MRI of Ligament and Tendon Injuries of the Elbow

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Learning objectives

- Review the normal anatomy of the tendons and ligaments of the elbow
- Recognize and describe the MRI findings of tendon injuries of the elbow
- Recognize and describe the MRI findings of ligament abnormalities and elbow instability
MRI of the elbow: Pathology

- **Tendon abnormalities**
  - Biceps tendon
  - Triceps tendon
  - Common flexor tendon
  - Common extensor tendon

- **Ligament abnormalities**
  - Medial (ulnar) collateral ligament
  - Radial collateral ligament
  - Annular ligament
  - LUCL
Elbow anatomy: Muscle compartments

- Biceps
- Brachialis
- Flexors
  - Common flexors (FCR, PL, FCU, FDS)
  - Pronator teres
- Triceps
- Anconeus

- Extensors
  - Superficial (brachiradialis, ECRL)
  - Common extensors (ECRB, ED, EDM, ECU)
  - Supinator
MR imaging technique

- ‘Eccentric’ joint; need to consider patient comfort
- **Supine**: arm at side, elbow extended, forearm supinated
- **Superman position**: prone position, arm above head, thumb pointing up (forearm supination) (when off-center imaging difficult: larger patients, scanner/coil factors)
- ‘**FABS**’ view: for distal biceps tendon
Biceps brachii: Normal anatomy

lacertus fibrosus (=bicipital aponeurosis)
Normal biceps tendon: MRI

Ax FS T2

Sag T1

Sag FS T2
MRI: ‘FABS’ view

“Flexed elbow, AB ducted shoulder, forearm Supinated”

Giuffre BM, Moss MJ. AJR 2004; 182:944-946
Biceps tendon abnormalities at the elbow

- Tendinopathy
- Complete rupture
- Partial rupture
- Cubital bursitis
Biceps tendinopathy

51 M

May be associated with
- partial tears
- cubital bursitis
Cubital bursa

- Lies between distal biceps tendon and anterior cortex of radial tuberosity
- Reduces friction between biceps and radial tuberosity
- Consists of bicipitoradial bursa and interosseous bursa (may communicate)
  
  *Skaf AY et al. Radiology 1999; 212: 111-116*

- Not visible on MRI if normal
- May lead to nerve compression: superficial or deep branch of radial nerve (posterior interosseous nerve [PIN])

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Cubital (bicipitoradial) bursitis

**Ddx:**
- Repeated mechanical trauma (most common)
- Inflammatory arthropathy
- Infection
- Bone proliferation
- Synovial chondromatosis
- Chemical synovitis
72F - Anterior tumefaction x 9 months with painful pronation and supination: Bicipital bursitis
Biceps tendon rupture

- 3% of all biceps tendon injuries (most are proximal)
- Avulsion at the radial tuberosity; myotendinous rare
- M >> F; 40-60 years old; dominant > non-dominant
- **Hx:** Typically a sudden extension applied to elbow in 90° flexion (e.g. weight-lifting); patients describe a “pop”, acute pain in antecubital fossa
Biceps tendon rupture

- **P/E:** Dx is obvious clinically if retracted: antecubital mass ("popeye sign"), ecchymosis, weak elbow flexion and forearm supination

- **Imaging** (MRI or US): especially useful if partial or non-retracted

- **Rx:** Surgical reinsertion must be performed early to avoid scarring down of biceps
65M- Complete biceps tendon rupture

Ax fatsat T2

Sag T1

FABS
Role of MRI in biceps tendon tears

- Not necessary in confirming cases of complete biceps tendon tears

- Useful in more subtle clinical presentations (e.g. elbow flexion may be normal):
  - complete tears without retraction (intact lacertus fibrosus)
  - partial tears

- Post-op evaluation
55M Acute anterior elbow pain after lifting grandchild

Complete biceps rupture; retraction is mild

Note intact lacertus fibrosus
47M Partial biceps rupture

FABS

Ax

Sag
Treatment of biceps tendon rupture

- Treatment of choice is early surgical repair

- Various techniques
  - one incision with suture anchor
  - two-incision to feed proximal stump through tunnel to allow attachment to radial tuberosity

- Post-op complications:
  - heterotopic ossification
  - posterior interosseous nerve palsy
MRI post-op biceps repair

39M: pre-op

Post-op
Post-op: FABS view

Pre-op:
Complete tear

Post-op
Effectiveness of MRI in detecting biceps tendon tears

- ~100% sensitivity for complete tears
- 59.1% sensitivity for partial tears

*Festa A et. al. JHS 2010; 35A: 77-83*

- Most common findings in partial tears:
  - increased signal intensity in tendon
  - cubital bursitis
  - bone marrow edema at radial tuberosity
Triceps tendon injury

- M, F, all ages
- FOOSH, forceful eccentric contraction with flexed elbow, direct trauma
- Sports with rapid/forceful extension: javelin, baseball, benchpressing, gymnastics
- Avulsion >> intrasubstance, myotendinous junction
Triceps tendon pathology: MRI findings

- **Tendinosis**: Abnormal signal intensity, +/- thickening

- Possible associated pathology: olecranon bursitis, marrow reaction, enthesophytosis

- **Tears**: Can distinguish partial vs complete, evaluate degree of retraction

- Sagittal plane best

- Triceps tendon retraction, fluid-filled gap, soft tissue edema
Complete triceps tendon tear

51M orderly, injured while lifting patient
Partial triceps tendon rupture, possible RA
Rotators of radius

Supination
- supinator
- pronator teres
- pronator quadratus

Pronation
- supinator
- pronator teres
- pronator quadratus
Extensors of the wrist

- Superficial (brachioradialis, ECRL)
- Common extensors (ECRB, ED, EDM, ECU)
Flexors of the wrist

superficial

- FCR
- palmaris longus
- FCU

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depth

- FPL
- FDS
- FDP
Medial and lateral elbow tendinosis ("epicondylitis")

- Pathology of common flexor tendon (pronator-flexor group)/common extensor tendon (supinator-extensor group) at medial/lateral epicondyle of humerus

- Lateral >> medial epicondylitis

- Seen in athletic or work activities 2y repetitive valgus/varus stresses

  - MEDIAL: golf ("golfer’s elbow", in ‘following’ arm), tennis, swimmers, pitchers, javelin throwing, bowling, archery, baseball, football, racquetball

  - LATERAL: tennis ("tennis elbow")/racquet sports, work activities (auto mechanics, cooks, painters, plumbers,...)
Medial and lateral elbow tendinosis

- **P/E:** Point tenderness at common flexor tendon origin

- **Radiographs:**
  - Normal
  - Enthesopathy at medial/lateral epicondyle
Elbow tendinosis ("epicondylitis")

- **Histology**: vascular and fibroblast hyperplasia, fibrillar degeneration of collagen; no inflammation

- **Pathophysiology**: microscopic/ macroscopic injury with incomplete healing response

- **MRI** useful in confirming clinical dx and determining extent of injury

*Kijowski R, DeSmet AA. Skel Radiol 2005; 34: 196-202*
Medial and lateral elbow tendinosis: MRI findings

- Examine axial and coronal planes

- Findings: tendon thickening, increased signal intensity of CFT or CET on T1- and T2-WI

- Tendon abnormalities may be asymptomatic: senescent changes?
Common extensor tendinopathy ("lateral epicondylitis")
Common flexor tendinopathy ("medial epicondylitis")

(normal)

Ulnar n.

(axial)

coronal
56 M Medial elbow tendinosis with partial tear
Elbow tendinosis: other MRI findings

- Paratendinuous soft tissue edema
- Bone marrow edema
- Medial: anterior bundle of UCL lesions (simultaneous vs. primary injury prior to tendon lesion); ulnar nerve neuropathy (seen in up to 60% of patients)
- Lateral: LUCL lesions, RCL lesions
- Joints: chondral defects, OA
The ulnar (medial) collateral ligament

* Primary stabilizer against valgus instability
UCL injury

- Chronic repetitive stress typically in baseball pitchers: extreme valgus forces during the late cocking phase and early follow-through phases of the throwing motion

- Total number of pitches is greatest determinant of likelihood of UCL failure

- Also in other overhead throwing activities, e.g. tennis, volleyball, javelin

- Less commonly acute valgus stress, acute dislocation

- May be complete or partial

- May occur at humeral insertion, mids substance, ulnar insertion
36M elbow dislocation

Severe acute ligamentous and tendinous tears
Partial UCL tear

2º acute elbow valgus injury

Lateral bone contusion

Partial UCL tear at humeral insertion

Case courtesy of Bill Morrison, MD
51M Chronic UCL changes

Normal

Sag T1
Partial tear at sublime tubercle

Case courtesy of Doug Goodwin, MD
Complete UCL tear

UCL avulsion at humeral insertion with retraction

Case courtesy of Bill Morrison, MD
UCL osseous avulsion

Normal

sublime tubercle avulsion
15M baseball pitcher UCL repair
‘Tommy John’ surgery

- UCL reconstruction using tendon graft

- Historic surgery performed by Dr. Frank Jobe in 1974, named after L.A. Dodgers pitcher who first had this surgery

- Until then, UCL injury often career-ending

- Now standard of care for throwing athlete
MRI Post UCL reconstruction

Intact

Re-tear

Courtesy of Bill Morrison, MD
Lateral elbow pain: ddx

- Lateral epicondylitis
- OCD capitellum
- Lateral osteoarthritis
- LUCL instability
- Radial tunnel syndrome
- Occult fracture
Medial elbow pain: ddx

(Also sequelae of the overhead throwing motion)

- Medial epicondylitis
- UCL injuries
- Ulnar neuritis
- Medial tendinosis
- Flexor-pronator strain or rupture
- Medial osteoarthrosis
- Valgus extension overload
  (UCL attenuation, posteromedial impingement, osteophytes)
- Occult fracture
Conclusion

• MRI is an important tool in patients with suspected tendon and ligamentous injuries of the elbow

• Knowledge of normal anatomy and variants is essential for precise interpretation

• Biceps and triceps tendon injuries typically due to acute event

• Common flexor tendon and UCL lesions typically due to repetitive microtrauma

• Close anatomic relationship of CFT, UCL and ulnar nerve: frequent concomittant lesions

• MRI can make a specific diagnosis and determine the severity of elbow pathologies