2015 EATA Student Program
Evaluation and Treatment of Common Sports Injuries to the Wrist and Hand
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I. Anatomy
   A. Osteology/Arthrology (Skeletal/Joint Structure)
      1. Distal radioulnar joint (DRUJ)
         a. Includes the TFCC (Triangular Fibrocartilage Complex)
         b. 1 deg of freedom - uniaxial pivot joint (sup/pron)
      2. Radiocarpal/Ulnomeniscotriquetral joint
         a. 3 deg of freedom (flex/ext/RD/UD/sup/pron)
         b. Ulnar Variance (positive or negative)
      3. Midcarpal joint
         a. 2 degrees of freedom (flex/ext/RD/UD)
      4. Carpometacarpal joint (CMC)
         a. the 2-5<sup>th</sup> CMC joints are plane joints with 1deg of freedom
            (flexion/extension occur only)
         b. the 1<sup>st</sup> CMC joint has 3deg of freedom
            (flexion/extension/abd/add/sup/pron/circumduction)
      5. Intermetacarpal joints 2-5
         a. really synarthrosis, not synovial joint
         b. 1 degree of freedom (volar/dorsal glide)
      6. Metacarpophalangeal joint (MP)
         a. they have 3deg of freedom (flexion/extension/abd/add/sup/pron)
      7. Interphalangeal joint (IP joints - PIP’s and DIP’s)
         a. 1 deg of freedom (flexion/extension)
   B. Musculature
      1. Extrinsic Hand Muscles
         a. volar side – Flexor carpi radialis
            - palmaris longus
            - flexor carpi ulnaris
            - flexor pollicis longus (FPL)
            - Flexor digitorum profundus (FDP)
            - Flexor digitorum superficialis (FDS)
         b. dorsal side – Abductor Pollicis Longus (APL)
            - Extensor Pollicis Brevis
            - Extensor carpi radialis longus (ECRL)
            - Extensor carpi radialis brevis (ECRB)
            - Extensor pollicis longus
            - Extensor digitorum communis
            - Extensor indicis
2. **Intrinsics** – lumbricales
   - palmar interossei
   - dorsal interossei
   - thenar muscles
   - hypothenar muscles
   - adductor pollicis

C. **Lymphatic System** – the only system that can remove large molecule substances such as excess plasma proteins, hormones, fat cells, and waste products from the interstitium that you see in **chronic edema**. The lymphatics are tubes which are in the dermis layer of the skin; they rely on changes in interstitial pressure to open and close (pressures>60mmHg will collapse the tubes).

1. “Squeezing” tissue removes the fluid from the lymph but not the large molecules, so the edema becomes more concentrated
2. The proteins are hydrophilic and when the pressure is removed, the fluid is attracted back into the interstitium

D. **Myofascial/Skin**

1. Dorsum of the hand is very different than the palm
2. The palmar fascia has longitudinal, transverse, and vertical fibers
   a. the vertical fibers run superficially to stabilize the thick palmar skin
   b. the lymphatics run through the dorsal hand

E. **Nerves**

1. Median
2. Ulnar
3. Radial

II. **Phases of Connective Tissue Healing**

A. **Inflammatory Phase**

1. vasodilation
2. hyperemia
3. increased cell permeability
4. increased vascularity
5. cell migration
6. debris removal

B. **Fibroplastic Phase**

1. **re-epithelialization** causing wound closure (skin)
2. **fibroplasia** – fibroblasts are activated and move along the fibrin meshwork to generate new collagen, elastin, GAG’s, proteoglycans, and glycoproteins
3. **neovascularization** – regeneration of small blood vessels
4. wound contraction
5. collagen with random alignment
C. Remodeling Phase
   1. consolidation phase
   2. increased wound strength
   3. realignment of collagen
   4. reduction of abnormal cross links
   5. maturation phase – the scar links change from weak hydrogen bonds to strong covalent bonds

III. Evaluation
   A. History of Mechanism
      1. Details as to the Mechanism of injury are very important because they can assist you with the evaluation, treatment, and prognosis
         a. examples - infection will precipitate more scar formation - a tendon laceration from a crush injury will have more scarring and surrounding tissue adherence than if from a clean knife
      2. PMH (past medical history)
         a. smoking is extremely significant especially with hand injuries
   B. Observation
      1. Skin
         a. obvious wound areas
         b. thickness and suppleness – noting callouses and thickness of skin folds
         c. skin atrophy (ex. from long term corticosteroid therapy)
         d. Russell’s sign
         e. Scars - can reduce the mobility of joints and tendons if they cause adhesions
               - dorsal scars can effect the flexion or mobility of the extensor tendons underneath
               - web space scars can interfere with the separation of the fingers and mcp joint flexion
      2. Circulation
      3. Edema
         a. note the location and type of edema
         b. when edema occurs in tissue and the fluid remains in the interstitium, the body uses two systems to remove it
               - the venous system relies on valves, the heart pumping, and muscle pumping to remove low plasma protein swelling (acute edema)
               - the lymphatics is the only system that can remove large molecule substances such as excess plasma proteins, hormones, fat cells, and waste products from the interstitium that you see in chronic edema. The lymphatics are tubes which are in the dermis layer of the skin; they rely on changes in interstitial pressure to open and close (pressures>60mmHg will collapse the tubes). “Squeezing”
tissue removes the fluid from the lymph but not the large molecules, so the edema becomes more concentrated. The proteins are hydrophilic and when the pressure is removed, the fluid is attracted back into the interstitium.

c. Treatment of the edema
- the treatment goal for acute (low plasma protein) edema is to decrease the fluid flow into the tissue/interstitium by elevation, compression, retrograde massage, etc
- the treatment goal for chronic edema is to reduce the excess plasma proteins in the interstitium by stimulating the lymphatics. This treatment is called Manual Edema Mobilization (MEM) and it incorporates the following:
  * light proximal to distal, then distal to proximal massage of the skin
  * specific pre- and post-exercises
  * massaging the lymph node areas proximal to the edema
  * the massage must follow the direction of lymphatic pathways

C. ROM – Hand/Fingers
1. The American Society of Hand Therapists endorses the American Medical Society’s method where the motions are measured from 0 degrees (neutral) starting position
   a. flexion measurements are (+) positive numbers
   b. extension to neutral is 0
   c. inability to extend a joint fully is a negative (-) number
   d. hyperextension is a (+) number
   e. example - -20/105 is 20deg extension lag and 105 deg of flexion
   f. Finger ROM measurements can be recorded as AROM, PROM, TAROM, TPROM, or flexion-DPC
      - TAROM – with each finger measured separately, it is the sum of the simultaneous active MP/PIP/DIP flexion in a fisted position minus the sum of any active extension deficits at the MP/PIP/DIP joints
      - TPROM – with each finger measured separately, it is the sum of the simultaneous passive MP/PIP/DIP flexion in a fisted position minus the sum of any passive extension deficits at the MP/PIP/DIP joints
      - Flexion-DPC – the distance between the pulp of finger and the distal palmar crease when the patient attempts to make a fist

C. ROM – Wrist – traditional goniometry
1. Flexion/ext – over 3rd met/across palm
2. RD/UD – over 3rd met
3. Sup/pron – plane of dorsal radius/ulna and longitudinal humeral line

D. Palpation
   1. to determine variations in skin temperature and sweating
   2. consistency of subcutaneous tissue
   3. presence and location of hypersensitivity
   4. muscle tone/spasm
   5. trigger points
   6. tenderness over specific structures

E. Joint Mobility – hypomobility treated differently than hypermobility

F. Strength
   1. MMT
   2. Grip (the 5 positions indicate muscle/tendon involvement)
   3. Pinch (Tip/Key)

G. Special tests as appropriate for the injury (see Special Test section)
   1. Tendon Integrity Testing
   2. Ligamentous Testing
   3. Provocation Testing
   4. Neurological Testing

IV. X-Ray Studies (besides fractures/dislocations)
   1. Variance
      a. positive ulnar variance
      b. negative ulnar variance

V. Differential Diagnosis of Common Finger/Hand injuries
   A. Mallet Finger – is a disruption of the terminal aspect of the extensor tendon either because of laceration, rupture, or avulsion
      1. Mechanism – forceful flexion of the dip joint when the finger is being actively extended.
      2. Conservative Treatment for acute mallet finger (less than 3 weeks old)
         a. 0-6 weeks – continual splinting of the dip joint in 10-15deg hyperextension (volar splints work best)
            - the splint may be removed once a day to prevent skin breakdown or maceration but the hyperextension must be maintained
            - if the dip joint bends, the splint wearing time must be started over
         b. after 6 weeks – active AROM at the dip joint is allowed in a limited range and for limited sessions each day. The mallet finger splint is worn outside of exercise. If an extensor lag develops, AROM sessions are decreased or put on hold and continual splinting resumed.
         c. at 8 weeks – if no extensor lag, the mallet splint is discontinued during the day but still worn at night. Gentle strengthening with putty, hand exerciser, etc can be added
         d. at 9 weeks – the mallet splint is discontinued if no lag
e. no PROM to the dip joint is done with mallet finger, only active

3. **Conservative Treatment** for chronic mallet finger (greater than 3 weeks old)
   a. 0-8 weeks – **continual** splinting of the dip joint in 10-15deg hyperextension (sometimes the dip joint may be pinned)
      - the splint may be removed once a day to prevent skin breakdown or maceration but the hyperextension **must** be maintained
      - if not pinned and if the dip joint bends, the splint wearing time must be started over
   b. after 8 weeks – active AROM at the dip joint is allowed in a limited range and for limited sessions each day. The mallet finger splint is worn outside of exercise. If an extensor lag develops, AROM sessions are decreased or put on hold and continual splinting resumed.
   c. at 9 weeks – if no extensor lag, the mallet splint is gradually discontinued during the day but still worn at night. Decreased 1 hour per day is typical. PROM may be added if the dip extensor lag is < 10deg.

4. **Surgical Treatment** for mallet finger (greater than 3 weeks old)
   a. is indicated when the avulsed distal fragment is 50% or greater of the articular surface of the distal phalanx
   b. surgical procedure – an incision is made along the area of the distal phalanx and dip joint. The displaced bone fragment is reapproximated along the distal phalanx. A k-wire is used to position the dip joint in extension.
   c. 3 days post-up – Dressing is removed and edema control is begun. A splint is made to protect the distal tip and pin and worn continually. Pin is cleaned daily with hydrogen peroxide (depending on physician)
   d. at 6 weeks – the pin is removed by the physician with **continual** splinting of the dip joint except during exercise sessions
      - AROM exercises are initiated to the dip joint (6 times a day for 5-10min)
   e. at 7 weeks – active AROM at the dip joint is allowed in a limited range and for limited sessions each day. Gentle ROM exercises may be initiated to the dip joint as long as and extensor lag is not present at the dip joint.
   f. at 9 weeks – splint wearing time is steadily decreased usually 1 hour per day
   g. at 10 weeks – discontinue splint during the day
   h. at 12 weeks – discontinue splint at night
B. Boutonniere Deformity versus Volar Plate Contracture

1. **Boutonniere Deformity** – Extensor tendon injury at Zone 3 and the lateral bands move volar to the axis of the PIP joint
   a. **Mechanism** – volar dislocation or subluxation of the PIP joint.
      - because the lateral bands are volar to the axis, when the extensor contracts, instead of extending the joint, they flex the PIP joint.
      - over time, the extensor force is concentrated on the DIP joint, causing DIP hyperextension and loss of DIP flexion.
      - in early stages, there is full passive extension of the PIP joint.
   
   **KEY – recognition of the injury**
   b. **Treatment:**
      - possible surgical repair
      - consult with a hand therapist
      - continuous splinting in extension, buddy taping is not sufficient
      - finger splints are generally accepted by officials if they are covered with tape.
      - when appropriate healing has occurred, early short-arc motion
      - exercise where the PIP joint is held in extension and the DIP is flexed
      - night splinting may be required for 2 to 3 months, and protective splinting for the remainder of the season

2. **Volar Plate Contracture at the PIP Joint**
   a. **Mechanism** - commonly injured with dorsal dislocation of the PIP joint (hyperextension injury).
   b. the volar plate is a fibrocartilaginous structure on the volar aspect of the PIP joint. In response to injury it can become fibrotic and immobile, thus limiting PIP joint extension.
   c. PIP joint extension will be limited **actively and passively**

3. **Treatment for the dorsal dislocation:**
   a. for a grade I– splinted in slight flexion until acute pain subsides.
   b. for a grade II - a dorsal splint with 20deg to 30deg of PIP joint flexion for approximately 7 to 14 days. After immobilization, the finger can be taped to an adjacent finger for protection. Patient needs to be watched for a missed Boutonniere.
   c. for a grade III - as per grade unless reduction is not maintained, then surgery is appropriate

4. **Treatment for the volar plate contracture:**
   a. modalities to increase mobility of the volar plate
b. volar plate mobilization
c. PIP ext stretches, with cuing to avoid hyperextension of the DIP joint
d. possible night time static splinting in progressive extension
e. possible day time dynamic splinting

C. Flexor Digitorum Profundus Injury versus a Flexor Digitorum Superficialis Injury

1. Flexor Digitorum Profundus Rupture or Avulsion
   a. Mechanism – a forceful eccentric load on the FDP can cause an avulsion off the distal phalanx
   b. Called Jersey Finger because this frequently occurs as a player grabs another player and the finger becomes caught in their jersey
   c. Signs and Symptoms:
      - swelling and discomfort at the DIP joint
      - patient will not be able to flex the DIP joint actively
   d. Treatment:
      - RECOGNITION – often missed if FDS function is intact
      - Referral to MD (surgery to re-attach tendon)

2. Flexor Digitorum Superficialis Injury (to 3rd through 5th fingers)
   a. Uncommon in athletics
   b. Mechanism – mostly lacerations from sharp objects
   c. Sign: patient will not be able to flex PIP joint of fingers with the other two fingers held in full extension
   d. Treatment:
      - referral to MD

VI. Differential Diagnosis of Wrist injuries by Zone Examination

A. Radial dorsal zone
   Structures to palpate: Radial styloid
   Scaphoid
   Scaphotrapezial joint
   Trapezium
   Base of the first met
   1st MCP joint

1. Radial styloid tenderness may indicate:
   a. contusion
   b. fracture
   c. if tenderness is accentuated with radial deviation (RD) – radioscaphoid arthritis

2. Scaphoid tenderness in the snuffbox may indicate:
   a. scaphoid fracture
b. scaphoid non-union
   c. scaphoid instability
3. Scaphoid and trapezium tenderness may indicate:
   a. scaphoid instability
   b. ST arthritis
   c. if accompanied by central dorsal complaints, see section III B4
4. First CMC joint tenderness may indicate:
   a. with a (+) Grind test (pain with axial compression of the 1st met with rotation) – 1st CMC joint degenerative arthritis
   b. with a (+) instability/laxity test (more laxity is present when the 1st met is distracted and moved side to side or RU direction while the trapezium is stabilized versus on the uninjured side) – 1st CMC joint instability or laxity
5. Extensor pollicis brevis (EPB) and abductor pollicis longus (APL) tenderness in the first extensor compartment (radial border of the anatomic snuffbox)
   a. with a (+) Finkelstein’s test (pain localized to the radial aspect of the wrist when thumb flexion is combined with UD of the wrist) – de Quervain’s tenosynovitis
6. Extensor pollicis longus (EPL) tendon tenderness may indicate:
   a. with incomplete thumb interphalangeal extension from pain – EPL tendonitis/Drummer’s Palsy
   b. with no active extension of the thumb interphalangeal joint – EPL rupture
7. EPB and APL muscle belly tenderness or crepitus with active thumb movement or friction and crepitus palpated 4 to 5 cm proximal to the radial styloid during wrist flexion and extension with radial deviation may indicate: intersection syndrome
8. Numbness, tingling, burning, and pain over the dorsal radial aspect of the hand may indicate:
   a. (+) Tinel’s with percussion along the course of the nerve produces tingling and pain which may radiate distally – Wartenberg’s Syndrome or Neuralgia (irritation of the Dorsal Radial Sensory Nerve)
   b. with more proximal complaints – CN root irritation?????

B. Central Dorsal Zone
   Structures to palpate: Distal radius (dorsal rim)
   Lister’s tubercle
   Lunate
   Scapholunate interval
   Capitate
   2nd and 3rd metacarpal bases
   2nd – 4th extensor tendons
   Posterior interosseous nerve (PIN)
1. **Distal radius dorsal rim tenderness** may indicate:
   a. (-) X-Ray changes – **Impingement of the scaphoid on the radius**
   b. (+) X-Ray changes and pain with pressure or with hyperextension and radial deviation of the wrist – **osteofyte**

2. **Lunate tenderness** only may indicate:
   a. (+) X-Ray changes – **Kienbock’s disease (avascular necrosis of the lunate)**

3. **Scapholunate interval tenderness** may indicate:
   a. patient history of recurrent nodular swelling in the wrist dorsum and complaints of pain with deep palpation that may not be detected by clinical exam – **dorsal wrist ganglion** (**tenderness may be present with wrist flexion or extension secondary to compression of the ganglion**)
   b. with localized non-nodular swelling – **scapholunate ligament injury**
   c. with localized non-nodular swelling and a (+) **finger extension test** (pain in the scapholunate region with resisted finger extension with the wrist in flexion) – **dorsal wrist syndrome**

4. **Scaphoid (in the snuffbox) and scaphotrapezial-trapezoid joint tenderness** with synovitis may indicate:
   a. and dorsal scapholunate synovitis, and (+) **finger extension test, and a positive Watson/scaphoid shift test** (reproduction of the patient’s symptoms and usually a painful clunk when the examiner applies pressure over the volar prominence of the scaphoid as the wrist is moved from UD to RD with slight flexion) – **scaphoid rotary subluxation**
   b. and/or a (+) **scaphoid thrust test** (an apparent shift of the scaphoid when the examiner pushes dorsally on the scaphoid tubercle) - **scaphoid rotary subluxation**
   c. and/or (+) **scapholunate ballottement test** (pain or increased motion relative to the other side when the scaphoid is moved in a volar and dorsal direction while the lunate is being stabilized) - **scaphoid rotary subluxation**

5. **2nd and 3rd metacarpal base and CMC tenderness** may indicate:
   a. with a bony prominence at the 2nd and 3rd metacarpal bases – **carpal boss**
   b. and/or a (+) **Linscheid test** (pain localized to the CMC joint area when the metacarpal heads are moved in a palmar and dorsal direction on one another) – **2nd and/or 3rd CMC ligament injury or instability**
c. **and/or a (+) metacarpal stress test** (pain at the CMC joint when the MCP joint is fully flexed and the metacarpal is pronated and supinated) – **CMC joint injury**

6. ECRL, ECRB, EDC tendon tenderness may indicate:
   a. with inability to extend the MP joints or incomplete MCP extension – **EDC tendon adherence or rupture**
   b. with pain on resisted MCP extension – **EDC tendonitis**

7. Dorsal wrist tenderness, proximal to Lister’s tubercle, may indicate: **PIN (Posterior Interosseous Nerve) Neuritis**

C. **Ulnar Dorsal Zone**
   Structures to palpate: Ulnar styloid
   Ulnar head
   DRUJ
   TFCC (triangular fibrocartilage complex)
   Hamate
   Triquetrum
   Lunotriquetral interval
   Fourth and fifth CMC joints
   Extensor carpi ulnaris (ECU)

1. **Ulnar styloid tenderness may indicate:**
   a. **ulnar styloid fracture**
   b. **ulnar fracture nonunion**

2. **DRUJ (distal radial ulnar joint) tenderness may indicate:**
   a. with prominence of the distal ulnar head – **DRUJ instability**
   b. and/or a (+) **piano key sign** (pain when the distal ulna springs back after volarly directed pressure on the pronated distal ulna is released) – **DRUJ instability**
   c. and/or (+) **piano key test** (pain, tenderness, and increased mobility relative to the uninjured side when the distal ulna is grasped and moved passively in a volar/dorsal direction at the extremes of pronation and supination) – **DRUJ instability**
   d. with a (+) **ulnar compression test** (pain at the DRUJ with pronation and supination occurs when radially directed pressure is applied on the ulnar head into the sigmoid notch of the radius) – **DRUJ arthritis**

3. **Fovea** (a groove at the base of the ulnar styloid that serves as an attachment point for the TFCC) tenderness -
   a. with (+) **TFCC load test** (pain, clicking, or crepitus and reproduction of the patient’s symptoms when the wrist is ulnarly deviated and axial loaded, and then moved volarly and dorsally, or the forearm is rotated) – **Ulnocarpal abutment (ulnar impaction syndrome)**
b. with (+) **TFCC load test** and a (+) **relocation test** (pain reduction when the subluxed ulnar carpus is relocated. The combined movement of pronation, and anterior to posterior glide of the carpus on the ulna relocates the carpus into normal alignment– **TFCC tear/ulnocarpal instability**

-the **pisiform boost test** may also be done but it is not as definitive as the TFCC load test or relocation test (see special test section)

4. Hamate tenderness on the dorsal aspect may indicate:
   a. **hamate fracture**

5. **Triquetrum** tenderness may indicate:
   a. **triquetal fracture**
   b. **triquetal instability**

6. Dorsal triquetral-hamate pain, swelling, and tenderness may indicate:
   a. with a (+) **midcarpal shift test/catch-up clunk test/pivot shift test** (painful clunk which reproduces the patient’s symptoms when a palmar load is placed over the capitate and the wrist is ulnarly deviated with a simultaneous axial load) – **midcarpal instability**

7. **Lunotriquetral (LT)** tenderness and swelling may indicate:
   a. with a (+) **ballottement test** (pain, clicking, or laxity when the lunate is stabilized and the lunate is mobilized volarly and dorsally) – **LT instability**
   b. and/or a (+) **shear test** (pain or clicking when the wrist is ulnarly and radially deviated with the lunate supported and the pisotriquetral complex is loaded in the anteroposterior plane) – **LT instability**
   c. and/or a (+) **ulnar snuffbox test** (pain complaints are reproduced when lateral pressure is applied on the triquetrum in the sulcus distal to the ulnar head. The sulcus is formed by the ECU and FCU tendons.) – **LT instability**

8. Fourth and fifth CMC tenderness may indicate:
   a. **CMC ligament injury**
   b. **CMC area fracture**

9. Extensor carpi ulnaris (ECU) tenderness may indicate:
   a. with pain on resisted motion (ext and UD)– **ECU tendonitis**
   b. with complaints of pain and snapping with forearm rotation and a (+) **ECU subluxation test** (observed and palpated ulnar and volar subluxation when the forearm is supinated, and the wrist is ulnarly deviated) – **ECU subluxation**

**D. Radial Volar Zone**

Structures to palpate: Radial styloid
Scaphoid tuberosity
STT joint
Trapezial ridge
Flexor carpi radialis (FCR)
Palmaris longus (if present)
Flexor tendons to the fingers
Medial nerve
Radial artery

1. **Radial styloid tenderness** may indicate:
   a. **distal radius fracture**
   b. with increased pain upon wrist extension and radial deviation – **radiocarpal ligament injury**

2. **Volar scaphoid tenderness** may indicate:
   a. **scaphoid disease**

3. **Scaphotrapeziumtrapezoid joint tenderness** may indicate:
   a. with painful and restrictd RD - **STT arthritis**

4. **STT joint or radiocarpal joint tenderness** may indicate:
   a. with swelling or soft mass at the base of the thumb to the distal thumb of the volar forearm - **volar wrist ganglion**

5. **Trapezium tenderness** may indicate:
   c. **trapezial fracture**

6. **FCR (flexor carpi radialis) tenderness and pain** with resisted flexion and radial deviation may indicate:
   a. **FCR tendonitis**

7. **Swelling over the finger flexor tendons** (FDS/FDP) and discomfort with active finger flexion may indicate:
   c. **FDS or FDP tenosynovitis**
   d. The tendons may also be tender and may demonstrate crepitus

8. **Complaints of numbness, pain, or tingling** from the distal wrist into the fingers in the median nerve distribution may indicate:
   a. with a (+) **Tinel’s sign/test** (pain and tingling radiates to the fingers in the median nerve distribution when the median nerve is gently percussed at the wrist level – **carpel tunnel syndrome**
   b. and/or a (+) **Phalen’s test** (numbness and tingling in the distribution of the median nerve with passive flexion of the wrist for 15 to 60 seconds) – **carpel tunnel syndrome**
   c. with a (+) **Lumbricale pinch test** (reproduction of the signs and symptoms when the patient is asked to hold a sheet of paper in a lumbricale pinch – **carpel tunnel caused by a more proximal origin of the lumbricales**

9. **Complaints of coldness and pain** in the central hand may indicate:
   a. with a (+) **Allen’s test** (if there is no flush of blood or a delayed flush observed when pressure is individually released on the radial or ulnar artery-see special test section) – **arterial occlusion**
b. with excessive hand swelling, stiffness, abnormal skin coloring, abnormal hair/nail growth, and/or sweating local to the hand – Complex regional pain syndrome (CRPS)/Reflex Sympathetic Dystrophy (RSD)

E. Ulnar volar zone

Structures to palpate: Pisiform
Hook of the hamate
Flexor carpi ulnaris (FCU)
Ulnar nerve
Ulnar artery

1. **Pisiform tenderness** may indicate:
   a. pisiform fracture
   b. with (+) **shear test** (pain or crepitus when the pisiform is pushed or rocked into or around the triquetrum) – pisotriquetral arthritis

2. **Hook of the hamate tenderness** may indicate:
   a. with pain accentuated with resisted flexion of the 4th and 5th finger with the wrist in UD – **hamate fracture**

3. Complaints of ulnar-sided pain and coldness and a (+) **Allen’s test** for the ulnar artery may indicate:
   a. **ulnar hammer/hypothenar hammer syndrome**

4. Complaints of numbness and paresthesias in the 4th and 5th fingers and possibly a (+) **Tinel’s sign**
   a. **cyclist’s palsy** (ulnar nerve compression within Guyon’s Canal)

5. Flexor carpi ulnaris (FCU) tenderness, swelling, and pain with resisted wrist flexion and UD may indicate:
   a. **FCU tendonitis**
   b. Pain may also be present with 5th finger abduction

**DIAGNOSES/TREATMENTS**

**Avascular Necrosis of the Lunate** – see Kienbocks Disease

**Boutonniere Deformity** – Extensor tendon injury at Zone 3 and the lateral bands move volar to the axis of the PIP joint

A. **Mechanism** – volar dislocation or subluxation of the PIP joint.
   1. because the lateral bands are volar to the axis, when the extensor contracts, instead of extending the joint, they flex the PIP joint
   2. over time, the extensor force is concentrated on the DIP joint, causing DIP hyperextension and loss of DIP flexion.
   3. in early stages, there is full passive extension of the PIP joint.
   KEY – recognition of the injury

B. **Treatment**:
   1. possible surgical repair
2. consult with a hand therapist
3. continuous splinting in extension, buddy taping is not sufficient
4. finger splints are generally accepted by officials if they are covered with tape.
5. when appropriate healing has occurred, early short-arc motion
6. exercise where the PIP joint is held in extension and the DIP is flexed
7. night splinting may be required for 2 to 3 months, and protective splinting for the remainder of the season

Carpal Boss – a carpal boss can be a variation or anomaly in some individuals and not necessarily pathologic. It may however represent hypertrophic changes of traumatic origin. These can occasionally cause pain and irritation of the local soft tissues

Complex Regional Pain Syndrome(CRPS)/Reflex Sympathetic Dystrophy(RSD)
A. Etiology/Mechanism
   1. painful lesion, either from trauma or disease
   2. Predisposition of the individual to develop the problem
   3. Abnormal sympathetic reflex
B. Signs and Symptoms
   1. pain
   2. swelling
   3. stiffness
   4. discoloration
   5. osseous demineralization on X-Ray
   6. temperature changes
   7. sudomotor changes
   8. vasomotor instability
C. Treatment
   1. Recognition and referral to specialty MD
   2. TENS (burst mode)
   3. splinting to avoid pain
   4. stress loading
   5. nerve blocks
   6. referral to hand therapist

Cyclist’s Palsy –
A. Mechanism – compression of the ulnar nerve in Guyon’s tunnel
B. Signs and Symptoms
   1. numbness and paresthesias in the 4th and 5th fingers
C. Treatment
   1. prevention of compression in this area
   2. anti-inflammatory modalities as needed
   3. gentle nerve glides
De Quervain’s Tenosynovitis – stenosing tenosynovitis of the APL and EPB tendons in the sheath

A. **Anatomy** – the APL and EPB tendons pass through the first dorsal compartment of the extensor retinaculum. There is a synovial sheath under the retinaculum encasing the tendons.

B. **Etiology** –
   1. **Microtrauma** – forceful, sustained, or repetitive thumb abduction and simultaneous wrist UD. Some MD’s feel that RD with pinch is the most stressful because the APL and EPB tendons are taut and sharply angulated at the wrist and trapeziometacarpal joint
   2. **Acute trauma** – sudden wrenching of the wrist and thumb while trying to restrain an object or person or a fall

C. **Signs and Symptoms**
   1. radial-sided wrist pain over the 1\textsuperscript{st} dorsal compartment
   2. pain can radiate to the thumb
   3. increased pain with increased tensile load on the EPB or APL
   4. (+) **Finkelstein’s test**
   5. wrist flexion will intensify the pain and extension should relieve it
   6. painful thumb extension
   7. MRI may show increased fluid in the 1\textsuperscript{st} extensor compartment
   8. rarely pseudotriggering
   9. can co-exist with or be confused with trapeziometacarpal arthritis, scaphoid fractures, scapholunate instability, intersection syndrome, radial neuritis, and radioscaphoid/scaphotrapezoid joint problems

D. **Treatment**
   1. splint to minimize UD at wrist and substitutes power grip for pinch
   2. anti-inflammatory modalities
   3. gentle gliding of tendons and gentle AROM
   4. possible injection into sheath
   5. after failed conservative management, surgical release of the 1\textsuperscript{st} dorsal compartment

**Dorsal Wrist Syndrome** – localized scapholunate synovitis

A. **Mechanism** – overstress of the SL ligaments
B. **Signs and Symptoms**
   1. (+) finger extension test
C. **Treatment**
   1. stabilization of the area externally (bracing)
   2. stabilization of the area internally (proprioceptive exc)
   3. anti-inflammatory modalities

**Dorsal Wrist Ganglion** – the most common mass on the dorsum of the hand and often arise from the scapholunate interval.

A. **Mechanism** – possibly a mechanism or a blow, but not necessarily
B. **Signs and Symptoms**
   1. they are soft and mobile
2. tenderness may be present with wrist flexion or extension

C. Treatment
   1. prevention of irritation (tape/brace) if needed
   2. possible surgery – typically needs some mobilization therapy afterward

Drummer’s Palsy – EPL tendonitis
   A. Etiology – the EPL tendon passes around Lister’s tubercle on its path to the thumb
   B. Mechanism – friction around Lister’s tubercle
   C. Signs and Symptoms
      1. tenderness of the third extensor compartment just ulnar to Lister’s tubercle
   D. Treatment
      1. splinting or resting of the tendon
      2. anti-inflammatory modalities
      3. possible injection

ECU subluxation – the ECU tendon is normally held securely in the ulnar groove of the distal ulna by the ECU sheath. With disruption of the sheath, the ECU tendon will sublux and snap during forearm rotation as it slides out of its groove and bowstrings ulnarly and volarly across the ulnar styloid. The ECU tendon is palpated in the gap between the ulnar styloid and the base of the fifth metacarpal with the forearm in pronation and during active ulnar deviation.

EPL tendonitis – see Drummer’s Palsy

Intersection Syndrome – stenosing tensynovitis of the second dorsal compartment
   A. Anatomy – the intersection where the radial wrist extensor tendons pass underneath the muscle bellies of the APL and EPB approximately 4 cm proximally to Lister’s tubercle
   B. Etiology
      1. repetitive wrist and/or thumb activities
      2. frequently seen in weight lifters and rowers
      3. possible bursal inflammation
   C. Signs and Symptoms
      1. pain and swelling of the overlying muscle bellies of the APL and EPB muscles
      2. possible redness
      3. possible painful crepitus with thumb and wrist movements
      4. grip and pinch are often painful and weak
   D. Treatment
      1. forearm or thumb spica splint
      2. anti-inflammatory modalities
      3. gentle gliding of tendons and gentle AROM
      4. possible injection
A. possible surgical release
   1. blood supply is limited and differences in resistance to compressive loads lead to microfractures within the lunate
   2. rarely a history of trauma
   3. ulnar-negative variance
   4. variations of the interosseous vasculature of the lunate

B. Signs and Symptoms
   1. pain in the central dorsal wrist
   2. weakness of the wrist
   3. stiffness
   4. (+) X-Ray or bone scan

C. Treatment
   1. if diagnosed before lunate collapse or OA – surgery to unload the forces on the lunate (radial osteotomy, ulnar lengthening, etc)
   2. if late diagnosis – salvage surgery – proximal row carpectomy or arthrodesis/fusion

Kienbock’s Disease - avascular Necrosis of the Lunate
A. Etiology/Mechanism
   1. blood supply is limited and differences in resistance to compressive loads lead to microfractures within the lunate
   2. rarely a history of trauma
   3. ulnar-negative variance
   4. variations of the interosseous vasculature of the lunate

B. Signs and Symptoms
   1. pain in the central dorsal wrist
   2. weakness of the wrist
   3. stiffness
   4. (+) X-Ray or bone scan

C. Treatment
   1. if diagnosed before lunate collapse or OA – surgery to unload the forces on the lunate (radial osteotomy, ulnar lengthening, etc)
   2. if late diagnosis – salvage surgery – proximal row carpectomy or arthrodesis/fusion

Mallet Finger – is a disruption of the terminal aspect of the extensor tendon either because of laceration, rupture, or avulsion
   1. Mechanism – forceful flexion of the dip joint when the finger is being actively extended.
   2. Conservative Treatment for acute mallet finger (less than 3 weeks old)
      a. 0-6 weeks – continual splinting of the dip joint in 10-15deg hyperextension (volar splints work best)
         - the splint may be removed once a day to prevent skin breakdown or maceration but the hyperextension must be maintained
- if the dip joint bends, the splint wearing time must be started over

b. after 6 weeks – active AROM at the dip joint is allowed in a limited range and for limited sessions each day. The mallet finger splint is worn outside of exercise. If an extensor lag develops, AROM sessions are decreased or put on hold and continual splinting resumed.

c. at 8 weeks – if no extensor lag, the mallet splint is discontinued during the day but still worn at night. Gentle strengthening with putty, hand exerciser, etc can be added

d. at 9 weeks – the mallet splint is discontinued if no lag

e. no PROM to the dip joint is done with mallet finger, only active

3. Conservative Treatment for chronic mallet finger (greater than 3 weeks old)

a. 0-8 weeks – continual splinting of the dip joint in 10-15deg hyperextension (sometimes the dip joint may be pinned)

- the splint may be removed once a day to prevent skin breakdown or maceration but the hyperextension must be maintained

- if not pinned and if the dip joint bends, the splint wearing time must be started over

b. after 8 weeks – active AROM at the dip joint is allowed in a limited range and for limited sessions each day. The mallet finger splint is worn outside of exercise. If an extensor lag develops, AROM sessions are decreased or put on hold and continual splinting resumed.

c. at 9 weeks – if no extensor lag, the mallet splint is gradually discontinued during the day but still worn at night. Decreased 1 hour per day is typical. PROM may be added if the dip extensor lag is < 10deg.

4. Surgical Treatment for mallet finger (greater than 3 weeks old)

a. is indicated when the avulsed distal fragment is 50% or greater of the articular surface of the distal phalanx

b. surgical procedure – an incision is made along the area of the distal phalanx and dip joint. The displaced bone fragment is reapproximated along the distal phalanx. A k-wire is used to position the dip joint in extension.

c. 3 days post-up – Dressing is removed and edema control is begun. A splint is made to protect the distal tip and pin and worn continually. Pin is cleaned daily with hydrogen peroxide (depending on physician)

d. at 6 weeks – the pin is removed by the physician with continual splinting of the dip joint except during exercise sessions
AROM exercises are initiated to the dip joint (6 times a day for 5-10min)
e. at 7 weeks – active AROM at the dip joint is allowed in a limited range and for limited sessions each day. Gentle ROM exercises may be initiated to the dip joint as long as and extensor lag is not present at the dip joint.
f. at 9 weeks – splint wearing time is steadily decreased usually 1 hour per day

g. at 10 weeks – discontinue splint during the day
h. at 12 weeks – discontinue splint at night

Reflex Sympathetic Dystrophy (RSD) see Complex regional pain syndrome (CRPS)

Triangular Fibrocartilage Complex Tear -
A. Anatomy/Function
1. consists of articular disc (triangular fibrocartilage), meniscus homologue (lunocarpal), ulnocarpal ligament, dorsal & volar radioulnar ligament, and ECU sheath
2. only the peripheral 15-20% of the TFCC has a blood supply
3. TFCC is main stabilizer of distal radioulnar joint, in addition to contributing to ulnocarpal stability
   a. volar TFC prevents dorsal displacement of ulna and is tight in pronation
   b. dorsal TFC prevents volar displacement of ulna and is tight in supination;
4. during axial loading, the radius carries the majority of load (82%), and the ulna a smaller load (18%)
   a. increasing the ulnar variance to a positive 2.5 mm increases the load transmission across the TFCC to 42%
   b. with the TFCC excised, the radial load increases to 94%;
B. Mechanism
1. Peripheryl tears are almost always secondary to ulnar deviation and forearm rotation with compressive load on the TFCC
2. Central tears are associated with degenerative processes or trauma
3. A positive ulnar variance is a predisposing factor
C. Signs and Symptoms
1. pain with forearm rotation (especially pronation), ulnar deviation, and gripping
2. a painful “click”
3. tenderness between the ulna and triquetrum
4. (+) TFCC load test
5. X-Rays may show an avulsion of the ulnar styloid or a tilt to the lunate and triquetrum. Ulnar variance will also be assessed.
6. Triple Injustion Arthrography – study of choice with tears being revealed as the contrast dye passes thru the radiocarpal joint and DRUJ
7. MRI – a complete tear would show a full thickness disruption which would extend thru the disc

D. Treatment (depends on location of tear)

1. Non-surgical:
   a. Application of a Sugartong or Muenster splint that immobilizes the forearm in neutral because this is the best position to allow the TFCC to heal
   b. Activity modification
   c. Steroid injections
   d. Anti-inflammatory modalities
   e. Stabilization exercises

2. Surgical:
   a. Central tears are debrided while peripherally tears are repaired.
   b. Ulnar shortening if there is a positive ulnar variance
   c. Wafer procedure

Ulnar Hammer/Hypotenar Hammer Syndrome – thrombosis of the ulnar artery

A. Mechanism – repeated impact on the ulnar side of the palm when using the hand to substitute for a hammer.

B. Signs and Symptoms
   1. ulnar sided pain and coldness
   2. (+) Allen’s test for ulnar artery

C. Treatment – referral to MD

Volar Plate Contracture at the PIP Joint

A. Mechanism - commonly injured with dorsal dislocation of the PIP joint hyperextension injury).
   1. The volar plate is a fibrocartilaginous structure on the volar aspect of the PIP joint. In response to injury it can become fibrotic and immobile, thus limiting PIP joint extension.

B. Signs and Symptoms - PIP joint extension will be limited actively and passively

C. Treatment for the dorsal dislocation:
   1. for a grade I – splinted in slight flexion until acute pain subsides.
   2. for a grade II - a dorsal splint with 20deg to 30deg of PIP joint flexion for approximately 7 to 14 days. After immobilization, the finger can be taped to an adjacent finger for protection. Patient needs to be watched for a missed Boutonniere.
   3. for a grade III - as per grade unless reduction is not maintained, then surgery is appropriate

D. Treatment for the volar plate contracture:
   1. modalities to increase mobility of the volar plate
   2. volar plate mobilization
   3. PIP ext stretches, with cuing to avoid hyperextension of the DIP joint
   4. possible night time static splinting in progressive extension
   5. possible day time dynamic splinting
Wartenberg’s Syndrome
A. Anatomy – the dorsal radial sensory nerve (DRSN) travels along the dorsal radial aspect of the wrist (very superficial) between the tendons of the brachioradialis and the ECRL.
B. Etiology – because of the superficial location, the DRSN is susceptible to compressive forces (ex. from tight wrist straps). Repetitive pronation, flexion, and UD (pronation causes the ECRL tendon to cross under the brachioradialis tendon and compress the DRSN).
C. Signs and Symptoms
1. flexion and UD puts the nerve on stretch which increases pain
2. numbness, tingling, burning and pain over the dorsal radial aspect of the hand
3. (+) Tinel’s
4. possible decreased sensation over the dorsal web and thumb dorsum
D. Treatment
anti-inflammatory modalities (phonophoresis)
heat modalities (not cold)
gentle stretching

IV. SPECIAL TESTS/PROVOCATION TESTS

Allen’s test – tests for arterial occlusion. A (+) test is if there is no flush of blood or a delayed flush observed when pressure is individually released on the radial or ulnar artery. Specifically, the subject makes a tight fist and the examiner occludes both the radial and ulnar arteries. The patient opens and closes the hand until the skin is white and blanched. The radial artery is then released, and the palm is observed for flushing which indicates blood flow. If there is no flush or if blushing is delayed relative to the uninvolved side, occlusion may be present. The test is repeated to assess the ulnar artery.

Ballottement test - tests for LT instability. A (+) test is pain, clicking, or laxity when the lunate is stabilized and the lunate is mobilized volarly and dorsally)

Catch-up clunk test/midcarpal shift test/pivot shift test - tests for midcarpal instability. A (+) test is a painful clunk which reproduces the patient’s symptoms when a palmar load is placed over the capitate and the wrist is ulnarily deviated with a simultaneous axial load.

ECU subluxation test – tests for ECU subluxation. A (+) test is observed and palpated with ulnar and volar subluxation when the forearm is supinated, and the wrist is ulnarily deviated.

Finger extension test – tests for dorsal wrist syndrome. A (+) test is pain in the scapholunate region with resisted finger extension with the wrist in flexion.

Finkelstein’s test – tests for de Quervain’s tenosynovitis. A (+) test is pain localized to the radial aspect of the wrist when thumb flexion is combined with UD of the wrist.
First CMC joint instability/laxity test – tests for **1st CMC joint instability or laxity**. A (+) test is more laxity present when the 1st met is distracted and moved side to side or in a RU direction while the trapezium is stabilized versus on the uninjured side.

Grind test for the first CMC joint – tests for **1st CMC degenerative arthritis**. A (+) test is pain and crepitus with axial compression of the 1st met with rotation. This grinds the articular surfaces of the base of the 1st met and the trapezium.

Linscheid test – test for **2nd and/or 3rd CMC ligament injury or instability**. A (+) test is pain localized to the CMC joint area when the metacarpal heads are moved in a palmar and dorsal direction on one another.

**Metacarpal stress test** - tests for **CMC joint injury**. A (+) test is pain at the CMC joint when the MCP joint is fully flexed and the metacarpal is pronated and supinated.

Midcarpal shift test/catch-up clunk test /pivot shift test - tests for **midcarpal instability**. A (+) test is a painful clunk which reproduces the patient’s symptoms when a palmar load is placed over the capitate and the wrist is ulnarly deviated with a simultaneous axial load.

**Phalen’s test** – tests for **carpel tunnel syndrome**. A (+) test is numbness and tingling in the distribution of the median nerve with passive flexion of the wrist for 15 to 60 seconds. Generally bilateral wrists held in 90deg flexion with the hand dorsums touching.

**Piano key test** – tests for **DRUJ instability**. A (+) test is pain, tenderness, and increased mobility relative to the uninjured side when the distal ulna is grasped and moved passively in a volar/dorsal direction at the extremes of pronation and supination.

**Piano key sign** – tests for **DRUJ instability**. A (+) sign is pain when the distal ulna springs back after volarly directed pressure on the pronated distal ulna is released.

**Pisiform boost test** – tests for **ulnocarpal instability** or TFCC tear. Not as definitive as the TFCC load test or the Relocation test. A (+) test is pain, clicking, or crepitis when a dorsally directed pressure is applied over the palmar aspect of the pisiform, resulting in lifting of carpals into normal alignment.

**Pivot shift test/ catch-up clunk test/midcarpal shift test (Hunter)** - tests for **midcarpal instability**. A (+) test is a painful clunk which reproduces the patient’s symptoms when a palmar load is placed over the capitate and the wrist is ulnarly deviated with a simultaneous axial load.

**Alternative pivot shift test (Magee)** – tests for **injury to the anterior capsule and interosseous ligaments**. The arm being tested is placed with the elbow flexed to 90deg and the forearm in full supination. The elbow is resting on a firm surface while the
examiner stabilizes the forearm and positions the hand in straight plane radial deviation. A (+) test is if the capitate shifts away from the lunate when the examiner takes the hand into full ulnar deviation (maintaining straight plane motion).

Relocation test – tests for TFCC tear/ulnocarpal instability. A (+) test is pain reduction when the subluxed ulnar carpus is relocated. The combined movement of pronation, and anterior to posterior glide of the carpus on the ulna relocates the carpus into normal alignment–

Scaphoid thrust test – tests for scaphoid rotary subluxation. A (+) test is an apparent shift of the scaphoid when the examiner pushes dorsally on the scaphoid tubercle.

Scapholunate ballottement test – tests for scaphoid rotary subluxation. A (+) test is pain or increased motion relative to the other side when the scaphoid is moved in a volar and dorsal direction while the lunate is being stabilized.

Shear test (at lunate)– tests for LT instability. A (+) test is pain or clicking when the wrist is ulnarly and radially deviated with the lunate supported and the pisotriquetral complex is loaded in the anteroposterior plane.

Shear test (at pisiform)– tests for pisotriquetral arthritis. A (+) test is pain or crepitus when the pisiform is pushed or rocked into or around the triquetrum.

Tinel’s Test – tests for nerve compression and regeneration. A (+) test is pain and tingling radiating through the nerve’s distribution when the nerve is gently percussed.

TFCC load test – tests for TFCC injury and Ulnocarpal abutment. A positive test is pain, clicking, or crepitus and reproduction of the patient’s symptoms when the wrist is ulnarly deviated and axial loaded, and then moved volarly and dorsally, or the forearm is rotated.

Ulnar compression test - tests for DRUJ arthritis. A (+) test is pain with radially directed pressure on the ulnar head into the sigmoid notch of the radius with pronation and supination.

Ulnar snuffbox test - tests for LT instability. A (+) test is pain complaints are reproduced when lateral pressure is applied on the triquetrum in the sulcus distal to the ulnar head. The sulcus is formed by the ECU and FCU tendons.

Watson/scaphoid shift test – tests for scaphoid rotary subluxation. A (+) test is reproduction of the patient’s symptoms and usually a painful clunk when the examiner applies pressure over the volar prominence of the scaphoid as the wrist is moved from UD to RD with slight flexion.

REFERENCES


Hunter J, Mackin E, Callahan A: Rehabilitation of the Hand, ed V, Mosby, St Louis, 2002


An excellent on line reference for orthopedic pathologies is www.wheelessonline.com