Ultrasonography: Sports Injuries

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Case #1: Supraspinatus Tendon

**Case #1:**
- **Findings:**
  - Well-defined hypoechoic defect
  - Cortical irregularity: greater tuberosity
  - Cartilage interface sign
- **Diagnosis:**
  - Articular-sided partial-thickness supraspinatus tear

Rotator Cuff Tears:
- Most tears are hypoechoic / anechoic
- Larger tears: deltoid dips into tendon gap
- Massive tear: non-visualization
- Adjacent cortical irregularity: important indirect sign of supraspinatus tear

Supraspinatus Insertion

**Supraspinatus Tears: extent**

- **Rim-rent Tear** or PASTA lesion
- **Partial Articular**
- **Partial Bursal**

*From: Fundamentals of Musculoskeletal Ultrasound*

**Supraspinatus Tears: extent**

- **Intrasubstance**
- **Full thickness**

*From: Fundamentals of Musculoskeletal Ultrasound*

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**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

**Articular Partial-thickness Tear: supraspinatus**

*Long Axis*  
*Coronal T2w*

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**Pitfall Alert!**

**Anisotropy**

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

Supraspinatus: long axis

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**Bursal Partial-thickness Tear: supraspinatus**

*Long Axis*  
*Coronal T2w*
Full-thickness Tear: supraspinatus

Note: Cartilage Interface Sign (open arrow)

Tendon Tear versus Tendinosis

*both may appear hypoechoic*

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

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

Case #1: Take Home Points

- Tear: well-defined hypoechoic defect
- Cortical irregularity: supraspinatus footprint
- Cartilage interface: articular extension
- Pitfall: focal anisotropy
- Tuberosity anatomy

Supraspinatus – Infraspinatus Junction

Middle Facet: Infraspinatus overlaps supraspinatus

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

Case #2: Distal Biceps Brachii

Long Axis: proximal

Radius

Long Axis: distal
Case #2:

• Findings:
  – Biceps brachii tendon defect
  – Tendon retraction
  – Posterior acoustic shadowing

• Diagnosis:
  – Biceps brachii tendon tear: retracted, full-thickness

Biceps Brachii:

• Insertion: radial tuberosity
  – Short head: superficial, distal
  – Long head: deep, proximal

• No synovial sheath
• Bicipitoradial bursa

Biceps Brachii Tendon: distal

1 = long head
2 = short head

Long Axis

Biceps Brachii: terminal bifurcation

Note: toggling the transducer, which creates anisotropy allows visualization of two tendon heads

Courtesy of M. Chiavaras, Hamilton, Ontario

Biceps Brachii Tendon: complete tear

Long Axis
Short Axis

Kalume Brigido M. Eur Radiol 2009; 19:1817

Biceps Brachii Tendon: complete tear non-retracted

Longitudinal: dynamic imaging

Kalume Brigido M. Eur Radiol 2009; 19:1817
Biceps Brachii Tendon: partial tear (short head)

Retracted superficial short head (yellow arrows)
Hypoechoic but intact deep long head (white arrows)

Biceps Tendon Tears: dynamic imaging

Case #2: Take Home Points

- Biceps brachii: terminal bifurcation
- Dynamic imaging:
  - Supination and pronation
  - Non-retracted full-thickness from partial-thickness tendon tear

Case #3: Distal Triceps Brachii

- Findings:
  - Triceps brachii tendon defect
  - Tendon retraction
  - Avulsion fracture fragment
- Diagnosis:
  - Triceps brachii tendon tear: retracted, partial-thickness

Anatomy of the Distal Triceps Brachii

- Superficial (blue arrow): long + lateral heads
- Deep (black arrow): medial head
  - Primarily muscular insertion

*From Resnick, Skeletal Radiol 2009; 38:171
Triceps Tear: partial thickness tear

- Superficial layer torn
  - Long and lateral heads
- Intact deep layer (medial head)
- Associated enthesophyte bone fragment
  - 1 – 2 cm in size
  - 2.5 – 4 cm retraction
  - No donor site

J Ultrasound Med 2011; 30:1351

Case #3: Take Home Points

- Triceps brachii: two distal tendons
- Partial-thickness tear:
  - Superficial: long and lateral heads
  - Avulsion olecranon bone fragment
  - Intact deep medial head

Case #4: Common Extensor Tendon

- Findings:
  - Hypoechoic swollen common extensor tendon
  - Hyperemia
  - Normal radial collateral ligament
- Diagnosis:
  - Tendinosis of common extensor tendon


Lateral Collateral Ligament Complex

- Radial collateral ligament (arrows)
- Common extensor tendon (E)
- Annular ligament (arrowhead)
- Lateral ulnar collateral ligament (curved arrow)
Lateral Collateral Ligament Complex

- Common extensor tendon (curved arrows)
- Radial collateral ligament (arrowheads)
- Annular ligament (a)


Epicondylitis:

- Common flexor and extensor tendons
- Abnormal hypoechochogenicity
  - Mucoid degeneration, tendinosis
- Anechoic: partial-thickness tear
- No inflammatory cells*

Potter, Radiology 1995; 196:43
Connell, AJR 2001; 176:777

Common Extensor Tendon: elbow

- Often called “tennis elbow” or “lateral epicondylitis” or “epicondylosis” or ……
- All terms are misnomers
- Those inflicted usually do not play tennis (professionally or correctly)
- It is not inflammatory
- It is not a primary problem of the epicondyle

Potter, Radiology 1995; 196:43
Connell, AJR 2001; 176:777

Case #4: Take Home Points

- The term “epicondylitis” is a misnomer
- Tendinosis and tendon tear
- No inflammation
- Radial collateral ligament tear: poor prognosis

Case #5: Ulnar Collateral Ligament

Neutral Dynamic: Valgus Stress
Case #5:

- **Findings:**
  - Non-visualization of ulnar collateral ligament
  - Widening of medial elbow joint with valgus stress
- **Diagnosis:**
  - Ulnar collateral ligament tear: complete

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**Ulnar Collateral Ligament**

- **Valgus stress:** 30 degrees elbow flexion
  - Unlock the olecranon
  - Stress the UCL anterior band
- **Gravity stress** is adequate, equal to Telos¹
- **Ultrasound measurements:**
  - Reliable and precise²

Ulnar Collateral Ligament: valgus stress

- >1 mm asymmetric gapping = 87% accuracy in diagnosis of UCL tear
  - MR arthrography accuracy = 88%
  - US + MR arthrography: accuracy = 98%
- Asymmetric joint space widening with stress:
  - Normal: 1.3 mm or less
  - Partial tear: 1.2 – 3.0 mm
  - Full thickness tear: 2.8 – 4.8 mm

Roedl JB et al. Radiology 2016

Case #5: Take Home Points

- Ultrasound can diagnosis UCL tears
- Dynamic imaging is essential:
  - Complete vs. partial tear
  - Intact but lax ligament
  - Complements MR arthrography

Case #6: Ulnar Collateral Ligament of Thumb

- Findings:
  - Non-visualization of ulnar collateral ligament
  - Hypoechoic round structure proximal to adductor aponeurosis and MCP joint
- Diagnosis:
  - Displaced ulnar collateral ligament tear: Stener lesion

Gamekeeper’s Thumb

- Injury of the ulnar collateral ligament (UCL) of the thumb
  - Historically, chronic injury in Scottish gamekeepers
  - Frequently, due to acute MCP joint hyperabduction
  - Skier’s thumb: up to 86% of thumb base injuries

Acute Mechanism
- Mandals
- Rabbit

Chronic Mechanism
**Ulnar Collateral Ligament: thumb**

*Note: sliding of adductor aponeurosis with isolated interphalangeal joint flexion*

**Radiographics 2006;26:1007**

**Stener Lesion:**
- Displaced proximal stump of torn UCL
  - Hypoechoic & round
  - Proximal to MCP joint
  - At proximal edge of adductor aponeurosis
- No tissue spanning MCP joint
- “Yo-yo on a string” sign
- Ultrasound: 100% accuracy

*Melville D. et al. Skeletal Radiology 2013; 42:667*
Case #6: Take Home Points
- Ultrasound is accurate for diagnosis of Stener lesion
- Stener: interposed aponeurosis
- Dynamic imaging is important:
  - Fluid tracks through ligament tear
  - Visualize the adductor aponeurosis

Case #7: flexor tendons of finger

Case #7:
- Findings:
  - Non-visualization A2 – A4 pulleys
  - Bowstringing of flexor tendons
- Diagnosis:
  - Pulley tears

Pulley Tear
- A2 and A4 pulleys: most important
- Sagittal image
  - Bowstringing
  - Hypoechoic edema / hemorrhage
- Dynamic evaluation*

*Radiology 2002; 222:755
Radiology 1998; 206:339

A2 – 4 Pulley Injury
- A2 and A4 pulleys: most important
- Sagittal image
  - Bowstringing
  - Hypoechoic edema / hemorrhage
- Dynamic evaluation*

A4 Pulley Injury: bowstringing
- Normal: < 1 mm; incomplete rupture: 1 – 3 mm; complete: 3 mm
Case #7: Take Home Points
- Non-visualization of pulleys
- Bowstringing of flexor tendons
  - Use dynamic imaging

Case #8: Iliopsoas Tendon

Short Axis

Case #8:
- Findings:
  - Abrupt snapping of psoas major tendon
  - Leg moved from abduction and flexion to straightening
- Diagnosis:
  - Snapping psoas major tendon

Snapping Hip Syndrome: iliopectos

Case #8: Take Home Points
- Snapping iliopsoas
  - Conflict between psoas major tendon and iliacus muscle
  - Abrupt movement when straightening leg from abduction / flexion
Case #9: Pubis

Long Axis:
Adductor Longus

Short Axis:
Common Aponeurosis

Findings:
- Hypoechoic swelling of common aponeurosis
- Cortical irregularity of pubis
- Hypoechoic swelling of adductor longus

Diagnosis:
- Common aponeurosis injury “Sports Hernia”

Sports Hernia?:
- Bulge posterior wall of inguinal canal
  - Direct inguinal hernia
- Osteitis pubis
- Common aponeurosis abnormality:
  - Rectus abdominis and adductors tendons
- Obturator nerve entrapment

Garvey JFW, et al. Hernia 2010; 14:17

Rectus Abdominis + Adductor: “Sports Hernia”

Note: common aponeurosis

From: RadioGraphics 2008; 28:1415

Rectus Abdominis / Adductor Tendinosis: “Sports Hernia”

Author: Joe Lemire, Hemisphere Magazine, Feb. 2015
Case #9: Take Home Points

• Several proposed causes for “Sports Hernia”
• Injury to common aponeurosis is one cause
  – Between rectus abdominis and adductor longus

Case #10: Patellar Tendon

• Findings:
  – Hypoechoic enlargement of proximal patellar tendon
  – Hyperemia
  – Cortical irregularity
• Diagnosis:
  – Tendinosis (Jumper’s Knee)

Patellar Tendinosis:

• Jumper’s knee
• Hypoechoic swelling
• Mucoid degeneration, possible interstitial tearing
• Hyperemia: neovascularity
• No inflammatory cells

Radiology 1996; 200:821

Case #10: Take Home Points

• Focal hypoechoic swelling of proximal patellar tendon
• Jumper’s knee
• Hyperemia = neovascularity
  – Correlates with pain

Case #11: Medial Head, Gastrocnemius
Case #11:

• Findings:
  – Hypoechoic hemorrhage
  – Distal muscle retracted proximal to aponeurosis
• Diagnosis:
  – Tear, medial head of gastrocnemius

Gastrocnemius, Soleus, and Plantaris: distal

Plantaris Tear

Soleus Hematoma
Case #11: Take Home Points

- Abnormal hypoechoic hemorrhage at normal distal tapering
- Hemorrhage
- Characteristic location for tear of medial head of gastrocnemius

Case #12: Achilles

- Findings:
  - Complete Achilles discontinuity
  - Intact plantaris tendon: medial
- Diagnosis:
  - Achilles full-thickness tear

Achilles Tendon: complete tear

- Full-thickness fiber disruption
- Herniation of hyperechoic fat into tendon gap
- Posterior shadowing at torn tendon ends


Achilles Tendon: complete tear

- Pitfall: intact plantaris tendon
  - Medial aspect of Achilles tendon
  - Misinterpreted as intact Achilles fibers

Radiology 2001; 220:406
Achilles Tendon: Dynamic Imaging

- Increase accuracy for full-thickness tear:
  - Widening of gap with passive dorsiflexion
  - Lack of tendon movement across tear
- Determine if ends approximate
  - Conservative versus surgical treatment

Achilles Tendon: dynamic imaging

Achilles Tendon: healing tear

Case #12: Take Home Points

- Dynamic imaging:
  - Differentiates partial from full-thickness tear
  - Assesses if stumps approximate
- Pitfall:
  - Do not misinterpret intact plantaris as Achilles fibers

On Line Case #1: Achilles
On Line Case #2

Anterior Talofibular Ligament  

Calcaneofibular Ligament

Syllabus on line and other educational material:  
www.jacobsonmskus.com

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