Ultrasound of Evaluation of Shoulder Pathology

Jon A. Jacobson, M.D.
Professor of Radiology
Director, Division of Musculoskeletal Radiology
University of Michigan

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- Not relevant to this talk

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Outline:
- Rotator cuff:
  - Cuff tear and tendinosis
  - Secondary signs of cuff tear
  - Calcific tendinosis
  - Post-operative cuff
- Biceps brachii tendon abnormalities
- Subacromial-subdeltoid bursa

Rotator Cuff Ultrasound:
- Accuracies:
  - Full-thickness tear: 96%1
  - Partial-thickness tear: 94%2
  - Equal to MRI: accuracy, size of tear3
- Patients prefer ultrasound over MRI4

Rotator Cuff Tear:
- Meta-analysis: 65 articles
- Full-thickness tears:
  - MRA, MRI, US = in sensitivity (92 – 95%)
  - MRA more specific
- Partial-thickness tears:
  - MRA most sensitive (86%) and specific
  - MRI (64%), US (67%)

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

1Teefey, JBJS Am 2000; 82:498.

de Jesus, 2009; 192:1701

AJR 1998; 171:229
Radiology 2004; 230:234
Rotator Cuff: pathogenesis

- Extrinsic:
  - Repetitive microtrauma: microtears
  - Subacromial impingement
- Intrinsic:
  - Degeneration: predispose to tear
  - Avascular region: critical zone
- Usually over age of 40 years

Rotator Cuff Abnormalities:

Categories:

- Partial-thickness tear
- Full-thickness tear
- Intra-substance tear
- Tendinosis

Supraspinatus: normal

Supraspinatus Tears: extent

Articular Partial-thickness Tear: supraspinatus
Articular Partial-thickness Tear: supraspinatus

Bursal Partial-thickness Tear: supraspinatus
Full-thickness Tear: supraspinatus

Note: Cartilage Interface Sign (open arrow)

Full-thickness Tear: supraspinatus

Note: Cartilage Interface Sign (open arrow)

Full-thickness Tear: supraspinatus

IST

Large Full-thickness Tear: supraspinatus

Long Axis

Short Axis

T2w Sagittal-oblique
Large Full-thickness Tear: supraspinatus

Long Axis Coronal T2w

Humerus

Deltoid

Intrasubstance Tear: supraspinatus

Long Axis

*Note lack of cartilage interface sign

Tendinosis

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


Tendon Tear versus Tendinosis

*both may appear hypoechoic

<table>
<thead>
<tr>
<th>Tear</th>
<th>Tendinosis</th>
</tr>
</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>

*At supraspinatus tendon footprint in patients over 40 years old

Tendinosis: supraspinatus tendon

Longitudinal Coronal-oblique T2w

*Radiology 2004; 230:234
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**Secondary Findings of Rotator Cuff Tears:**

- Volume loss of tendon substance
- Cortical irregularity
- Effusion (articular & bursal)
- Cartilage interface sign

**Tendon Volume Loss:**

- Flat or concave outer margin of supraspinatus*
  - Deltoid muscle dips into tendon gap
- Full-thickness tears
- Bursal sided partial-thickness tears
- Not seen in tendinosis

*Hodler et al. Radiology 1988; 169:791

**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

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

**Full-thickness Tear: supraspinatus**

Short Axis

**Cortical Irregularity: no significance**

Long Axis
Subscapularis Tendon
Short Axis
Humerus
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

Joint Effusion:
- posterior glenohumeral joint recess

Cartilage Interface Sign:
- Reflective interface between hypoechoic hyaline cartilage and adjacent fluid
- Indicates articular extension of tear
- Limited value

Small Full-thickness Tear: supraspinatus

Fatty Infiltration and Muscle Atrophy
- Supraspinatus and infraspinatus
  - Infraspinatus: only variable to predict cuff healing
- Associations:
  - Chronic, large, anterior supraspinatus tears
- Ultrasound:
  - Moderate to good correlation with MRI
  - Improved reliability with extended field-of-view

3Khoury et al. AJR 2008; 190:1105.
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

**Supraspinatus Atrophy**

**Atrophy: supraspinatus and infraspinatus**

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Tendon Calcification:
- Degenerative: thin, linear deposit
- Calcific tendinosis:
  - Formative: well-defined, dense shadow
  - Resorptive:
    - Globular, amorphous
    - Variable shadow
    - Best success with aspiration


Subscapularis: calcific tendinosis

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Farin et al. Skeletal Radiol 1996; 25:551

Degenerative Calcification

Calcific Tendinosis

Formative
Defined, shadow

Resorptive
Amorphous, little shadow

Calcific Tendinosis

- Hydroxyapatite deposition: dystrophic
  - Usually do not have cuff tear
- Appearance:
  - 79% hyperechoic & shadowing
  - No shadow: 7%
- Two phases:
  - Formative
  - Resorptive: painful

Farin et al. Skeletal Radiol 1996; 25:551
Post-operative Rotator Cuff:
- Post-op tendon: echogenic & thin*
- Reimplantation trough
- Echogenic sutures & anchors

*Mack et al. AJR 1988; 150:1089

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

Post-operative cuff: recurrent tear

Arthroplasty: Intact Cuff
Arthroplasty: Cuff Tear

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Biceps Tendon:
- Shoulder joint effusion:
  - Collects around biceps tendon
  - Tendon sheath communication
  - Joint fluid collects dependently

Inflammatory Tenosynovitis: biceps tendon

Biceps Tendon:
- Tendinosis:
  - Hypoechoic
  - Swollen
  - No inflammatory cells (not tendinitis)
  - Possible tenosynovitis

Skendzel J, et al. AJR 2000; 197:942
Aponeurotic Expansion of Supraspinatus Tendon
- Up to 49% of shoulders
- Cleft: coronal plane
- Origin: supraspinatus
- Distal: pectoralis or bicipital groove

Moser et al. Skeletal Rad 2015; 44:223

Biceps Tendon
- Subluxation
- Dislocation

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Subacromial-subdeltoid Bursa: fluid

Coronal

Coronal T2w

Subacromial-subdeltoid bursa: anterior

Proximal

Distal

Sagittal
Subacromial-subdeltoid Bursa: thickening

Bursal Thickening Simulating Intact Cuff

Calcific Bursitis

Impingement: bursal fluid
- Abnormal pooling of subacromial-subdeltoid bursal fluid
- Lateral acromion:
  - Coronal plane, active arm elevation
  - Not visible in neutral position, no cuff tear
- At coracoid:
  - Axial plane, active elevation internal rotation

Impingement Test

Impingement Syndrome

Farin et al. Radiology 1990; 176:845
Stalensberg et al. AJR 2006; 187:894
**Impingement: supraspinatus**

**Take-home Points**

- Must follow a protocol
- Cuff tears: avoid anisotropy
- Cortical irregularity: important indirect sign
  - Supraspinatus tears
- Dynamic: impingement
- Joint effusion: biceps

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