Shoulder Ultrasound: Anatomy and Scanning Techniques

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Rotator Cuff Anatomy:
• Supraspinatus
• Infraspinatus
• Teres Minor
• Subscapularis

Rotator Cuff

Subacromial-subdeltoid bursa (light blue)

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)
Ultrasound Appearance:
- Tendon: *hyperechoic*, fibrillar
- Muscle: relatively *hypoechoic*
- Bone cortex: *hyperechoic*, shadowing

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

Anisotropy: supraspinatus tendon
- Long Axis

Anisotropy: subscapularis tendon
- Short Axis

Anisotropy: subscapularis tendon

US: normal appearance
- Cartilage
  - Hyaline: hypoechoic
  - Fibrocartilage: hyperechoic
- Joint fluid
  - Simple: anechoic
  - Complex: mixed echogenicity
Shoulder Ultrasound Examination

Technique: position #1
- Neutral, supination
  - Hand on lap, palm up
  - Anterior (10-17 MHz)
  - Biceps tendon:
    - Transverse, longitudinal

Long Head of Biceps Brachii Tendon

Scanning: basics
- Heel-toe maneuver
  - Evaluating long axis of tendon
  - Eliminate anisotropy

Scanning: basics
- Toggle
  - Evaluating short axis of tendon
  - Help identify tendon
  - Eliminate anisotropy

Technique: position #1
- To find biceps longitudinal
  - Use bone landmarks
  - Find lesser tuberosity: pyramid shape
  - Move lateral to bicipital groove
Long Head of Biceps Brachii Tendon

**Technique: position #2**
- External Rotation
  - Anterior
  - 10-17 MHz linear
- Subscapularis tendon
  - Longitudinal, transverse
- Biceps dislocation

External Shoulder Rotation

Subscapularis

**Technique: position #3**
- Internal rotation, extension
  - Back of hand at other back pocket
  - Anterior (7-13 MHz linear)
- Supraspinatus
  - Start longitudinal
  - Infraspinatus
Neutral Position

Internal Rotation

Technique: position #3
• Modified Crass
  – Hand at closest hip pocket
  – Easier to tolerate
  – Long axis: aim toward ear
  – Improved biceps visualization
  – Overestimates size*

Ferri, AJR 2005; 184:160

Modified Crass Position

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

Short Axis

Long Axis
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 alone¹
- Biceps tendon (intra-articular)
  - Important landmark: complete evaluation

Supraspinatus and Infraspinatus Tendons

Short Axis (Greater Tuberosity)

Infraspinatus Footprint

From: Mochizuchi T. JBJS 2008; 90:962

Supraspinatus - Infraspinatus Junction

• Longitudinal:
  – Flattening of greater tuberosity
  – Tendon striations: anisotropy infraspinatus
• Transverse:
  – 1.3 – 2.3 cm posterior to biceps tendon
  – Infraspinatus overlaps supraspinatus
  – Slight volume loss

Supraspinatus – Infraspinatus Junction

Note: flat

Note: angle

Middle Facet: Infraspinatus overlaps supraspinatus

From: Chang ET et al. AJR 2014; 202:w376

Long Axis to Supraspinatus over Middle Facet
**Supraspinatus – Infraspinatus Junction**

- **Long Axis**
- **Short Axis**

**Technique: position #4**
- Neutral position
  - 10-17 MHz linear
  - Acromioclavicular joint
  - Subacromial-subdeltoid bursa
  - Dynamic: impingement

**Subacromial-subdeltoid Bursa**

- Coronal

**Technique: position #5**
- Neutral position: posterior (5 – 12 MHz)
  - A. Posterior glenohumeral joint
    - Joint recess, infraspinatus
    - Labrum, spinoglenoid notch
  - B. Muscle atrophy
  - C. Suprascapular notch
    - Superior labrum

**Impingement Test**

**Infraspinatus Tendon & Posterior Labrum**

- **Infraspinatus: Long Axis**
No Atrophy

Short Axis

Suprascapular Notch and Superior Labrum

Coronal Plane

Pitfall: technique

- Improper arm position
- Incomplete evaluation of the supraspinatus
- Transverse imaging too distal
- Anisotropy
- Measuring cuff tear

Improper Arm Position:

- Inadequate internal rotation/extension
- Supraspinatus is hidden beneath acromion

Improper Positioning: supraspinatus
Incomplete Evaluation of Supraspinatus:

- Scan entire width of greater tuberosity
- Many tears occur anteriorly over superior facet
- Include biceps on transverse image as landmark

Transverse Imaging: supraspinatus

- Uniformly thins over greater tuberosity
- Cuff absent beyond greater tuberosity
- Confirm with orthogonal longitudinal imaging

Anisotropy: supraspinatus
**Pitfall Alert!**

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

*Supraspinatus: long axis*

**Articular Partial-thickness Tear: supraspinatus**

*Long Axis*  
*Coronal T2w*

**Cuff Tear Measurement: change with position**

*Crass Position*  
*Modified Crass Position*

*Ferri, AJR 2005; 184:180*

**Pitfall: misinterpretation of normal**
- Rotator interval
- Musculotendinous junction
- Supraspinatus - infraspinatus junction

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

*From: Ding et al. JBJS 2015; 96:E176*

*Middleton et al. AJR 1986; 146:555*
Rotator Interval

Short Axis US  Sag-obl MR Arthrogram

Musculotendinous Junction:
- Supraspinatus: several distinct tendons
- Appears as hypoechoic area extending into tendon
- Usually terminates by mid-tendon
- Characteristic tapering from proximal to distal

Turrin et al. Skeletal Radiology 1997; 26:89

Musculotendinous Junction: supraspinatus

Long Axis  Short Axis

Musculotendinous Junction: subscapularis

Short Axis

Rotator cuff: structure
- Supraspinatus: 2 tendons
  - Anterior cylindrical tendon
  - Posterior flat tendon
  - Infraspinatus overlaps supraspinatus distally

Musculotendinous Junction:
- Subscapularis: several distinct tendons
- Appears as hypoechoic area extending into tendon
- Heterogeneous to lesser tuberosity
Supraspinatus - Infraspinatus Junction

- Converging fibers – posterior
  - Over middle facet of greater tuberosity
- Hypoechoic fibers: anisotropy
- Regular intervals

Take-home Points

- Must follow a protocol
- Important landmarks:
  - Greater tuberosity facet anatomy
  - Rotator interval
- Pitfalls:
  - Anisotropy
  - Incomplete evaluation of supraspinatus

Syllabus on line and other educational material:
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