Rotator Cuff Pathology

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Fundamentals of Musculoskeletal Ultrasound are copyrighted by Elsevier Inc.

Outline:
• Rotator cuff tears:
  – General comments
  – Primary signs
  – Secondary signs
• Miscellaneous cuff pathology

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%)

d de Jesus, 2009; 192:1701

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
Rotator Cuff Abnormalities:

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

**Supraspinatus: normal**

Supraspinatus Insertion


Supraspinatus Tears: extent

From: *Fundamentals of Musculoskeletal Ultrasound*

Supraspinatus Tears: extent

From: *Fundamentals of Musculoskeletal Ultrasound*

Rotator Cuff Tear: Extent

- Partial-thickness:
  - Interstitial
  - Articular
  - Bursal
- Full-thickness, incomplete:
  - Extends to two surfaces
- Full-thickness, complete:
  - Entire tendon discontinuous
  - Full width
Outline:

- Rotator cuff tears:
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  - Primary signs
  - Secondary signs
- Miscellaneous cuff pathology

Partial-thickness Tear:

- Usually hypoechoic / anechoic
  - May see hyperechoic fiber stump*
  - Articular, bursal, or intrasubstance
  - Associated cortical irregularity
  - Little if any tendon volume loss
    - Unless bursal location

van Holsbeeck et al. Radiology 1995; 197:443

Articular Partial-thickness Tear: supraspinatus

Pitfall Alert!

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

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

Full-thickness Tear: supraspinatus

Note: Cartilage Interface Sign (open arrow)
**Full-thickness Tear: supraspinatus**

- Short Axis
- T2w Sagittal-oblique

**Large Full-thickness Tear: supraspinatus**

- Long Axis
- Short Axis

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

*Radiology 2004; 230:234

**Intrasubstance Tear: supraspinatus**

- Long Axis

*Note lack of cartilage interface sign

**Chronic Full-thickness Tear: supraspinatus**

- Long Axis
- Short Axis
- 1 year earlier

**Intrasubstance Tear: supraspinatus**

- Long Axis

**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

\[2\text{Hodler et al. Radiology 2005; 237:594.}\]
\[3\text{Wall LB et al. JBJS 2012; 94:e83.}\]
\[4\text{Nazarian et al. 2008; 190:27.}\]
Atrophy: supraspinatus and infraspinatus

No Atrophy

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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
**Full-thickness Tear: supraspinatus**

**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

**Cortical Irregularity: no significance**

**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**

**Cartilage Interface Sign:**
- Reflective interface between hypoechoic hyaline cartilage and adjacent fluid
- Indicates articular extension of tear
- Limited value
Small Full-thickness Tear: supraspinatus

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Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
- Calcific tendinosis

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
Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
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Subscapularis Tear:
- Isolated tear: rare, trauma
- Part of massive cuff tear
- Anterosuperior cuff tear:
  - Supraspinatus and subscapularis borders of the rotator interval

Pfirrmann et al. Radiology 1999; 213:709
Subscapularis Tear: dynamic imaging

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
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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
Post-operative Cuff: retear

Post-operative cuff: recurrent tear

Open arrow = bioabsorbable suture anchor

Open arrow = suture

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Post-operative cuff
- Calcific tendinosis
Tendon Calcification:

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


Calcific Tendinosis

• Hydroxyapatite deposition: metaplasia
  – 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

Calcific Tendinosis: resorptive phase

Patient #1
Patient #2: Intra-osseous invasion

Calcific Tendinosis: supraspinatus

Use of Tendon Anisotropy

Long axis
Calcific Tendinosis: aspiration

• Percutaneous lavage and aspiration
  – Best: rounded amorphous calcification
  – Correlate with radiography
• 3-10 cc syringes: Lidocaine
• 20 – 22 gauge needle
• Position patient: syringe is dependent

Calcific Tendinosis: aspiration

• Inject Lidocaine, then aspirate
  – Dilute calcification
  – Syringe dependent
  – Calcification will flow into needle
  – Repeat until calcification decreases
• Inject steroids into adjacent bursa

Calcific Tendinosis: lavage/aspiration

Patient #1 Patient #2

Teres Minor Atrophy:

• Isolated finding: 3%
• Usually without visible pathology in quadrilateral space:
  – Mass, paralabral cyst, etc.
• May relate to variation in origin and length of teres minor innervation

Sofka, Skeletal Radiol 2004; 33:514
Friend, Surg Radiol Anat 2010; 32:243

Teres Minor Atrophy

Take-home Points

• Must follow a protocol
• Secondary signs of cuff tear:
  – Cortical irregularity, volume loss, cartilage interface sign
• Orientation:
  – Greater tuberosity facets, rotator interval
Syllabus on line and other educational material:
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