MR Imaging of the Shoulder: Rotator Cuff

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

Trauma
- Slipped on bathroom mat, MR

Tendon calcification
- Silent phase
- Active phase

< 10% of rotator cuff tears
Tendon calcification

Calcium Hydroxyapatite Deposition Disease (HADD)  
Ca\(_{10}\)(PO\(_4\))\(_6\)(OH\(_2\))

Calcific tendinitis

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Calcific tendinitis

Rotator cuff degeneration

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

Rotator cuff degeneration

Critical zone
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

Bursal thickening

Subacromial bursitis

- Impingement
- Calcific tendinitis
- Infection
- Inflammatory synovitis

Subacromial bursitis

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

Bigliani et al, Orthop Trans 10:216, 1986
Acromial morphology

Type 1  Type 2  Type 3

Subacromial spur

Subacromial spur

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

Acromial morphology

Laterally down-sloping

Os acromionale

Pre-acromion  Meta-acromion  Neo-acromion
**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

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**Subcoracoid bursa**

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

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

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**Tendinopathy ↔ Partial tear**
Partial rotator cuff tears

- Bursal side
- Articular side
- Intertendineus

Partial tear bursal

- Increased sensitivity for partial articular sided tears with MR arthrography

Partial tear articular

Insertional tear

- Peel-back
- Rim rent tear
- PASTA lesion
  - Partial Articular Surface Tendon Avulsion
- Concealed tear
Layer I is superficial, measures 1 mm and is composed of fibers from the coracohumeral ligament which extend posteriorly and obliquely. Layer II is composed of densely packed fibers that parallel the long axis of the tendon and measures 3-5 mm in thickness. Layer III is 2 mm thick and composed of smaller bundles of collagen which are loosely organized at an approximately 45° angle to the long axis of the tendon. Layer IV is composed of loose connective tissue and thick collagen bands and merges with fibers from the coracohumeral ligament. Layer V is the shoulder capsule and measures approximately 2 mm in thickness.
**Delamination**

- CC
- LL

**Sentinel cyst**

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

**Differential retraction**

- Retraction strap component

**Full thickness tear**

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

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

**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

**Retraction**

**Complete tear**

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

Infraspinatus

- Infraspinatus
- Internal rotation
Infraspinatus tear

• 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, GHL injury and HAGL lesion


Subscapularis
**Subscapularis tear**

*Image of MRI scans showing subscapularis tear.*

**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 23:5:21, 2005
Krief, AJR 184:1490, 2005*

**Rotator interval**

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

**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
Adhesive capsulitis

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


**Atrophy**

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

Pfirrmann et al, Radiology 232:709, 2004

**Atrophy**

- Fatty infiltration
- Volume loss
- Can be masked by muscle edema

Mellado et al, AJR 184:1466, 2005
High-riding

Deltoid dehiscence

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