The Ulnar Side of the Wrist!

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1. Review anatomy & biomechanics of the ulnar side of the wrist
2. Explore the patho-mechanics following trauma to the wrist
3. Explore special tests to aid diagnosis
4. Brief review of therapy treatments
Non-traumatic wrist pain accounts for 58 per 10,000 referrals from 1° care per year.

Financial cost to 2° care:
- Number of referrals
- Investigations
- Treatment: Conservative & surgical
- Follow-up appointments

_Ulna sided wrist patients_ unlikely to be discharged within a year of start of referral.
27% likely to require surgery

Ref: Dean, BJF et al., Rheum. Advances in practice 7 July 2020

Management led by patient preference & clinical experience rather than evidence based information

Ref: Robba et al. JHS(Eur) 2019
Crossopterygia: Primitive lobe-finned fish
*Ulnar Side of the Wrist*

2 main areas:

Lunotriquetral Joint (LT)
Distal Radioulnar Joint (DRUJ)
Radioulnar Joints

Asymmetrical; Bi-condylar joint

2 convex articulations
2 concave articulations
Distal Radioulnar Joint

Anatomy:
Trochoid joint
Formed by:
Concave Sigmoid notch of Distal Radius
Convex seat of Ulnar Head

3 Planes of movement:
Longitudinal
AP-PA translation Rotation

Axis of Rotation:
Centre of Radial Head

Fovea origin Ulna Head:
Supination – Proximal palmar
Pronation – Distal Dorsal
*Biomechanics of DRU Joint*

**TENSEGRITY:**
“Synergy of tension & compression forces. Tension and compression are inseparable and coordinate functions of structural systems…{that} are mechanically stable not because of strength of individual members but because of the way the entire structure distributes and balances mechanical stresses”

Hagert, E; Hagert, CG. Understanding stability of the distal radioulnar joint through the understanding of its anatomy. *Hand Clinic 2010;26:459-466*
*Distal Radioulnar Joint*

**Osseous:** Sigmoid notch; Distal Radius; Ulna; Ulnar Carpus

**Soft Tissue:**

Triangular Fibrocartilage Complex (TFCC) includes:

1. Triangular Fibrocartilage (TFC)
2. Meniscal Homologue
3. Ulnotriquetral, Ulnolunate, Ulnocapitate ligts (Ulno-carpal ligament complex)
4. ECU & sub-sheath
5. Dorsal & Palmar Radioulnar ligaments (DRUL & PRUL)
6. Pronator Quadratus (PQ)
7. Interosseous membrane (IOM): Distal (DIOM)  
   Distal Oblique Bundle (DOB)
8. Capsule
Distal Radioulnar Joint

**Sigmoid Notch:**
Radius curve **TWICE** as big as Ulna Head.

**Ulna Styloid:**
Insertion for **SUPERFICIAL** fibres of DRU & PRU ligaments

**Ulna Fovea:**
Well vascularized.
Insertion for **DEEP** fibres of DRU & PRU ligaments
Triangularfibrocartilagenous Complex
“Iceberg Concept”

Tip: Distal component
Submerged: Proximal component

**DISTAL component:**
* UCLC
* Superficial DRU ligaments.
* Disc (Triangular Fibrocartilage – TFC).

*Function*: Suspend Ulnar carpus; Shock absorber; Load transmission

**PROXIMAL component:**
* Deep ligament

*Function*: Stabilizer of DRUJ & Ulnar carpus
1. Attachment of Deep Fibres of RUL
2. Attachment of Superficial fibres of RUL
3. Pre-styloid area of Fovea
4. ECU tendon sheath & periosteum
5. Extensor retinaculum of ECU
6. Distal Oblique Bundle of IOM
1. Dorsal Radioulnar ligament
2. Attachment of DEEP fibres
3. Palmar Radioulnar ligament
4. Palmar capsule of DRU joint
5. Distal Oblique Bundle
**TFCC: Radioulnar Ligaments**

3 layers of TFCC:

1\textsuperscript{st} Dorsal and Palmar Radioulnar ligaments (Superficial fibres)

2\textsuperscript{nd} Radio-palmar fibres to the periosteum & ECU tendon sheath
Radio-dorsal fibres to the palmar area of the ulna styloid

3\textsuperscript{rd} The deep fibre system
Paradox of Al Ekenstam & Schuind

Which part of the Distal Radioulnar Ligament Stabilises the Joint?

Altman, E et al (2016) JHT
Haugdtvedt et al (2017) JHS
Pronated & Supinated DRU Joint

**PRONATION:**

DORSAL superficial fibres
PALMAR deep fibres
tighten.

**SUPINATION:**

PALMAR superficial fibres
DORSAL deep fibres
tighten.
Ulno-carpal ligt Complex (UCUL)

1. Ulnocapitate Ligament
2. Ulnolunate Ligament
3. Ulnotriquetral ligament

**FUNCTION:**
- Suspends ulnar carpus
- Shock absorber
- Transmits load

4. TFC
5. Proximal Radioulnar Ligament
6. Deep part of PQ
7. Superficial part of PQ
* TFC

- Fibrocartilage
- Vascular on ulnar aspect, otherwise avascular

**Palmar Classification:**
- Class 1 Traumatic
- Class 2 Degenerative
## Palmar Classification

<table>
<thead>
<tr>
<th>Type</th>
<th>Where?</th>
<th>Stable/Unstable</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Avascular</td>
<td>Central disc (TFC)</td>
<td>Stable</td>
</tr>
<tr>
<td>1B</td>
<td>Vascular</td>
<td>Ulnar attachment TFC</td>
<td>Stable</td>
</tr>
<tr>
<td>1C</td>
<td>Ulnatriquetral/Ulnalunate ligaments detached</td>
<td>Unstable</td>
<td>Reattach</td>
</tr>
<tr>
<td>1D</td>
<td>Avascular</td>
<td>Radial attachment (TFC)</td>
<td>Stable?</td>
</tr>
<tr>
<td>2A</td>
<td>Perforation</td>
<td></td>
<td>Conservative</td>
</tr>
<tr>
<td>2B</td>
<td>2A + chondromalacia</td>
<td></td>
<td>Conservative</td>
</tr>
<tr>
<td>2C</td>
<td>Full thickness perforation</td>
<td></td>
<td>Conservative</td>
</tr>
<tr>
<td>2D</td>
<td>2a,b,c with Lunotriquetral Interosseous ligament tear</td>
<td></td>
<td>Ulna shortening</td>
</tr>
<tr>
<td>2E</td>
<td>2D + arthritis</td>
<td></td>
<td>Joint replacement</td>
</tr>
</tbody>
</table>
*ECU & ECU Sub-sheath*

1,2,3 UCLC complex
4. Meniscus Homologue
5. TFC
6. Dorsal Radioulnar ligaments

**ECU sheath** – Stabilizes DRU joint in neutral rotation.

7. ECU Tendon

**FUNCTION:**
Dynamic stabilizer in supination & forearm rotation.
Position of ECU exiting Sub-Sheath

Pronation

Supination Flexion
*ECU Sub-Sheath Tension*
*Pronator Quadratus*

1. Ulnocapitate Ligament
2. Ulnolunate Ligament
3. Ulnotriquetral ligament
4. TFC
5. PRU ligts.

**Pronator Quadratus:**
6. Deep Head
7. Superficial Head

**FUNCTION:**
Dynamic stabilizer
*Interosseous Membrane*

**Distal oblique bundle (DOB)**

**Thin Distal Interosseous membrane (DIOM)**

No DOB

**Origin:** Oblique from Ulna distally to Radius proximally.

Radioulnar ligaments & Interosseous membrane known as the **INTERGRATED OSSEOLIGAMENTOUS SYSTEM**
Function of Interosseous membrane:
- Transmits load from Radius distally to Ulna proximally
- Stabilizes DRU joint

Only 40% of patients will have a Distal Oblique Bundle (DOB)

**DIOM:**
2° stabilizer of DRUJ if RU ligaments injured.

**DOB:**
Stabilizer in neutral rotation: provides volar and dorsal stability.

**ISOMETRIC ACTION.**
## Summary of Biomechanics

What happens when soft tissues are injured?

Does wrist position alter stability?

<table>
<thead>
<tr>
<th></th>
<th>Neutral</th>
<th>Extension</th>
<th>Radial Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>7 mm</td>
<td>5 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>ECU cut</td>
<td>20 mm</td>
<td>21 mm</td>
<td>21 mm</td>
</tr>
<tr>
<td>Radioulnar ligaments injured</td>
<td>14 mm</td>
<td>12 mm</td>
<td>10 mm</td>
</tr>
<tr>
<td>Ulnocarpal ligament complex injured</td>
<td>7 mm</td>
<td>7 mm</td>
<td>6 mm</td>
</tr>
</tbody>
</table>

What happens when soft tissues are injured?

Does wrist position alter stability?
**Summary of Biomechanics**

**NORMAL DRU Joint:**

<table>
<thead>
<tr>
<th>40N Force Applied</th>
<th>Neutral Position</th>
<th>Supinated Position</th>
<th>Pronated Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Translation</td>
<td>7 mm</td>
<td>5 mm</td>
<td>6 mm</td>
</tr>
</tbody>
</table>

**TFCC & DOB injured?**

<table>
<thead>
<tr>
<th></th>
<th>Dorsal</th>
<th>Palmar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>3 mm</td>
<td>4 mm</td>
</tr>
<tr>
<td>TFCC injured</td>
<td>10 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>Distal Oblique Bundle injured</td>
<td>23 mm</td>
<td>17 mm</td>
</tr>
</tbody>
</table>
*Patho-mechanics of a fall*
ECU and a fall.....

Activity: Fall onto the hand
1. Muscle activity increases suddenly
2. Shock waves transmit distal to proximal up towards the shoulder
3. ECU & FCU work to reduce the strength of the shock waves

Heavy load: Shock waves increase
Bone # more likely

Less load: Shock waves increase
Soft tissue injury likely
Distal Radius & Instability

- Distal radius fracture with coronal shift (arrows show direction of reduction)
- Displaced bibasilar styloid fracture
- Absent “Push-Pull” (disrupted bony DRUJ articulation)
- Loosened DOB
- “Push-Pull” relationship restored

Axis of forearm rotation

TFCC

DOB (tensioned)
*Special Tests & Diagnosis!

Can’t see the wood for the trees......
1. DRUJ Ballottement test
2. DRU joint compression
3. Dynamic Instability test
4. TFCC Stress test
5. TFCC Compression test
6. Press test
7. Ulna Fovea test
8. ECU Synergy test
9. Ice Cream “scoop”
10. LTIL fovea test
11. Shuck Test (TFCC toggle)
12. Supinated Test
13. Piano Key
14. Grind test etc………………!!!
Key tests???

1. Modified Ballottement
2. Shuck (Toggle) test
3. Ulna Fovea
4. TFCC Compression test
5. Grind test

6. ECU Synergy test
7. Cobra test

8. LTIL Fovea
MODIFIED BALLOTTEMENT: +ve Pain +/- Increased movement
Forearm pronated
Fix the radiocarpal joint
Glide the Ulna AP-PA direction

**Increased glide +/- Pain:**
- Neutral = Radioulnar ligament injury
- Radial deviation = Ulnocarpal ligament injury

SHUCK (Toggle) TEST: +ve Pain at extreme e.o.r +/- Increased movement
Elbow on table
Fix radiocarpal joint: Test in Neutral
Rotate forearm **Full Supination:**
- Increased mvt = Injury DEEP dorsal fibres

**Full Pronation:**
- Increased mvt = Injury DEEP palmar fibres
- **ULNA FOVEA: +ve Pain**
  Palpate in Ulna fovea

- **TFCC +/- compression: +ve Pain**
  Ulna deviate wrist and glide ulna +/- axial compression through UC jt.

- **GRIND TEST: +ve Pain**
  Squeeze Radius and Ulna together

- **ECU SYNERGY TEST: +ve Pain with APL resistance**
  Elbow in table
  Therapist palpates ECU tendon
  Patient tries to palmar abduct thumb against resistance

- **COBRA TEST: +ve Painful click as ECU subluxes**
  Elbow on table
  Patient flexes wrist fully
  Therapist palpates ECU tendon as patient supinates and pronates

- **LT FOVEA: +ve Pain**
  Palpate in LTIL fovea
**TREATMENT OPTIONS**

**Strengthening:** ECU: UD & Extensor PQ

Triceps, the Rhomboids, and the Lats

*Avoid* bicep curls, push ups, pull ups, pull downs with the wrist supinated, and pectoralis (chest) strengthening

ECU: Ulnar deviator

ECU: Extensor

NEVER USE DUMBELLS!
Information for patients on self-management.
Stretches for cervical spine; shoulder, wrist.
Exercises for muscle imbalance in upper limb.

Information for medical professionals

Stabilizing exercise program in triangular fibrocartilage complex.
Ref: Bonhof-Jansen, EDJ; Kroon, GJ; Brink, SM; van Uchelen, JH (2019)
Rehabilitation with a stabilizing exercise program in triangular fibrocartilage complex lesions with distal radioulnar joint instability: A pilot intervention study.
Hand Therapy, July 11.
https://doi.org/10.1177/1758998319861661
Accessed 31/7/2020
EXERCISE EXAMPLES......
THE END
THANK YOU
FOR
TAKING PART
References

5. Folk, MWM; Fang, CX; Lau, TW; Fung, YKE; Fung, BKK; Leung, FRL (2018) The status of the Triangular Fibrocartilagenous complex after the union of distal radius fracture with internal plate fixation. *International Orthopaedics: 23.*


