TFCC Tears and Repair

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Introduction

• Tears of the TFCC are a common cause of ulnar-sided wrist pain
• Traumatic tears usually occur with an extension and pronation force to an axially loaded wrist
• Patients typically have pain with ulnar deviation and rotation of the wrist
Functions of DRUJ

- Distal link between radius and ulna
- Allows radius and attached carpus to pivot smoothly around ulna
- TFCC
  - major stabilizer of the DRUJ
  - provides suspensory mechanism for ulnar carpus
  - central articular disk is the load-bearing component of TFCC
  - allows transmission of axial load from carpus to forearm
Anatomy - The TFCC

Thanks to Rebecca Yu, MD
Anatomy - Soft Tissue

- TFCC (Triangular Fibrocartilage Complex)
  - Distal radioulnar ligaments
    - Palmar
    - Dorsal
  - Articular Disk
  - ECU Subsheath
  - Meniscal homologue
  - Ulnar collateral ligament
  - Ulnar extrinsic ligaments
Anatomy of the TFCC
Anatomy of the TFCC

- Dorsal and palmar radioulnar ligaments
  - Ulna fovea to palmar and dorsal margins of sigmoid notch
  - Ligamentum subcruentum: deep and strong vertical foveal insertion
Anatomy of the TFCC

- Fibrocartilaginous articular disk
  - Load transmission
  - Transitions to hyaline cartilage radially, does not insert into distal sigmoid notch
Anatomy of the TFCC

- **ECU sheath**
  - Arises from dorsal fovea
  - Distal radioulnar ligament splits to form the ECU tendon sheath
Anatomy of the TFCC

- Meniscal homologue
  - Ulnar leash of tissue sweeps distally from surface of articular disk to the triquetrum (90%) or triquetrum + lunate (10%)
Anatomy of the TFCC

• Ulnar Collateral Ligament
  – loose fibers passing from tip of ulnar styloid to triquetrum, pisiform, and articular disk
  – Resists radial deviation
Anatomy of the TFCC

- Ulnar extrinsic ligaments and LTIL
Anatomy - Blood Supply

Only peripheral 10-30% has a blood supply

Bednar, Arnoczky, Weiland, JHS 1991
Biomechanics

• **Force Transmission**
  – Typically 80% of compressive force from the wrist is borne through distal radius
  • 20% through ulna
Biomechanics

Force transmission changes with ulnar variance
+2 mm ulnar variance results in increase to
40% through ulna
Clinical Evaluation
Clinical Evaluation - History

• Fall on an axially loaded pronated wrist

• Pain with forced pronation or supination

• Pain with gripping in ulnar deviation
Clinical Evaluation- Physical Exam

• Fovea sign
  – Focal tenderness to palpation at ulnar styloid base

• TFCC stress test
  – Axial load, ulnar deviation, rotation

• Test for DRUJ stability (piano key & shuck test) in all positions - neutral, pronation & supination
Examination
Imaging

- Standard Radiographs
- “Zero Degree - PA”
  - Elbow flexed to 90°
  - Shoulder abducted to 90°
  - Hand flat on X-ray cassette
  - Standard for measuring ulnar variance
Imaging

- Ulnar Variance  PA
Ulnar Variance

Ulnar Positive Variance  Ulnar Negative Variance
Imaging - CT

- Visualizes:
  - Sigmoid notch depth
  - Congruency of ulnar head
  - Arthritic changes

- Both wrists should be scanned in:
  - Pronation
  - Neutral
  - Supination
Imaging - Arthrography

- Triple injection (DRUJ, radiocarpal and midcarpal)
- Useful for evaluating TFCC, SL and LT
  - Specific patterns of leakage observed with specific injuries
- Seldom performed
  - Many asymptomatic patients found to have degenerative tears
    - 42% sensitivity
    - 20% specificity

Chung KC, JHS 1996
Imaging - MRI

- Radial attachment of articular disk at sigmoid notch
- Articular disk
- Styloid insertion
- Foveal insertion
- Ligamentum subcruentum
Imaging - MRI

• ± MR Arthrography (Intra-articular injection)
• ± Indirect MR Arthrography (IV contrast)
• 1.5T: 85% sensitive
• 3.0T: 94% sensitive

Anderson et al JHS 2008, Faber et al JHS 2010
Imaging - Arthroscopy

- **Gold Standard**
- **Diagnostic as well as therapeutic**
- **Can detect TFCC tears as well as other pathology**
  - chondral lesions
  - other ligamentous injuries
- **TFCC Tears:**
  - Loss of resiliency to probing (Trampoline test)
  - Indirect visualization of a peripheral tear
    - Hyperemia along periphery
    - Tears of LT ligament
    - ECU sheath injury
Imaging - Arthroscopy
Imaging - Arthroscopy

- Trampoline Test
  - Ballottment of articular disk
TFCC Tears

- Classification of TFCC tears
  - Palmer, 1989
  - Traumatic
    - IA – central perforation - DEBRIDE
    - IB - ulnar/peripheral avulsion - REPAIR
    - IC – distal/volar avulsion - DEBRIDE
    - ID – radial avulsion - DEBRIDE
  - Degenerative
TFCC Tears

• Can result in isolated ulnar sided wrist pain as well as DRUJ instability

• Mechanism of injury:
  – Extension with pronation to axially loaded wrist
  – Can also occur with hypersupination

• More common in patients who are ulnar positive or neutral
  – Ulnar negative patients have thicker articular disks
TFCC Classification

Palmer’s Classification of TFCC Injuries

Class 1: Traumatic
Type A: Central perforation
Type B: Medial avulsion (ulnar attachment)
  With distal ulnar fracture
  Without distal ulnar fracture
Type C: Distal avulsion (carpal attachment)
Type D: Lateral avulsion (radial attachment)
  With sigmoid-notch fracture
  Without sigmoid-notch fracture

Class 2: Degenerative (ulnocarpal impaction syndrome)
Stage A: TFCC wear
Stage B: TFCC wear with lunate and/or ulnar chondromalacia
Stage C: TFCC perforation with lunate and/or ulnar chondromalacia
Stage D: TFCC perforation with lunate and/or ulnar chondromalacia and
  lunotriquetral-ligament perforation
Stage E: TFCC perforation with lunate and/or ulnar chondromalacia, lunotriquetral-ligament perforation, and ulnocarpal arthritis

TFCC Treatment

• History, clinical findings, and studies are all used to formulate a plan

• Non-operative management is the initial treatment
  – Unless there is gross instability
  – Immobilization in for 4-6 weeks may allow healing of a TFCC tear
    • 57% versus 43%
    • Acute peripheral tears would be expected to heal given their vascularity

• Otherwise, surgical intervention
  – Debridement vs repair
  – Based on location of tear
Palmer 1A Tear

- Central tear
- Unlikely to heal (avascular)
- May be debrided
  - up to 2/3 of disk without affecting load transfer
- Typically ulnar positive variance:
  - Consider ulnar recession (wafer) or shortening osteotomy
Palmer 1C Tear

• Usually treated non-operatively or with debridement
• If repair is necessary be mindful of ulnar artery and nerve in region whether repairing through scope or open
Palmer 1D Tear

- Controversial
- Little if any vascularity to area
- Open and arthroscopic (difficult) treatments report good outcomes
  - Scope:
    - Meniscal repair sutures used
    - Exit between 1st and 2nd wrist extensor compartments (radial sensory nerve)
  - Open:
    - Dorsal approach between 5th and 6th extensor compartments
- Simple debridement has satisfactory results
Palmer 1D Repair
Palmer 1B (Peripheral) Tear
Treatment Options for IB Tears

• Conservative
  – If DRUJ is stable
  – Long arm casting x 4-6 weeks

• Surgery
  – Open repair using bone tunnels
  – Mini-open repair using Mitek anchor
    • Chou & Sotereanos (2003)
  – Exogenous fibrin clot
    • Whatley & Arnoczky (2000)
Open vs Arthroscopic TFCC Repair: What’s the Evidence?

- Anderson and Berger, et al. (JHS 2008)
  - 75 patients over 10 years
  - 36 arthroscopic, 39 open
  - Mean f/u: 43 months
  - **NO** significant differences in objective and subjective outcomes
  - Non-significant trend toward increased ulnar nerve irritation with open repair
  - 17% total reoperation rate for DRUJ instability
    - 8 open, 5 arthroscopic
### Comprehensive Classification of TFCC Peripheral Tears and associated Ulnar Styloid Fractures

<table>
<thead>
<tr>
<th>CLASS 0</th>
<th>CLASS 1</th>
<th>CLASS 2</th>
<th>CLASS 3</th>
<th>CLASS 4</th>
<th>CLASS 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated styloid fracture without TFCC Tear</td>
<td>Distal TFCC Tear</td>
<td>Complete TFCC Tear</td>
<td>Proximal TFCC Tear</td>
<td>NON-repairable TFCC Tear</td>
<td>DRUJ Arthritis</td>
</tr>
</tbody>
</table>

#### Clinical Findings

- **DRLJ Ballottement Test**
  - Negative
  - Slight Laxity (Hard end-point)
  - Mild to Severe Laxity (Soft end-point)

#### Radiographic Findings

- Intact Ulnar Styloid or Tip Fracture of the Ulnar Styloid
- Basilar Fracture of the Ulnar Styloid

#### Artthroscopic Findings

- Appearance of the Distal TFCC (during RC Arthroscopy)
  - Normal Appearance (NO tear)
  - Peripheral Tear
  - Normal Appearance (NO tear)
  - Massive Tear Degenerated Edges
  - Frayed Edges Failed Suture

- Tension of the proximal TFCC (Hook Test)
  - Taut TFCC (Negative Hook Test)
  - Loose TFCC (Positive Hook Test)

- Cartilage status of DRLJ
  - Well preserved Cartilage
  - Degenerative or Traumatic Cartilage Defect

#### Suggested treatment

- Splitting for pain relief (Fragment removal in chronic painful cases)
- TFCC Suture (Splitting of acute cases)
- TFCC Forveal Refixation
- Styloid fixation
- Tendon Graft Reconstruction
- Arthroplasty
Open Repair
Treatment Options for IB Tears

- Arthroscopic repair
  - Outside-inside using meniscal repair needles
    - Whipple & Geissler (1993)
    - Knot tied over a button
    - Knot tied under the dorsal/ulnar skin
Treatment Options for IB Tears

- Arthroscopic Repair, cont
  - Inside-outside using meniscal repair needles
    - Trumble (1996)
  - Inside-outside using a Tuohy needle
    - Araujo & Poehling (1996)
  - All-arthroscopic
Arthroscopic-Assisted Repair
Disadvantages of Current Techniques

• Extra/larger incision
• Prominent subcutaneous suture knots
• Patient intolerance of buttons
  – Painful, unsightly, malodorous, skin changes
  – Septic arthritis
• Possible nerve injury
Introduction

• All-Arthroscopic Method of Repair
  • Yao et al, Arthroscopy, 2007

A Novel Technique of All-Inside Arthroscopic Triangular Fibrocartilage Complex Repair
All-Arthroscopic TFC Repair

• Pretied suture device
• Designed for knee meniscal repair
• New technique for the use in TFC repairs
• Potential for Decreased:
  – Operative time
  – Incisions
  – Prominent suture knots
• Increased
  – Efficiency
  – Safety
  – Strength
Biomechanical Strength and Safety Study

- 10 matched fresh-frozen cadaveric wrist specimens
- Iatrogenically produced peripheral TFC tears
- Experimental group:
  - Two pretied suture devices in vertical configuration
- Control group:
  - two outside-in 2-0 PDS sutures in vertical configuration (ala Whipple/Geissler)
- Location of implants relative to the N/V structures
- Instron MTS
  - specimens loaded to failure
Ulnar Dissection

Whipple/Geissler (PDS)
Distance from UNB: 1.9 cm
Distance from DBUN: 4.6 mm

Suture Device
Distance from UNB: 1.8 cm
Distance from DBUN: 17.1 mm
Biomechanical Study
Biomechanical Strength of Repair

Figure 3: Load to failure of Suture Device versus 2-0 PDS (*p<0.05)

Yao, JHS, 2009
Arthroscopy Set-Up
Portals

ECU over ulnar head

Lister’s tubercle

6-R

3-4

EPL
Arthroscope in 3-4
Probe in 6R
Insertion of Suture Device
Arthroscope in 6R
Suture device in 3-4
Pre-Repair

Arthroscope in 3-4

Probe in 6R

Post-Repair
Clinical Experience

- Retrospective Review 2005-2009
  - One hand surgeon
  - Patients with persistent ulnar-sided wrist pain despite immobilization and injections
  - MRI consistent with TFC tear
  - No concomitant DRUJ instability
Methods

• **Objective data:**
  - range of motion
  - grip strength
  - return to activity
  - post operative complications

• **Subjective data:**
  - *quick*DASH
  - PRWE questionnaires
Results

- 14 patients
- Mean f/u: 16.1 months
- Supination: 81 (+/- 13.1)
- Grip strength: 66% (+/- 13.8)
- quickDASH: 10.2 (+/- 11.4)
- PRWE: 18.8 (+/- 13.5)
- Mean time to full activity: 5.2 months
- 0 surgical complications
Conclusion

• All-arthroscopic repair of peripheral TFC tears show excellent short term results
  – 1 year followup, 93% achieved excellent subjective outcomes based on quickDASH and PRWE

• Benefits of this technique are
  – ease of use
  – lack of prominent suture knots or button
  – no extra incisions
  – safety
  – strength of repair
    • reduced immobilization from long arm Munster cast (6 wks) to short arm cast (4 wks)
Thank You!