MSK Imaging

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Wrist joint
Wrist joint complaint
- Pain
- Trauma
- Swelling

Indications

- Patient preparation:
- Fasting 4-6h
- Patient position: supine
- Procedure
  - Surface coil [one wrist]

Suspected inflammation or tumors
Extremity MRI

- Elbow
- Wrist
- Knee
- Ankle
Examination technique

- Surface coil
- Small field of view (FOV) 8-12 cm
- Coronal or sagittal scout (T1WI)
- Axial T1, PD and T2 WIs
- Coronal T1, Gradient, STIR WIs
- Sagittal T2 or gradient (phalangeal pathology)
How to know the pulse sequence?!
- Cortical bone
- TFCC
- Mature fibrous tissue (ligaments and tendons)
- Calcifications (physiological, pathological)

\[\text{T}_1 \quad \text{Low signal}\]
\[\text{T}_2 \quad \text{Low signal}\]

[Non mobile protons]
Fluid [effusion, cyst, articular cartilage, ...]

Fat [Subcutaneous fat, dermoid cyst, ...]
**Anatomy**

- Distal radioulnar joint
- Radio carpal joint
- Mid carpal joint

**Bones**
The radius has two articular fossae [Scaphoid, lunate]
The radial sigmoid notch articulates with the ulna
Lister’s tubercle on the dorsal surface of the radius
Normal biomechanics of the distal radioulnar joint with mild dorsal shift in pronation and volar shift in supination.
The ulna articulates with the lunate and triquetrum.
The ulna is separated from the carpal bones by the triangular fibrocartilage (TFC).
The proximal surface should form a smooth unbroken arch.
**Inter carpal ligaments**

- Comparable strength to the ACL
- SL triangular in shape in coronal images
- LT Horseshoe shaped

**Scapho - lunate & luno - triquetral ligaments**
MR Arthrography
Scapho-lunate ligament
Scapho-lunate ligament tear
Scaoholunate ligament vertical tear without carpal instability. Fat-suppressed T1–weighted coronal MR arthrogram. The lunotriquetral ligament is absent.
Traumatic avulsion of the Scapholunate ligament on a STIR coronal image. The Scapholunate \textit{interval} is widened.
Torn scapholunate from its weaker attachment to the scaphoid
Palmaris longus tendon is fused to the midline of flexor retinaculum
Carpal tunnel is the passage for the flexor tendons between the carpus and the flexor retinaculum

Contents
Flexor digitorum superficialis
Flexor digitorum profundus
Flexor pollicis longus
Extensor digiti quinti proprius = EDQ

Tendons of The dorsum
Anatomy

TFCC

Triangular Fibrocartilage

SCAPHOID  MC  TRIGUEIRA
LUNATE  IL  RC
RADIUS
- Equilateral triangle (axial)
- Arises from the medial surface of the radius
- Inserts into the base of the styloid process
- The central portion is thin, common site of tear
- Is important for stabilization of the DRUJ

Triangular fibrocartilage complex TFCC
Triangular fibrocartilage complex (TFCC)

- Biconcave disc (coronal)
- Homogenous low signal
- Discoid shape (sagittal)
- Insertion of TFCC into ulnar styloid process by fascicles directed to the styloid tip & base
- Ulnar collateral ligament extends from styloid to triquetrum, hamate & 5th metacarpal bone
- Meniscus homologue = the thickened fibers of the UCL distal to the TFCC
A fold of fibrous tissue interposed between the ulnar styloid and triquetrum. It may represent a remnant of a free meniscus interposed between the ulna and triquetrum in the primary weight bearing wrist.
- Vascular supply accounts for the **peripheral** 20% of the disc
- Peripheral lesions are surgically repaired
- Central lesions are surgically excised
Injury of the TFCC causes pain
- Vollar tear causes dorsal subluxation
- Dorsal tear causes volar subluxation
- Massive tear causes dislocation in any direction
- Traumatic tears occur near the radius [ young ]
- Degenerative tears occur near the ulna [ old ]
Injuries of TFCC

Unusual in the 1st two decades
- 40% by the 5th decade
- 50% by the 6th decade

Intrasubstance degeneration
↑ signal within the disc in T2WIs
not reaching the surface, when reaches the surface degenerative tear [usually central]

Central perforation
Slit like perforation near the radial attachment with contrast leak into the DRUJ
Avulsion of the Ulnar attachment with contrast leak. Torn SL with absent LT ligaments
Associated findings:
- Synovitis or radial carpal joint effusion (T2)
- Chondromalacia of the lunate, triquetrum, ulna
TFCC injury
Avulsion of the Radial attachment with contrast leak.

Central perforation with lunate chondromalacia.
Intact LT ligament
Focal tear of the radial aspect of TFCC
Large tear of the radial aspect of TFCC
Ulnar variance

- If the ulna is short = negative variance
- If the ulna is long = positive variance
- Both are equal = neutral variance

The relative lengths of the radius and ulna
-ve ulnar variance with degeneration of TFC
+ve ulnar variance with deformity of TFC
Ulno-lunate impingement syndrome
Ulnar abutment syndrome

- +ve variance → impaction of the elongated ulna against the surface of the lunate
- Thin or torn TFC
Excessive ulnar positive variance
Painful compression of the distal ulna on the medial surface of lunate

Associated findings:
- TFC injuries
- Lunate cartilage degeneration
- Marrow changes in the lunate and ulna
- LT ligament disruption
- Instability
Ulnar impaction syndrome

Subchondral pseudo cysts
Marrow edema
Torn TFC & LT ligaments
Carpal tunnel syndrome

- Chronic discomfort + tingling of the fingers in the median nerve distribution
- 30-60 years Female: Male = 5:1  Bilateral 50%

- Swelling of the nerve at pisiform level
- Flattening of the nerve at hamate level

Normal nerve is elliptical in shape and of intermediate signal
Carpal tunnel syndrome

- Nerve swelling
- Nerve flattening
- ↑ signal on T2
- Bowing of the flexor retinaculum
Carpal tunnel syndrome

- **Idiopathic**
- Tenosynovitis of the flexor tendons
- Fractures → scarring within the tunnel
- Inflammatory lesions: RA, gout, granulomatous infection
- Tumors of the **median nerve**: neurofibroma, hamartoma, fibrolipoma
- Tumors inside the tunnel: ganglia, lipomas, hemangiomas
- Volume ↑ in the tunnel: acromegaly, hypothyroidism, DM, SLE
HT = Hamate / Trapesium
PD = Perpendicular distance
Swelling, deformity, abnormal signal of the median nerve
Carpal tunnel syndrome
Endoscopic release of the FR + enhancing synovitis
Hook of hamate fracture impinging on the carpal tunnel with flattening of the median nerve and bone marrow edema of hamate
Fibrolipomatous hamartoma of median nerve
Neurofibroma of the median nerve
Lipoma of the carpal tunnel
Tenosynovitis of the flexor tendons with compression of the median nerve, the nerve is swollen and hyper intense.
Carpal tunnel secondary to tenosynovitis
Granulomatosus tenosynovitis in the carpal tunnel
Ulnar nerve

Guyon’s canal
Ulnar nerve anatomy
Colles’ fracture:
Distal radial fracture with dorsal angulation and radial shortening.

Subchondral erosion of lunate
Post-traumatic bone marrow edema
Bone marrow edema of hamate secondary to trauma
Boxer who developed sudden ulnar–sided wrist pain following a punch. He also had limited pronation-supination and joint line tenderness. Coronal GRE MR image shows a Complex tear of the TFCC
Ulnar styloid fracture with marrow edema
Die punch fracture: Depression fracture of the lunate fossa with proximal displacement of the lunate bone

Dislocation of DRUJ with torn TFC
Die Punch Fracture

- Intra-articular distal radial fracture of the lunate fossa
- Dorsal displacement of the medial fragment
- Dorsal tilt and shortening of the radius
Scaphoid Fracture

- 2nd most common fracture of the wrist
- Usually involves the waist of scaphoid 70%
- Incomplete and tubercle fractures → good prognosis
- Complete fractures are considered unstable → 50% non union

Complications:
- AVN, delayed union
- Osteoarthritis
- Carpal tunnel syndrome
Scaphoid fracture with avascular necrosis, radio scaphoid sclerosis
Scaphoid avascular necrosis

- Posttraumatic
- Affects the proximal pole
- MRI → Low signal in T1 and T2 WIs
- Gd - DTPA → enhancement of hyperemic tissue at the fracture edge with no enhancement in the necrotic bone
Scaphoid fracture with avascular necrosis of the proximal pole
Avascular necrosis of the scaphoid
Corner sign of the radial styloid process

Intact scapholunate ligament
Avascular necrosis of the scaphoid

Nipple sign [pointing proximal pole]
Kienbock's disease

20 – 40 years 2:1 = male: Female may be bilateral

**Stage I** Normal X ray, +ve bone scan
MRI low signal bone marrow in T1 & T2 WI

**Stage II**
Sclerosis on X rays
Diffuse low signal in T1 and T2
Flattening of the lunate bone
Heterogenous signal on STIR

**Stage III**
Fragmentation

**Stage IV**
Fragmentation + OA
20 – 40 years  2:1 = male: Female  may be bilateral

**Stage I**  normal X ray, +ve bone scan
MRI low signal bone marrow in T1 & T2 WI

**Lunate avascular necrosis**

After treatment with cast immobilization
Stage II

- Sclerosis on X rays
- Diffuse low signal in T1 and T2
- Flattening of the lunate bone
- Heterogeneous signal on STIR
Stage III
Fragmentation

Stage IV
Fragmentation and OA
Capitate avascular necrosis
Bone cyst
Ganglion cyst

Cystic swelling overlying a joint or a tendon sheath

Ganglion cyst at the joint between hamate and triquetrum
Value of coronal images

- Triangular fibrocartilage
- Ulnar variance
- Scapho-lunate & luno-triqueteral ligaments
- Fractures & AVN of the carpal bones
- Arthropathies
Value of axial images

- Distal radioulnar joint
- Carpal tunnel & contents
- Flexor and extensor tendons
Value of sagittal images

- Triangular fibrocartilage
- Tendons of the fingers
Normal TFCC
Partial tear of flexor carpi radialis
Ganglion cyst
Avascular necrosis of the scaphoid bone
Carpal tunnel syndrome
Ulnar impaction syndrome

A wrist of a tennis player radiograph shows positive ulnar variance. Coronal STIR MR image shows a small focus of hyperintense signal in the ulnar aspect of the proximal lunate, due to ulno-lunate impaction. Coronal GRE MR image shows an ulnar-sided TFCC tear.
A wrist radiograph shows stress changes adjacent to the distal radial and ulnar growth plates. Coronal GRE MR image shows a central perforation of the TFCC. Positive ulnar variance is better seen on the MR image.

Female gymnast with left wrist pain and tenderness at the DRUJ on dorsiflexion.

Positive ulnar variance with torn TFCC
On axial T1-weighted image, the lipomatous component of the tumor is hyperintense whereas the fatty component is suppressed on axial fat-suppressed T2-weighted images.
Anatomy
Lunate avascular necrosis [Kienbock’s disease]

Stage II
Loss of signal
Flattening and elongation
Negative ulnar variance
Single broad base attachment of the TFCC [ Normal variant ]

Air injected during MR arthrography
سبحانك اللهم و بحمدك نشهد ان لا اله الا انت نستغفرك و نتوب اليك

Thank you

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Recurrent fibromatosis
FIGURE 11-15. A T2*-weighted image showing the triangular fibrocartilage complex. Black arrows, radial attachments of triangular fibrocartilage; white arrows and UC, ulnar collateral ligament; M, meniscus homologue; pr, pre styloid recess; tfc, triangular fibrocartilage.
FIGURE 11-76. The TFC. (A) The distal aspect of the TFC or central disk is shown to be contiguous with the articular cartilage of the distal surface of the lunate fossa (small black arrows). The volar and dorsal radioulnar ligaments contribute to the striated tissue between the ulnar styloid and the central disk. High signal intensity articular cartilage (large white arrow) is present at the radial attachment of the central disk to the sigmoid notch of the radius. Note that the central disk is in direct contact with the articular cartilage of the ulnar head in the absence of distal radioulnar joint fluid distention (small white arrow). (B) The extensor carpi ulnaris tendon and sheath (ECU) are identified on a more dorsal coronal image in the plane of the TFC. The TFC attaches to the sheath of the extensor carpi ulnaris tendon dorsomedially. (A, B: fat-suppressed T1-weighted coronal MR arthrographic images.)
Scaphoid fracture with avascular necrosis, radio scaphoid sclerosis = SLAC LESION
SCAPHO-LUNATE ADVANCED COLLAPSE = SLAC

SCAPHOID NON UNION ADVANCED COLLAPSE = SNAC

SNAC = SLAC + scaphoid non union

Chondral loss between the distal pole scaphoid and distal radius
Fracture with lunate impaction
Scaphoid fracture with avascular necrosis

Scapho-lunate ligament intact with fluid signal around
Pathology

miscellaneous lesions

Arthropathies

- Bone marrow edema
- Synovitis & effusion
- Intercarpal ligaments
- TFCC
- Scapholunate dissociation
- Proximal migration of Capitate
- Ulnar migration of lunate
- Synovitis
- Marrow edema
- Chondro calcinosis
Pathology
miscellaneous lesions

Tenosynovitis
Fluid around the tendon

Tenosynovitis of FDS & FDP
Tenosynovitis
Tenosynovitis
Tenosynovitis of all flexor tendons

FDS, FDP, FPL