DIFFERENTIAL DIAGNOSIS

Wrist and forearm
Pre-op assessment

Instability
Elbow Instability

- Acute dislocation
- Instability associated with fractures
- Chronic instability
  - Lateral collateral instability
  - Ulnar collateral instability

Ligaments

- Lateral ulnar collateral ligament:
  - Provides varus stability to Lateral HUJ in 0-140deg,
  - In PLRI: radial head subluxes posteriolaterally
Etiology PLRI

- Traumatic injuries
  - Simple dislocation (foosh with axial compression, supination and valgus strain)
  - Complex instability
- Often Associated with Coronoid and Radial Head Fractures
  - Terrible Triad Fx/Dlxn
- May Be Sequelae of Simple Dislocation

- Iatrogenic

- Tardy PLRI
  - Varus Malunion (rare)

PLRI

- Pathoanatomy: *three-dimensional displacement pattern*
  - Chronic instability pattern
    - Proximal radio-ulnar joint is stable
    - Ulna supinates away from humerus
    - Radius is along for the ride, subluxes posterior to capitulum
    - The abnormality is usually posttraumatic and presents with *locking, snapping, clicking, catching, and recurrent dislocation of the elbow*.

- MCL Usually Heals
- LUCL May Not
- Almost All Recurrent Instability
- Due to Failure of LUCL Complex to Heal
PLRI

- Primary restraint to posterolateral rotatory instability of the elbow is the combination of the lateral collateral and annular ligaments.

- The principal secondary restraints are the extensor muscles with their fascial bands and intermuscular septa.

PLRI Diagnosis

- Lateral elbow pain
- Weight bearing on hand elicits pain / inability to weight bear on extended wrist and elbow
  - Occurs with the Forearm Supinated and the Elbow Nearly Extended
  - Patients Feel Reduction At 30-40° Flexion While Pronating

- Palpate elbow (bilaterally to assess for excessive movement of radial head)
- Provocative test
  - Pivot shift
  - Drawer
  - Push up test
Push-up Sign

- Patient Does a Push-Up with the Forearms Supinated and the Arms Wider than Shoulder Width
- Positive = Apprehension /Symptom Reproduction occurs as the Elbow is Terminally Extended

Chair Sign/ Test

- Synonyms: Stand-up test.
- Position: seated in a chair with armrests.
- Patient rises from the chair using arms in supinated position
- Apprehension or dislocation on terminal extension of the elbow indicates PLRI.
Table-top relocation test

- Patient performs a press-up on the edge of a table using one arm, with the forearm in supination.

- In the presence of instability, apprehension occurs at about 40° flexion.
  
  The examiner’s thumb pressing on the radial head prevents displacement and relieves apprehension.

Posterolateral Rotatory Apprehension Test

- Synonyms: lateral pivot-shift test
- Elbow is supinated with mild force at wrist and a valgus moment is applied to elbow during a flexion movement.
- Patient feels apprehension and reproduction of symptoms.
- If under anesthesia can feel subluxation/reduction.
Lateral Pivot-Shift Test

- Supine position with forearm overhead and elbow extended.
- Shoulder abducted and externally rotated
- Elbow is then supinated with force and flexed to >40° with a valgus load applied.
- Positive result is palpable / visible clunk as the ulna and radius reduce suddenly.
- Best performed **under anesthesia**.

Pseudo-Valgus Laxity

- PLRI is Only Present with the Forearm Supinated

- True Valgus Instability due to MCL Attenuation is Present Regardless of Forearm Rotation

- PLRI = Apparent Valgus Instability in Supination that Resolves in Pronation
Physical Examination

- Pivot Shift Test (O'Driscoll)
  - Only Found in 38% of Awake Patients
  - 8/8 Patients Under GET
- Pseudo-Valgus Laxity
- Push-Up Sign
  - 87.5% (7/8) Sensitive
- Chair Sign
  - 87.5% (7/8) Sensitive
- Table top Relocation test
  - Table top relocation test--New clinical test for posterolateral rotatory instability of the elbow. Arvind CH¹, Hargreaves DG.

Differential Diagnosis

- Tennis Elbow
- Radial Tunnel Syndrome
- Radiocapitellar Disorders
  - Arthritis
  - Fracture
  - Plica
  - Avascular Necrosis (OCD)
- Referred Pain from the Shoulder
Osteochondral injuries

- OCD
- Chondral injury
  - Capitulum
  - Radial head
- Loose bodies

- These are results of valgus force associated with throwing
OCD

- Pathogenesis
  - Tenuous blood supply to lateral aspect of distal humerus in immature individuals
  - Valgus stress → Radiocapitellar joint compression → Arterial injury at subchondral plate → Osteonecrosis

- Early signs
  - Cartilage softening

- Later stages
  - Cartilage lacks support
  - Chondral separation
  - Cartilage flaps
  - Loose bodies
  - Synovitis / effusion

- Severe cases
  - DJD

OCD

- 1 degree of angulation affects subchondral bone
- 2 degrees angulation affects articular cartilage

- Eg: Knee / ankle in children/ adolescents with running / jumping
- In elbow: overhead athletes eg: baseball, racquet sports or gymnasts
OCD

Active Radiocapitellar compression test

Patient actively pronates and supinates the forearm in full extension causing compression at the radiocapitellar joint.

Positive test: reproduction of patient's symptoms.

Indicates: Capitellar OCD,

(Peterson R, ICL 1999;48:393)

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OCD

Elbow placed in 90 deg flexion

Examiner places one hand cupping the elbow with the fingertips directly over the radial head and lateral epicondyle

Examiner places the other hand in patients hand and exerts a compressive force through the radius while moving the elbow through a small range of flexion / extension, pronation / supination

Positive test: Pain at radial head and palpable grating
Radial tunnel
- Originates at the level of radiocapitellar joint

- Boundaries are
  - Medial border: Brachialis proximally and biceps tendon distally
  - Roof and lateral border: BR and ECRL proximally and ECRB distally

- Theoretical space
SITES OF COMPRESSION

• At elbow: The thickened fascial tissue: fibrous band of Radial capitellar joint (capsule)

• Below elbow: Tendinous margin of origin of ECRB

• Leash of Henry: impinges the nerve throughout the proximal portion of the tunnel

• Arcade of Frosh: Radial nerve lays underneath this semi circular arch at the proximal end of supinator ms.

• Supinator: 2 heads as it passes between it

• Distal edge of supinator

ARCADE OF FROSH
SURFACE ANATOMY

LIU ET AL 2009 (ADVANCES IN PHYSIOTHERAPY)

INCIDENCE

• Rare
  • 1%-1.2% - nontraumatic UE nerve entrapments
  • Higher incidence in women
    • Zager 2000
RISK FACTORS

• Repetitive trauma / micro trauma
• Occupational risk factors
  • Static pinching or squeezing of objects or tools
  • Working with the elbow extended
  • Maintained positioning of the forearm in pronation or supination
  • Repetitive forearm rotation
    • Roquelaure et al. (2000)

SIGNS AND SYMPTOMS RADIAL TUNNEL SYNDROME

• Pain (diffusely localized pain) from the lateral aspect of elbow
  • 4-5 cm distal to lateral epicondyle- dorsal side of forearm
• Sensory complaints and motor weakness have been reported but are not characteristic of this pain syndrome
• Symptoms worse after activity
• Vague dorsal wrist pain
• Heaviness / fatigue of the involved limb

• PIN syndrome
  • Motor symptoms only; transient pain if present
  • Weakness of digital extensors and ECU
RADIAL TUNNEL SYNDROME

- Affects only the sensory portion of the nerve; any weakness is secondary to pain (Barnum et al., 1996).
  - May be caused by intermittent and dynamic compression of the nerve in the proximal part of the forearm associated with repeated pronation and supination (Portilla Molina et al., 1998)
  - May also be caused by a lesion in the supinator muscle or in the septum between the extensor carpi radialis brevis and the extensor digitorum muscle (Verhaar and Spaans, 1991)

PIN SYNDROME

- Continuous or intermittent compression of the PIN in the radial tunnel (Konjengbam & Elangbam, 2004).
  - Affects the motor portion of the nerve, and therefore patients present with loss of motor function or even complete palsy of one or more muscles innervated by the PIN
  - Weakness and dysfunction is the primary symptom, not pain.
EXAMINATION

- Palpation for abnormal tenderness over radial tunnel
- Palpate 4-5cm distal to the lateral epicondyle with forearm in neutral

PROVOCATIVE TESTS

- Passive pronation to end range with elbow extended and wrist flexed (supinator stretching / tightening of fascial origin of ECRB)
- Resisted supination with elbow and wrist extended (test for Arcade of Froshe)
EXAMINATION

- Middle finger test (+) for radial tunnel (elbow extended and wrist neutral, pain over the radial tunnel)

- Radial tunnel: test middle finger then perform resisted repeated supination, then test middle finger again: weakness indicator of radial tunnel pathology

- ULT 2 RN bias
  - Depress shoulder extend elbow, hyperpronate, flex wrist and fingers

ACTIVE QUICK TEST – RADIAL NERVE
Patient supine
Therapist depresses the shoulder girdle

Elbow Extension
Whole arm internal rotation
Wrist and thumb flexion
Fingers left out
Therapists adds slight abduction of the shoulder
DIAGNOSTIC TEST

- Radial tunnel injection test
  - Complete relief of pain following a temporary block of the PIN with a 3-5 cc of local anesthetic.
  - With a successful block, the patient will have temporary paralysis of wrist and finger extension, but will have no further pain!
  - Any coexisting tenderness over the lateral epicondyle will still be present, which helps to differentiate the two disorders.

DIFFERENTIAL DIAGNOSIS

- Cervical Radiculopathy
  - C6 – C7 (Spurling’s Test)
- Lateral Epicondylitis
  - 5% coexist
  - **Site of pain**
- PIN
  - Motor deficits
- Radio-humeral Joint pathology
Lateral Epicondylitis

- Tendons that attach to the lateral epicondyle of the elbow are too tight or restricted, causing irritation/inflammation.
  - The two tendons originate at the lateral epicondyle (elbow) and insert in the wrist.
  - ECRL
  - ECRB
  - Finger extensors also originate at the elbow
- Too much stress is put on the tendons as they taper down to the bony attachment
Sports related etiology

- 30-60 years of age
- 50% recreational tennis players
- 2 times greater risk for patients who play tennis for over 2 hrs / week

EMG EVALUATION

- Ground strokes result in greatest ms activity of ECRL, ECRB and EDC
- Maximum impact during acceleration phase and early follow through

Lateral epicondylitis

- Microscopic tears with formation of reparative tissue on the lateral epicondyle
- Undersurface of ECRB tendon most hypovascular, seems to have most degenerative changes
- The natural history of this disease is 70-80% resolution at 1 year
Lateral Epicondylitis

- **History**
  - Lateral elbow pain
  - Just distal or at lateral epicondyle
  - Activity related
  - Insidious or sudden onset
  - Associated weakness
  - Progressive severity
    - Brushing teeth -> shaking hands -> picking a cup -> rest pain

- **Physical Exam**
  - Location and reproducibility of pain
  - Resisted wrist extension test
  - Resisted middle finger test

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Lateral epicondylitis tests

- **Mills Sign**
  - Passive elbow extension with wrist flexed and forearm pronated

- **Cozen test**
  - Resistive wrist extension with elbow extended and forearm pronated

- **Grip strength/weakness**
  - 35% less with elbow extended compared to flexed using dynamometer
  - *Baratz 1993*
Lateral Epicondyle Differential diagnosis

Radial Tunnel

Pronating the forearm to end range position with elbow in extension (supinator stretching, Fascial origin of ECRB tightens)

Resistance to supination (from a pronated position) increases pain (classic test for arcade of frosh)

Radio Capitellar arthritis

- Wolfe test
  - resistive wrist extension with distraction of radial head to rule out radial head pathology

- ECRB Ms shares fibers of EDC to 2nd and 3rd MC
- Thus test for 2nd / 3rd may be EDC or ECRB differentiated through resistive testing of 4th and 5th
## Differential Diagnosis

<table>
<thead>
<tr>
<th>SYNDROMES</th>
<th>Palpation</th>
<th>Test</th>
<th>Positive test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral Epicondylitis</td>
<td>Tenderness at or just distal to lateral epicondyle</td>
<td>Middle finger test Positive – pain over LE, Negative for other fingers</td>
<td>Passive pronation to end range with elbow extended, Pain rarely prevalent</td>
</tr>
<tr>
<td>Radial Tunnel Syndrome</td>
<td>Tenderness 4cm distal to LE</td>
<td>Middle finger test Positive-pain over RT</td>
<td>Passive pronation to end range with elbow extended, Pain present</td>
</tr>
<tr>
<td>PLRI</td>
<td>Lateral epicondylar pain</td>
<td>Pivot shift test</td>
<td>Feeling of giving way</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drawer test</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Chair test</td>
<td></td>
</tr>
<tr>
<td>Radio capitellar arthrosis</td>
<td>Tenderness at radial head</td>
<td>Active pronation / supination will result in pain</td>
<td>Pain with active movement</td>
</tr>
</tbody>
</table>
Wrist Zones

• Landmarks
• Dorsal:  
  – Radial styloid  
  – Lister's Tubercle  
  – Ulnar styloid  
• Palmar:  
  – Radial Styloid  
  – Pisiform  
  – Tubercle of trapezium  

• 3 dorsal zones  
• 2 volar zones

Dorsal Radial Zone: DeQuervains

• Etiology:  
  • Tendinosis of the sheath or tunnel  
  • APL & EPB  
  • Overuse injury / incorrect mechanics, pain with lifting  
  • Young mothers
DORSAL RADIAL ZONE: DEQUERVAINS

- Physical exam
  - Pain / tenderness over 1st dorsal compartment
- Finkelstein test
- Resistive thumb extension test

Dorsal Radial Zone: DeQuervains

- Superficial branch radial nerve
- Wartensburg syndrome
  - Courses radially around the forearm and supplies the dorsal aspect of forearm, hand and thumb
Dorsal Radial Sensory Nerve

- Superficial branch radial nerve
  - (+) tinels at the Wartensburg point of exit

Dorsal central zone: TENDONITIS

- 2nd dorsal tendonitis
- Etiology
  - Repetitive wrist extension
- Palpation:
  - Point tenderness over ECRL/B
- Test:
  - Pain with passive stretch and resistive extension of the wrist
Dorsal central zone – Intersection

- **Etiology**
  - Involvement of APL/EPB & ECRB/L proximal to dequervains area
  - It is a painful condition of the forearm and wrist.
  - 1st and 2nd dorsal compartment affected
  - Repeated wrist / thumb extension
    - weight lifters,
    - downhill skiers,
    - canoeists.

### DIFFERENTIAL DIAGNOSIS

<table>
<thead>
<tr>
<th>Condition</th>
<th>Symptoms</th>
<th>Sensory Test</th>
<th>Diagnostic Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dequervains</td>
<td>Pain over the 1st dorsal compartment</td>
<td>Negative</td>
<td>Finkelstien (+)</td>
</tr>
<tr>
<td>Warternburg's Syndrome</td>
<td>Dorsal radial aspect of hand</td>
<td>Positive Tinel's over the superficial Radial Sensory nerve</td>
<td>Finkelstein (-)</td>
</tr>
<tr>
<td>Intersection syndrome</td>
<td>Pain over intersection area i.e. distal radial forearm</td>
<td>Negative</td>
<td>Passive thumb flexion, radial deviation and combined wrist flexion</td>
</tr>
</tbody>
</table>
DORSAL CENTRAL ZONE

- **Etiology**
  - High velocity injuries
  - Hyperextension injury

- **History & Physical examination**
  - Wrist pain
  - Point tenderness over Lunate
  - Weakness in grip
  - Limited DF
  - Clicking
  - Increase in size or depression at lunate
  - Murphy sign
  - Gymnasts

- **Tests: Lunate: AP view**
  - Ulnar (-) variance

Dorsal Central Zone

- **Lunate:**
  - Kienbocks
  - Occult ganglion
  - Perilunate Fx/dislocation - CTS
  - Kienbocks: -Ulnar minus variance
**DORSAL CENTRAL ZONE: LUNATE**

- Kienbocks: Ulnar minus variance
- Treatment: Wrist cock up
- Surgery

**DORSAL GANGLION**

- Hand Overuse/ extension/ weight bearing
- Carpal swelling
  - No place for swelling to go
- Swelling pops out over capitate
  - Due to relief from capsule weak spot
Dorsal Ganglion

- Causes
  - Hypermobility or
  - Hypomobility
- If no return of fluid to source
- Synovial fluid “jells” definitely no return of fluid
- Activities like Yoga exaggerate it

Pea sized tender nodule

DORSAL CENTRAL ZONE: CMC BOSS
Dorsal Central Zone: CMC Boss

- Right hand (2:1)
- Between the third and fourth decades.
- Throwers wrist
- The mass may be asymptomatic, but the patient may complain of considerable pain and aching especially with end range dorsiflexion or with weight bearing
  - 2\textsuperscript{nd}/3\textsuperscript{rd} metacarpal= hypertrophic due to acute trauma/chronic sprain
- Bursal sac

Best visualized with the hand in 30 to 40 degrees supination and 20 to 30 degrees ulnar deviation ("carpal boss view").

Dorsal Ulnar Zone: DRUJ

- Etiology:
  - Trauma

- Physical examination
  - Active / passive Pronation/supination painful
  - Point tenderness DRUJ
DORSAL ULNAR ZONE: DRUJ

- Tests
  - Piano Key (in pronation / supination)
  - Ballotment (Linscheid 1993)
    Stabilize capus + active extension with forearm pronated
  - Increased movement compared to other side (+/-) pain

DORSAL ULNAR ZONE ECU

- The ECU in the 6th compartment is in a separate tunnel
  - Formed from the infratendinous retinaculum,
  - Separated from the supratendinous retinaculum by loose areolar tissue.
**ECU SUBLUXATION**

- The tendon assumes an obtuse angle directed medially during supination.
  - The apex of the angle is at the transition point between proximal dynamic stabilizer and the distal fixed stabilizer.

- This angle creates an ulnar directed stress during ECU muscle contraction that is accentuated by forearm supination and ulnar deviation.

**DORSAL ULNAR ZONE**

- Attrition of the ECU from stress induced tenosynovitis could be a source of chronic ulnar wrist pain.
  
  The deep fascial tunnel of the ECU can rupture, permitting subluxation of the tendon during forearm rotation.

Type A, failure of the ulnar leaf/attachment; type B, midsubstance or radial leaf failure; and type C, delamination or stripping of ulnar leaf from external way of sulcus.
Dorsal Ulnar Zone: ECU

- **Etiology**
  - Tendonitis
  - Subluxation

- **Mechanism**
  - ECU Tendonitis => repetitive supination, palmar flexion/ulnar deviation.
  - (office workers, rowing/ golfing)

- **Mechanism**
  - ECU subluxation => forced supination, palmar flexion, and ulnar deviation.
  - The ECU tendon is relocated with pronation

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Dorsal Ulnar Zone: ECU

- ECU palpated in its groove adjacent to the ulnar styloid.

- The ECU => prominent with wrist in supinated and ulnarly deviation.

- Recurrent painful subluxation => palpable snap when the forearm is actively supinated with the wrist flexed and ulnarly deviated.

- When stenosing tenosynovitis is present, the tendon is tender to palpation and swollen.

- Crepitus => swollen ECU subsheath.
DORSAL ULNAR ZONE: ECU

- **Physical exam**
  - **Tendonitis**
    - passive supination painful
    - resistance to dorsiflexion and ulnar deviation (+)
  - Synergy test(++)
  - **Subluxation**
    - Resisted Pronation / supination may cause subluxation

- **Synergy test**
  - Elbow flexed 90°; forearm in full supination; wrist neutral; fingers in full extension
  - 2. Examiner grasps patients thumb and middle finger and palpates the ECU tendon with the other hand.
  - The patient then abducts the thumb against resistance
  - 3. Presence of both ECU and FCU muscle contraction is confirmed
  - 4. Re-creation of pain along the dorsal ulnar aspect of the wrist is considered to be a positive test for ECU tendonitis

TFCC

- **Etiology**
  - Rich blood supply on the periphery
  - Dorsal & volar radiocarpal arteries
  - Periphery- intrinsic healing capacity
  - Central TFCC – poor vascularity
TFCC

- **History**
  - Twisting with palmar rotation
  - With marked ulnar deviation, compressive load on TFC, particularly w/ positive ulnar variance;
  - Forced ulnar deviance, such as batting a baseball, subjects the TFC to heavy loads

TFC Structure

- **Periphery**
  - Type I collagen: for **tensile** loading
  - Integrated with R-U ligaments
  - Well vascularized and innervated

- **Center**
  - Type II collagen: for **compressive** loading
  - Poorly vascularized and innervated

- **Disc**
  - is biconcave towards ulnar and carpus, middle is very thin
  - A hole can exist in the center of the disc
  - Incidence: hole : no hole
  - Adolescence 1:6
  - Elderly: 1:1 due to degradation, could lead to instability
Ulnar Variance

- Thickness of disc dependent on the state of ulnar variance
- Ulnar (+): Thin disc with increased compressive loads through the center of the disc
- Ulnar (-): thick disc with increased tensile loads through the disc

Clinical significance

- Peripheral rupture:
  - Source of pain
  - Can be repaired
- Center rupture:
  - Focus of degradation
  - Must be excised if torn

Dorsal Ulnar Zone- TFCC

- Physical examination
  - Stabilize carpus, forearm pronation + active pronation and supination
- Ulno-carpal abutment
  - Ulnar (+) variance
TFCC - Differential

- **What:**
  - Dull aching pain @ rest, sharp pain with movement especially pronation/ supination
  - Weakness with resistive tests
- **Where:**
  - Ulnar (TFC, ECU, DRUJ, UCL (VOLAR / DORSAL), ULNO CARPAL JOINT)
  - Location very reliable
  - Clamp Sign (TFC)
  - Diffuse ulnar sided (arthritis/ tenosynovitis)

- **When:**
  - Pain during lifting objects in *pronation* => TFC
  - Pain during lifting objects in *supination* => ECU
  - S/P high impact / trauma
  - Gymanists => microtrauma/ laxity
  - Volley ball, falls during sports undetected fx

TFCC

- **TFCC lesion typically localized**
  - If proximal/ with or without sensory complaints => Cubital/ TOS

- **Inspection**
- **Swelling**
  - Distal to ulnar head => TFCC
  - Longitudinal over ulnar head => ECU
  - Diffuse => arthritis of carpus

- **Atrophy**
  - Hypothenar eminence: Ulnar nerve entrapment
  - Dorsal 1st web space: Ulnar nerve involvement

- **Ulnar Head**
  - Location of distal prominence in relation to carpus
  - Increased prominence =>possible instability or TFCC affliction
  - In pronation how much does the carpus drop palmarly with respect to ulnar head
  - Ballottment test
Dorsal Ulnar Zone

- Mid-carpal instability
  - Pain / tenderness over ulnar side between triquetrum and hamate
  - Wrist sagging on the ulnar side
- Etiology
  - Trauma

Dorsal ulnar zone

Midcarpal instability

- Wrist sagging on the ulnar side
- Loading the capitate then moving to ulnar deviation = clunk
EXTENSOR TIGHTNESS

- Extensor tightness proximal to the wrist
  - To test: passively hold the digits in composite flexion while passively flexing the wrist. If the digits are pulled into extension as the wrist is passively flexed, extrinsic tightness proximal to the wrist exists. (note position of wrist when extensor tension is first detected to document stiffness)

- Extensors tightness distal to the wrist
  - To test: passively hold PIP and DIP joints in flexion and passively flex the MCP joint. If the PIP and DIP joints are pulled into extension when the MCP joint is passively flexed, extensor tightness distal to the wrist exists.

Treatment is learned in a few hours; Diagnosis takes a lifetime to learn -

Cyriax

Thank you