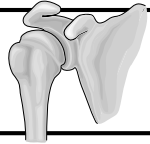




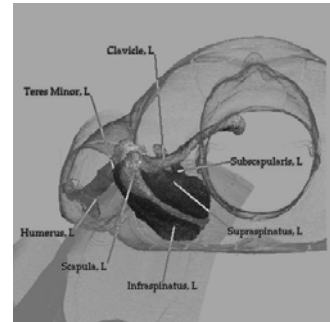
MR Imaging of the Shoulder: Rotator Cuff

Dr. Mini N. Pathria M.D., FRCP(C)
Department of Radiology
University of California School of Medicine
San Diego, California

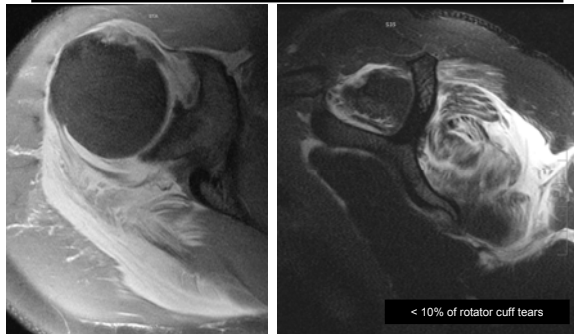


Rotator cuff

- Acute
 - Trauma
 - Calcific tendinitis
- Degenerative
 - Tendinosis
 - Impingement syndrome
 - Tear

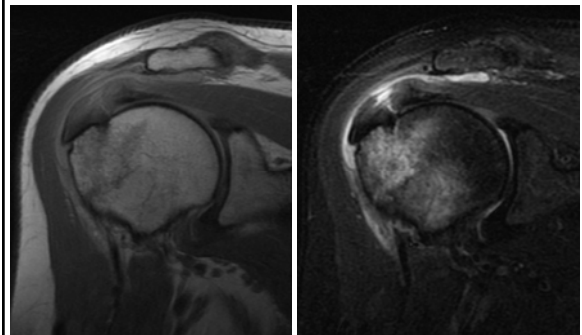


Trauma



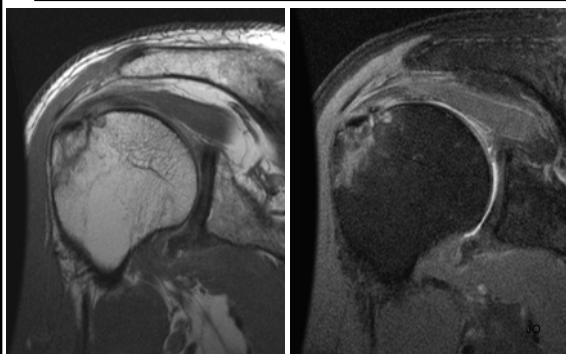
WB

Trauma



Slipped on bathroom mat, MR

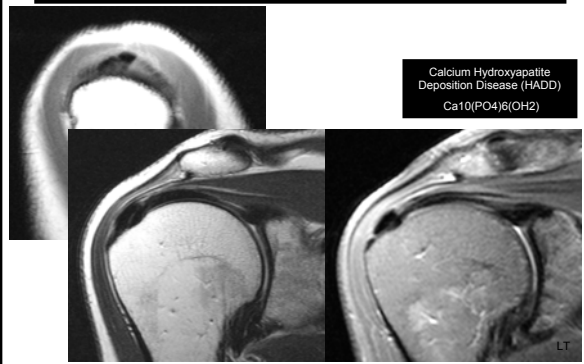
Trauma



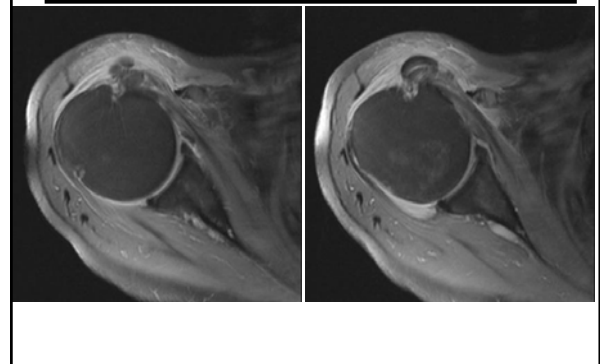
Tendon calcification



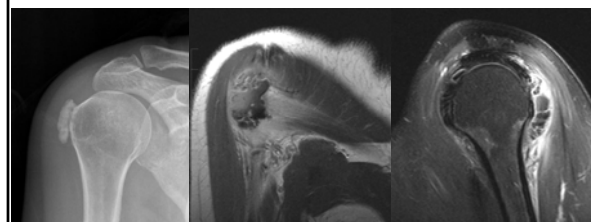
Tendon calcification



Calcific tendinitis

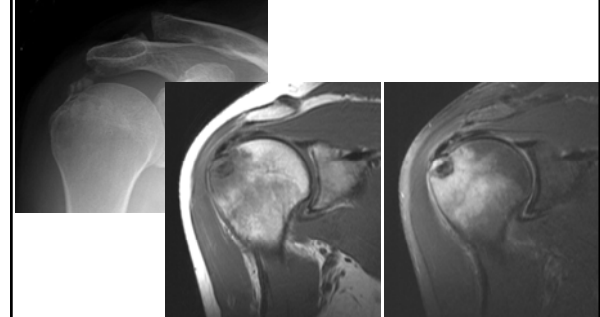


Calcific tendinitis



MJ

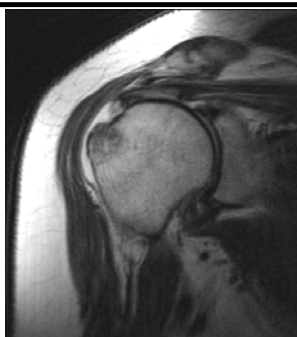
Calcific tendinitis



KG

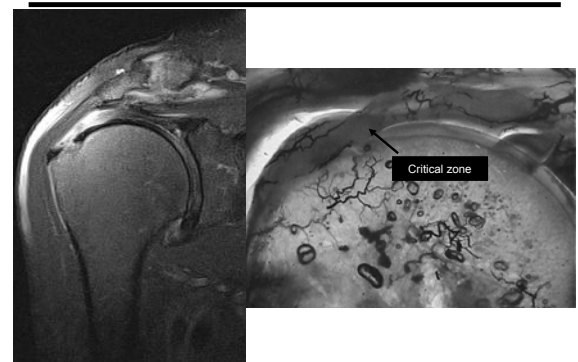
Rotator cuff degeneration

- Impingement
- Aging and degeneration of the cuff
- Ischemia of critical zone
- Glenohumeral instability
- Repetitive trauma



SB

Rotator cuff degeneration



Impingement syndrome

- Entrapment of soft tissues between humeral head, acromion and coracoacromial arch
- Leads to subacromial bursitis, rotator cuff edema and hemorrhage, and ultimately rotator cuff tear

Neer

Bursal thickening

RM

Subacromial bursitis

Subacromial bursitis

- Impingement
- Calcific tendinitis
- Infection
- Inflammatory synovitis

RA, BB

Impingement syndrome

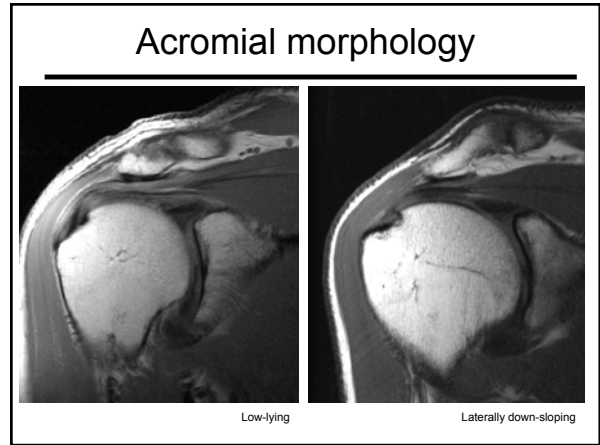
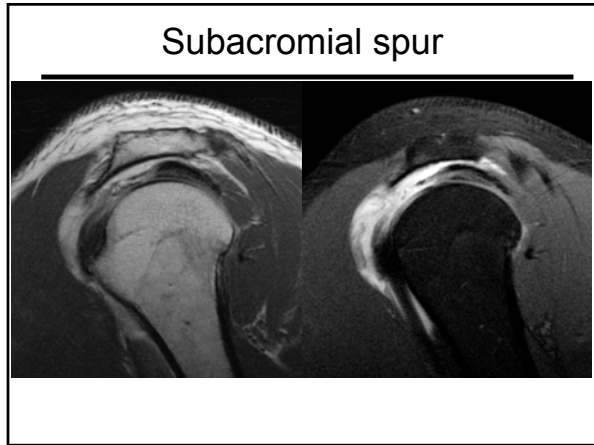
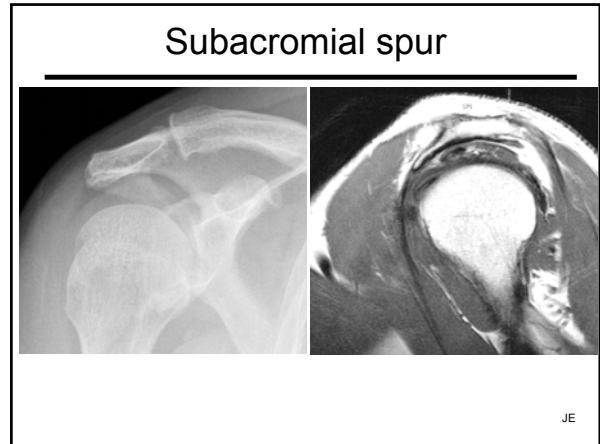
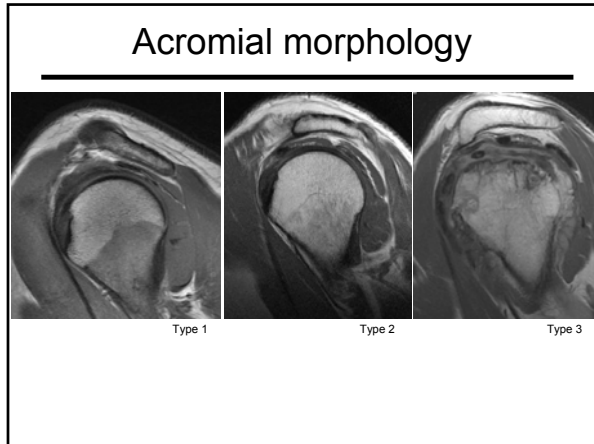
Acromioclavicular joint osteoarthritis

Acromial morphology

- Shape of undersurface of acromion in sagittal plane one or two slices lateral to AC joint
- Association of acromial morphology with risk of impingement and rotator cuff tear

Type 1 "Flat" Type 2 "Curved" Type 3 "Hooked"
 High rate of RCTs

Bigliani et al. Orthop Trans 10:216, 1986



Os acromionale

- Can lead to impingement of infraspinatus due to bony ridge on undersurface
- Can be hypermobile, causing pain and dynamic impingement
- Acromial decompression often unsuccessful in presence of os acromionale

Os acromionale

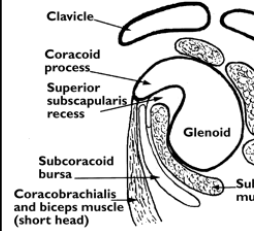
Subcoracoid impingement

- Normal 4-11 mm
- Subcoracoid impingement <6 mm
- Coracoid tip sclerosis
- Cystic changes of humeral head or lesser tuberosity
- Subcoracoid bursitis
- Tear of subscapularis

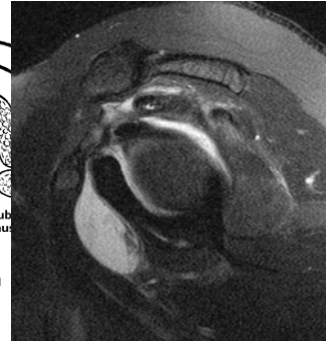


Friedman RJ et al, Cine MRI of the subcoracoid region. Orthopedics 21:545, 1998

Subcoracoid bursa

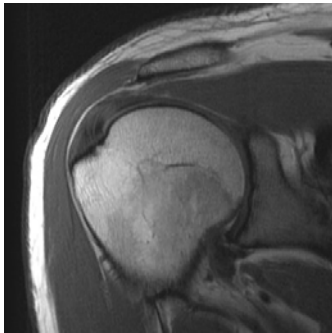


Schraner AB et al, AJR 176:812, 2001



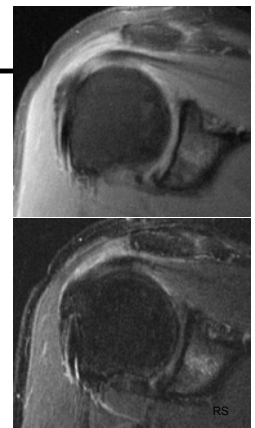
Tendinopathy

- Increased signal on T1 and PD
- Normal signal on T2
- Alteration in tendon size or morphology

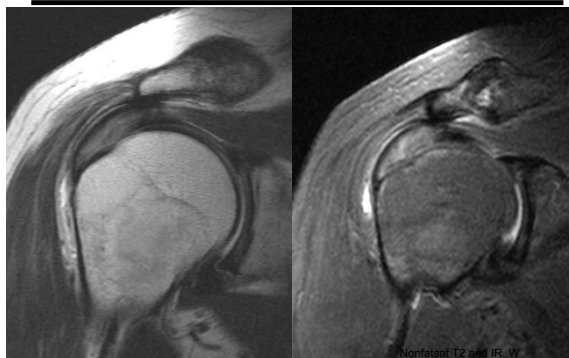


Magic angle

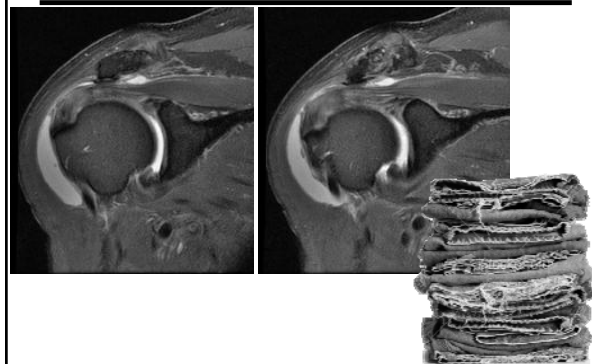
- Field orientation artifact in collagen causing focal T2 prolongation
- Artifact maximal when tissue is oriented at 55° to main magnetic field
- Most prominent on short TE sequences
- Disappears on long TE sequences
- Normal tendon morphology and size

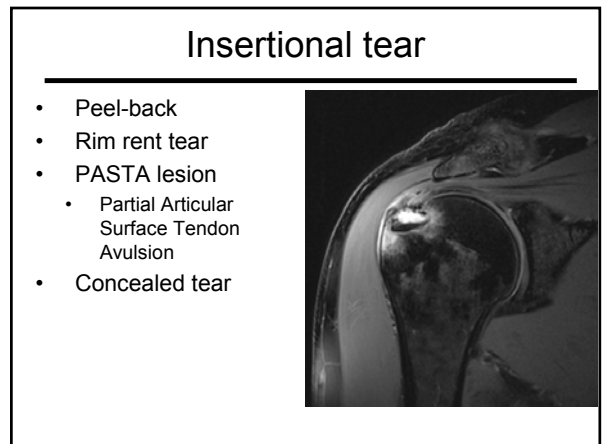
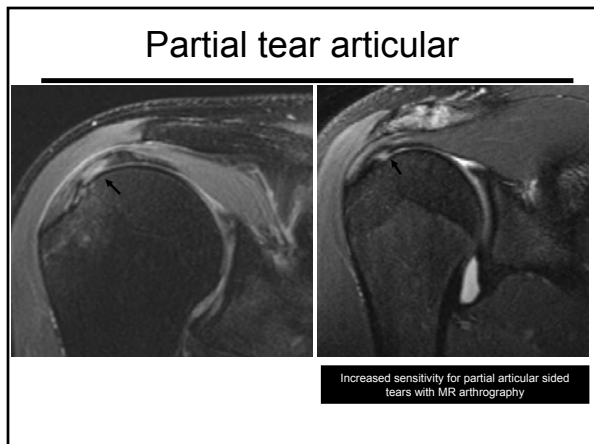
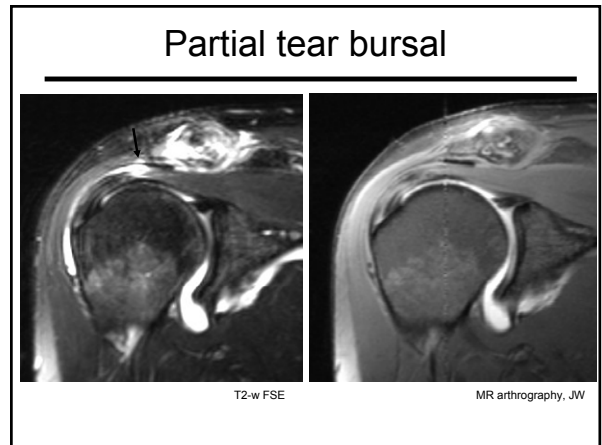
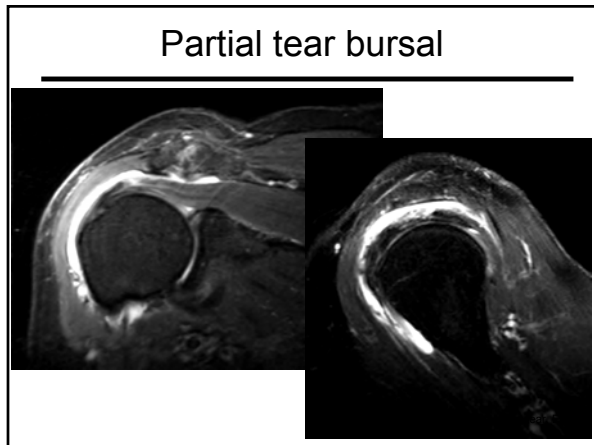
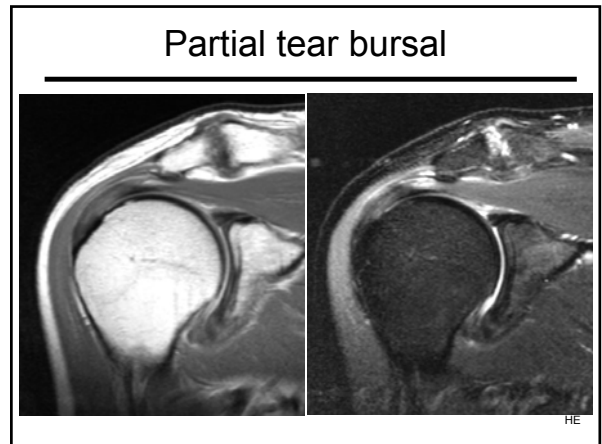
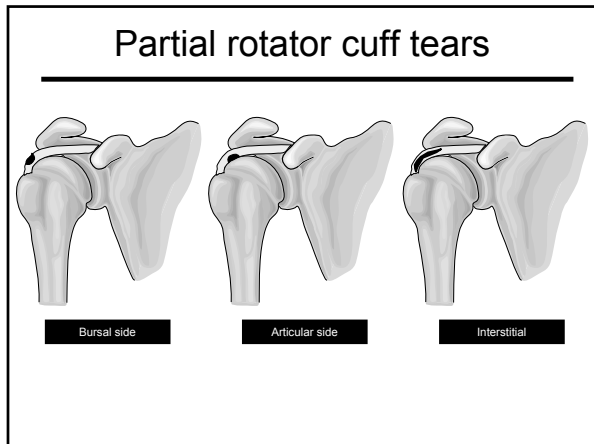


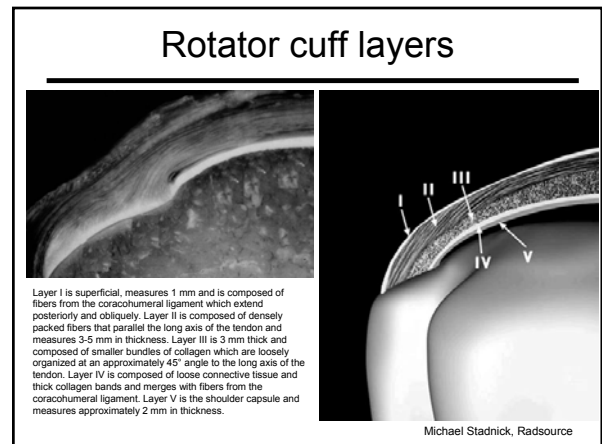
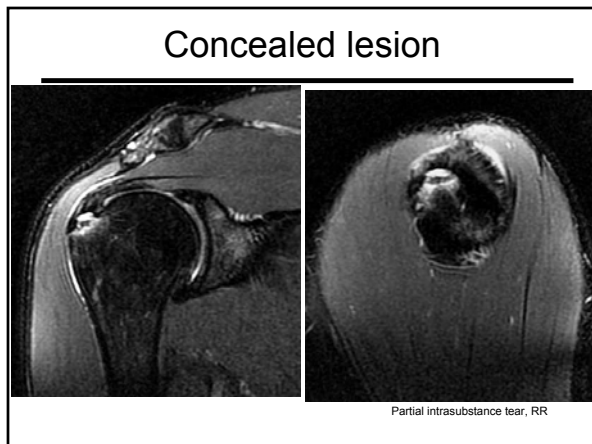
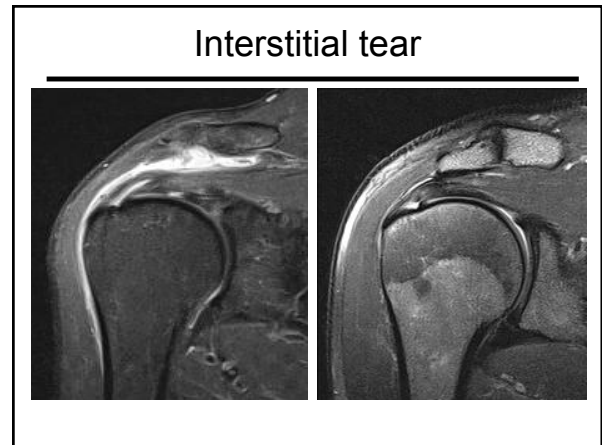
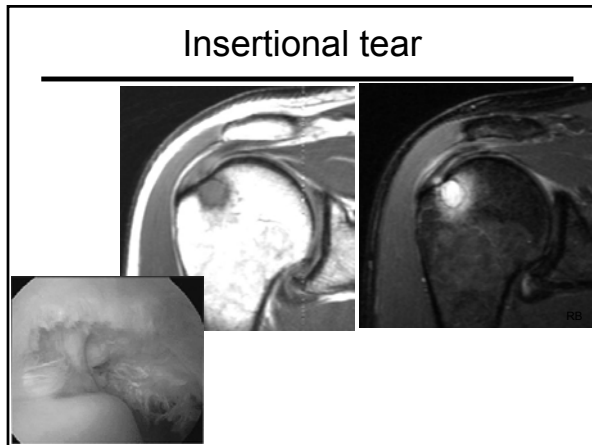
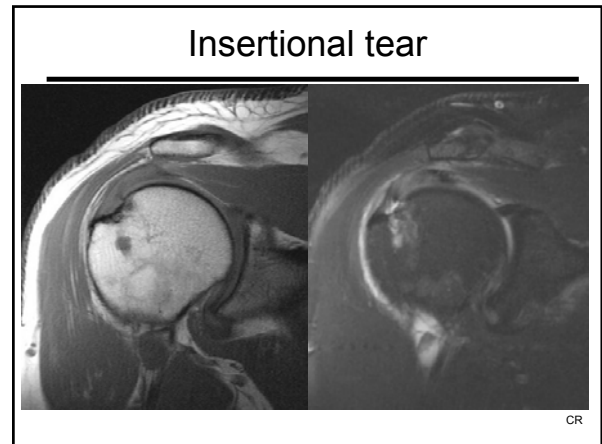
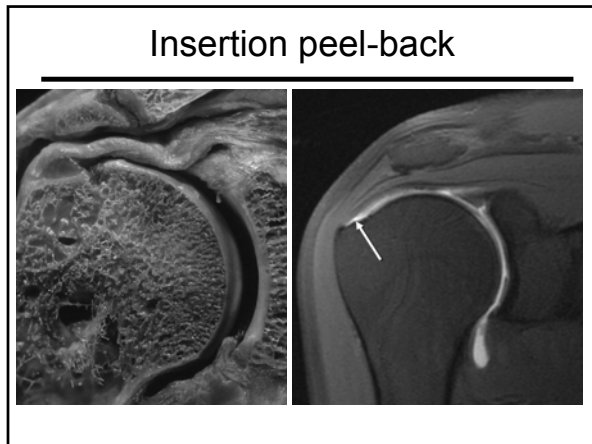
Tendinopathy



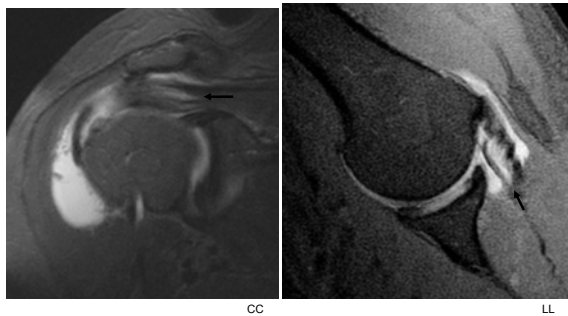
Tendinopathy ↔ Partial tear







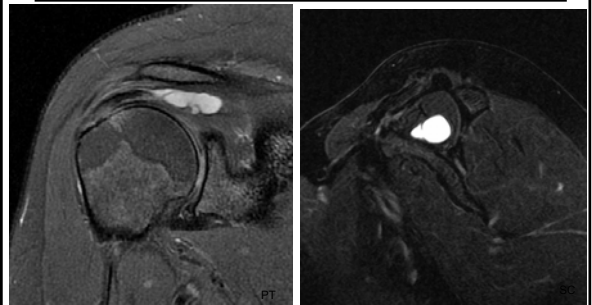
Delamination



CC

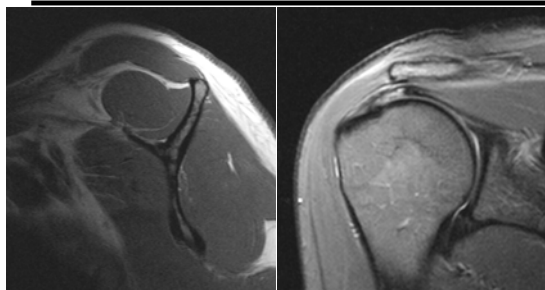
LL

Sentinel cyst

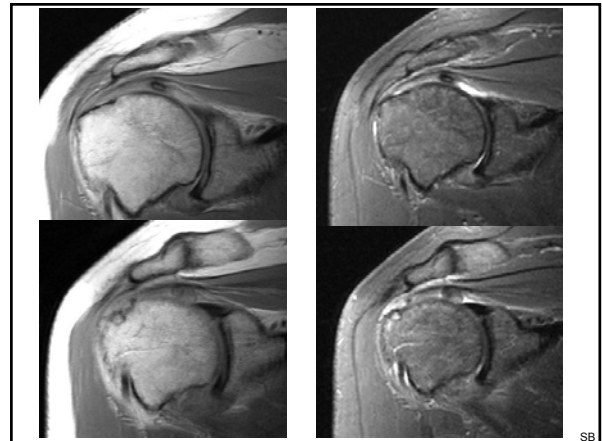


Sanders TG et al, Association of Intramuscular Cysts of the Rotator Cuff With Tears

Differential retraction

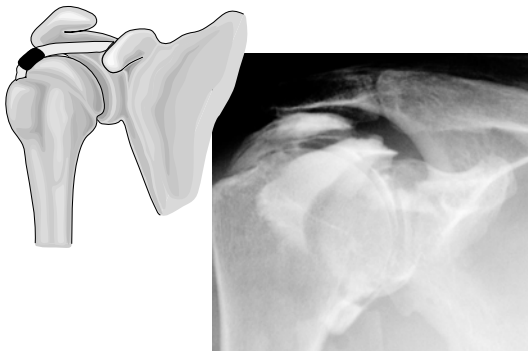


Retraction strap component



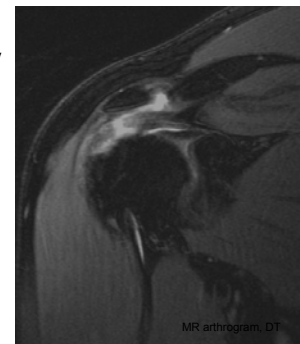
SB

Full thickness tear



Full thickness tear

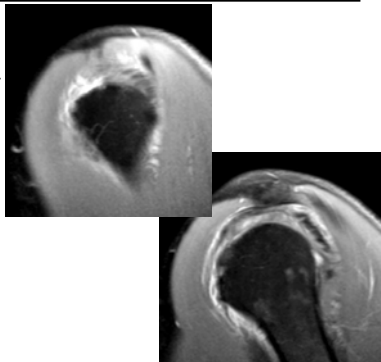
- Retraction of tendon
- Tendon discontinuity with fluid in gap
- Focal increased signal on T2w in tendon
- Severe attenuation or irregularity



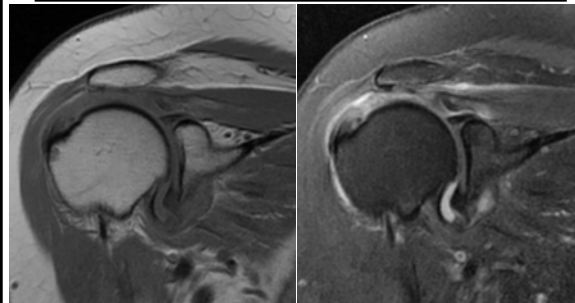
MR arthrogram, DT

Full thickness tear

- Tears preferentially involve anterior fibers of supraspinatus
- Peripheral sagittal images



Full thickness tear



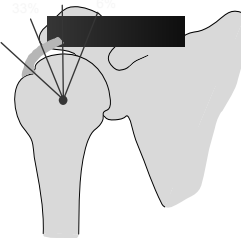
AT



Retraction and pseudotendon formation.

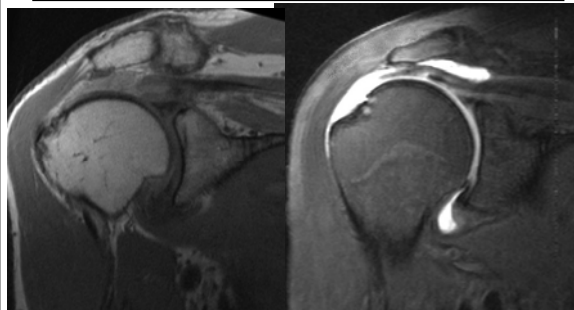
Myotendinous junction

- End of muscle fibers of supraspinatus
- Normal myotendinous junction lies above center of humeral head
- Furthest normal position medially is at 1:00 o'clock position



adapted from Steinbach LS et al, Shoulder Magnetic Resonance Imaging, Lippincott-Raven

Retraction

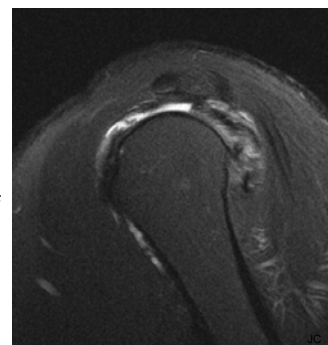


SB

MRA, FV

Complete tear

- Tendon torn all the way from anterior to posterior
- High-riding humerus
- Erosion of undersurface of acromion and superior humeral head

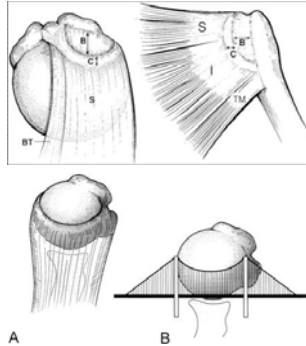


IC

Rotator cable

Superior (left) and posterior (right) projections of the rotator cable and crescent. The rotator cable extends from the biceps to the inferior margin of the infraspinatus tendon, spanning the supraspinatus and infraspinatus tendon insertions.

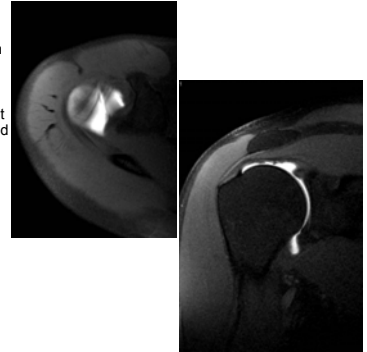
B, mediolateral diameter of rotator crescent; C, width of rotator cable; S, supraspinatus; I, infraspinatus; BT, biceps tendon; TM, teres minor.



Burkhart et al, The rotator crescent and rotator cable. Arthroscopy 9:611-6, 1993

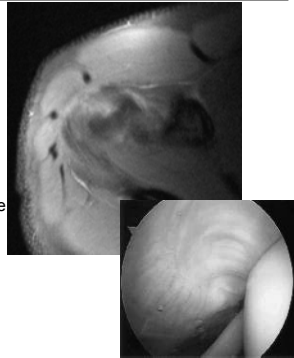
Rotator cable

- Rotator cable
 - Thickening of the capsule derived from the coracohumeral ligament that surrounds the distal SS and IS tendons. It is consistently located at the margin of the avascular zone
- Rotator crescent
 - Thin, crescent-shaped sheet of rotator cuff comprising the distal portions of the supraspinatus and infraspinatus insertions



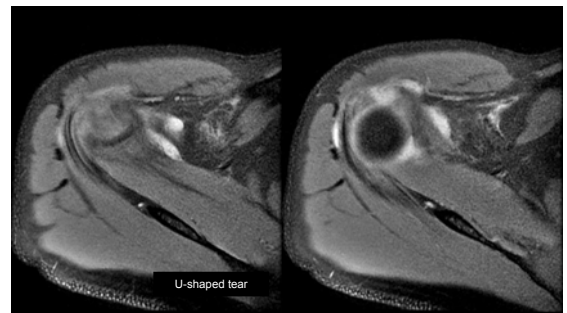
Rotator cable

- In cable dominant shoulder there is less retraction with RCT and less loss of function
- In cable non-dominant shoulder, the tear usually extends to MTJ and is therefore harder to repair
- Detachment of 1/2 or 2/3 of supraspinatus tendon in the crescent area has minor effect on the force transmission of the rotator cuff because these forces are transmitted along the rotator cuff cable, bypassing the tear

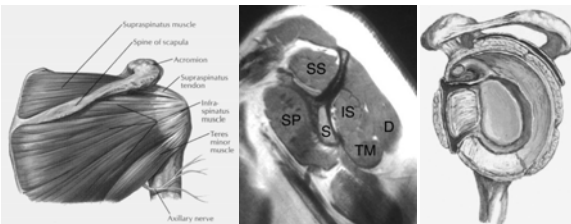


Burkhart et al, The rotator crescent and rotator cable. Arthroscopy 9:611-6, 1993

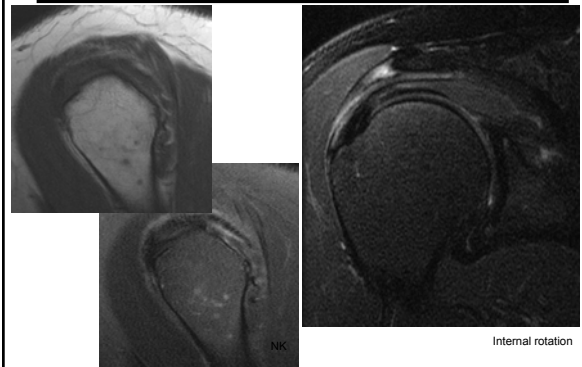
Rotator cable



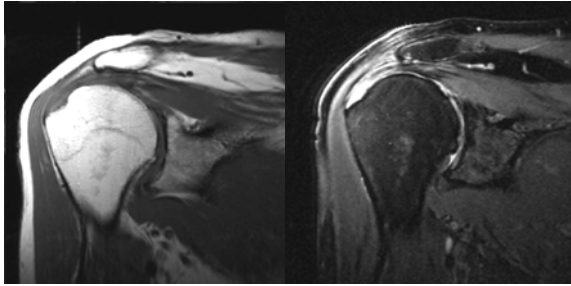
Infraspinatus



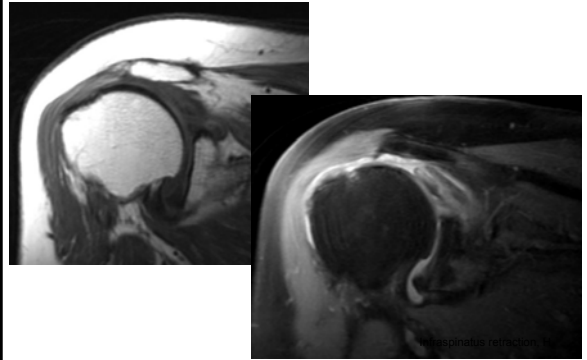
Infraspinatus



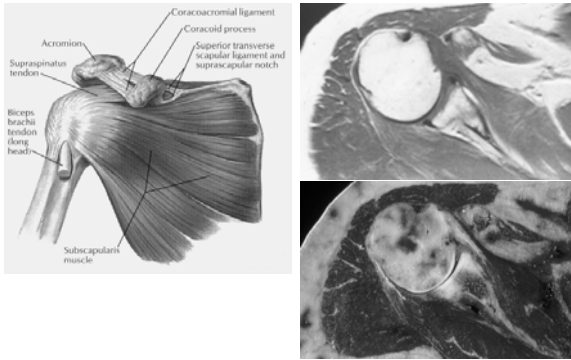
Infraspinatus tear



Infraspinatus tear

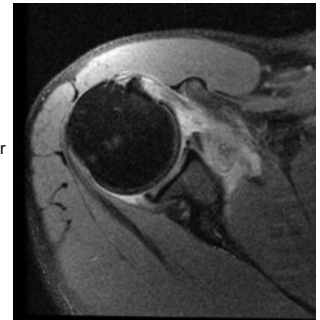


Subscapularis



Subscapularis

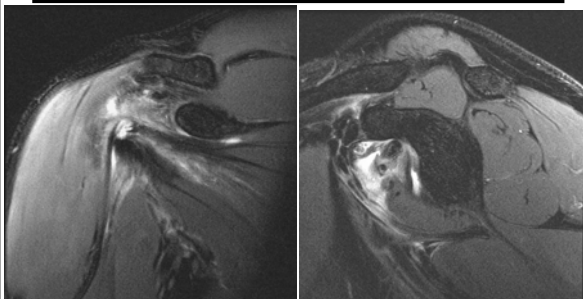
- Isolated tear of the subscapularis tendon is usually traumatic
- External rotation and hyperextension of abducted arm
- Anterior shoulder dislocation or recurrent anterior shoulder instability
- Near bony insertion on the lesser tuberosity
- May have avulsion of the tuberosity and associated internal malpositions of the biceps tendon, GHJ injury and HAGL lesion



Gerber et al, Isolated rupture of the subscapularis tendon. JBJS 78:1015, 1996

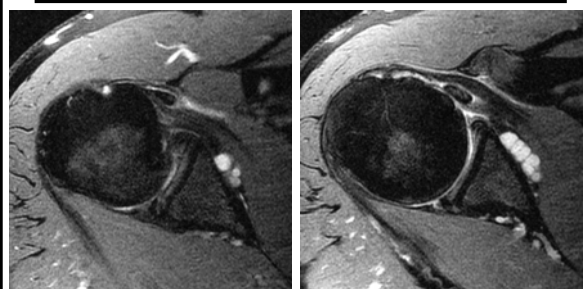
IS

Subscapularis tear



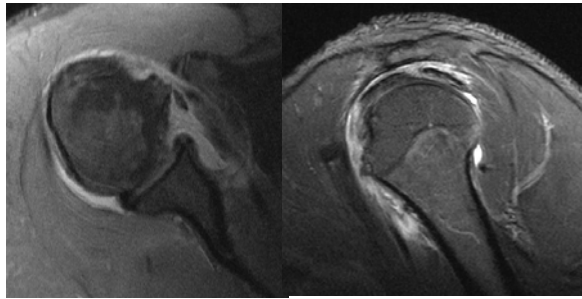
KB

Subscapularis tear



TS

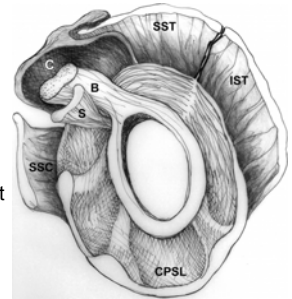
Subscapularis tear



CR

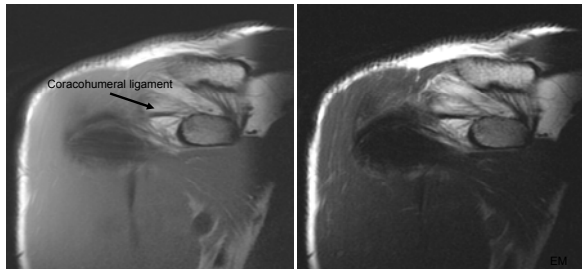
Rotator cuff interval

- Triangular space located between supraspinatus, subscapularis, and base of the coracoid
- Floor is humeral head
- Roof is rotator interval capsule, largely made up of coracohumeral ligament (SGHL provides contributions peripherally)
- Contains biceps tendon and SGHL



Morag et al, Radiographics 235:21, 2005
Krief, AJR 184:1490, 2005

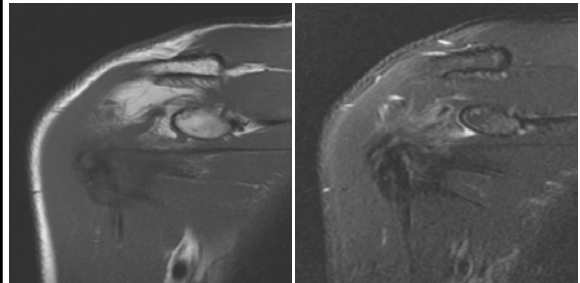
Rotator interval



- Wide medially, narrows laterally
- Capsule blends with rotator cuff at humerus

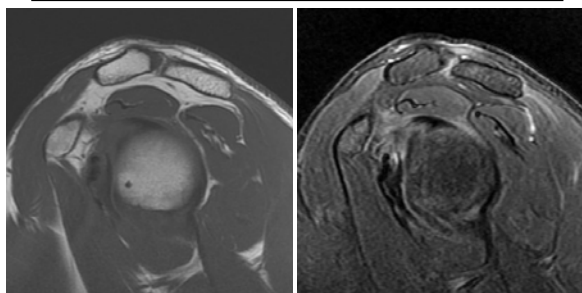
EM

Rotator interval



GB

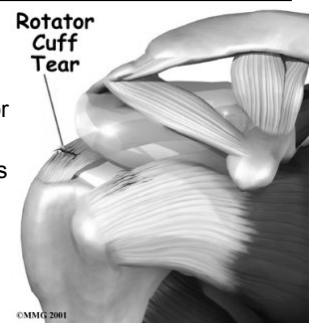
Rotator interval



GB

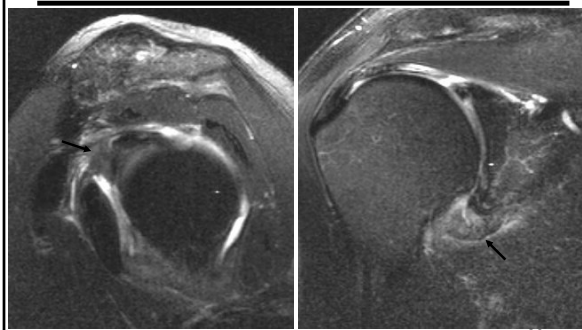
Rotator cuff interval tear

- Can be torn in association with supraspinatus or subscapularis tear or tear can be isolated
- Tear exposes biceps tendon
- Tear of rotator interval difficult to diagnose with MR



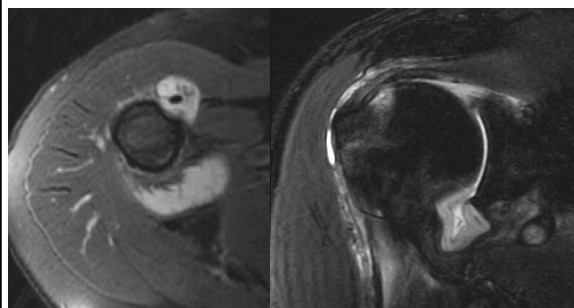
©MMG 2001

Adhesive capsulitis



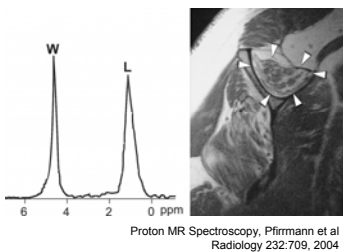
GC

Rheumatoid arthritis



Atrophy

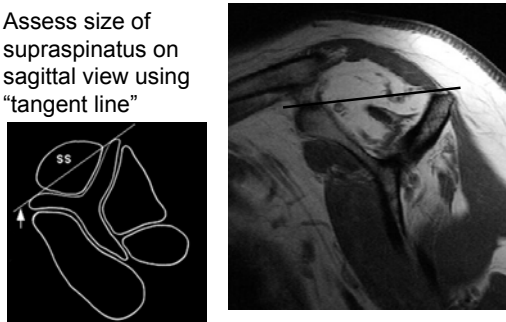
- Important predictor of surgical outcome
- Loss of >50% of muscle volume correlates with poor outcome
- Significant fatty atrophy (fat equal to muscle) poor prognostic indicator



Zanetti et al, Invest Rad 33:163, 1998

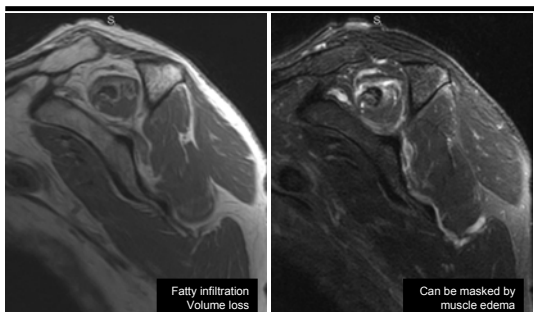
Atrophy

- Assess size of supraspinatus on sagittal view using "tangent line"

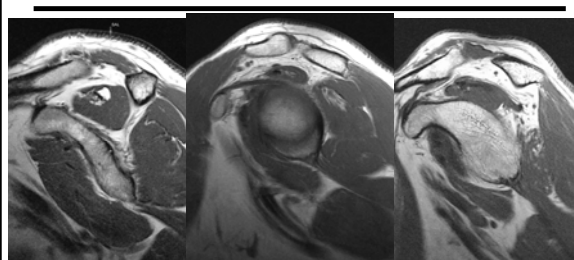


Mellado et al, AJR 184:1456, 2005

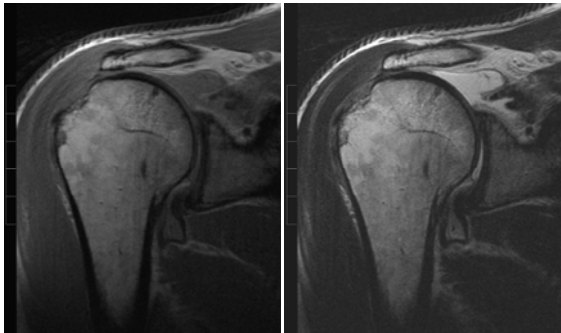
Atrophy



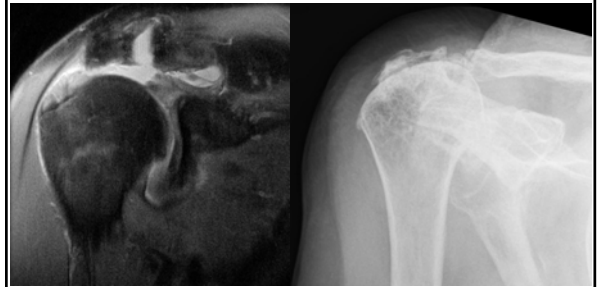
Atrophy



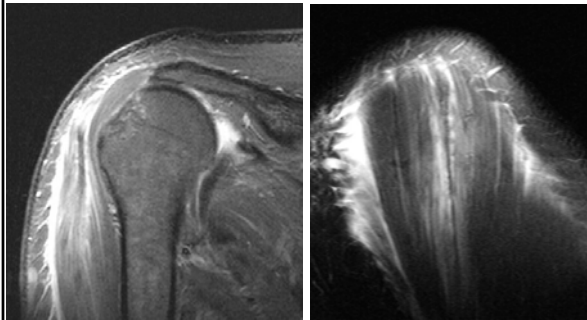
High-riding



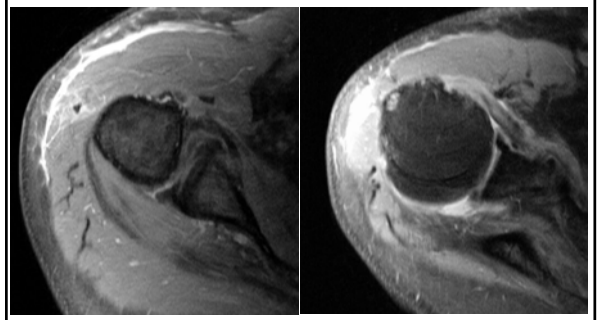
High-riding



Deltoid dehiscence



Deltoid dehiscence



UCSD

