How to approach a Shoulder MRI

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Routine Shoulder MRI Protocol

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	ETL	BW
Axial PD FSE FatSat	12-14	512 x 256 2	4/ 0.5	2000-3000	20- 40		8	16
Cor Oblique FSTIR	16-18	256 x 192 2	4/ 0.5	> 1500	20- 40	3.0 T: 180 1.5 T: 150 0.7 T: 100 0.3 T: 70	8	16
Cor Oblique T1 SE NonFatSat	16-18	256 x 256 1	4/ 0.5	400-800	minimum			16
Sag Oblique T2 FSE NonFatSat	14-16	256 x 192 1	4/ 1	> 2000	90- 110		8	16

MR Arthrogram of the Shoulder

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	ETL	BW
Axial T1 SE FatSat	12-14	256 x 192 2	3/ 0.5	400-800	minimum		16
Cor Oblique T1 SE FatSat	14-16	256 x 192 2	3/ 0.5	400-800	minimum		16
Cor Oblique PD FSE FatSat	14-16	256 x 192 2	3/ 0.5	>1500	30-50	8	16
Sag Oblique T1 SE NonFatSat	14	256 x 192 1	4/1	400-800	minimum		16
ABER T1 SE FatSat	14	256 x 192 2	3/ 0.5	400-800	minimum		16

Step by step approach

1. Evaluate for Impingement:
   - Check for a subacromial spur on the *Coronal T1 non-fat saturated* sequence
   - Check for an Os acromiale on the *Coronal T1 non-fat saturated* and the *Axial Proton Density (PD) fat saturated* sequences
   - Check for AC joint osteoarthritis on the *Coronal STIR, Axial PD fat saturated* and *Coronal T1* sequences.

1. Evaluate the acromioclavicular (AC) joint:
   - Check on the *Coronal STIR* for marrow edema, capsular edema/disruption, and ligamentous integrity or injury (including the coracoclavicular ligament)
   - Evaluate alignment

Step by step approach

3. Subacromial/ Subdeltoid Bursa:
   - Using the *Coronal STIR* evaluate for bursitis, excess fluid or hydroxyapatite deposition

4. Rotator Cuff tendons:
   - Using the *Coronal STIR* to evaluate the supraspinatus and infraspinatus tendons (remember to check the anterior most footprint of the supraspinatus):
     - Check for tendinosis: tendon thickening, attenuation, and/or intrasubstance signal alteration, hydroxyapatite deposition
     - Check for partial thickness, interstitial, and full thickness tearing

Step by step approach

4. Rotator Cuff tendons (continued):
   - Confirm the findings on *Sagittal oblique T2 non fat saturated* and *Axial Proton Density fat saturated* sequences → on these sequences you get a better look at the infraspinatus tendon in its entirety
   - Measure tendon tears in the AP dimension on the *Sagittal oblique T2 non fat saturated* images
   - Measure tendon retractions on the C*oronal T2 fat saturated* sequence.
   - Evaluate the integrity of the subscapularis and teres minor tendons on the *Axial PD fat saturated* and the *Sagittal oblique T2 non fat saturated* sequences.

Step by step approach

5. Long Head Biceps Tendon (LHBT):
   - Evaluate the integrity of the LHBT on the *Axial PD fat saturated* sequence and confirm it on the *Coronal STIR* sequence (the intra-articular portion can commonly be evaluated on the *Sagittal oblique T2 non fat saturated* sequence as well)
   - Evaluate the location of the LHBT at the level of the lesser tuberosity on the *Axial PD fat saturated* sequence
   - Evaluate for subluxation/ dislocation of the LHBT

Step by step approach

6. Rotator Cuff Muscle Bulk:
   - Evaluate on the *Sagittal oblique T2 non fat saturated* sequence → fatty streaking/replacement can be confirmed on the *Coronal T1 non fat saturated sequence*

7. Rotator Interval:
   - Evaluate if the fat within the rotator interval is preserved or infiltrated on the *Coronal T1 non fat saturated* sequence → Confirm with *Sagittal oblique T2 non fat saturated* and *Coronal STIR* sequence

Step by step approach

8. Glenohumeral Joint:
   - Evaluate for alignment
   - Check the *Coronal STIR and Axial PD fat saturated* sequences for:
     - Presence of a joint effusion
     - Synovitis
     - Intraarticular bodies
   - Evaluate the hyaline cartilage for partial or full thickness defects on the *axial PD fat saturated* and *Coronal STIR* sequences

Step by step approach

8. Glenohumeral Joint (continued):
   - Evaluate for labral tears on *Coronal STIR* and *Axial PD fat saturated* sequences. Evaluate for:
     - abnormal morphology, intrasubstance signal alteration, displaced fragments, paralabral cysts, etc.
     - extension of a labral tear into the LHBT, glenohumeral ligament, rotator interval
   - Evaluate the inferior glenohumeral ligament for injury, thickening, or periligamentous edema on the *Coronal STIR* sequence

Step by step approach

9. Notches:
   - Evaluate for mass/ mass effect in the suprascapular and spinoglenoid notch, and within the quadrilateral space on the *Coronal STIR* and *Sagittal oblique T2 non fat saturated* sequences

10. Bone Marrow:
   - Evaluate for osseous contusion/ fractures, Hill-Sach's deformity, bony Bankart on *Axial PD fat saturated, Coronal STIR, Coronal T1* and *Sagittal oblique T2 non fat saturated* sequences

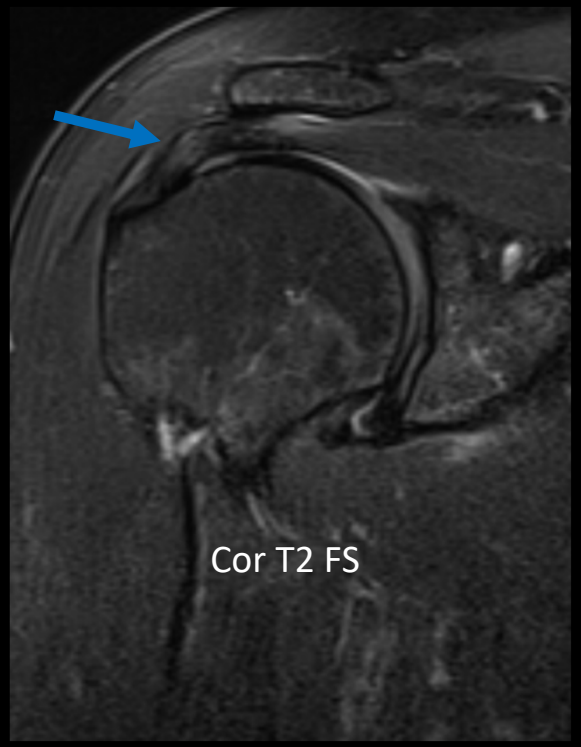
Step by step approach

11. Final Survey + Localizer:
    - Using the *Axial PD fat saturated*, make a final survey of the surrounding soft tissues and Scapula for any additional abnormalities

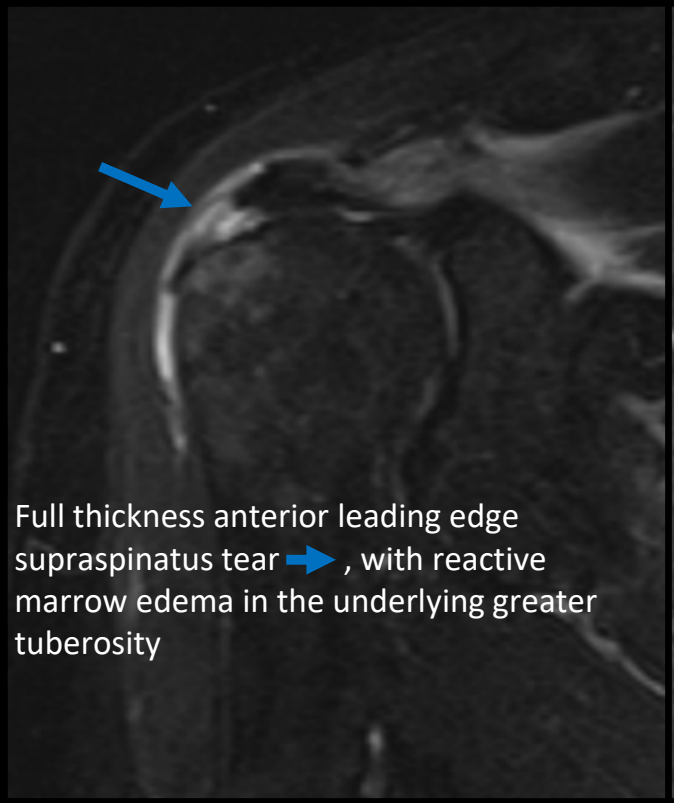
Common Cases

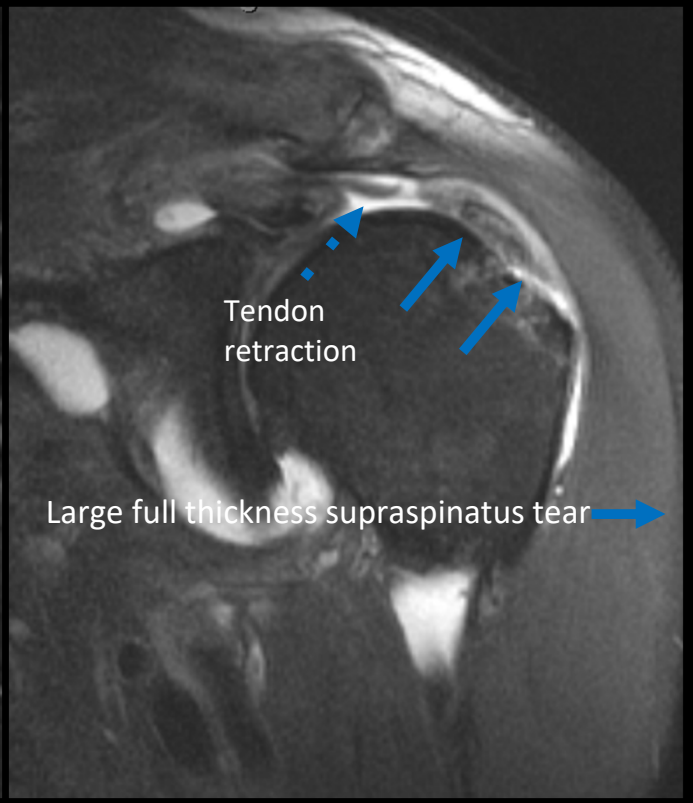
Rotator cuff tendinosis/tear

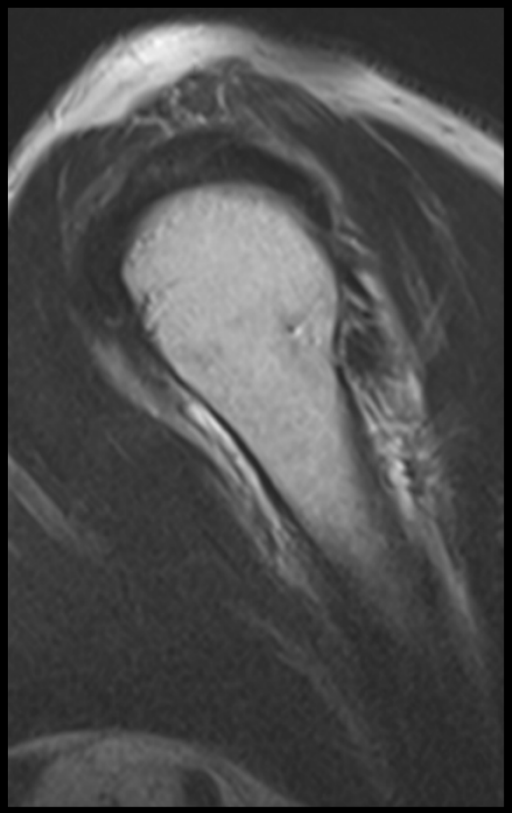
- Mucoid degeneration
- Supraspinatus tendon most commonly affected
- Tendon thickening with increased signal intensity (T1 + T2)
- Grading: mild, moderate severe



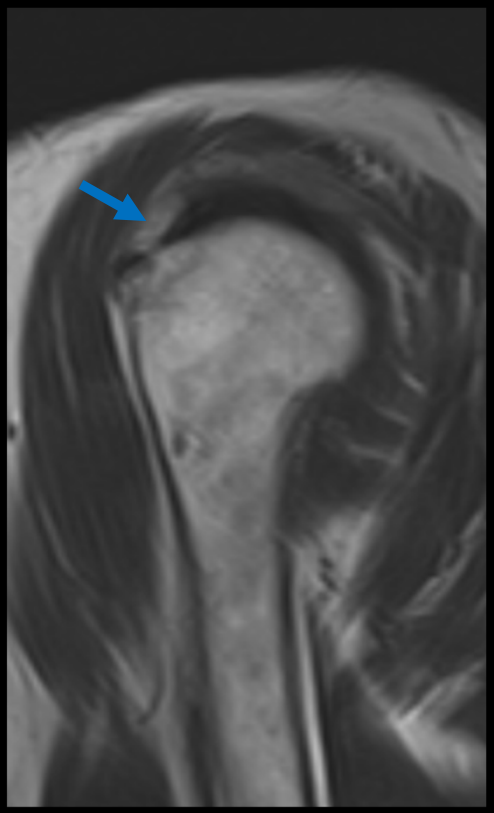
- Tears in normal tendons are rare (trauma)
- Partial vs. full thickness vs. complete tears need to be differentiated
- Gap in the tendon filled with fluid



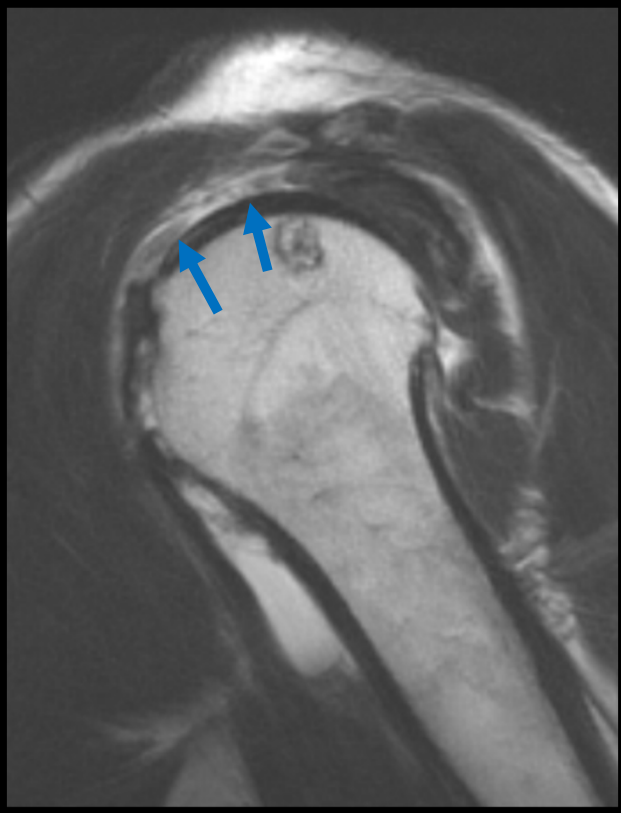




Intact rotator cuff



Full thickness tear

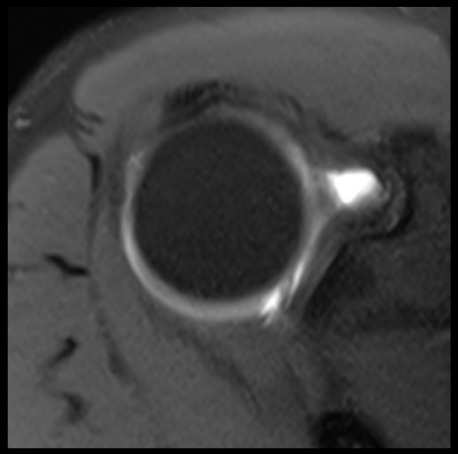


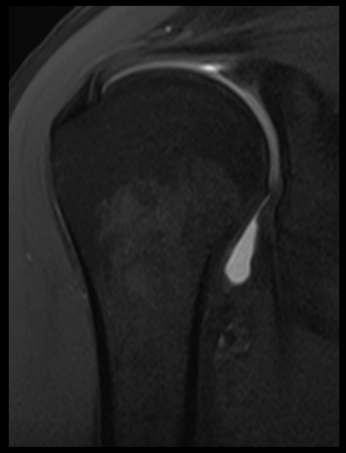
Large full thickness tear

Superior labrum anterior-posterior (SLAP) tear

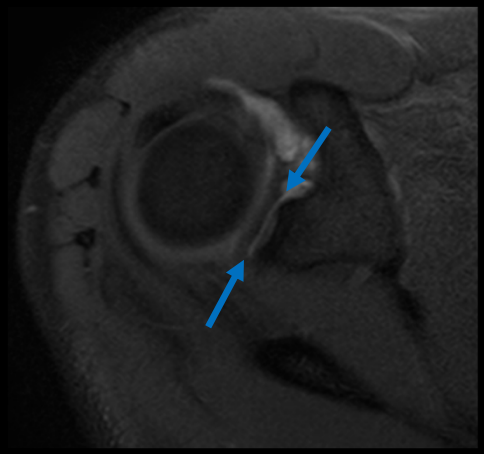
- Results from repetitive avulsive stress from the origin of the long head biceps tendon
- Common symptoms besides pain include clicking/popping
- Most important differential diagnosis are normal labral variants
- Best seen on MR arthrography (MRA)
- Best plane to assess for SLAP tears is coronal oblique (but use all three planes)

MRA- Normal labrum





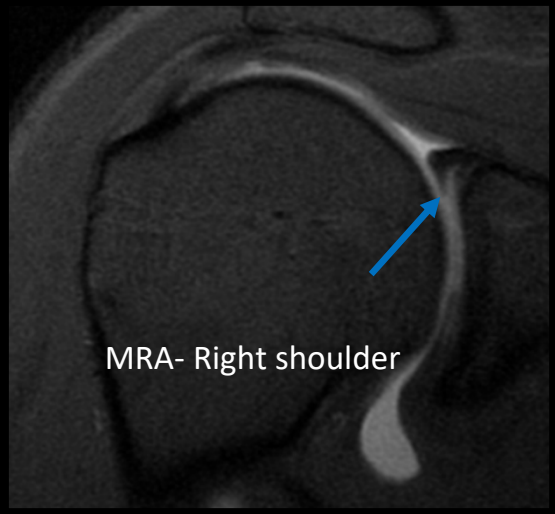
MRA- SLAP

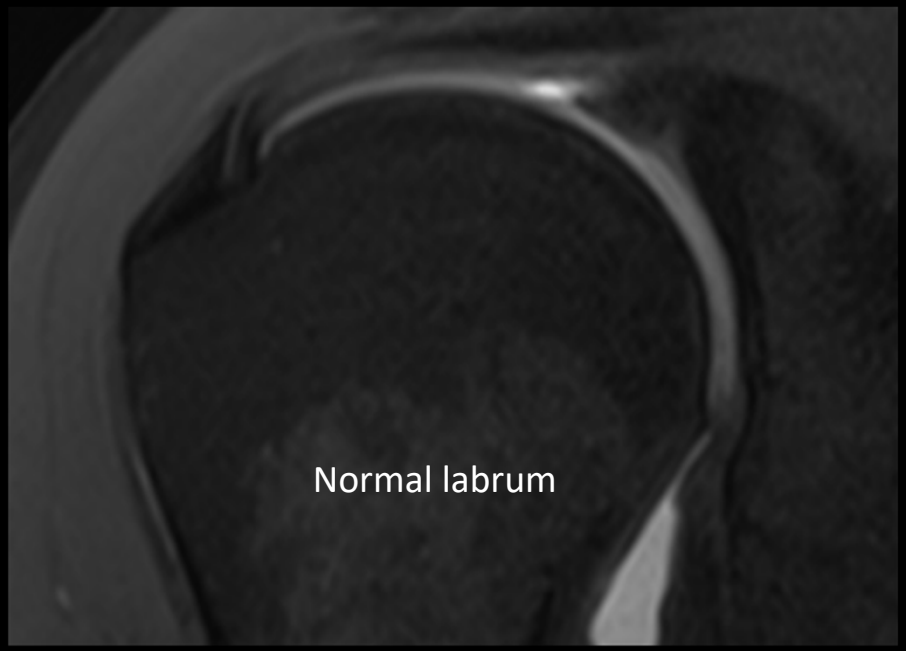


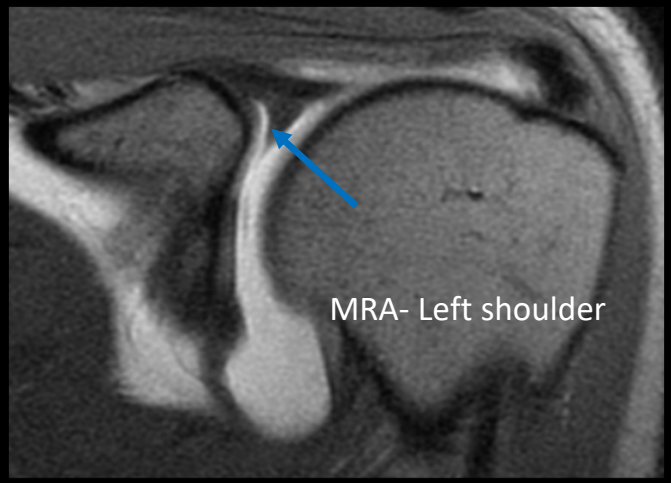
Contrast points laterally

Sublabral recess (normal variant)

Compared to SLAP tear, contrast points medially/towards the glenoid

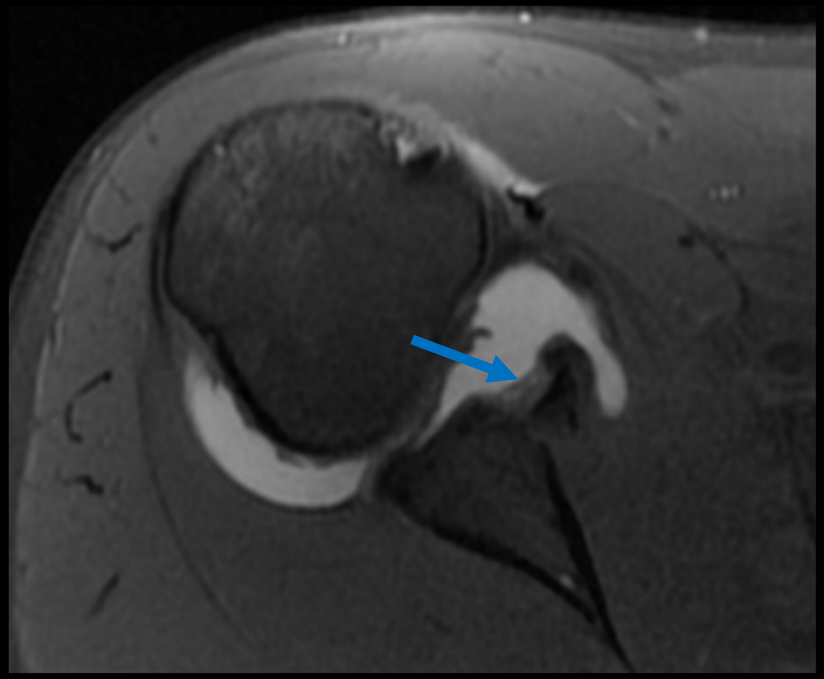




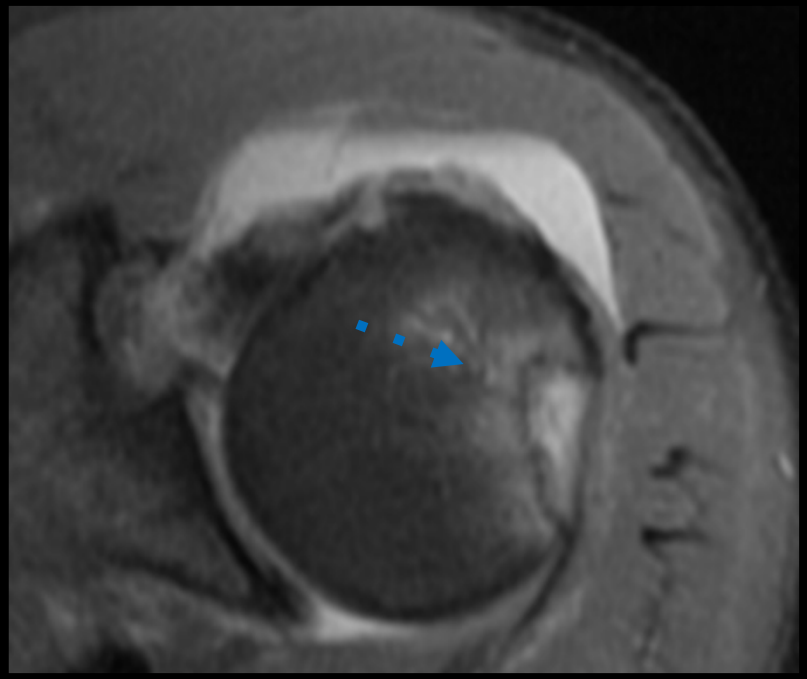


Anterior shoulder dislocation

- 95% of shoulder dislocations
- Vey high recurrence rate in young patients (90% in <20 years old)
- Humeral head is displaced anteriorly, inferiorly, and medially
- Often associated with Hill Sachs and Bankart lesions



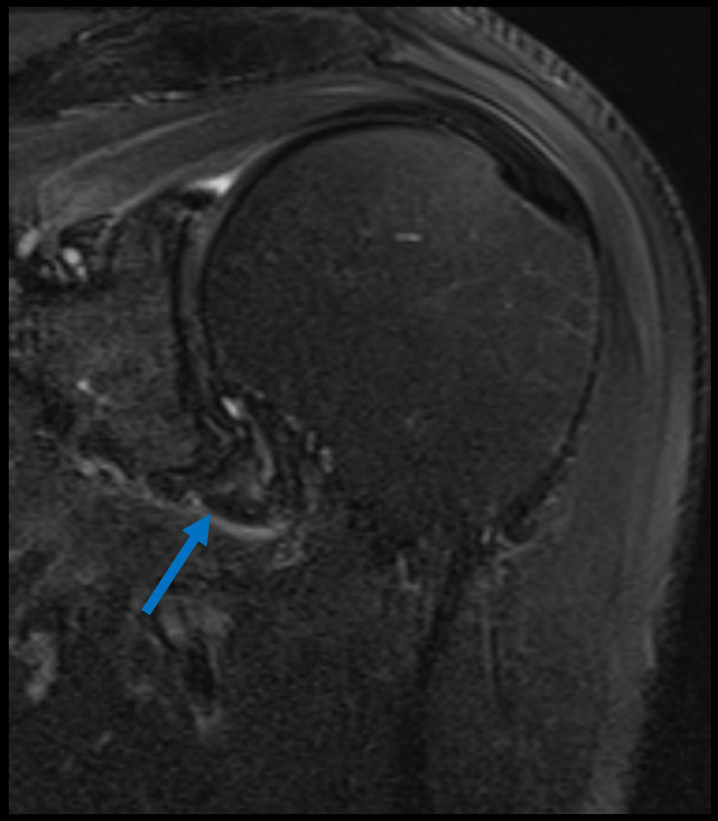
Large osseous Bankart fracture ➡ of the anteroinferior glenoid with an articular step off after a recent anterior shoulder dislocation

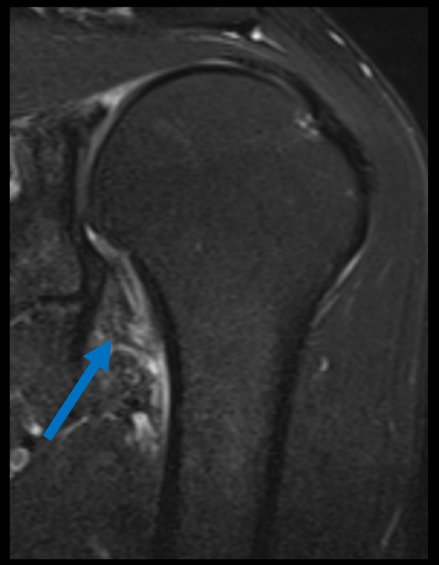


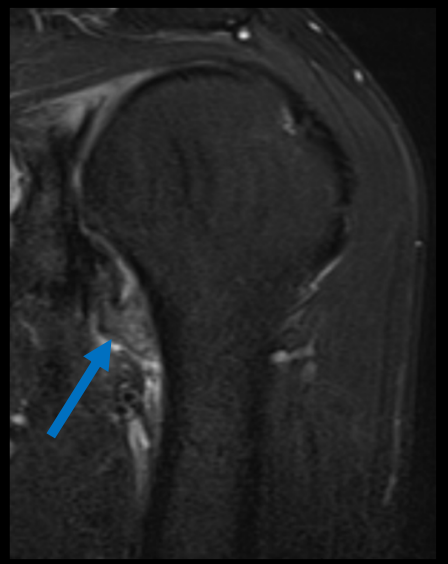
Large Hill-Sachs lesion ▪ ▶ of the posterolateral humeral head with reactive osseous edema

Adhesive capsulitis

- ’Frozen shoulder’
- Presents with shoulder pain and decreased range of motion due to synovial inflammation and capsular fibrosis
- Pericapsular thickening/edema within the axillary recess →, a typical location for adhesive capsulitis



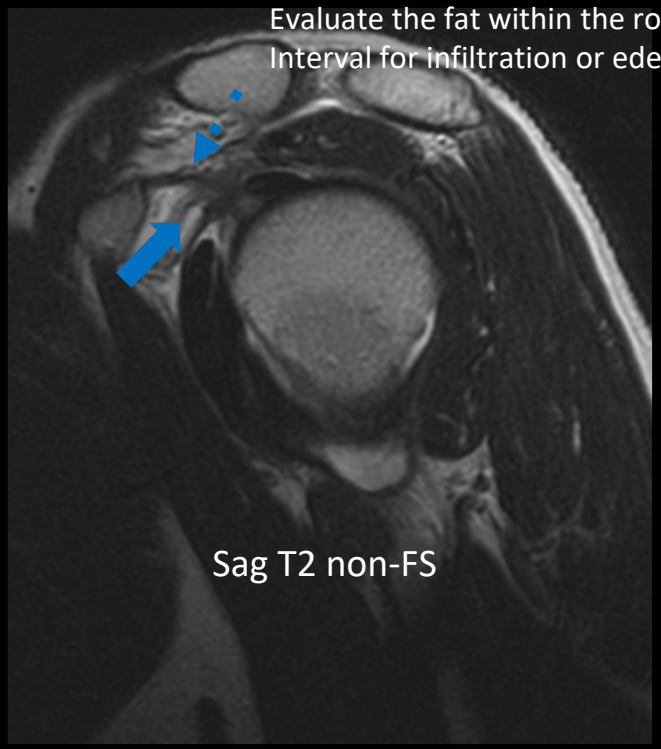




- Infiltration in the rotator interval and thickening of the coracohumeral ligament (CHL) are hallmarks of this condition

- Typical findings on arthrography are extravasation of contrast with relatively low glenohumeral joint volume

Evalaute the CHL for thickening.
Evaluate the fat within the rotator Interval for infiltration or edema.

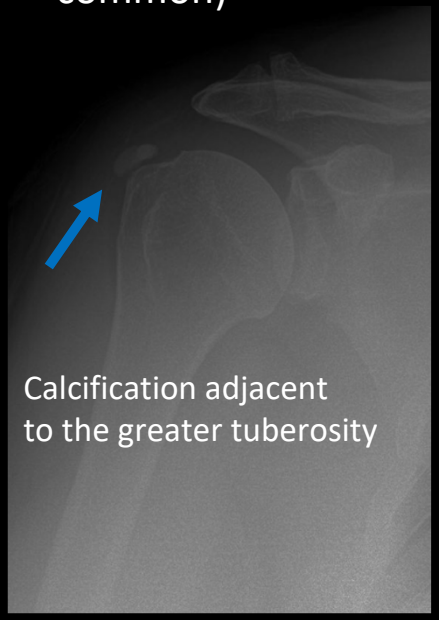


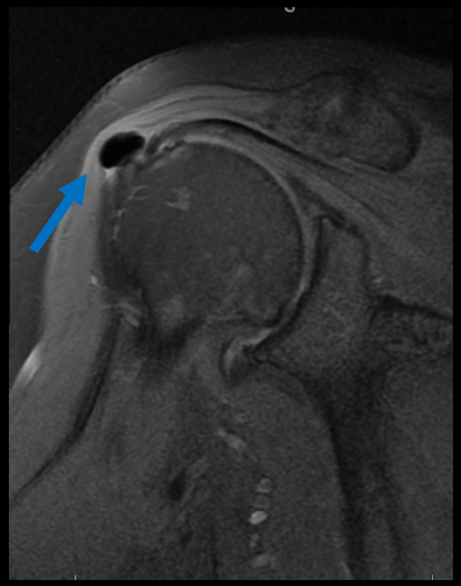
Sag T2 non-FS

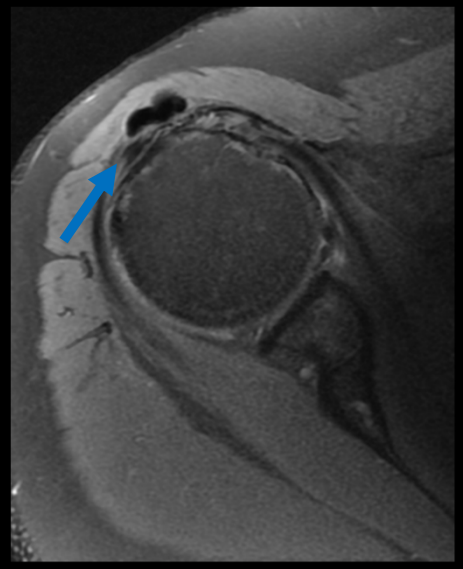
MRA shows extravasation of contrast into the subscapularis tendon

Calcific tendinosis

Hydroxyapatite deposition, in this case located in the supraspinatus tendon (most common)

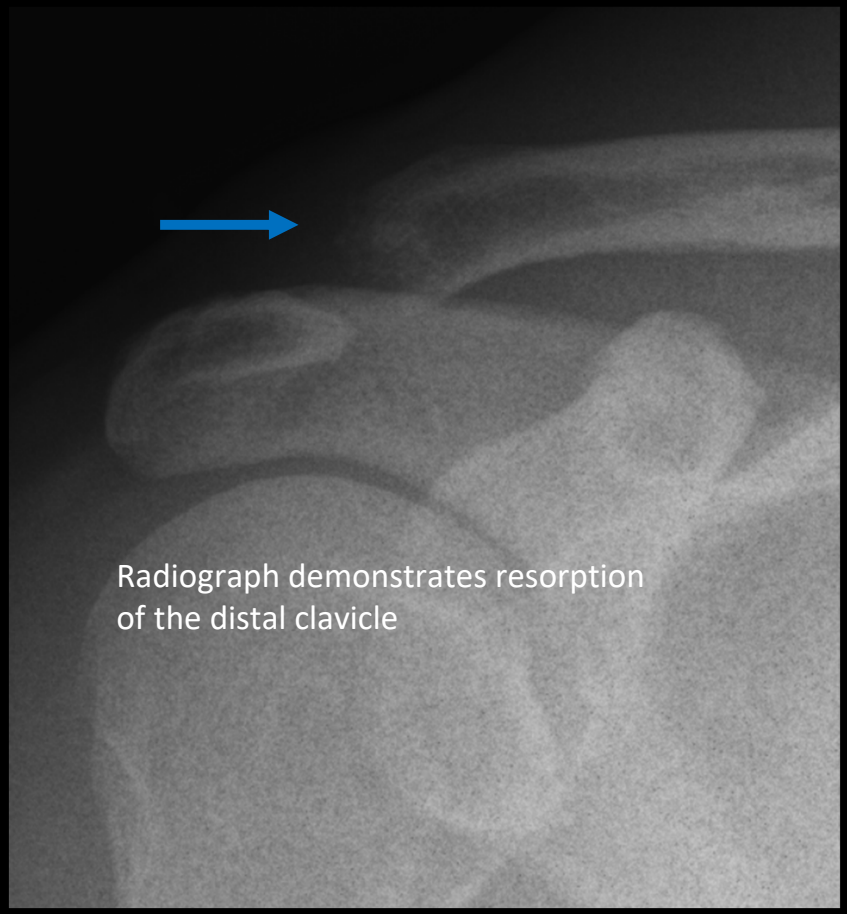




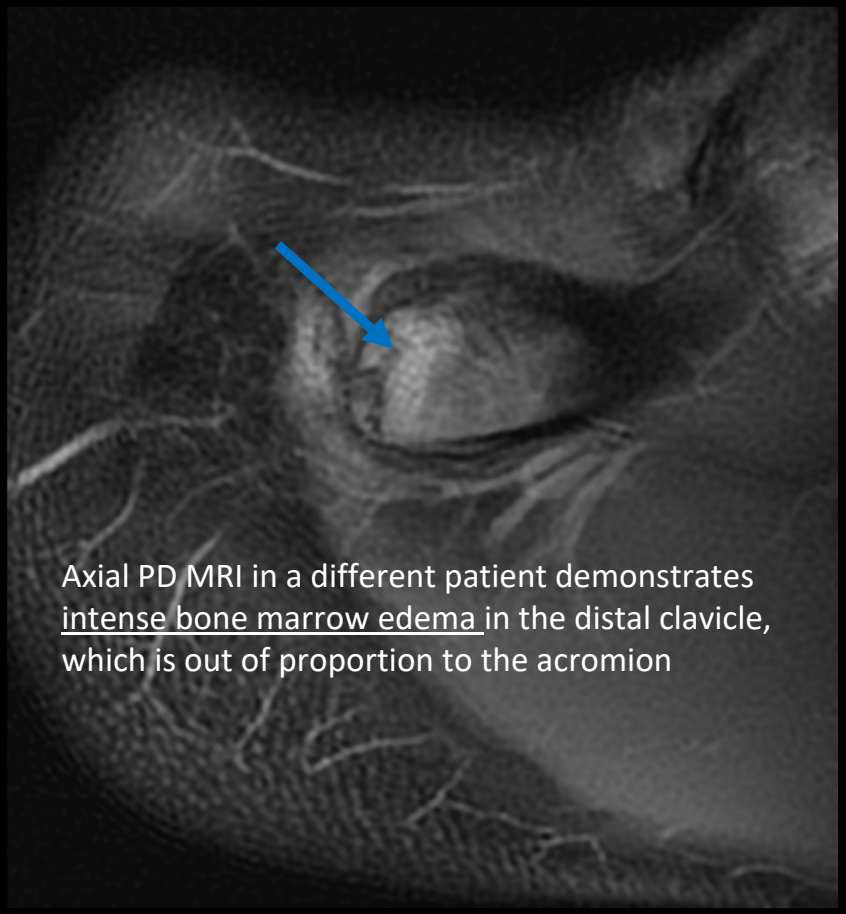


- Low signal on all sequences (can blend in with the tendon in less obvious cases)
- Can demonstrate blooming artifact on gradient echo sequences (not shown)

Distal clavicular osteolysis (DCO)



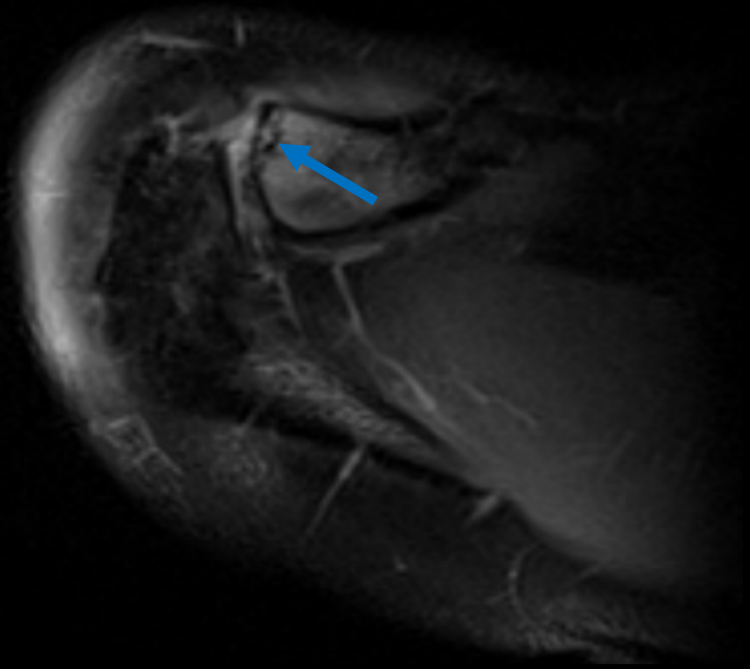
Radiograph demonstrates resorption of the distal clavicle



Axial PD MRI in a different patient demonstrates intense bone marrow edema in the distal clavicle, which is out of proportion to the acromion

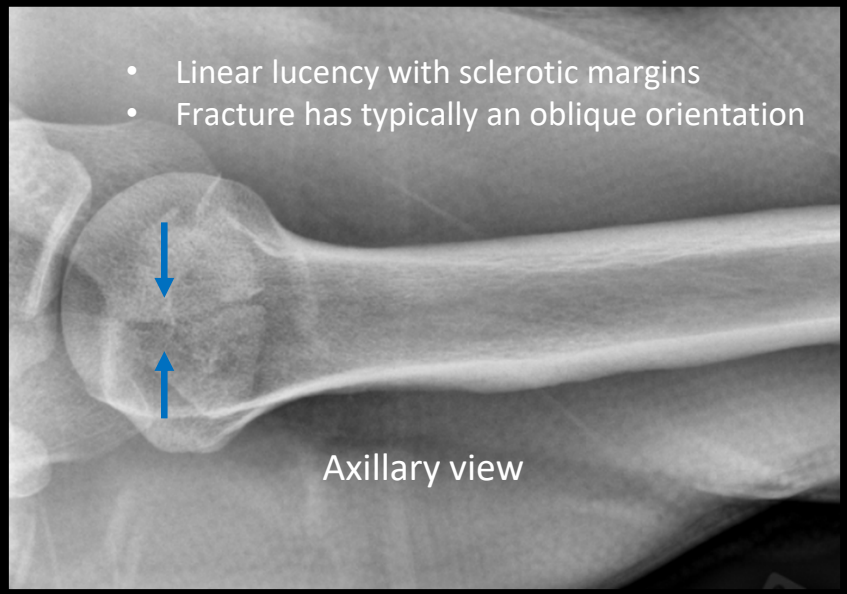
Intense marrow edema in the distal clavicle with an nondisplaced subchondral fracture →, an associated finding

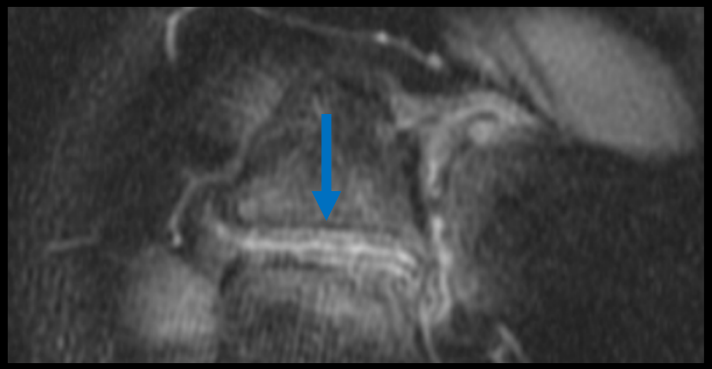
DCO is classically described in weightlifters (repetitive microtrauma), but occurs also in the posttraumatic setting (after AC joint injury)

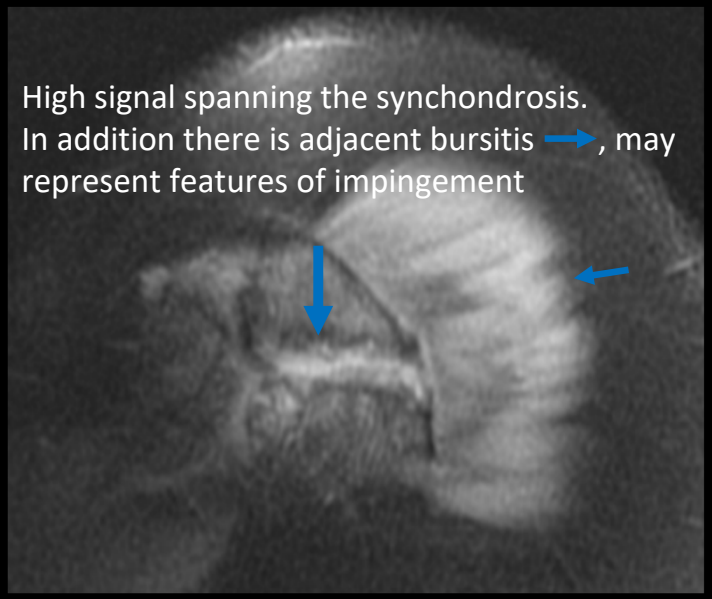


Os acromiale

- Unfused acromial apophysis
- 3 ossification centers of the acromion:
  - Preacromion (most distal)
  - Mesoacromion (mid)
  - Metaacromion (proximal)
- Normal apophysis can be unfused until age of 25
- On MRI evaluate for signal intensity in the acromial synchondrosis → stable vs. unstable
- Unstable os acromiale have questionable association with impingement and subsequent rotator cuff tendinopathy






High signal spanning the synchondrosis.
In addition there is adjacent bursitis, may represent features of impingement


No features of active osseous stress response