Shoulder MRI for Rotator Cuff Tears

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Goals of Presentation

- Shoulder anatomy
- Function of rotator cuff
- MRI approach to diagnose cuff tear
- Anatomy on MRI images
- Visualize supraspinatus tear on MRI
Our Patient

- 78 yo man with several months of increasing left shoulder pain especially with moving arm across front of body

- Physical exam suggestive of rotator cuff tear
  - Pain limiting range of motion
  - Weakness (especially of external rotation)

- Menu of radiology tests available
  - Plain film of shoulder to evaluate for bony anatomy and joint positioning
  - MR arthrogram (if think labral tear is involved)
  - MRI
Anatomy of Shoulder

- Ball and socket joint
- Great range of motion
- Four separate articulations
  - Glenohumeral, acromioclavicular, sternoclavicular, and scapulothoracic
- Focus on glenohumeral joint – ball and socket between humeral head and glenoid fossa of the scapula
Shoulder Joint

www.jointinjury.com
Rotator Cuff

- Complex of muscles & tendons that arise from the scapula, and attach to humerus
- SITS muscles/tendons
  - Supraspinatus
  - Infraspinatus
  - Teres minor
  - Subscapularis

All these tendons blend with the fibrous capsule to form the musculotendinous cuff + glenohumeral ligaments

- Functions as the *dynamic* stabilizer of the joint
- Reinforces joint capsule (superiorly, anteriorly, posteriorly)
Sagittal View Diagram

Rotator Cuff at Shoulder Joint

- Coracoacromial Ligament
- Subacromial Bursa
- Coracoid Process
- Acromion
- Supraspinatus
- Infraspinatus
- Subscapularis
- Teres Minor
- Glenoid Labrum
- Fibrous Capsule

Picture: www.bodybuilding.com
Supraspinatus

- Most often injured
- Primary function is abduct the humerus (but also has a role in humeral rotation)
- Depresses humeral head to counteract the uplifting force of the deltoid muscle
- Most superior muscle/tendon – extends over the top of humeral head and inserts on greater tuberosity superiorly

Picture: www.abcbodybuilding.com
Infraspinatus

- Main function is external rotation of humerus
- Also functions to depress humeral head and static stabilizer of glenohumeral joint
- Inserts on greater tuberosity (inferior and posterior to supraspinatus tendon)

Picture: www.abcbobybuilding.com
Teres Minor

- Least commonly injured
- Powerful external rotation of humerus
- Posteroinferior to the infraspinatus
- Also helps prevent subluxation of humeral head
- Inserts inferiorly on greater tuberosity
Subscapularis

- Largest and most powerful of SITS
- Main function is internal rotation (also functions to adduct, depress humerus)
- Also reinforces anterior joint capsule and becomes continuous with it
- Tendon fibers merge with transverse humeral ligament and fuse with fibers from supraspinatus into sheath that encompasses the biceps tendon
- Insertion from anterior scapula to superior aspect of lesser tuberosity (anterior humerus)

Also sends fibers over bicipital groove

Picture: www.abcbodybuilding.com
Biceps Tendon (long head)

- Not part of SITS but important for shoulder movement
- Stabilizes humeral head in glenoid during abduction of shoulder
- Proximal insertion is superior glenoid and posterosuperior glenoid labrum then traverses across superomedial aspect of humeral head and enters bicipital groove

Picture: www.orthogastonia.com
Rotator Cuff Tears

- **Occurs from:**
  - End result of chronic subacromial impingement
  - Progressive tendon degeneration from traumatic injury
  - Or a combination of these factors

- **Inciting injury is often a fall onto an outstretched arm, direct blow to the shoulder, or a rapid accelerating incident (e.g., pulling on a starter cable)**

- **Patients with a history of recurrent rotator cuff tendonitis are at increased risk for a tear**

- **Supraspinatus** most commonly torn
MRI – Standard Views

Axial
- Extending from level of acromion through the glenoid

Oblique coronal
- Obtained parallel to the scapula and supraspinatus and extending through subscapularis tendon anteriorly and infraspinatus tendon posteriorly

Oblique sagittal
- Level of scapula neck through lateral border of greater tuberosity (perpendicular to coronal plane)
Scout Image & Coil

• Scout images obtained in coronal plane to serve as localizer for subsequent pulse sequences
• Coil improves spatial resolution via higher signal:noise ratio
NL MRI – Coronal Oblique

Superior

Supraspinatus M

Deltoid M

Subscap M

Medial

T1 image, PACS, BIDMC
Normal MRI - Sagittal

Supraspin T, M
Subscap T
Deltoid
Anterior

Infraspin T, M
Teres minor T,M

T1, fat saturation, PACS, BIDMC
MRI Anatomy

Normal infraspinatus T

Normal subscap T

Biceps T

T2* coronal oblique image. (Musculoskeletal MRI, 2001)

Biceps tendon (white arrow head). T2* axial. (Musculoskeletal MRI, 2001)
MRI of Full-Thickness Tears

- Defects are filled with fluid, granulation tissue, or synovium
- Thus, defects have fluid-like signal on MR
- Might also see tendon retraction
- The spine of the scapula separates the supra and infraspinatus on axial images
Rotator Cuff Tear

Normal

Supraspinatus tear

http://www.emedx.com
Complete supraspinatus tear. T1 coronal oblique image. Torn end of supraspinatus tendon (white arrow) and medial retraction of the musculotendinous junction (between black arrows). (Musculoskeletal MRI, 2001)
Partial Tears

Classification of partial tears.  A. Articular surface partial.  B. bursal surface partial.  C. Intrasubstance partial (Figure: MRI of Shoulder, 2003)
Partial Supraspinatus Tear

T1 coronal oblique image. Partial tear: linear intermediate signal (arrow) between distal supraspinatus tendon and greater tuberosity. (Musculoskeletal MRI, 2001).
Full-thickness, partial width tear

T2, coronal sagittal. PACS, BIDMC
Impingement

Clinically – Pain with abduction + external rotation or elevation with internal rotation

Coracoacromial arch
- Humeral head posteriorly
- Acromion superiorly
- Coracoid process + coracoacromial ligament anteriorly

Conditions that limit space within this arch can lead to impingement and eventual tears in supraspinatus tendon
Coracoacromial Arch

www.orthoontheweb.com
Acromion Shapes

Sagittal perspective of different acromial shapes. Black circle represents supraspinatus tendon on anterior shoulder. Types III and IV have higher incidence of impingement. (Musculoskeletal MRI 2001, and Bigliani 1991)
Orientation can predispose to impingement and tear. Especially “low-lying” and “Inferolateral.” (Musculoskeletal MRI, 2001)
MRI of Inferolateral Acromion

T1 coronal image. Acromion (A) tilts inferiorly relative to the horizontal clavical (C). This narrows the space between humeral head and acromion where the supraspinatus tendon and the subacromial/subdeltoid bursa exist, increasing risk for impingement and tear.

(Musculoskeletal MRI, 2001)
Back to our patient

Complete supraspinatus tear on T2 image (red arrow). Superior translation of HH. Atrophy of supraspin. Acromion is Type II. (T2, PACS BIDMC)
Back to our patient

- Torn and retracted subscap T M (red arrow)
- Displaced biceps T
- Axial T2
- PACS, BID

Displaced biceps tendon
Treatment

- Non-operative – with most partial tears, or if surgery is contraindicated
  - Acute: ice and NSAIDs
  - Physical rehabilitation
  - Restrict overhead reaching and lifting
  - Lidocaine/steroid injection
Treatment

Operative Management

- Indicated in young patients with severe tears
- Delay longer than 6 wks can lead to atrophy
- Young pts who fail non-op management

Open repair vs. arthroscopic repair

- Depending on pathology
References

- Musculoskeletal MRI. Kaplan et al. W.B. Saunders Company. 2001
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