Shoulder Ultrasound

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Outline:
• Rotator cuff tears:
  – Primary and secondary signs
  – Pitfalls
• Miscellaneous pitfalls

Rotator Cuff Tears
• Tears are hypoechoic / anechoic
• Indirect signs at ultrasound:
  – Cortical irregularity: supraspinatus footprint
  – If present on radiographs, 75% have tear
  – Volume loss
  – Massive tear: non-visualization

AJR 1998; 171:229
Radiology 2004; 230:234

Rotator Cuff Tears
• Supraspinatus: most common
• Patients < 40 years old
  – Not common
  – Partial, articular, anterior
  – Associated labral pathology
• Degenerative tears
  – Posterior aspect of supraspinatus
  – May extend anterior or posterior

Supraspinatus: normal
Long Axis
Supraspinatus Insertion


Supraspinatus Tears: extent

Rim-rent Tear
Partial Articular
Partial Bursal

From: Fundamentals of Musculoskeletal Ultrasound

Supraspinatus Tears: extent

Intrasubstance
Full thickness

From: Fundamentals of Musculoskeletal Ultrasound

Articular Partial-thickness Tear: supraspinatus

Long Axis
Coronal T2w

Bursal Partial-thickness Tear: supraspinatus

Long Axis
Short Axis

Pitfall Alert!
Anisotropy

- Sound beam oblique to tendon fibers
- Artifactually hypoechoic
- Most common location for this error: rim rent area

Supraspinatus: long axis
Bursal Partial-thickness Tear: supraspinatus

Long Axis  Coronal T2w

Full-thickness Tear: supraspinatus

Note: Cartilage Interface Sign (open arrow)

Tendinosis

- No inflammatory cells
  - Mucoid degeneration, chondroid metaplasia
- Hypoechoic, ill-defined
- Possible increased thickness
- No cortical irregularity*

*Radiology 2004; 230:234
**Tendon Tear versus Tendinosis**

*both may appear hypoechoic*

<table>
<thead>
<tr>
<th>Tear</th>
<th>Tendinosis</th>
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</thead>
<tbody>
<tr>
<td>Anechoic</td>
<td>Hypoechoic</td>
</tr>
<tr>
<td>Well-defined</td>
<td>Ill-defined</td>
</tr>
<tr>
<td>Homogeneous</td>
<td>Heterogeneous</td>
</tr>
<tr>
<td>Thinned</td>
<td>Swollen</td>
</tr>
<tr>
<td>Bone irregularity*</td>
<td>Smooth cortex</td>
</tr>
</tbody>
</table>

*T at supraspinatus tendon footprint in patients over 40 years old

**Fatty Infiltration and Muscle Atrophy**

- Supraspinatus and infraspinatus
  - Infraspinatus: only variable to predict cuff healing1
- Associations:
  - Chronic, large, anterior supraspinatus tears2
- Ultrasound:
  - Comparable to MRI3
  - Improved reliability with extended field-of-view4

3Wall LB et al. JBJS 2012; 94:e83.
4Nazarian et al. 2008; 190:27.

**Fatty Infiltration and Muscle Atrophy**

- Indistinct tendon-muscle border
- Increased muscle echogenicity
  - Compare to teres minor
- Decreased muscle bulk
  - Compared to teres minor
  - Bone landmark: ridge in scapula
  - Short axis: infraspinatus 2x size

**Atrophy: supraspinatus and infraspinatus**

**No Atrophy**
Rotator Cuff Tears:
- General comments
- Secondary signs of rotator cuff tear
- Pitfalls in rotator cuff sonography

Secondary Findings of Rotator Cuff Tears:
- Volume loss of tendon substance
- Cortical irregularity
- Effusion (articular & bursal)
- Cartilage interface sign

Tendon Volume Loss
- Full-thickness
- Bursal Partial-thickness

Cortical Irregularity:
- Greater tuberosity: at supraspinatus insertion
- When present: 75% have rotator cuff tears
  - Patient over 40 years old
- When absent: 96% normal cuffs by sonography

Joint & Bursal Effusions:
- Joint effusion (biceps tendon)
- Subacromial-subdeltoid bursal fluid: >1 mm distention
- If both: 95% positive predictive value for rotator cuff tear

*Hollister et al. AJR 1995; 165:605
Joint Effusion and Bursal Fluid

Small Full-thickness Tear: supraspinatus

Intrasubstance Tear: supraspinatus

Rotator Cuff Tears:
- General comments
- Secondary signs of rotator cuff tear
- Pitfalls in rotator cuff sonography

Improper Positioning: supraspinatus

Incomplete Evaluation of Supraspinatus
Incomplete Evaluation of Supraspinatus

Cuff Tear Measurement: change with position

Musculotendinous Junction: supraspinatus

Supraspinatus – Infraspinatus Junction

Supraspinatus – Infraspinatus Junction

Bursal Thickening Simulating Intact Cuff

Note: flat

Note: angle

From: Chang EY et al. AJR 2014; 202:w376
Pseudofibers with Full-thickness Tear

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
- Non-cuff pitfalls

Infraspinatus Tear: full-thickness

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
- Non-cuff pitfalls

Partial-thickness Articular Tear: subscapularis

Focal Full-thickness Tear: subscapularis
Subscapularis Tear: full-thickness

- Long Axis
- Contralateral side

Subscapularis Tear: full-thickness

- Transverse
- Contralateral side

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
- Non-cuff pitfalls

Post-operative Rotator Cuff:
- Post-op tendon: echogenic & thin*
- Reimplantation trough
- Echogenic sutures & anchors

*Mack et al. AJR 1988; 150:1089

Intact Post-operative Cuff

Post-operative Rotator Cuff:
- Recurrent tear: usually large with nonvisualization
- Focal hypoechogenicity: equivocal
**Miscellaneous Cuff Pathology:**

- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
- Non-cuff pitfalls

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**Biceps Tendon:**

- Glenohumeral joint effusion:
  - Collects around biceps tendon
  - Tendon sheath communication
  - Seen in 97% with joint effusion
  - Abnormal: > 1 mm

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*Zubler et al. Eur Radiol 2011; 21:1868*
Shoulder Joint Recesses
- Long head biceps tendon sheath
- Posterior recess:
  - Image with shoulder in external rotation
- Axillary recess
- Subscapularis recess

Subacromial-subdeltoid bursa (SASD) vs. subscapularis recess (SSR) vs. subcoracoid bursa (SCB)

Subscapularis Recess
- Note redistribution of joint fluid with internal and external shoulder rotation

Subcoracoid Bursa

Inflammatory Tenosynovitis: biceps tendon
- Partial-thickness tear:
  - Hypoechoic / anechoic cleft
  - Tenosynovitis
  - Sensitivity: 27%
  - Accuracy: 88%
  - Subluxation / spur
  - Important secondary signs

Skendzel J, et al. AJR 2011; 197:942
**Aponeurotic Expansion of Supraspinatus Tendon**
- Up to 49% of shoulders
- Cleft: coronal plane
- Origin: supraspinatus
- Distal: pectoralis or bicipital groove

**Pitfall Alert! Pseudo Biceps Tendon**
- Biceps brachii long head
- Complete retracted tear
- Visible “fibers” in groove
  - Collapsed tendon sheath
  - Aponeurotic expansion of supraspinatus
- Look for distal retracted tendon and absent tendon in rotator interval

**Biceps Tendon Subluxation**

**Biceps Tendon Dislocation**

**Biceps Brachii: anatomy**
- Origin: supraglenoid tubercle of scapula and labrum
- Reflection pulley: stability
  - Coracohumeral ligament
  - Superior glenohumeral ligament
  - Superior aspect of subscapularis

**Rotator Interval Tear**
- Abnormal hypoechoigenicity, non-visualization
- Abnormal supraspinatus, superior glenohumeral ligament, subscapularis
- Biceps instability
  - “Chondral Print Sign”
  - Intracapsular instability

*Zappia M et al. Skeletal Radiol 2016: 45:35*
Large Full-thickness Tear: geyser sign

Long Axis
Coronal T1w

Post-traumatic Osteolysis of the Clavicle

Labral Tear and Labral Cyst

Long Axis: infraspinatus
Short Axis: infraspinatus

*Note: non-compressible

Pitfall: suprascapular vein dilation

Suprascapular Notch and Superior Labrum

Coronal Plane

Take-home Points

• Rotator cuff pitfalls:
  - Partial articular: focal anisotropy
  - Partial bursal: SA-SD bursal thickening
  - Full-thickness: extent, chronic tear
• Secondary signs of cuff tear:
  - Cortical irregularity (SST), thinning, cartilage interface
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