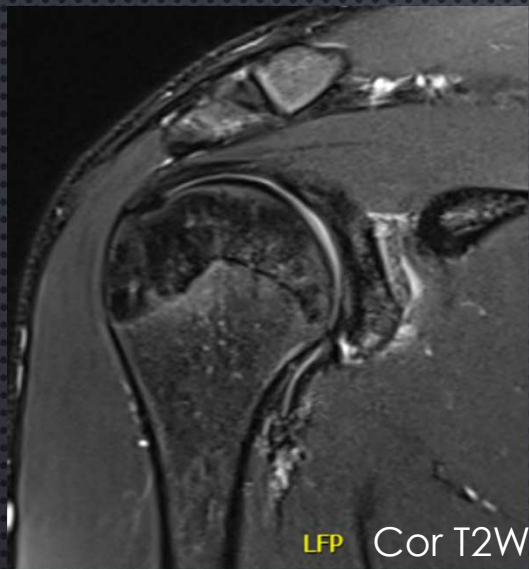
## OBJECTIVES:

- 1) RECOGNIZE BASIC MRI SEQUENCES USED FOR MSK IMAGING
- 2) UNDERSTAND APPROPRIATE ORDERING PRACTICES FOR ADVANCED MSK IMAGING, INCLUDING MRI, CT AND US

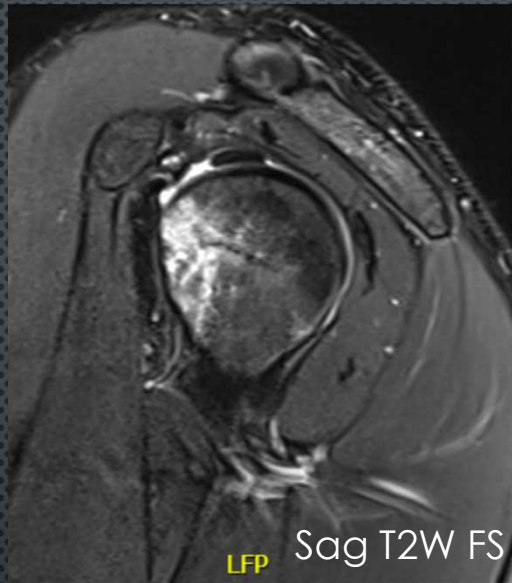
# THE COOL (AND EXPENSIVE) MRI

- MRI VERY SENSITIVE FOR SOFT TISSUE AND MARROW PATHOLOGY
  - TRAUMA: JOINT DERANGEMENT, OCCULT FXS
  - ST AND BONY MASSES: LOCALIZATION, CHARACTERIZATION
    - \*\* MUST BE IN CONJUNCTION WITH RADIOGRAPH
  - INFECTION: MOST SENSITIVE FOR EARLY OSTEOMYELITIS, ST ABSCESS, EXTENT OF ST/BONE INVOLVEMENT

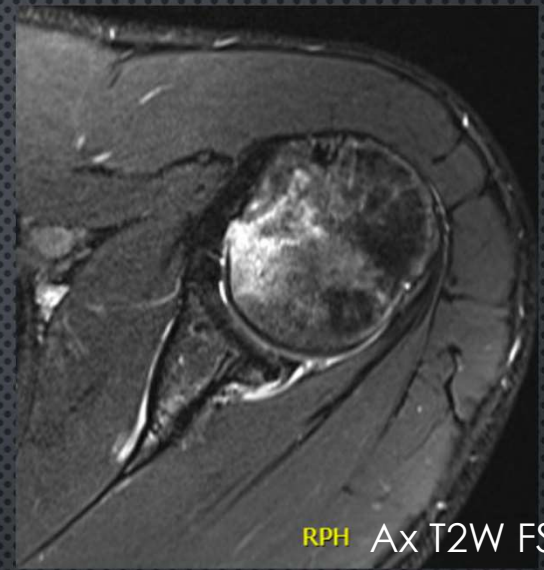




LFP Cor T2W FS



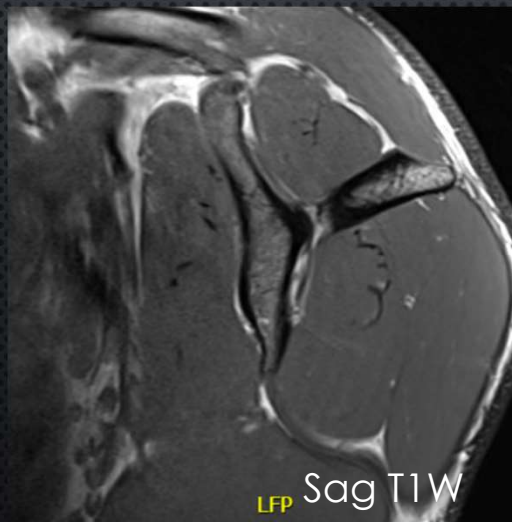
LFP Sag T2W FS



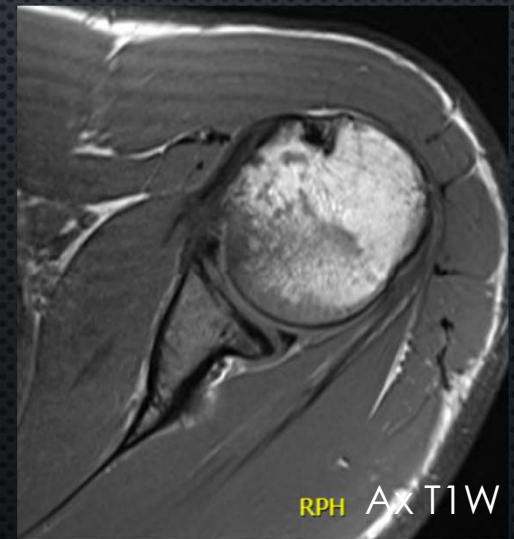
RPH Ax T2W FS



LFP Cor PD

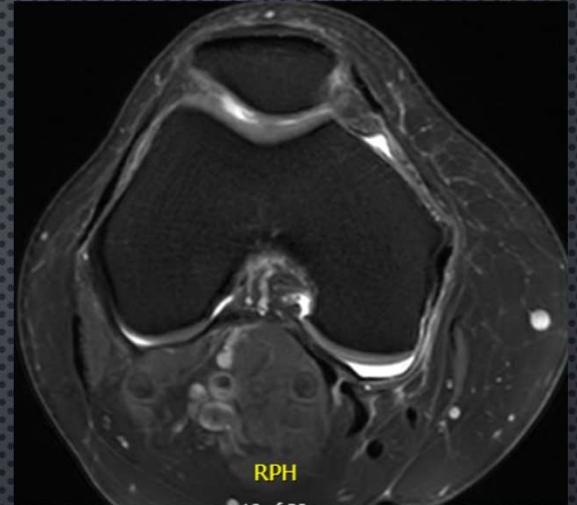
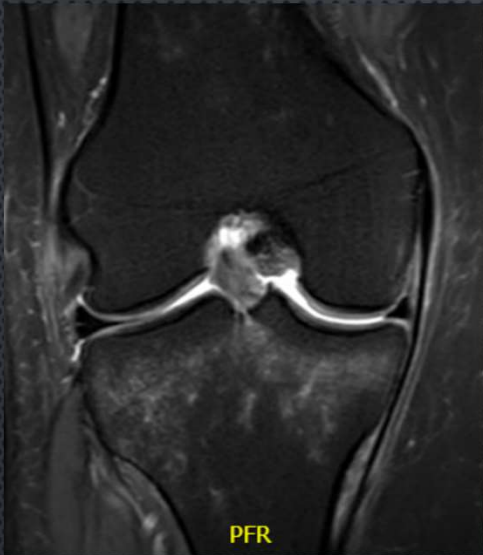


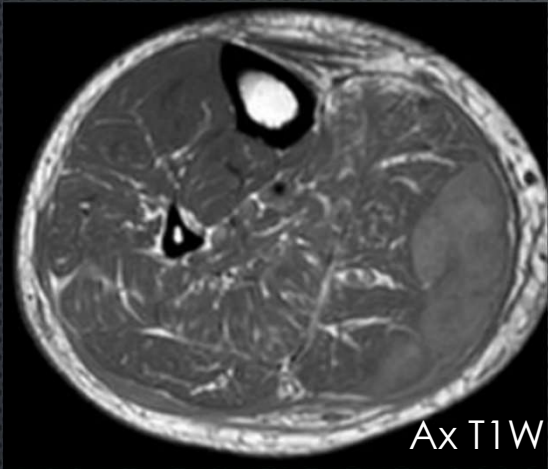
LFP Sag T1W



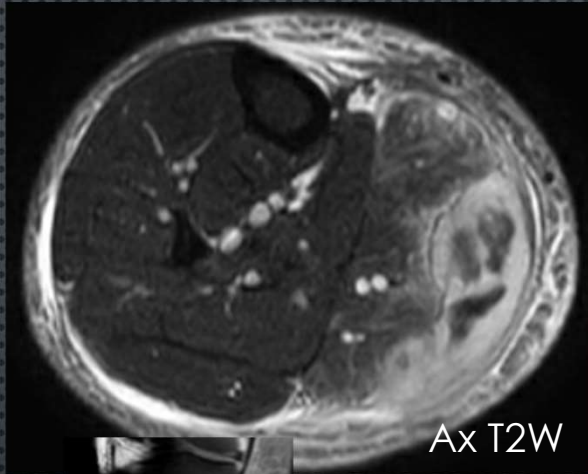
RPH Ax T1W



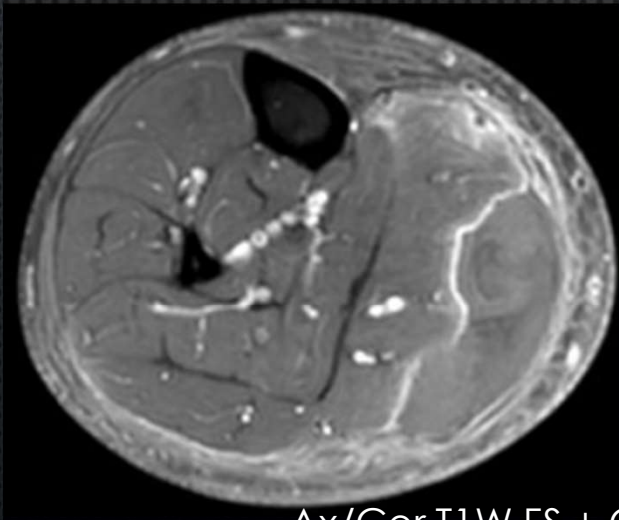




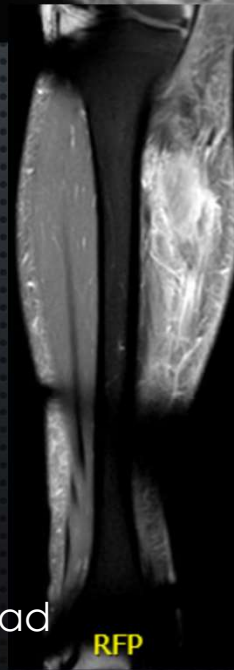
Ax T1W



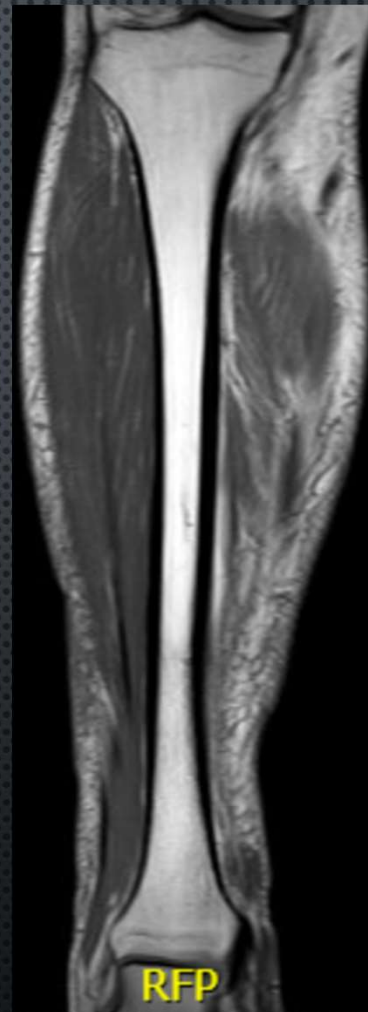
Ax T2W



Ax/Cor T1W FS + Gad

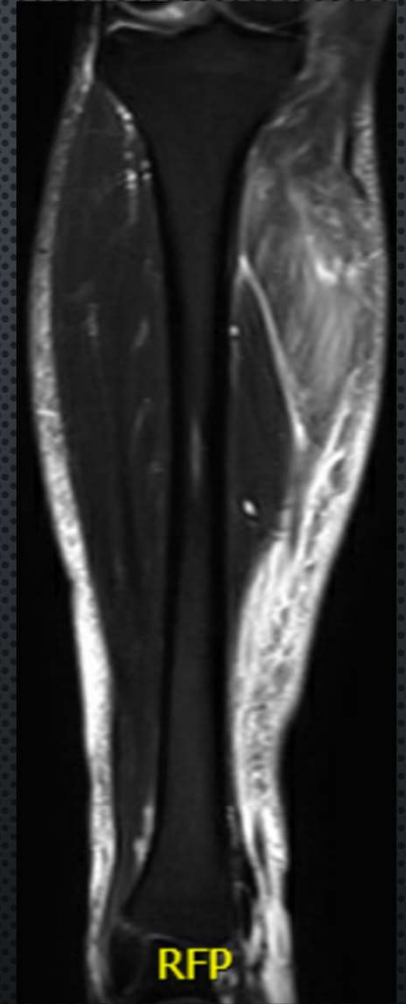


RFP



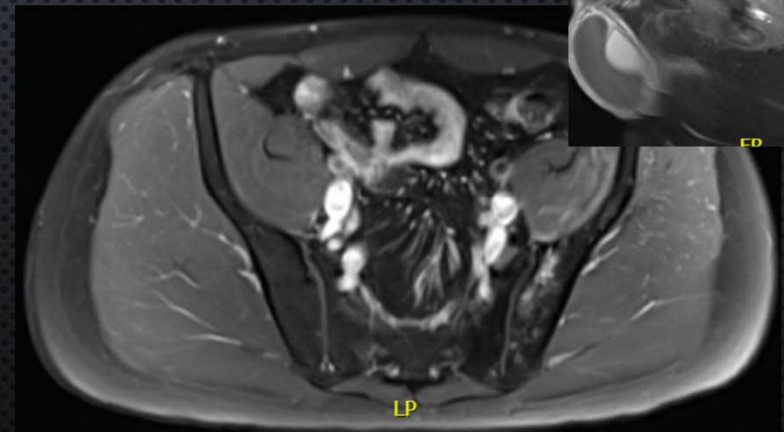
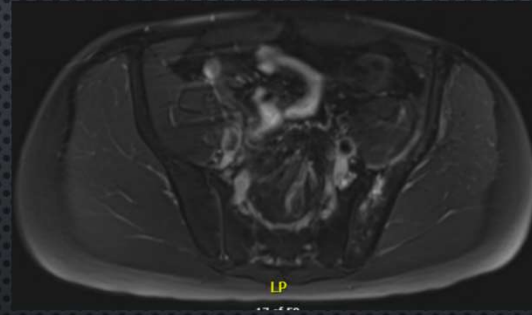
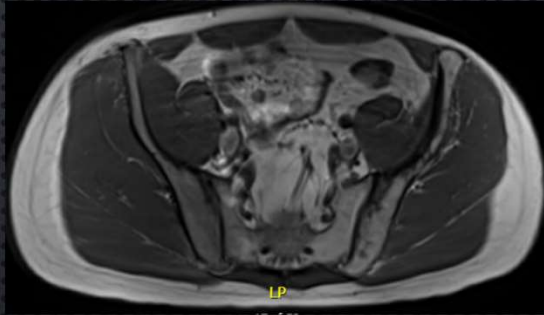
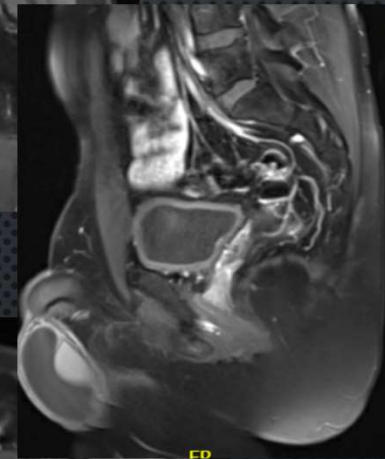
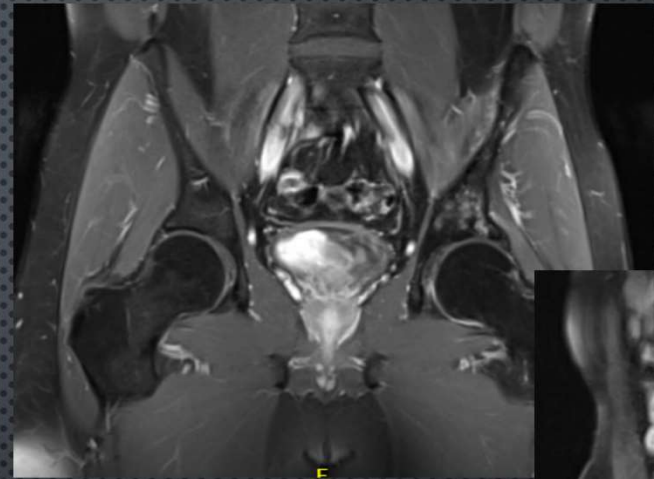
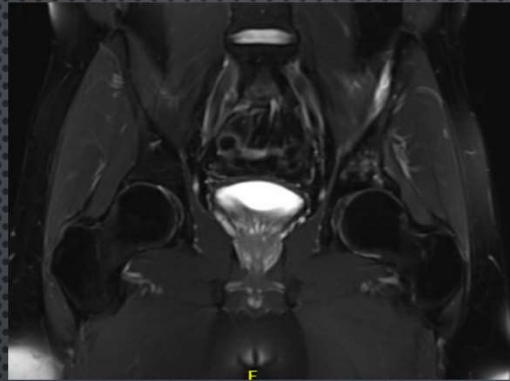
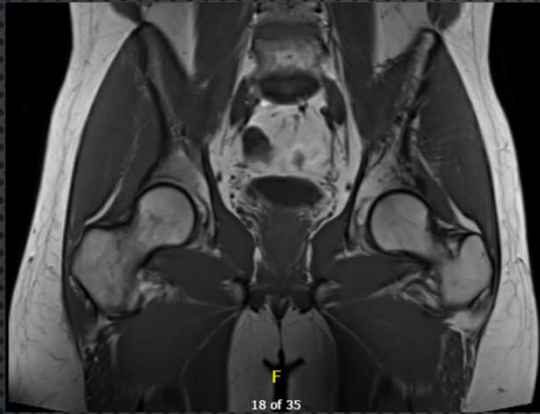
RFP

Cor T1W



RFP

Cor STIR



T1W

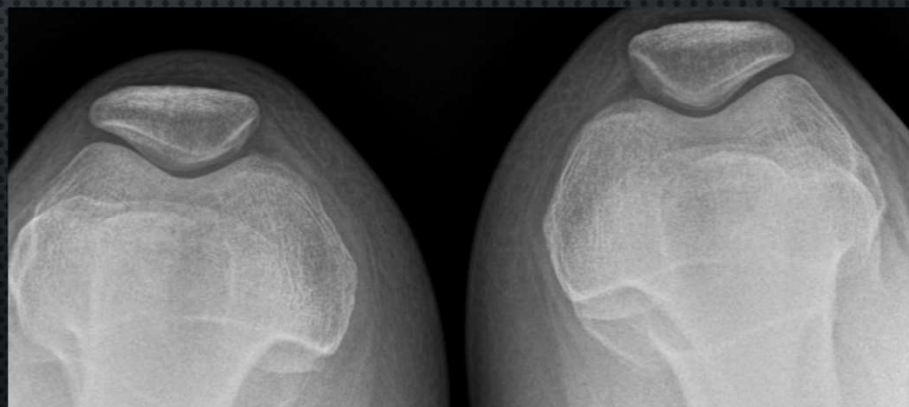
T2W

Postcontrast

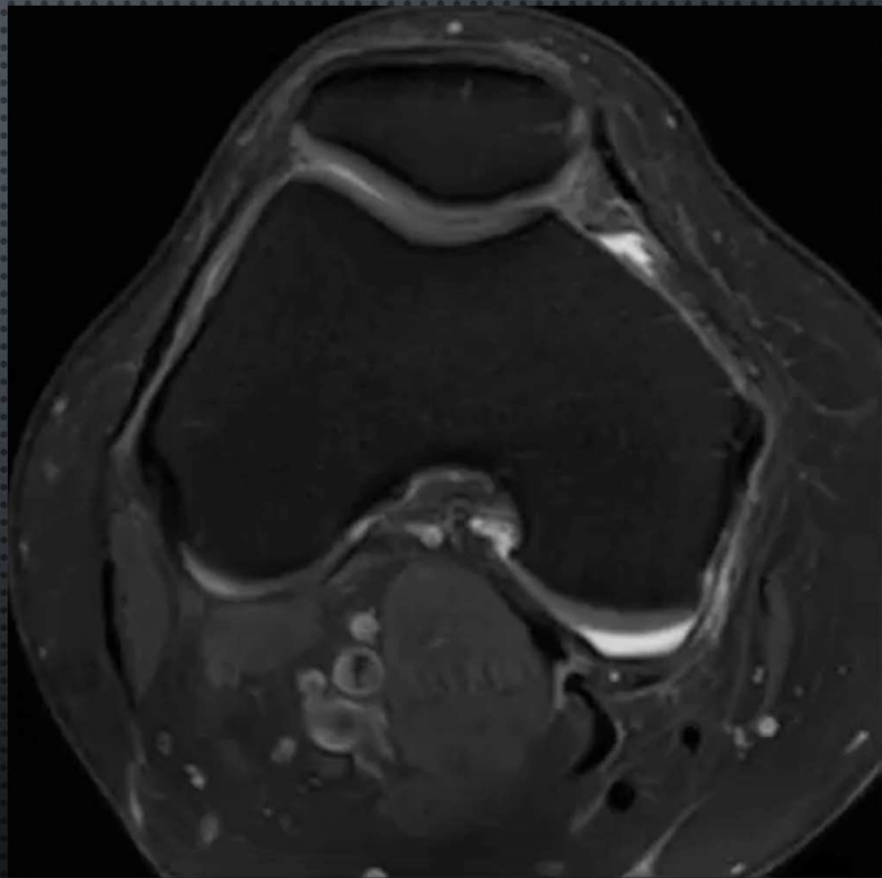
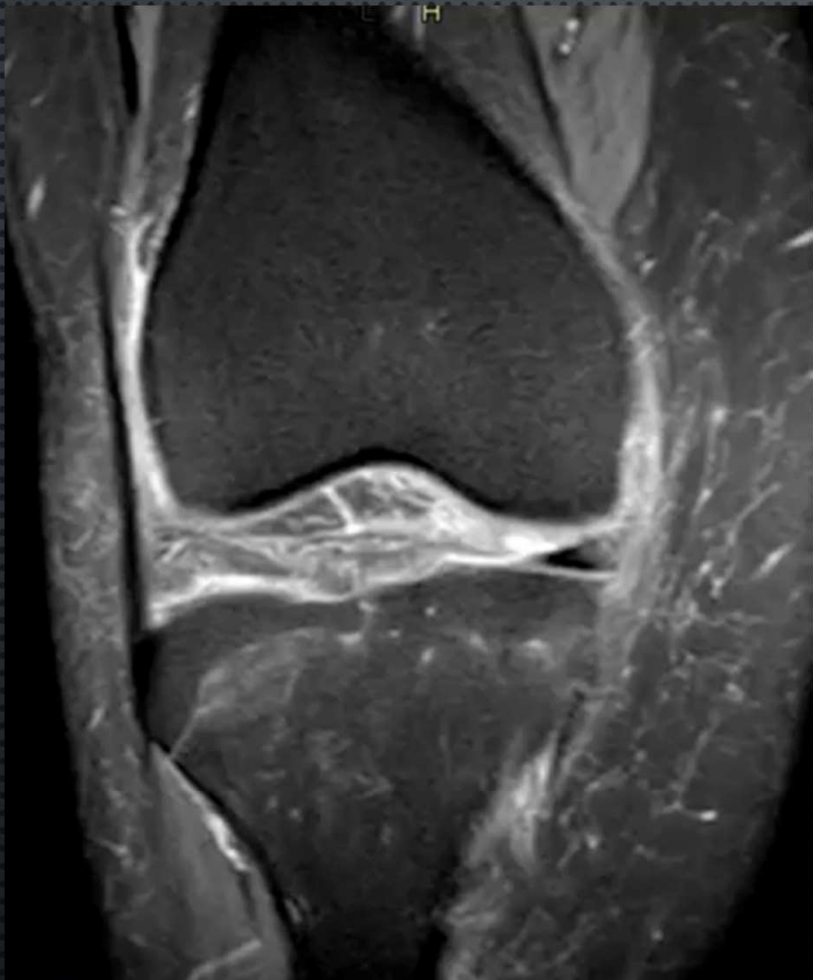
# JOINTS

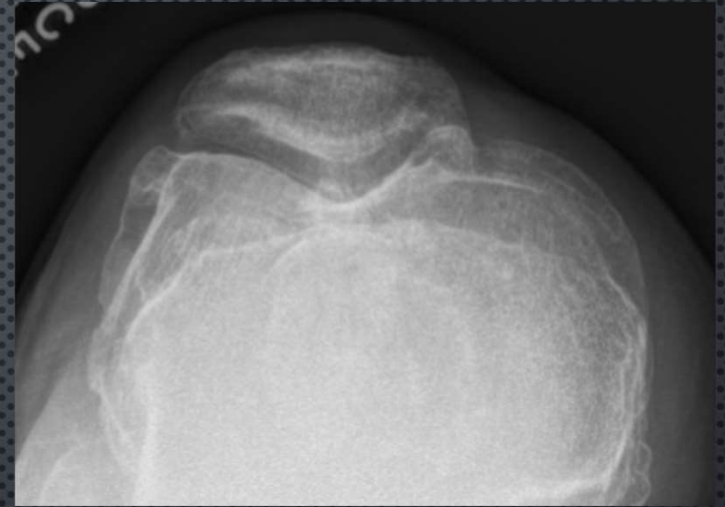


- MRI BY FAR THE BEST IMAGING MODALITY FOR INTERNAL DERANGEMENT OF JOINTS, INCLUDING ACUTE AND CHRONIC PAIN/INJURY
- CONTRAST NEVER INDICATED
- BACK TO MY MANTRA: ALWAYS GET A RADIOGRAPH FIRST
  - \*FINDINGS MAY PRECLUDE NEED FOR MRI
  - \*SURGEONS WILL NEED THEM 😊

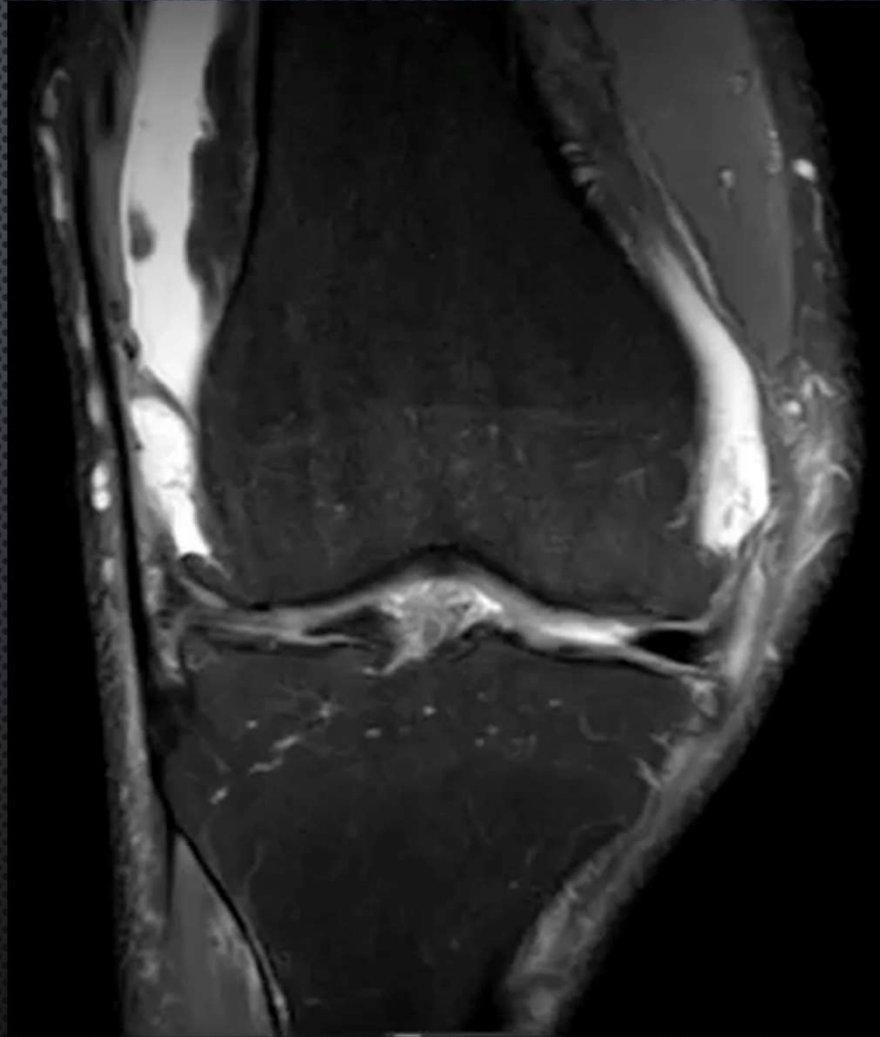


63 yo acute knee injury





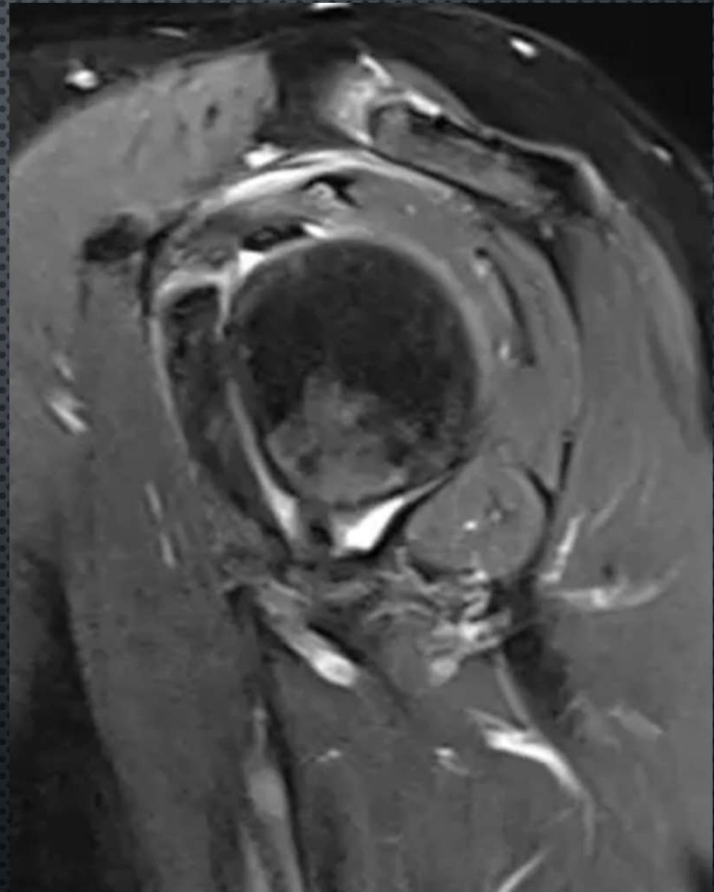
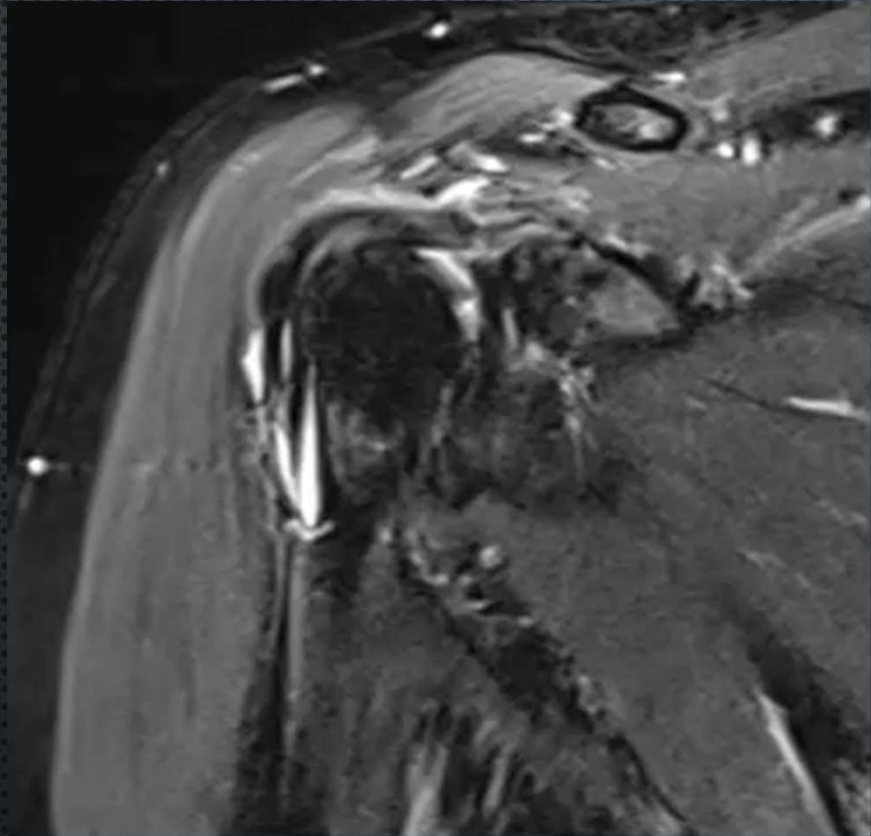
71 yo minor injury to  
the knee, acute on  
chronic pain





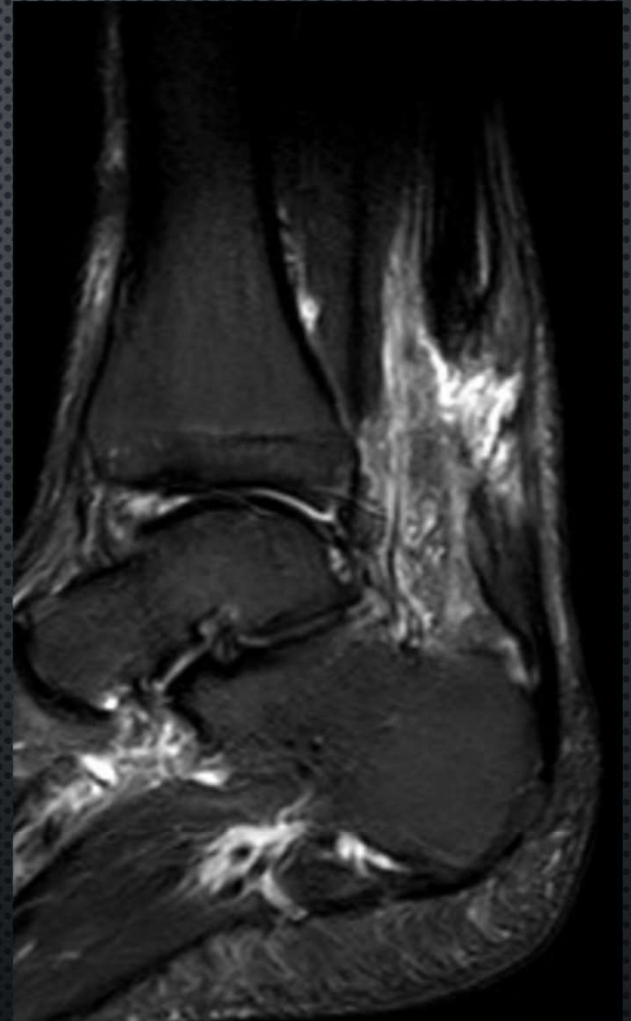
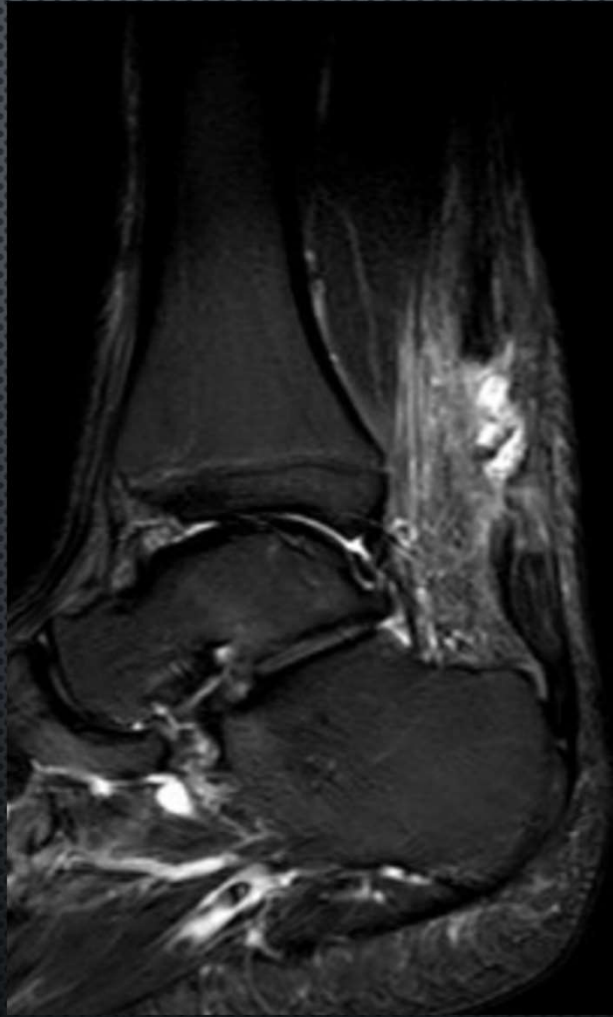
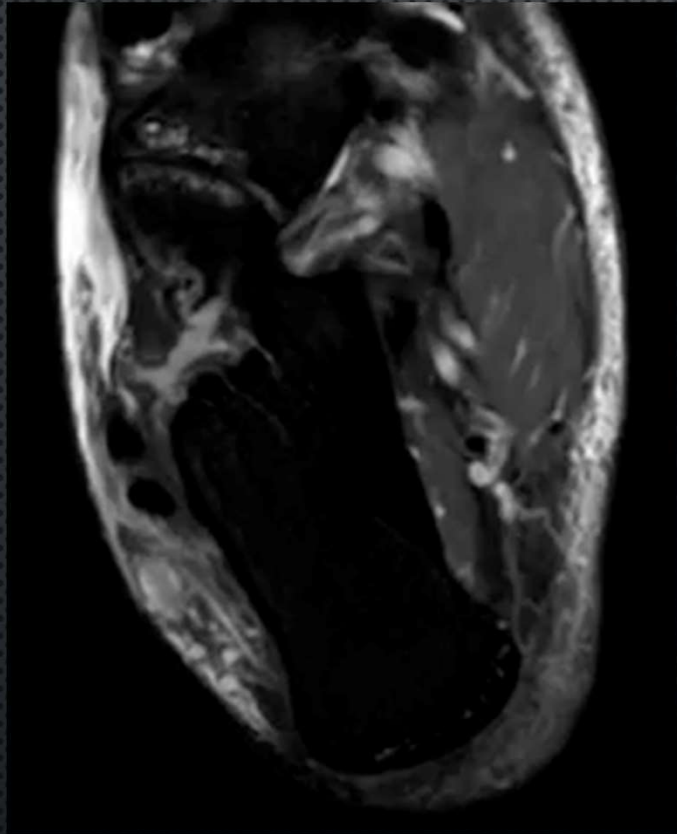


48 yo acute on chronic  
shoulder pain, no recent  
injury





Rec flag FB  
player, acute  
pop and pain  
with foot  
planting



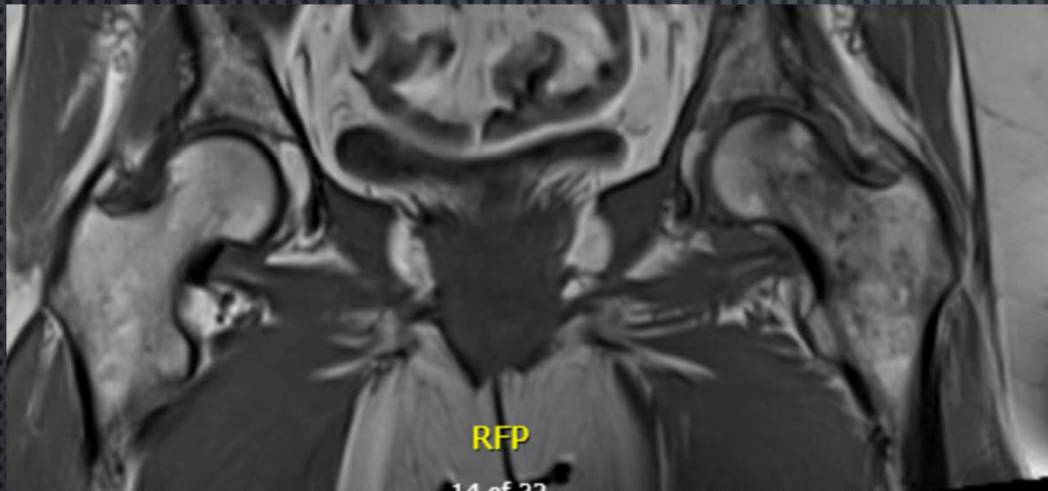
# OCCULT/INSUFFICIENCY FRACTURES

- IN THE SETTING OF OSTEOPENIA, MRI IS THE OPTIMAL MODALITY TO ASSESS FOR RADIOGRAPHICALLY OCCULT FRACTURES
  - SPECIFICALLY, GLF WITH CONCERN FOR PROX FEMORAL FX
  - NONTRAUMATIC ACUTE SPINE, PELVIS OR LE PAIN WITH CONCERN FOR INSUFFICIENCY FX
  - \*CONTRAST NOT NECESSARY
- ALSO OPTIMAL MODALITY TO EVAL FOR RADIOGRAPHICALLY OCCULT STRESS INJURIES, AND TO GRADE INJURY

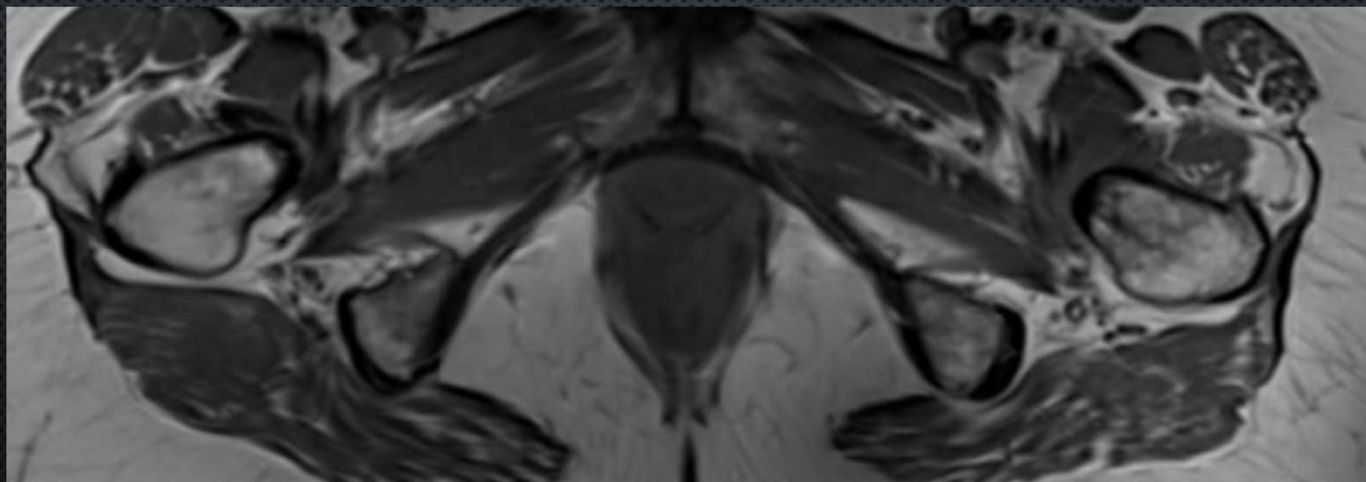
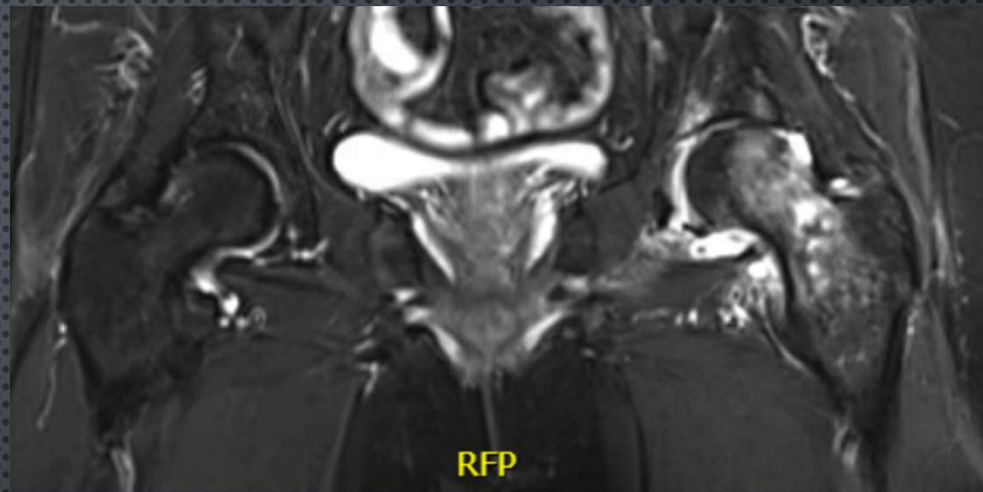




70 yo woman, minor fall with left hip pain



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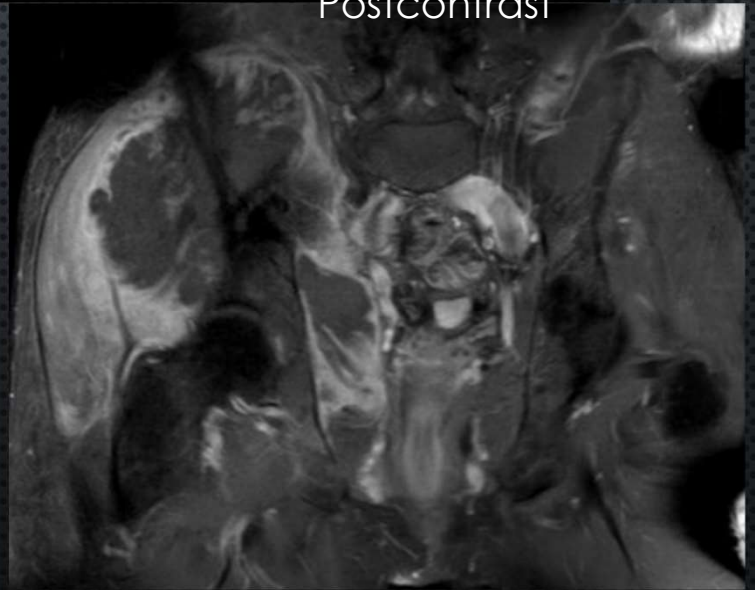
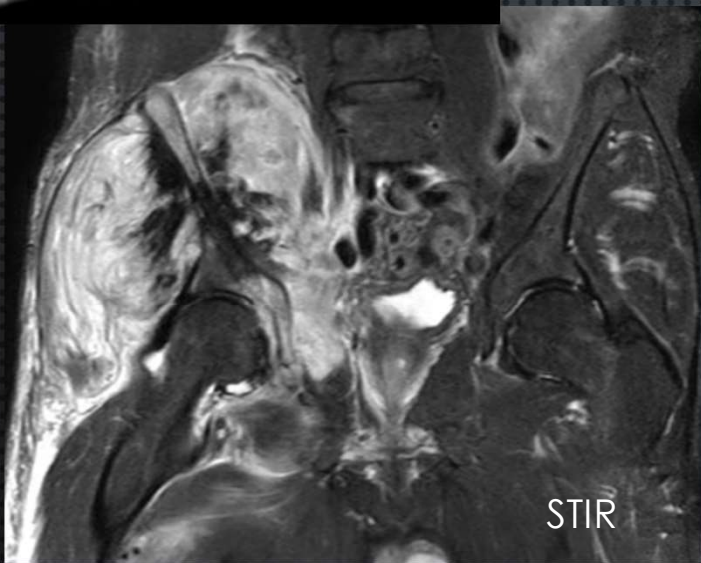
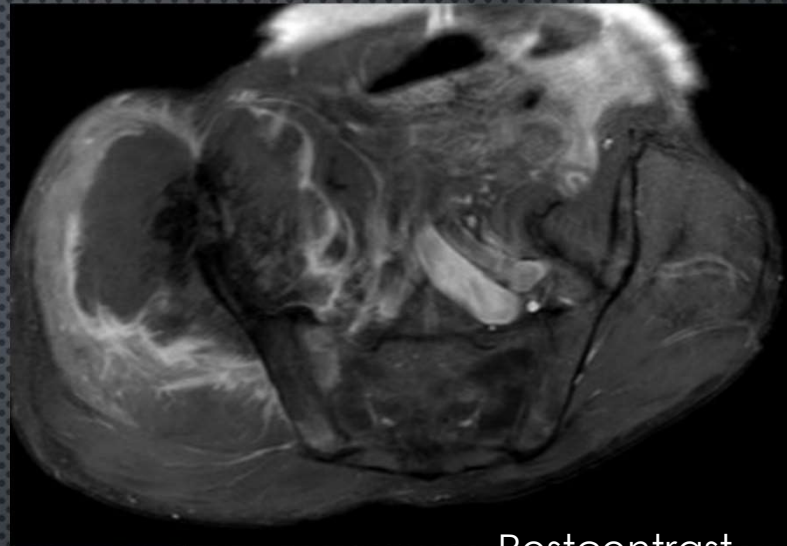
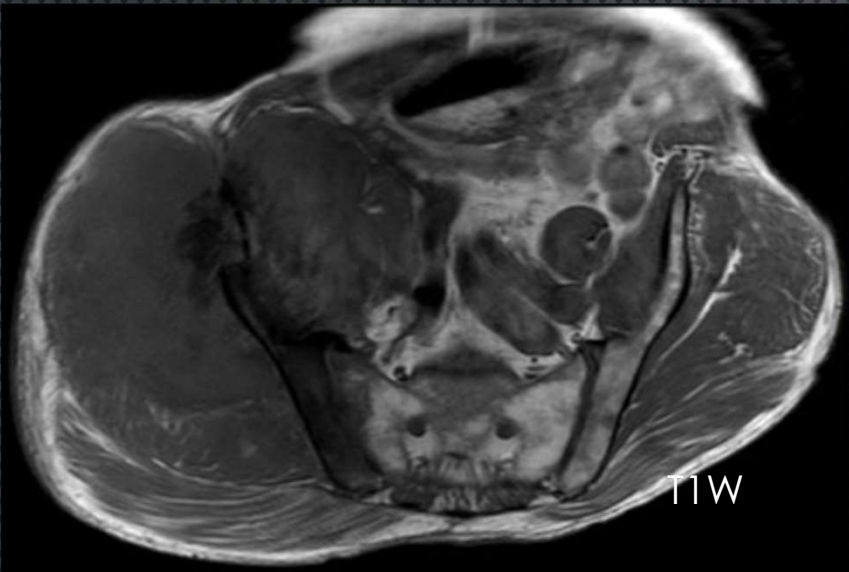
# INFECTION/TUMOR

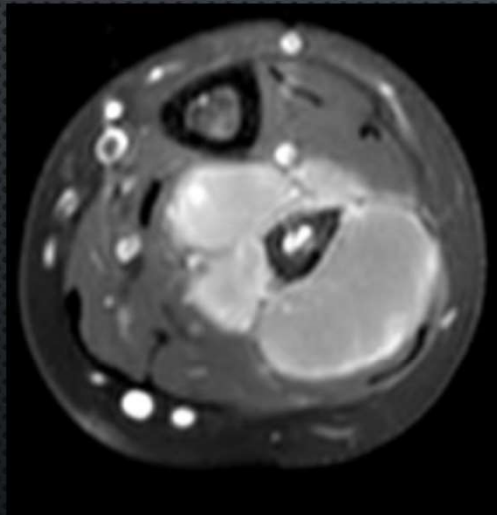
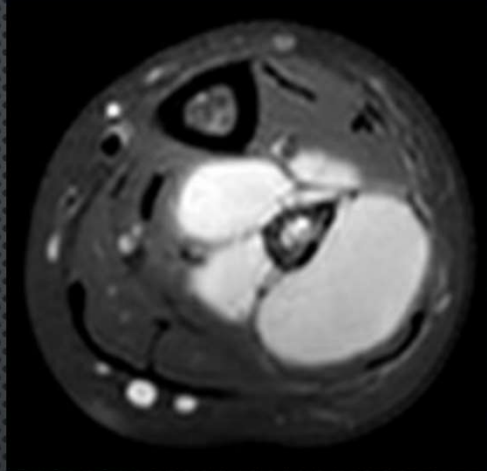
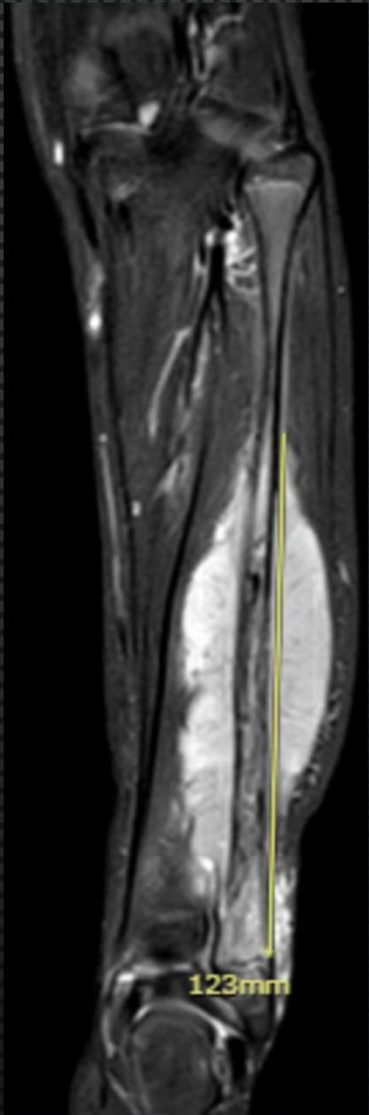
- ST AND BONY MASSES: LOCALIZATION, CHARACTERIZATION
  - \*\* MUST BE IN CONJUNCTION WITH RADIOGRAPH
  - WITH CONTRAST PLEASE
- INFECTION: MOST SENSITIVE FOR EARLY OSTEOMYELITIS, ST ABSCESS, EXTENT OF ST/BONE INVOLVEMENT
  - CONTRAST NOT NEEDED FOR EVALUATION OF OSTEOMYELITIS
  - HOWEVER, VERY HELPFUL FOR ABSCESS, EXTENT OF ST INFX, AND EVIDENCE OF ST ISCHEMIA





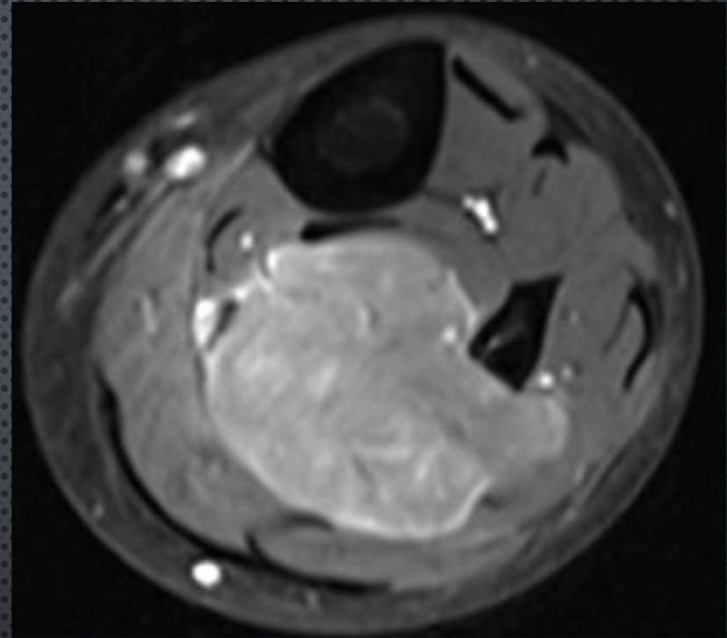
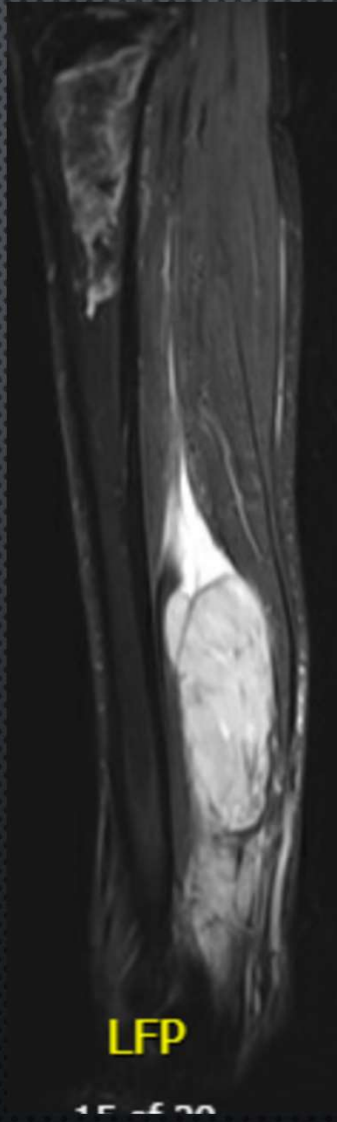
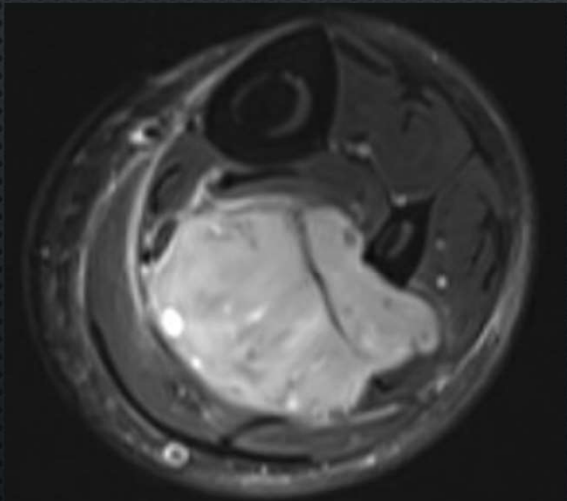
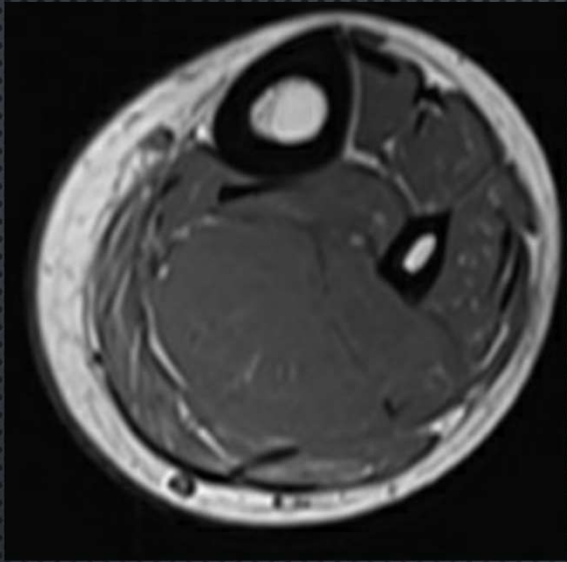
65 yo osteosarcoma





4 yo Ewing sarcoma

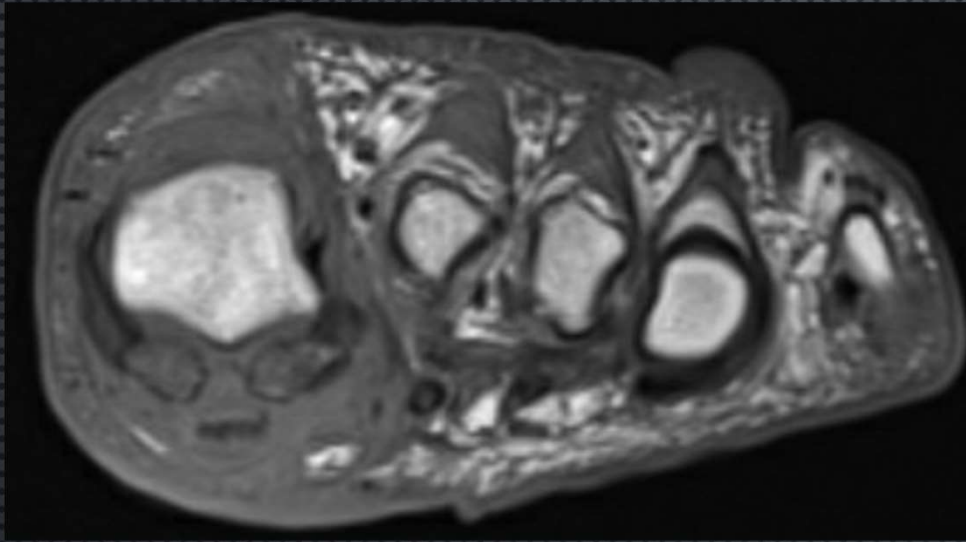




ST masses characterized  
and staged with MRI

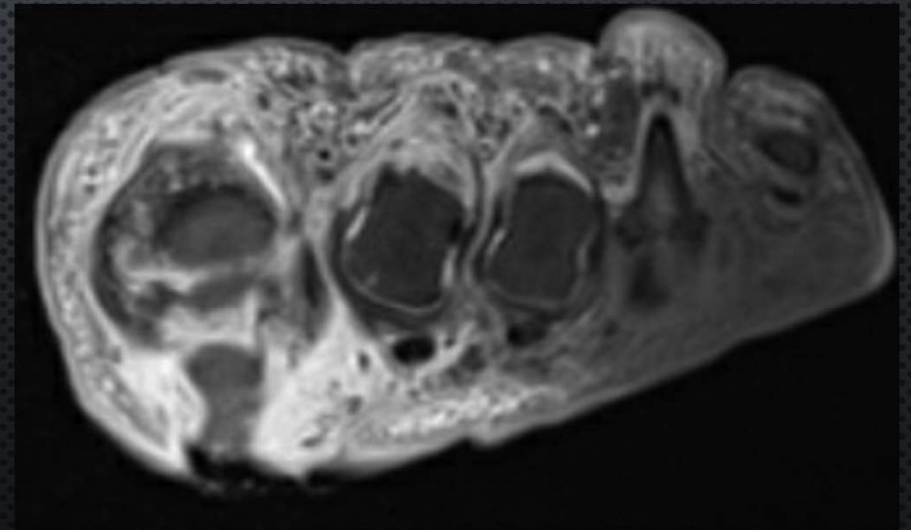
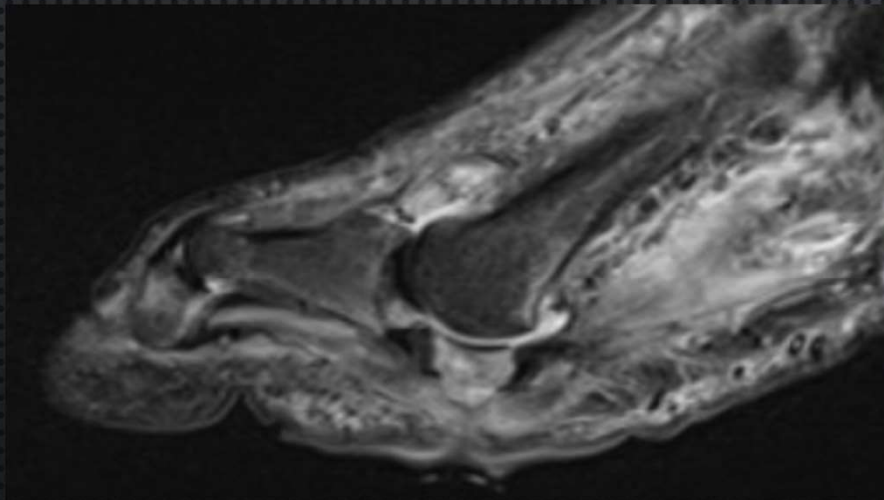
47 yo diabetic foot ulcer,  
concern for osteo





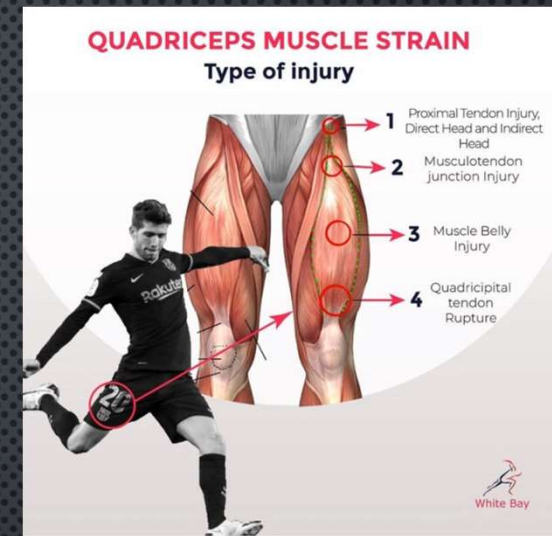
Again, contrast not necessary for bone involvement, but helpful for ST abscess and ischemia

\*Noncontrast MRI still MUCH better than CECT for this indication

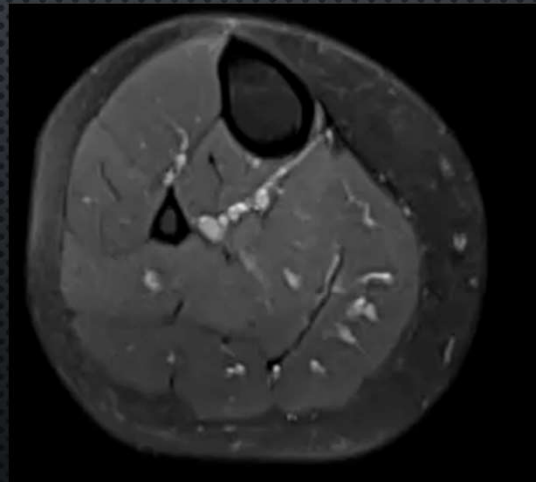
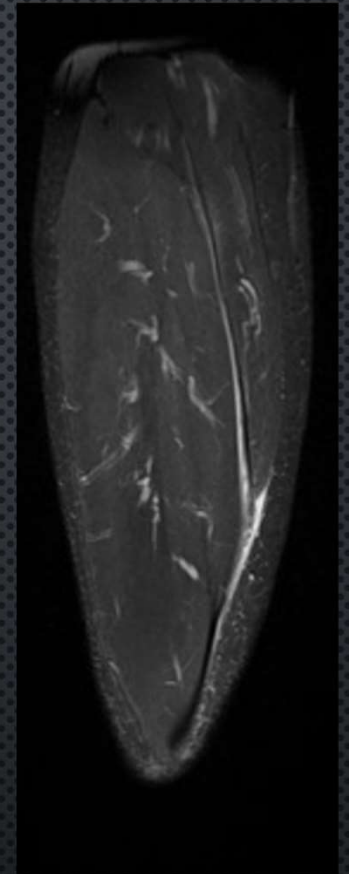
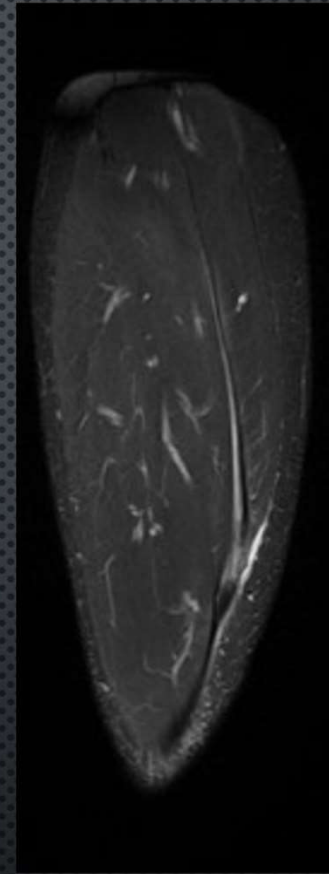


# TENDON/MUSCLE

- MRI PROVIDES EXQUISITE TISSUE CONTRAST
- HIGHLY ACCURATE FOR ACUTE MUSCLE/MTJ/TENDON INJURIES
- AS OPPOSED TO US, NOT OPERATOR-DEPENDENT
- \*CONTRAST NOT NECESSARY

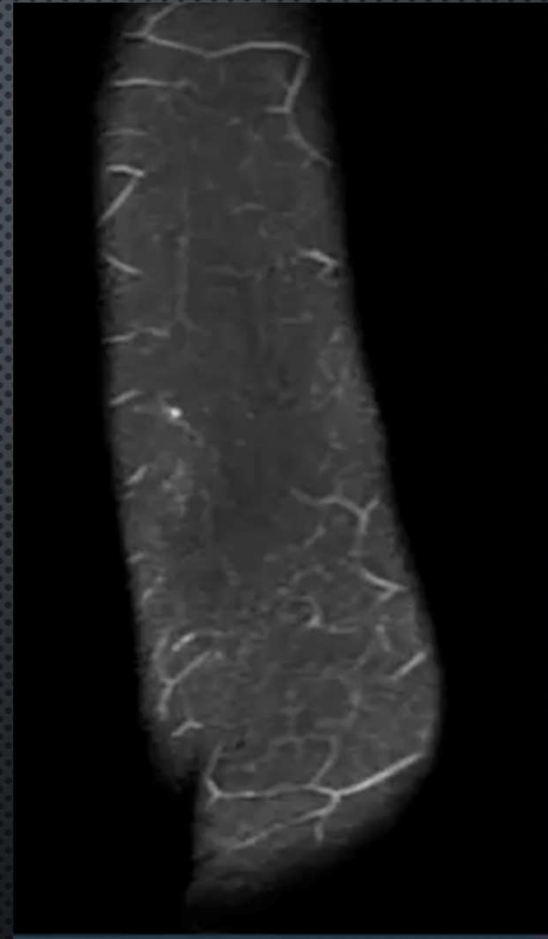
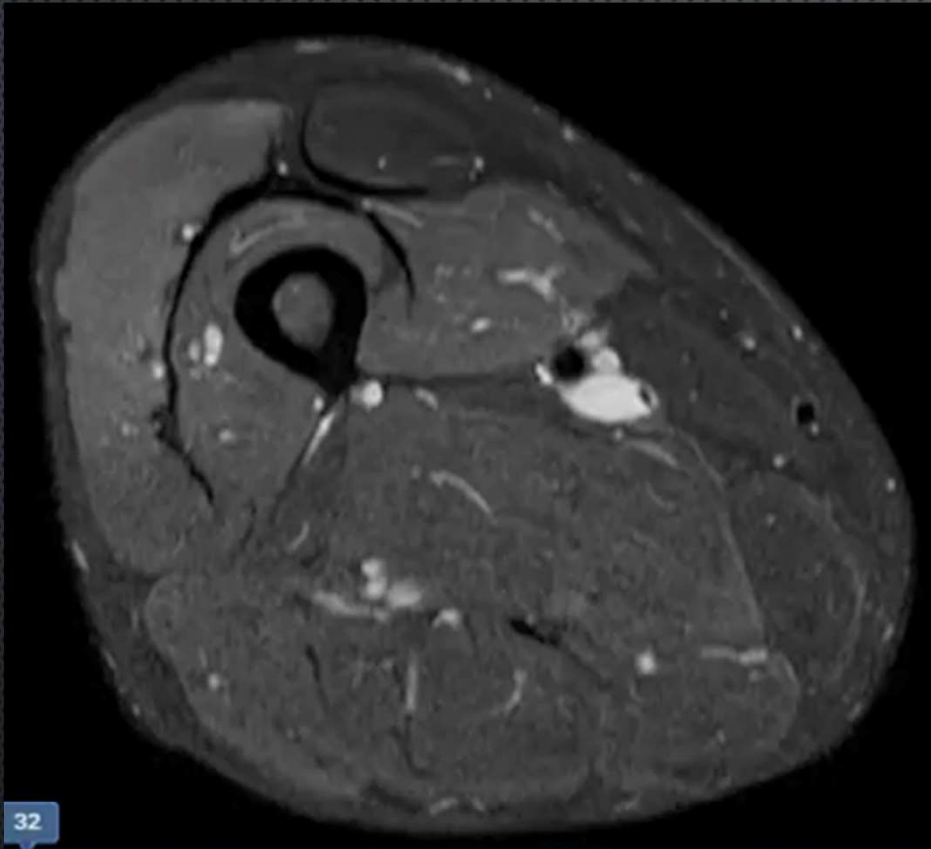


Google

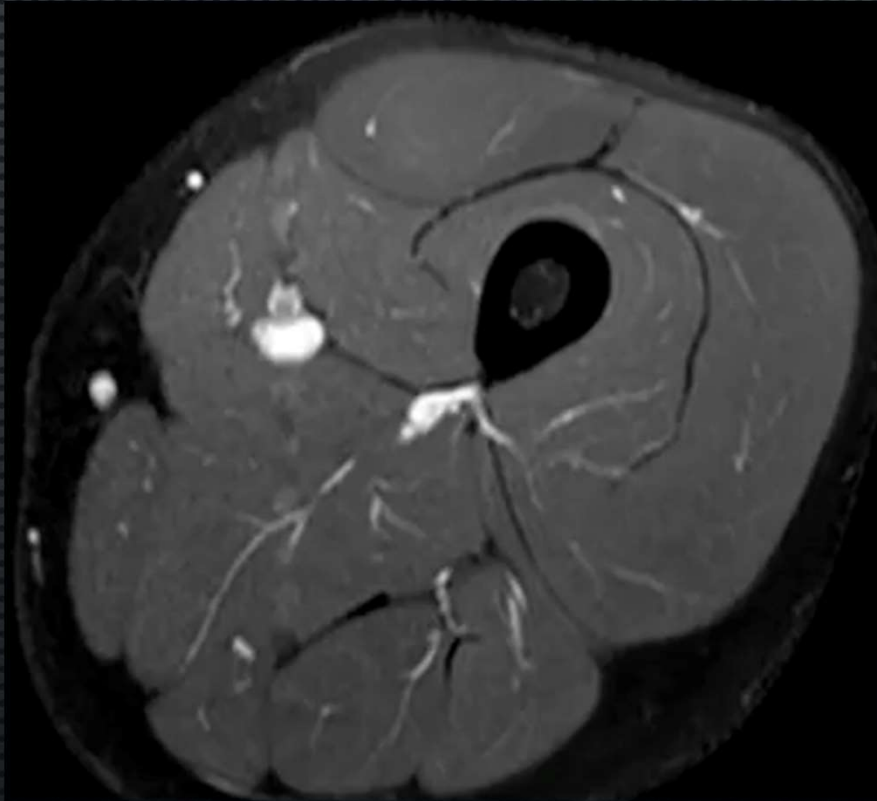


Medial head gastric  
myofascial tear





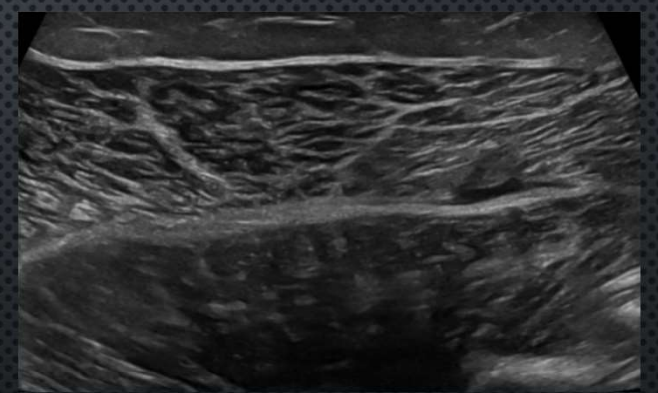
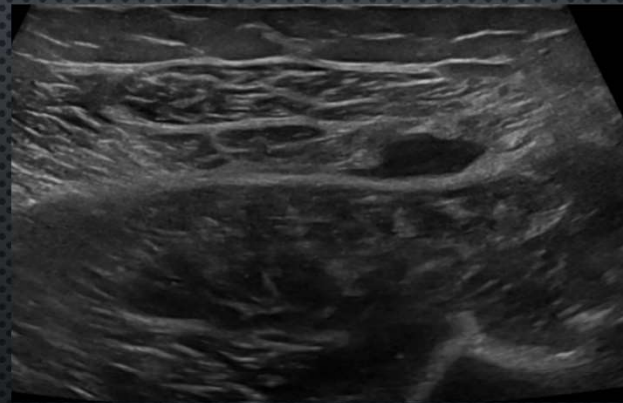
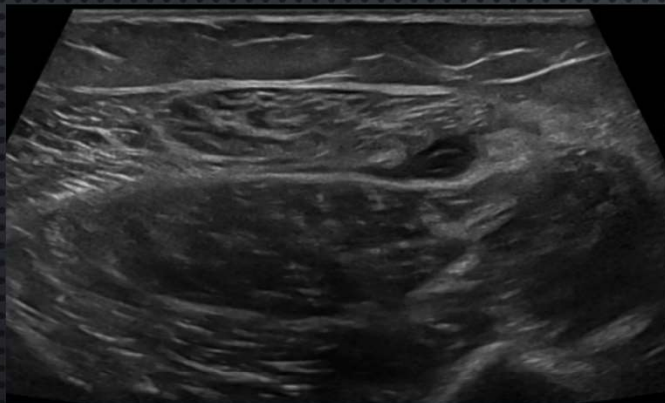
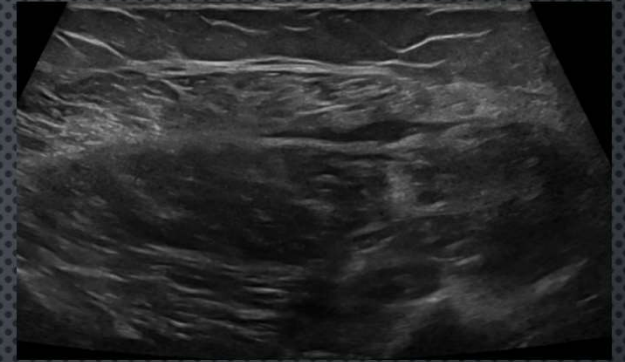
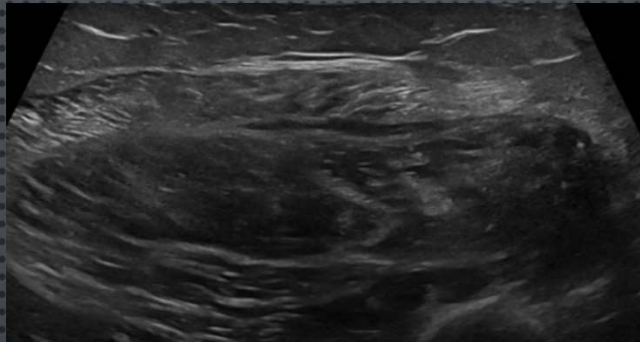
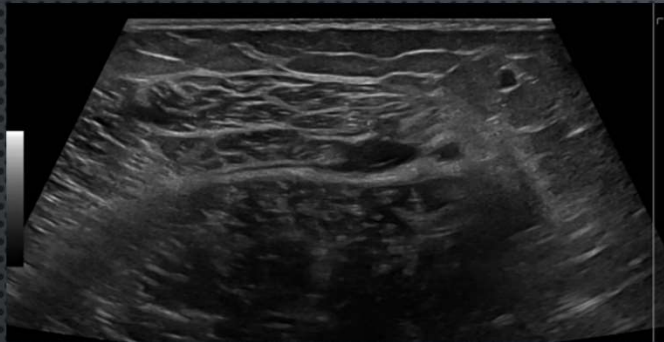
Chronic high grade vastus lateralis tear and scarring



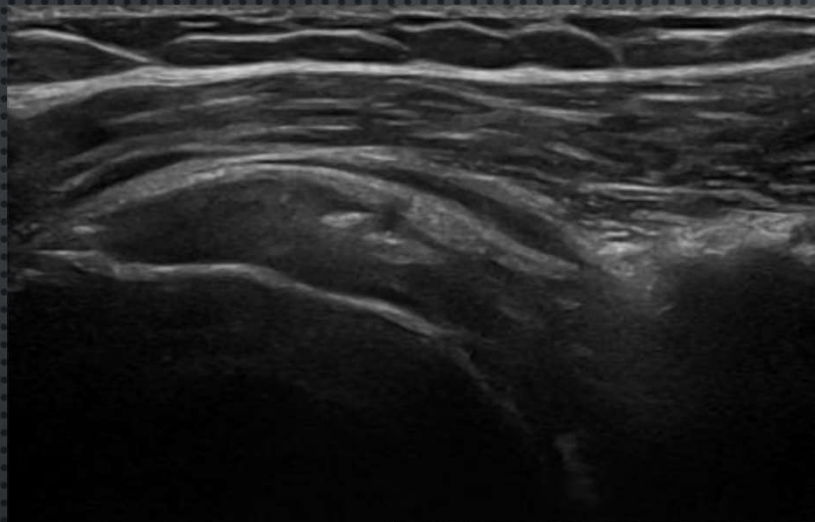
Distal rectus femoris myotendinous tear

# ULTRASOUND

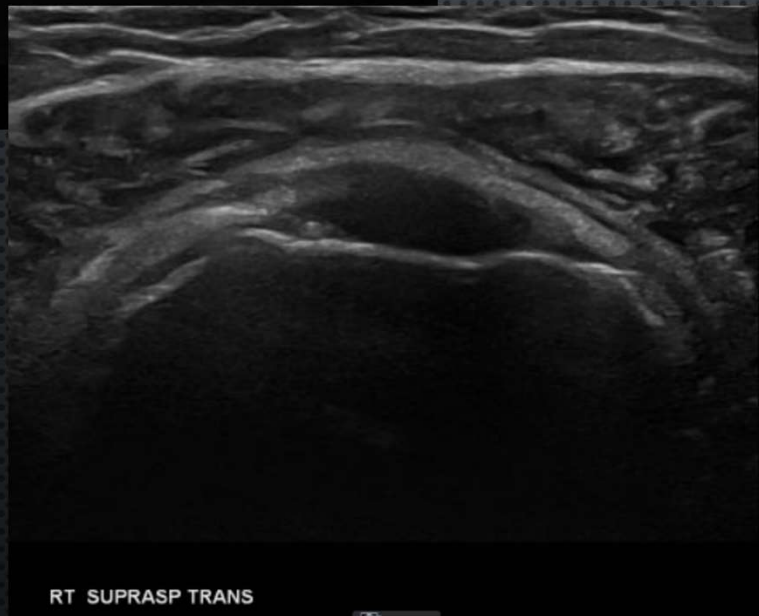
- USEFUL FOR SPECIFIC TENDON EVALUATION, ESP IF MRI CONTRAINDICATED (ROTATOR CUFF, PERONEAL TENDONS, BICEPS)
- ALSO USEFUL FOR MUSCLE INJURIES
  - NOT AS SENSITIVE OR SPECIFIC AS MRI
  - HIGHLY OPERATOR DEPENDENT
- GREAT TO EVALUATE CYSTIC VS SOLID MASSES, ALTHOUGH MRI BETTER TO EVAL SURROUNDING STRUCTURES



Medial head gastrocnemius myofascial tear



RT SUPRASP LONG



RT SUPRASP TRANS

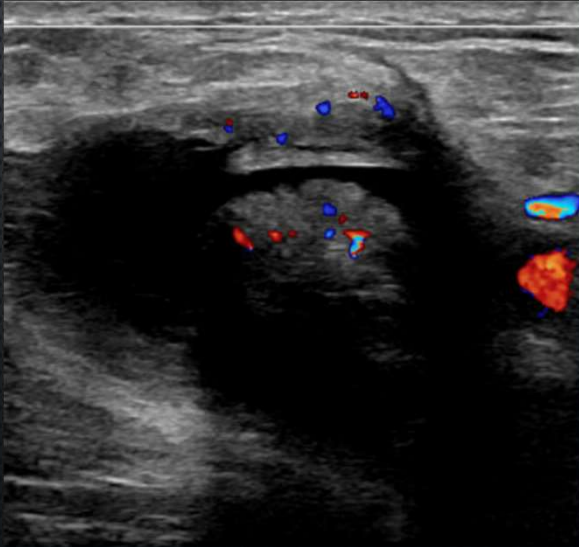
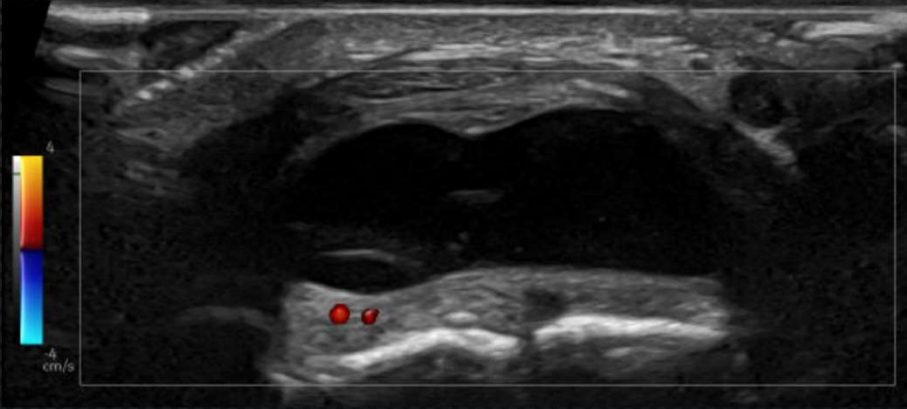
High-grade  
partial SS tear



RT Supra Infra LAX

Normal

# CYSTIC VS. SOLID



## WHEN IS ULTRASOUND NOT USEFUL?

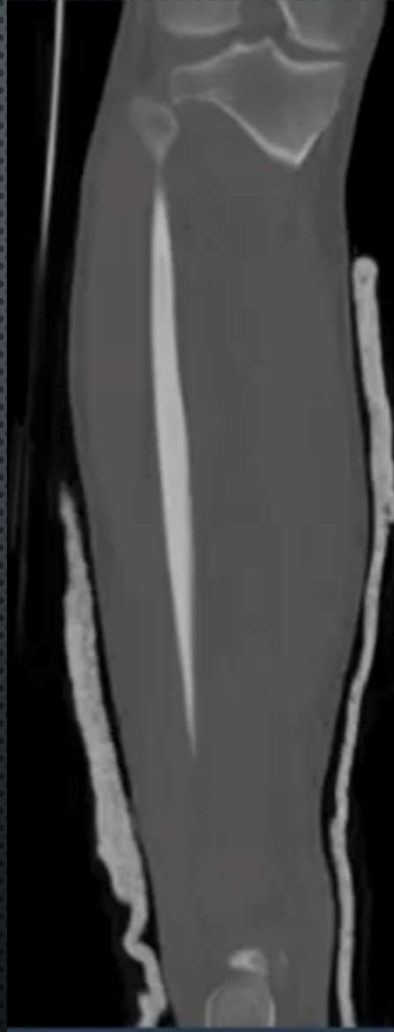
- VAGUE PAIN INDICATIONS
- ACUTE OR CHRONIC JOINT-RELATED PAIN
- INJURY WITH CONCERN FOR INTERNAL DERANGEMENT
- \*\*IF IN DOUBT, CONSULT MSK RADIOLOGIST FOR GUIDANCE IN WHICH MODALITY TO ORDER 😊

# THE HELPFUL (AND POTENTIALLY HARMFUL) CT

- MAY BE COUNTERINTUITIVE, BUT LIMITED USE IN MSK IMAGING
  - MUCH BETTER SPATIAL RESOLUTION THAN MRI, NOT AS GOOD TISSUE CONTRAST
  - GREAT BONY DETAIL (SOUND FAMILIAR?)
  - ESSENTIAL FOR SURGICAL PLANNING OF COMPLEX FRACTURES
  - HELPFUL IN CHARACTERIZING CERTAIN TUMORS/TUMOR-LIKE LESIONS
  - MAY BE USEFUL IF MRI CONTRAINDICATED
  - SIGNIFICANT IONIZING RADIATION

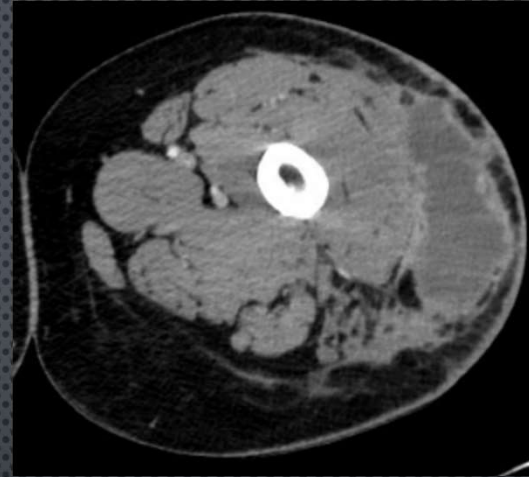






## CT FOR ST INFECTION

- CECT EXTREMELY USEFUL IN THE URGENT SETTING FOR DETECTION OF INTRAMUSCULAR OR SQ ABSCESS, E/O DEEP SPACE INFX
- \*\*NECROTIZING ST INFECTION REMAINS A CLINICAL DIAGNOSIS, CT NEITHER SENS NOR SPEC UNLESS ST GAS IS PRESENT (ALMOST NEVER)



## LET'S SUM IT ALL UP

- ALWAYS DEFAULT TO GETTING RADIOGRAPHS FIRST. OCCASIONALLY MIGHT NOT BE NECESSARY BUT CHEAP, READILY ACCESSIBLE, AND VERY LITTLE RADIATION
- NONCONTRAST MRI:
  - JOINT DERANGEMENT
  - RADIOGRAPHICALLY OCCULT FRACTURES
  - MUSCLE/TENDON INJURY
- CONTRASTED MRI
  - CONCERN FOR TUMOR OR INFECTION

# LET'S SUM IT ALL UP

- ULTRASOUND:
  - LUMPS AND BUMPS
  - DEPENDING ON RADIOLOGIST AVAILABILITY, SOME MUSCLE/TENDON INJURY
  - NOT USEFUL FOR NONSPECIFIC PAIN
  - TO BE A USEFUL MODALITY, THERE MUST BE A SPECIFIC CLINICAL QUESTION
- CT
  - LIMITED UTILITY
  - SURGICAL PLANNING AND FOLLOWUP
  - SOFT TISSUE INFECTION

THANK YOU!

