Rotator Cuff and Biceps Pathology

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Outline
- Rotator cuff tears:
  - Primary and secondary signs
- Miscellaneous pathology
- Biceps tendon 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%)

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

d e Jesus, 2009; 192:1701

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

Long Axis

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

Supraspinatus Tears: extent

Partial Articular Partial Bursal

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

Articular Partial-thickness Tear: supraspinatus

Long Axis Coronal T2w

From: Fundamentals of Musculoskeletal Ultrasound
**Pitfall Alert! Anisotropy**

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

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**Bursal Partial-thickness Tear: supraspinatus**

- Long Axis
- Coronal T2w

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**Bursal Partial-thickness Tear: supraspinatus**

- Long Axis
- Short Axis

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**Full-thickness Tear: supraspinatus**

- Note: Cartilage Interface Sign (open arrow)

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**Full-thickness Tear: supraspinatus**

- Short Axis

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**Large Full-thickness Tear: supraspinatus**

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

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

*Note lack of cartilage interface sign

**Tendinosis: supraspinatus**

**Tendon Tear versus Tendinosis**

*both may appear hypoechoic

**Tear**
- Anechoic
- Well-defined
- Homogeneous
- Thinned
- Bone irregularity*

**Tendinosis**
- Hypoechoic
- Ill-defined
- Heterogeneous
- Swollen
- Smooth cortex

*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 healing
- Associations:
  - Chronic, large, anterior supraspinatus tears
- Ultrasound:
  - Comparable to MRI
  - Improved reliability with extended field-of-view

*Wall LB et al. JEEE 2012; 94:e83.
*Nazarian et al. 2008; 190:27.
Atrophy: supraspinatus and infraspinatus

Short Axis (extended field-of-view)

No Atrophy

Short Axis (extended field-of-view)

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

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

Cortical Irregularity: no significance

Humerus

Long Axis
Subscapularis Tendon
Short Axis
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

Small Full-thickness Tear: supraspinatus

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Calcific tendinosis

Infraspinatus Tear: full-thickness

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Calcific tendinosis
Partial-thickness Articular Tear: subscapularis

Focal Full-thickness Tear: subscapularis

Subscapularis Tear: full-thickness

Miscellaneous Cuff Pathology:
- Infraspinatus tendon
- Subscapularis tendon
- Calcific tendinosis

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
Degenerative Calcification

Biceps Brachii: pathology

- Tendinosis
- Tear: partial and full-thickness
- Subluxation and dislocation
- Association with:
  - SLAP and anterior rotator cuff tears
- Causes: acute injury, repetitive injury, degeneration

Biceps Tendon:

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

Shoulder Joint Recesses

- Long head biceps tendon sheath
- Posterior recess:
  - Image with shoulder in external rotation
- Axillary recess
- Subscapularis recess

Biceps Tendon Sheath

- Intra-articular body
  - Echogenic
  - Possible shadowing
  - Single or multiple
  - Associated with glenohumeral joint osteoarthritis

Septic Joint

- Biceps tendon sheath distention
- Heterogeneous
- Increased blood flow
- Non-specific

1Zubler et al. Eur Radiol 2011; 21:1858
Biceps Tendon: tendosynovitis

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

Biceps Tendon

- Partial-thickness tear:
  - Hypoechoic /anechoic cleft
  - Tendosynovitis
  - 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

Moser et al. Skeletal Rad 2015; 44:223

Pitfall Alert!
Pseudo Biceps Tendon

- Biceps brachii long head
- Complete retracted tear
- “Pseudofibers” in groove
  - Collapsed tendon sheath
  - Aponeurotic expansion of supraspinatus
- Look for distal retracted tendon and absent tendon in rotator interval
**Take-home Points**

- Must follow a protocol
- Most cuff tears: anterior supraspinatus
  - Use rotator interval as landmark
- Cortical irregularity: important indirect sign
  - Supraspinatus tears
- Dynamic: impingement, adhesive capsulitis
- Joint effusion: biceps, posterior