MR Imaging of the Wrist and Hand
MR wrist and hand

• Technical considerations

• Internal derangement of the wrist
  – TFCC
  – Ligaments

• Osseous abnormalities

• Arthritis, Tendons, and Ligaments

• Miscellaneous
Technique

- Supine, hand by side (avoid excessive pronation)
- Prone, hand above head
- Decubitus, hand in front directed cranially
- Comfortable immobilization
Protocol

- Routine protocol
- Tailored protocol for specific indications (tumor, infection)
- MR arthrography
<table>
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<th>Plane</th>
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Imaging planes

- Axial sequence done first
- Radial styloid to ulnar styloid
- Parallel to volar surface of radius
Wrist Arthrography
Indications

- Intercarpal ligaments
- Triangular fibrocartilage
- Scaphoid nonunion
- Soft tissue ganglia
- Wrist prosthesis

TFCC and LT ligament perforations
Wrist Arthrography Technique

• Controversy about which compartments and how many compartments need to be injected

• Most common single injection is radiocarpal
Wrist Arthrography

Arthrographic technique

- Radioscaphoid

- Always obtain plain film series

- DSA 1 frame/sec preferred

Lunotriquetral ligament perforation
Wrist Arthrography
Wrist compartments

- First carpometacarpal
- Midcarpal, which communicates with common carpometacarpal
- Radiocarpal
- Distal radioulnar
Wrist Arthrography
Which Joint?

• R/O TFCC tear
  – Radiocarpal injection;
  – If negative, distal radioulnar joint

• R/O ligament tear
  – Midcarpal injection;
  – If negative, radiocarpal joint

• Second injection can be done digitally or following 2 hour delay
TFCC

- Triangular fibrocartilage
  - Volar and dorsal distal radioulnar ligaments
- Ulnocarpal meniscus
- Meniscus homologue
- Ulnocarpal ligaments
- Ulnar collateral ligament
- Sheath of ECU
TFCC - Perforation

- Conventional MR
  - Abnormal morphology
  - Defect in the TFCC
  - Fluid within the defect
  - Fluid in the inferior radioulnar joint (DRUJ)
TFCC - Perforation

- Communication between the radiocarpal and the distal radioulnar joint

- MR arthrography will clearly show perforation, and help differentiate attrition from acute tear
Impaction syndromes

- Ulnar impaction (ulnar abutment)
- Ulnar styloid impaction syndrome
- Ulnar styloid nonunion
- Hamatolunate impaction
- (Ulnar impingement)

Cerezal et al, Radiographics 2002
Ulnar impaction

- Also known as ulnar abutment syndrome
- Seen with long ulna
- Cystic changes and sclerosis of distal ulna, lunate, triquetrum
- TFCC tear

Illustration from Cerezal et al, Radiographics 2002
Ulnar Styloid Impaction Syndrome

- MR imaging may show chondromalacia of the ulnar styloid process, subchondral sclerosis of the styloid tip, and proximal triquetral bone.

- Tx: Resection of all but the most proximal 2 mm of the styloid process

Cerezal, et al. Radiographics.2002;22
Ulnar Styloid Impaction Syndrome

- Ulnar-sided wrist pain caused by impaction between an excessively long ulnar styloid process and the triquetrum.

- Ulnar styloid process greater than 6 mm in length

- Dx can be made based on radiographic findings and provocative clinical testing
Ulnar Styloid Nonunion Impaction

- Result of nonunion of ulnar styloid fracture
- Styloid fragment abuts triquetrum
- TFCC may be abnormal, depending on level of fracture

Illustration from Cerezal et al, Radiographics 2002
Hamatolunate Abutment

- Abnormal configuration of quadrilateral space

Illustration from Cerezal et al, Radiographics 2002
Hamatolunate Abutment

- 50% of lunate bones have a separate medial facet on the distal surface for articulation with the hamate bone.

- Repeated impingement and abrasion in full ulnar deviation.

- 25% cartilage erosion proximal pole of the hamate bone.
Ulnar impingement

- Seen with short ulna
- Degenerative changes at proximal radioulnar joint

Illustration from Cerezal et al, Radiographics 2002
Extrinsic ligaments

- **Dorsal**
  - Radiolunatotriquetral
  - Ulnotriquetral

- **Volar**
  - Radioscaphocapitate
  - Radiolunotriquetral
  - Radioscapholunate
Intrinsic Intercarpal ligaments

• Scapholunate ligament
  – Perilunate injury

• Lunotriquetral ligament
  – Perilunate injury
  – Reverse perilunate injury
  – Ulnocarpal impaction
Greater and lesser arcs

- 1 Greater arc injury
- 2 Lesser arc injury
- Various combinations usually occur
Lunotriquetral ligament

- Small ligament between lunate and triquetrum
- Often difficult to visualize on MR imaging
- Accuracy of MR limited
Carpal Tunnel Syndrome

• Clinical diagnosis: pain, paresthesia distribution of median nerve, Tinel’s sign

• Nerve conduction abnormal

• MR findings:
  – Swelling median nerve at level of pisiform
  – Increased T2 signal in median nerve
  – Flattening median nerve at level of hamate
  – Palmar bowing flexor retinaculum

• Masses in carpal tunnel:
  – neuromas, ganglion cysts, lipomas, and hemangiomas.
Carpal Tunnel Syndrome

- Normal
- Tenosynovitis
- Osseous spur
- Mass
Bifid Median Nerve
Persistent Median Artery

- Anomalies of median nerve anatomy:
  - high divisions of the median nerve (bifid median nerve): incidence 2.8% in a dissection study of 246 hands
  - accessory branches proximal to the carpal tunnel
  - accessory branches in the distal carpal tunnel
  - variations in the course of the thenar branch
Carpal Tunnel Post Op MR

• Normal
  – widening of the fat stripe posterior to the flexor digitorum profundus tendons

• Failed Release
  – Incomplete release of the flexor retinaculum
  – Excessive fat within the carpal tunnel
  – Neuromas, scarring, and persistent neuritis
Fibrolipomatomatous Hamartoma

- Present as child or young adult
- Slowly enlarging palmar mass, CTS
- M=F
- UE 90%
- Median nerve 85%
- 50% macrodactyly
  - Macrodystrophia lipomatosa

Macrodystrophia lipomatososa

- 2nd + 3rd digits hand or foot
- Diffuse increase in fibroadipose
- Osseous and ST overgrowth
- Growth ceases at puberty

Fibrolipomatous Hamartoma

- **Ultrasound**
  - Cable like appearance

- **MRI**
  - Enlarged nerve
  - Low signal fascicles
  - Surrounding fat

Ulnar tunnel syndrome

- Occurs in Guyon’s canal
- Masses
- Fractures
- Accessory muscle
Osseous lesions

- Occult fracture
- Known fracture
  - Healing
  - Complications
- Osteonecrosis
Scaphoid nonunion

- Simple nonunion: undisplaced, no instability or osteoarthritis

- Unstable nonunion: displacement 1 mm or more

- Scaphoid nonunion advanced collapse (SNAC): radioscaphoid and midcarpal OA
Isolated capitate fracture

- 0.3% of all carpal injuries

- Usually caused by hyperextension

- Usually associated with other carpal injuries such as a scaphoid fracture

- Isolated non-displaced waist fractures usually missed on plain films

- Can lead to posttraumatic arthritis, AVN or non-union
Osteonecrosis

- Lunate
  - Kienböck’s

- Scaphoid
  - Proximal pole

- Hamate
  - Hook after Fx

- Capitate
Kienböck’s disease

- Osteonecrosis of lunate
- Ages 20-40
- Fixed position and vulnerable blood supply of lunate
- May have history of trauma
- Ulna minus present in 75%
Kienböck’s disease

- Diffuse or focal low on T1, variable on T2

- Specific when entire lunate abnormal, adjacent bones not affected, and ulna minus

- Joint effusion and adjacent synovial inflammation may be present

- Fragmentation in advanced disease
Carpal Boss/Carpe Bossu

- bony protuberance at dorsal wrist
- base of the second and third metacarpals
- adjacent to capitate and trapezoid
- osteophyte or an accessory ossicle (os styloideum)
Extensor digitorum brevis manus (EDBM)

- Located on dorsum of wrist, ulnar to the extensor indicis proprius

- The proximal belly of the EDBM lies distal to the extensor retinaculum and extends to the middle 2\textsuperscript{nd} and 3\textsuperscript{rd} metacarpals

- Muscle forms a fusiform mass on the dorsal wrist
Extensor digitorum brevis manus

- Incidence reported between 1% and 9%

- Pain caused by synovitis due to recurrent constriction of the hypertrophic belly by firm distal edge of flexor retinaculum

- Various classifications based on insertion of EDBM and relation to extensor indices proprius
Inflammatory arthritis

- Rheumatoid arthritis
- Seronegative spondyloarthropathy
- Crystal induced arthritis
- Inflammatory osteoarthritis
- Nonspecific synovitis
Gout

• It is recommended that MRI studies be done with gadolinium to evaluate any tendon sheath involvement and to evaluate for osteomyelitis in the differential.
Tendons

- Anatomy
- Tenosynovitis
- Degenerative disease
- Tendon injury
- “Trigger” finger
Extensor Tendon Compartments

I-Abductor pollicis longus and extensor pollicis brevis
II-Extensor carpi radialis longus and brevis
III-Extensor pollicis longus
IV-Extensor digitorum communis and extensor indicis
V-Extensor digiti minimi
VI-Extensor carpi ulnaris
de Quervain’s tenosynovitis

- Tenosynovitis of first dorsal compartment (APL, EPB)
- Pain and swelling
- Finkelstein's test (pain when thumb is held and wrist deviated ulnarly)
Intersection Syndrome

Extensor retinaculum

Extensor carpi radialis longus and brevis tendons

Abductor pollicis longus and extensor pollicis brevis tendons

Intersection
Flexor tendon injuries

- Less common than extensor tendon injuries
- Closed vs open (more common)
- Closed: Sudden hyperextension during active flexion (aka “jersey finger”)

- Types:
  - I: Retraction of tendon into palm
  - II: Retraction of tendon to PIP
  - III: Bony avulsion
  - IV: III + avulsion of tendon from fracture fragment

- Rx: Primary repair for most
Trigger finger

- Nodule develops on flexor tendon
- Nodule becomes entrapped on the pulleys holding tendon in place
- Catching, followed by abrupt release
UCL and Stener’s

- Bony avulsion or ligamentous injury
- Torn end superficial to adductor aponeurosis = Stener
Stener lesion

- Entrapment of adductor aponeurosis
Gamekeeper’s thumb

- Sudden valgus stress applied to the MCP joint of the thumb.
- Initially described as an occupational hazard in English game wardens.
- Now recognized in skiers…led to change in design of ski poles and also to the recommendation for skiers to discard their ski poles during a fall.
- Attenuation or disruption of the ligamentous apparatus of the thumb.
- Possible associated pain, swelling, tenderness, edema and pinch instability.
Volar Ligaments

- Thick fibrocartilaginous structures
- Placed between the collateral ligaments, to which they are connected
- Loosely united to the metacarpal bones BUT
- Very firmly attached to the bases proximal phalanges
- Volar surfaces blended with the transverse metacarpal ligament
- Grooves for the passage of the Flexor tendons
- Deep surfaces form parts of the articular facets for the heads of the metacarpal bones, and are lined by synovium
Collateral Ligaments

- rounded cords, placed on the sides of the joints

- attachments:

- posterior tubercle and adjacent depression on the side of the head of the metacarpal bone

- phalanx.
Boxer’s Knuckle

Damage to the sagittal bands of the extensor hood which help stabilize the extensor tendon during joint motion.

Sxs: pain, swelling, loss of full range of motion, subluxation of the extensor tendon

T2 Fat Sat with fingers extended

Subluxation of extensor tendon after clenching fist