Rotator Cuff Pathology

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Disclosures
• Consultant: Bioclinica
• Advisory Board: Philips
• Book Royalties: Elsevier
• Not relevant to this talk

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Rotator Cuff

Supraspinatus
Subscapularis
Infraspinatus
Teres Minor
Biceps
Long Head

Note: Subacromial-subdeltoid Bursa (light blue)

Ultrasound Appearance:
• Tendon: hyperechoic, fibrillar
• Muscle: relatively hyperechoic
• Bone cortex: hyperechoic, shadowing

Anisotropic Effect
• Tendon is artifactually hypoechoic
• Sound beam is not perpendicular to fibers
• Tendon, ligament > muscle

Supraspinatus Tendon: normal
• Hyperechoic and fibrillar echotexture
• Convex superior surface
• Uniform thickness: transverse
Technical Considerations

- > 10 Mhz (prefer at least 12 Mhz)
- Supraspinatus: long axis most important plane
  - Less pitfalls, easy recognition of anatomy
  - >90% accuracy long axis alone
- Biceps tendon (intra-articular)
  - Important landmark: complete evaluation

1 Arend CF et al. J Ultrasound Med 2010; 29:1725
Supraspinatus – Infraspinatus Junction

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

Rotator Cuff Tears:
- 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

Rotator Cuff Abnormalities:
- Categories:
  - Partial-thickness tear
    - Articular-sided
    - Bursal-sided
    - Intrasubstance (or interstitial)
  - Full-thickness tear
  - Tendinosis

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

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

Rotator Cuff Tear: Extent
- Partial-thickness:
  - Interstitial
  - Articular
  - Bursal
- Full-thickness, incomplete:
  - Extends to two surfaces
- Full-thickness, complete:
  - Entire tendon discontinuous
  - Full width

Supraspinatus Tears: extent
- Partial Articular
- Partial Bursal

From: Fundamentals of Musculoskeletal Ultrasound

Supraspinatus Insertion

From: Siebold et al. Radiographics 1999; 19:685

Supraspinatus Tears: extent
- Intrasubstance
- Full thickness

From: Fundamentals of Musculoskeletal Ultrasound

Articular Partial-thickness Tear: supraspinatus
- Long Axis
- Coronal T2w
Pitfall Alert!
Anisotropy
- Sound beam oblique to tendon fibers
- Artifactually hypoechoic
- Most common location for this error: rim rent area

Articular Partial-thickness Tear: supraspinatus
- Long Axis
- Coronal T2w

Bursal Partial-thickness Tear: supraspinatus
- Long Axis
- Short Axis
Full-thickness Tear: supraspinatus

Note: Cartilage Interface Sign (open arrow)

Full-thickness Tear: supraspinatus (full-width)

Full-thickness Tear: supraspinatus

Long Axis T2w Coronal-oblique

Full-thickness Tear: supraspinatus

Short Axis T2w Sagittal-oblique

Full-thickness Tear: supraspinatus

Short Axis T2w Sagittal-oblique

Large Full-thickness Tear: supraspinatus

Long Axis Short Axis
**Intrasubstance Tear:**
- supraspinatus

**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

**Fatty Infiltration and Muscle Atrophy**

- Supraspinatus and infraspinatus
  - Infraspinatus: only variable to predict cuff healing
- Associations:
  - Chronic, large, anterior supraspinatus tears
- Ultrasound:
  - Comparable to MRI
  - Improved reliability with extended field-of-view

**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

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**Infraspinatus Atrophy**

- Short Axis
- Long Axis

**Supraspinatus Atrophy**

- Short Axis
- Long Axis

**Atrophy: supraspinatus and infraspinatus**

- Short Axis (extended field-of-view)

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**No Atrophy**

- Short Axis (extended field-of-view)

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**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:

- 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

*Todler 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

*Hodler et al. Radiology 1988; 169:791

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

Humerus

Subscapularis Tendon
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

Supraspinatus: full-thickness tear
Fellow (partial tear); Faculty (full-thickness tear)

Rotator Cuff Tears:

- General comments
- Secondary signs of rotator cuff tear
- Pitfalls in rotator cuff sonography

Improper Positioning: supraspinatus
Incomplete Evaluation of Supraspinatus

Internal Rotation

Short Axis US

Incomplete Evaluation of Supraspinatus

Long Axis

Long Axis

Subacromial-subdeltoid Bursa:
- Hyperechoic synovium may appear similar to tendon fibers
- Hyperechoic thickness that extends beyond greater tuberosity is synovium and not cuff fibers

Bursal Thickening Simulating Intact Cuff

Long Axis

Short Axis

Pseudofibers with Full-thickness Tear

Long Axis

Short Axis

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
Infraspinatus Tear:
- Isolated tear: rare, trauma
- Part of massive cuff tear:
  - If supraspinatus tear, look for extension
  - Tear extends over middle facet >1.3 cm from rotator interval on transverse image

Subscapularis Tear:
- Isolated tear: rare, trauma
- Part of massive cuff tear
- Anterosuperior cuff tear:
  - Supraspinatus and subscapularis borders of the rotator interval

Pflimann et al. Radiology 1999; 213:709

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

Take-home Points

• Must follow a protocol
• Most cuff tears: supraspinatus
  – Use rotator interval as landmark
  – Understand greater tuberosity facets
• Cortical irregularity: important indirect sign
  – Supraspinatus tears

Syllabus on line and other educational material:
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