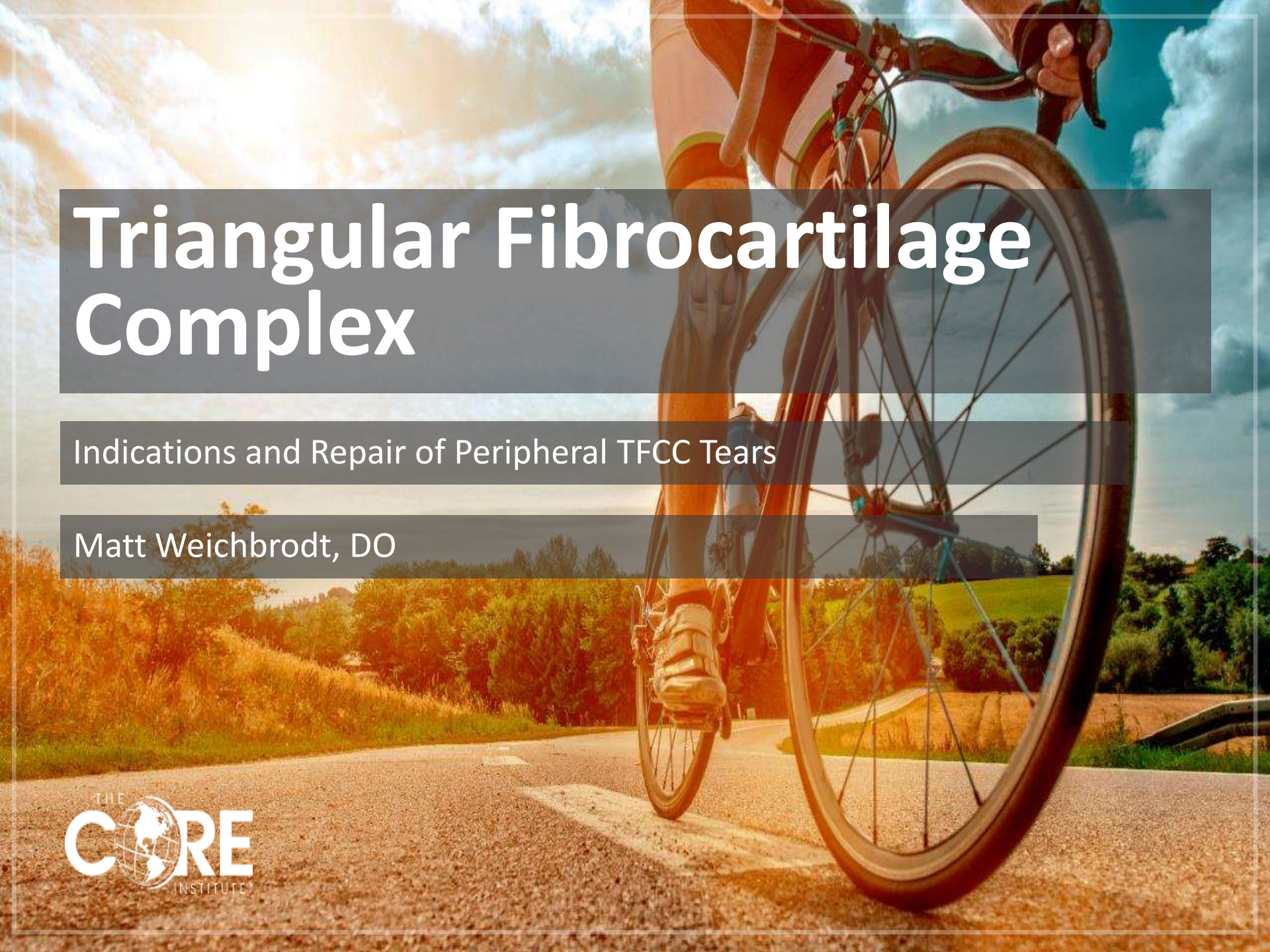


Triangular Fibrocartilage Complex

Indications and Repair of Peripheral TFCC Tears

Matt Weichbrodt, DO

THE CORE INSTITUTE

No Disclosures

THE CORE INSTITUTE
Center for Orthopedic Research and Education®

Objectives

Determine indications and treatment options for peripheral TFCC tears

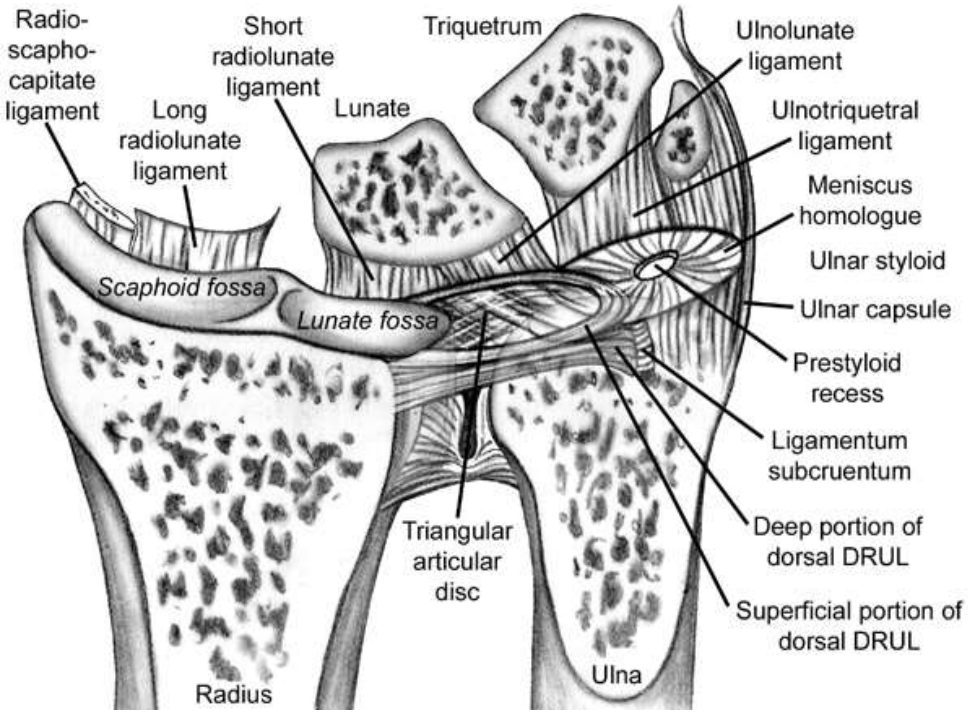
What is the TFCC?

Triangular Fibrocartilage Complex (TFCC) is both a ligamentous and cartilaginous structure that suspends the distal radius and ulnar carpus from the distal ulna.

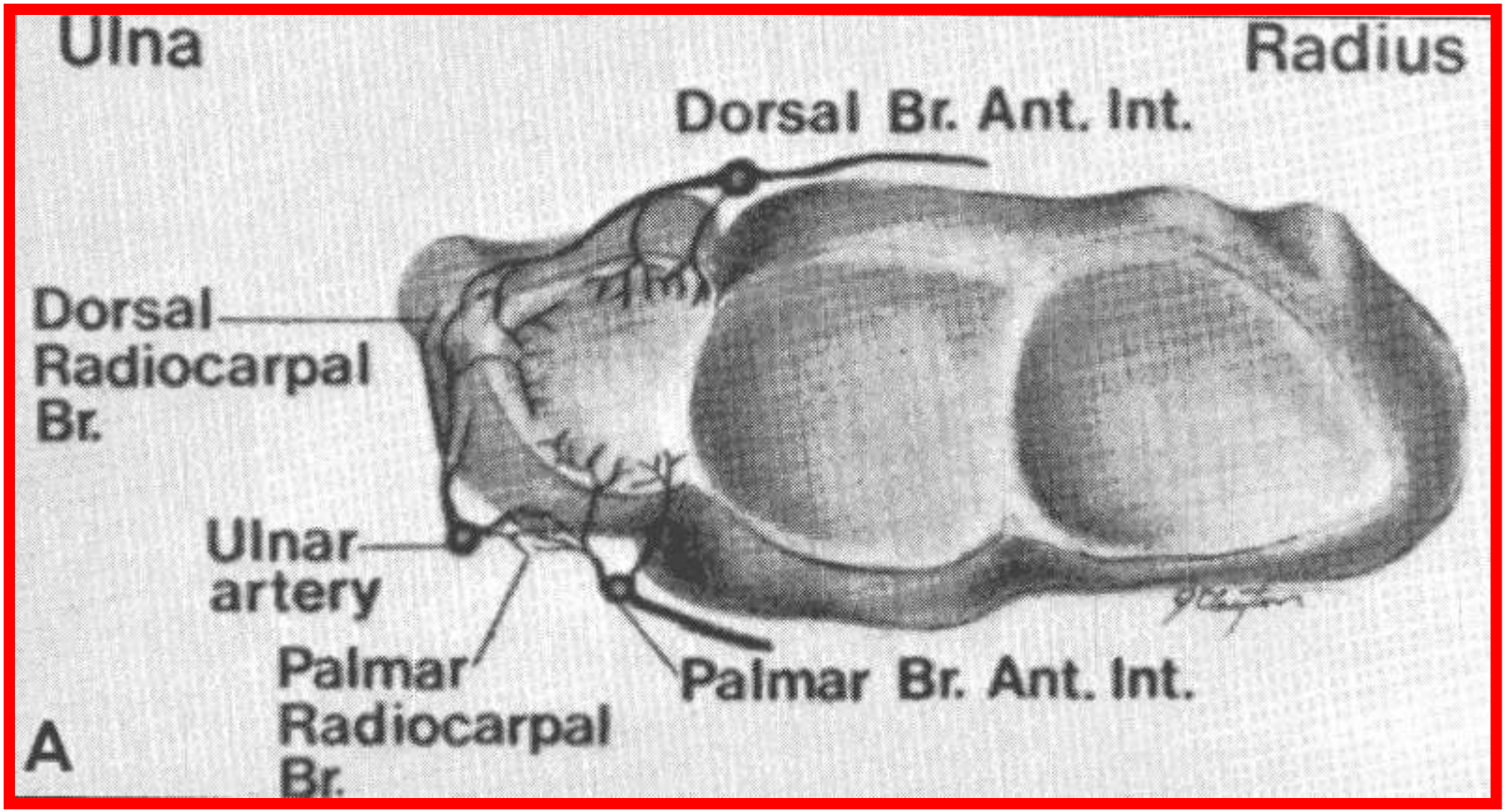
- It arises from the sigmoid notch of the radius and inserts onto the base of the ulnar styloid (Fovea).

Anatomy (Palmer ‘81)

- Dorsal and Volar Radioulnar Ligaments
- Ulnar Collateral Ligament
- Meniscus Homologue
- Articular Disk
- Extensor Carpi Ulnaris
- Ulnolunate/Ulnotriquetral ligaments
- Lunotriquetral Ligament



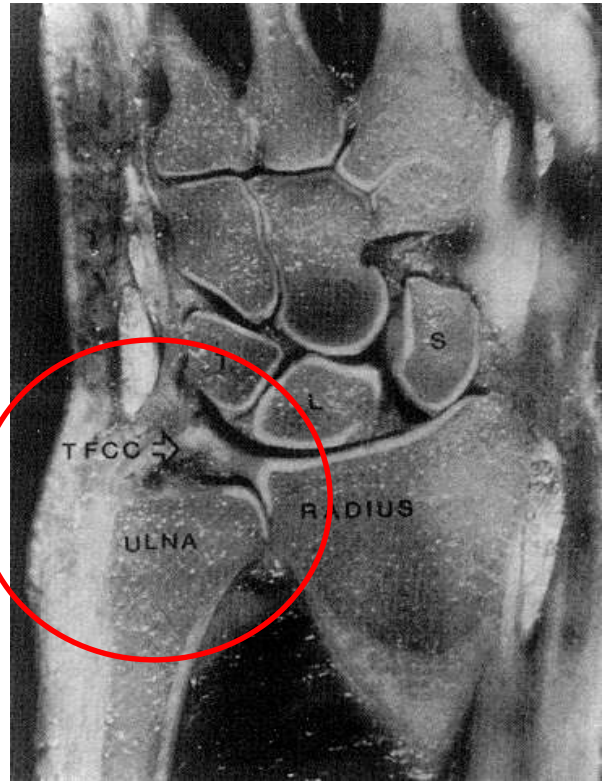
TFCC Vascular Anatomy



Central 80% of TFCC is avascular

TFCC Functions

- Central cartilaginous surface (compressive zone)
- Rotational forearm stabilizer
- Suspension of ulnar carpus (tensile zone)
- Transmission of Axial load
  - 20% of wrist
  - 2.5mm ulnar + increases to 40%



Patient History: TFCC injury

- Typically skeletally mature active patient
- Report an acute rotational injury or ulnar load
  - Often sports/work related
- Recurrent ulnar sided wrist pain/tenderness
- May describe a feeling of ulnar instability
  - Clicking/locking/popping
- Loss of strength may lead to difficulty with daily activities: twisting a jar lid or door knob, turning a screwdriver or steering wheel, lifting objects

Physical Examination

- Site of localized foveal tenderness (ballotable area between the triquetrum and ulnar styloid)
- ROM (painful forearm rotation)
- Pain at extremes of range of motion (passive ulnar deviation and radial deviation against resistance)
- Pinch/Grip strength decreased
- Pain with lift off test
- DRUJ Instability

Diagnostic Imaging

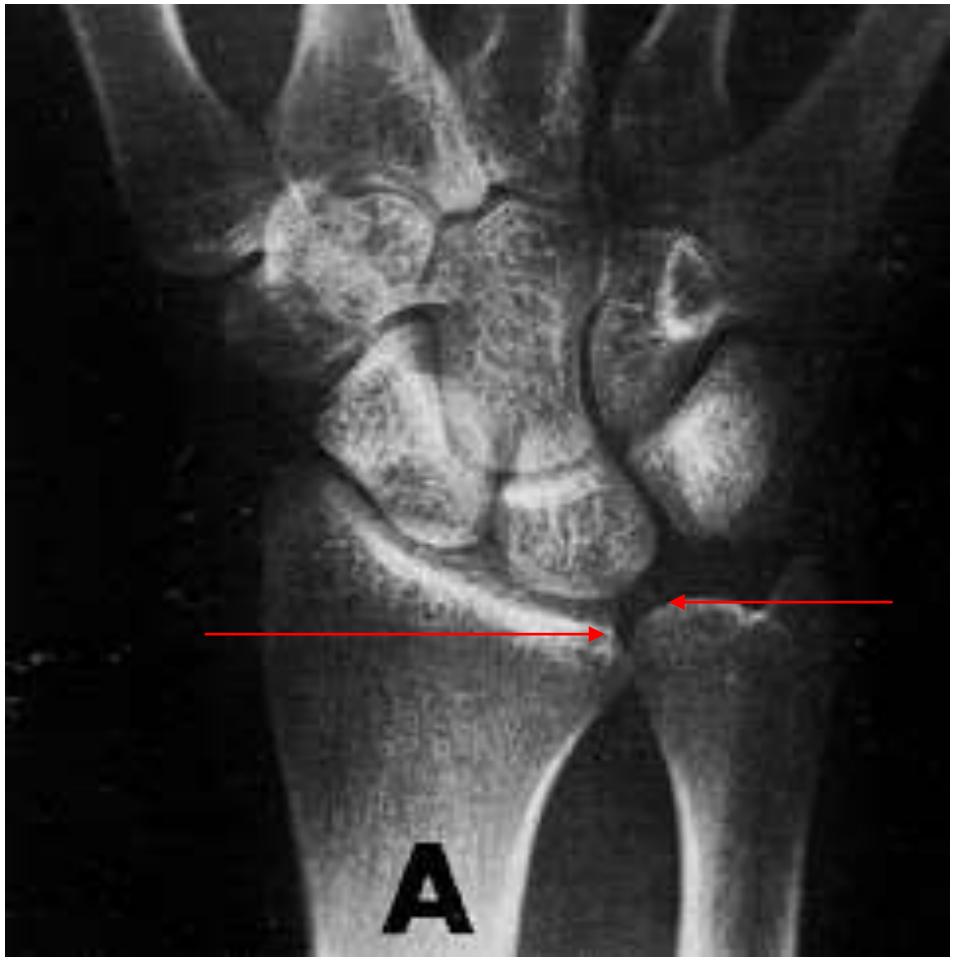
- Start with plain films
  - PA, lateral, oblique, pronated grip view
- CT Arthrography
- MRI ± Arthrogram
  - CTA and MRA meta-analysis found equivalent sensitivity/specificity (J. Wrist Surg. Treiser et al. 2018)
  - MRI/MRA meta-analysis for dx of TFCC tears (JBJS. Smith et al. 2012)
    - MRI sens:0.75 and spec:0.81
    - MRA sens:0.84 and spec:0.95

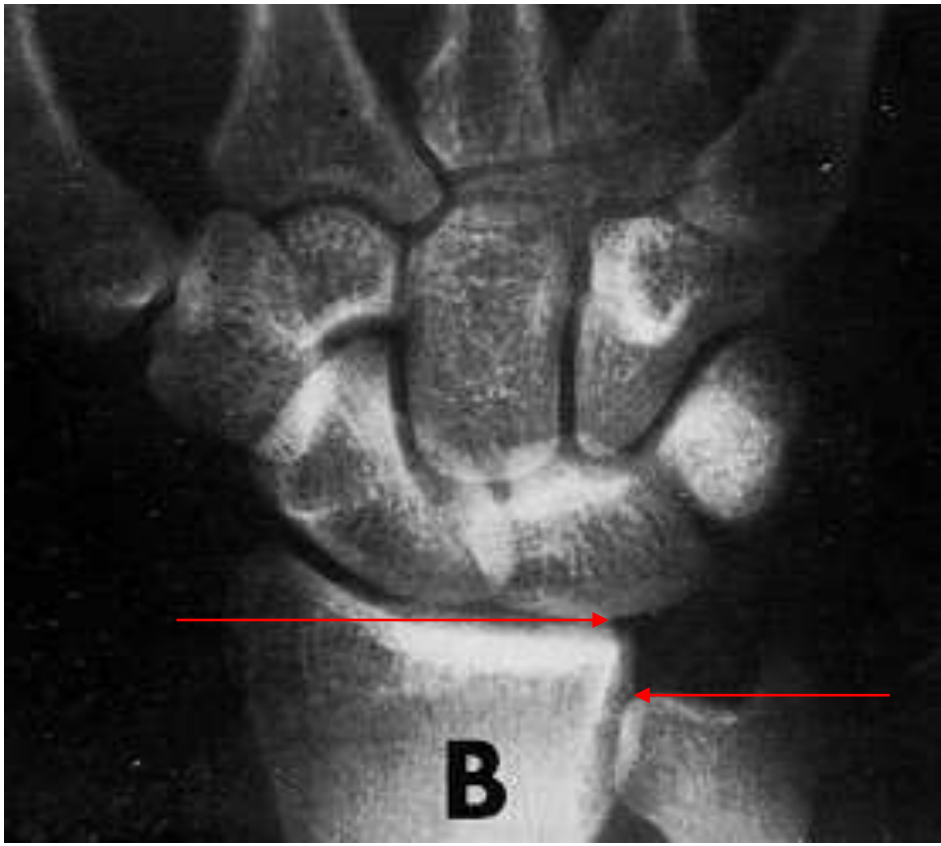
Ulnar deviation

Neutral

Radial deviation

Ulnar Variance





Ulnar Variance: Does is matter?

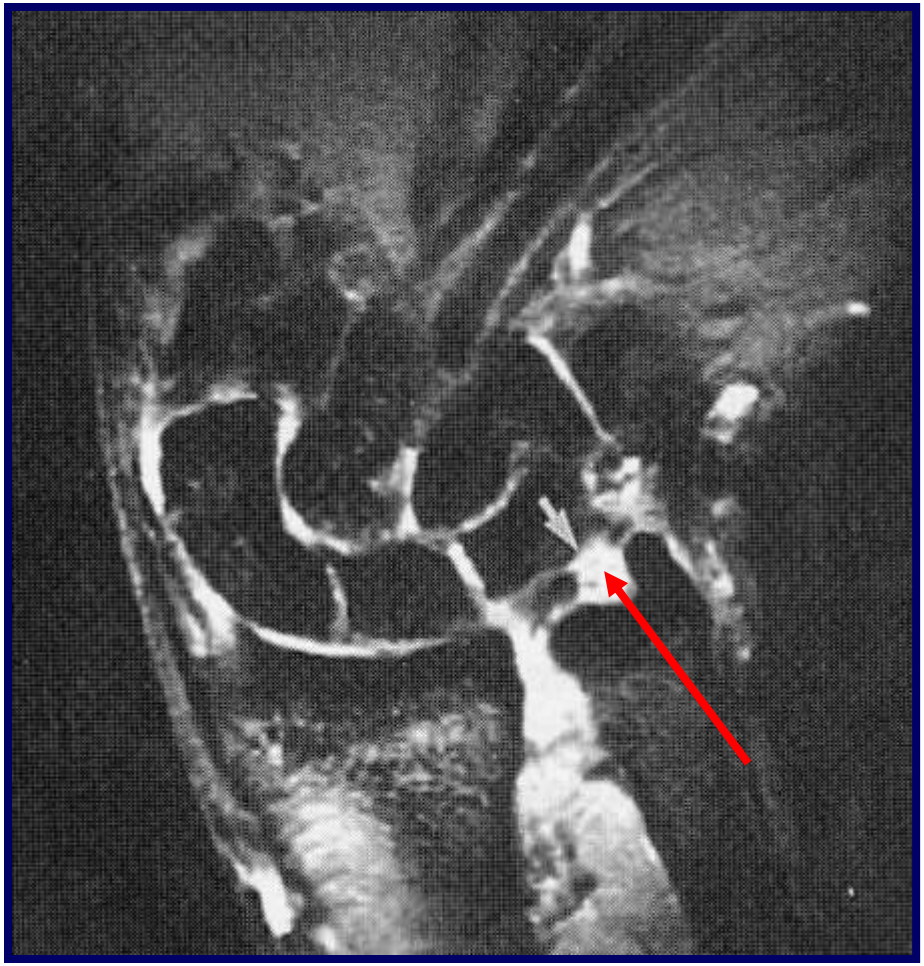
- 73% of TFCC tears occur in ulnar neutral/positive
- Biomechanical studies have demonstrated that shortening the ulna by even 2.0 mm dramatically decreases the force transmitted to the ulna by the carpus

Wrist Arthrography

TFCC Tear

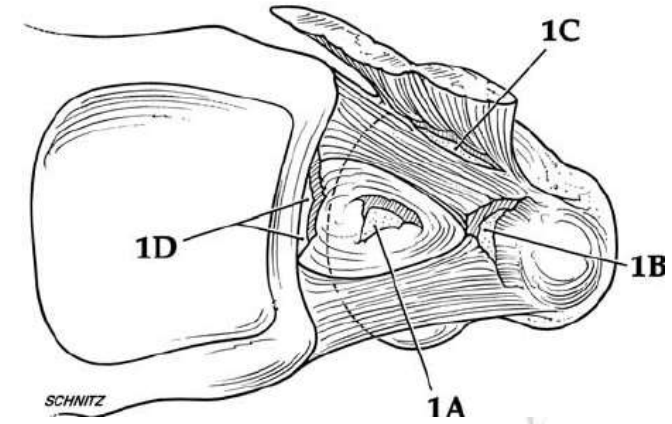
MRI

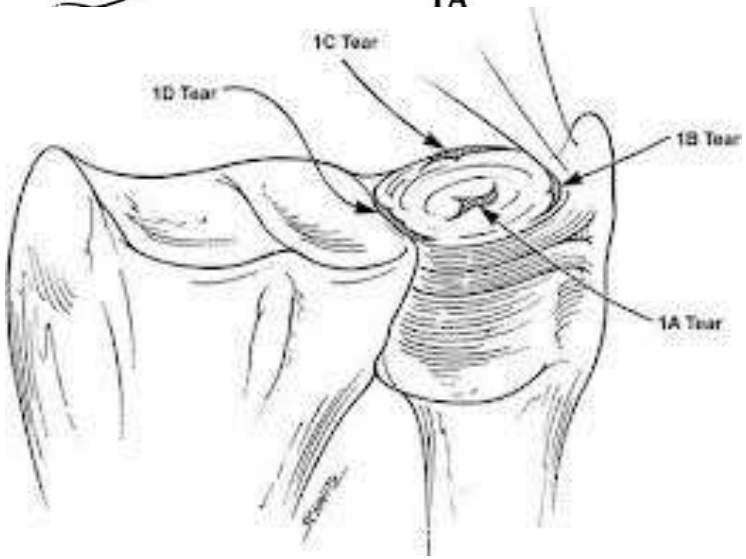
Peripheral TFCC Tear



Palmer Classification:TFCC Tears(JHS 1989)

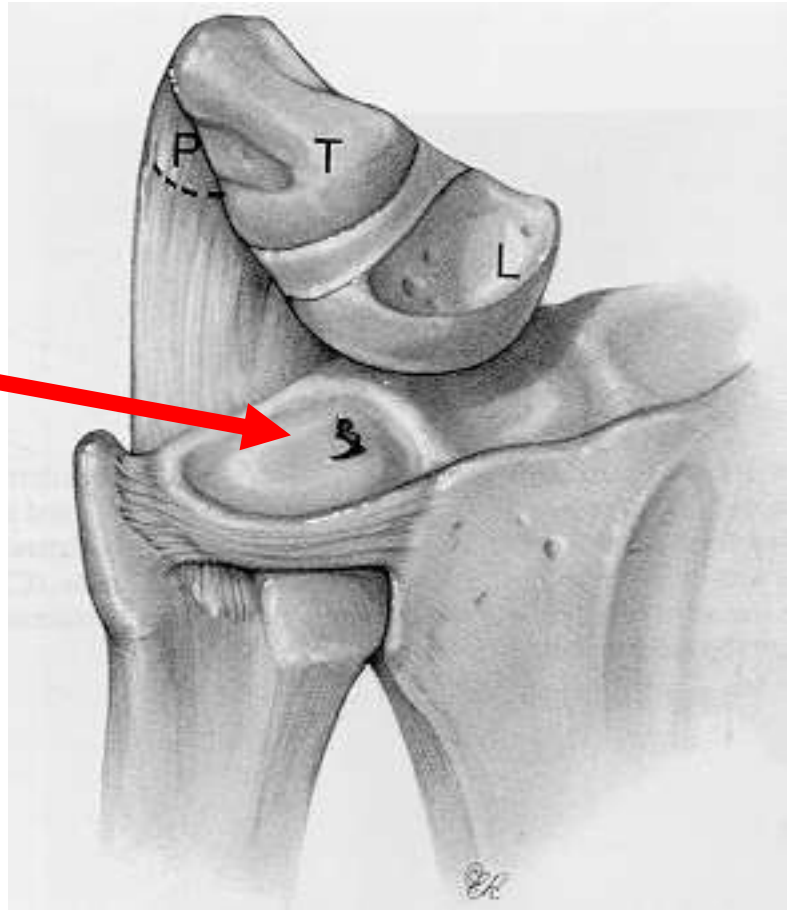
- Traumatic (Class 1)
  - fall on outstretched extremity
  - hyper rotation of forearm
  - 4 injury patterns
- Degenerative (Class 2)
  - “Ulnar Impaction Syndrome” - repetitive loading
  - 5 stages of injury





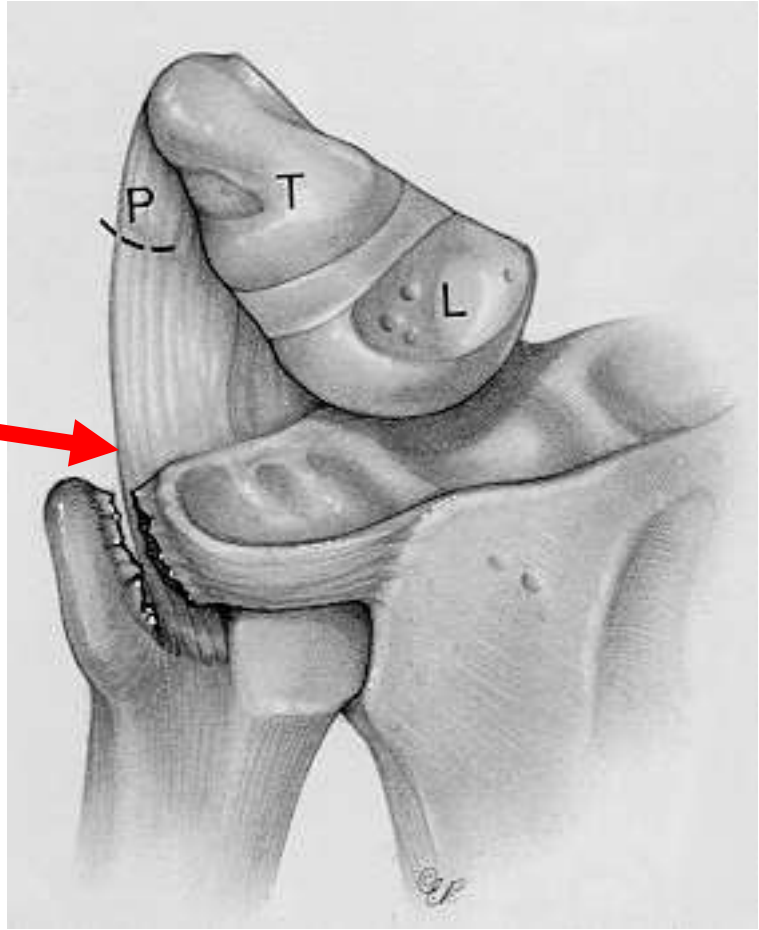
TFCC Injury: Class 1A

central perforation



TFCC Injury: Class 1B

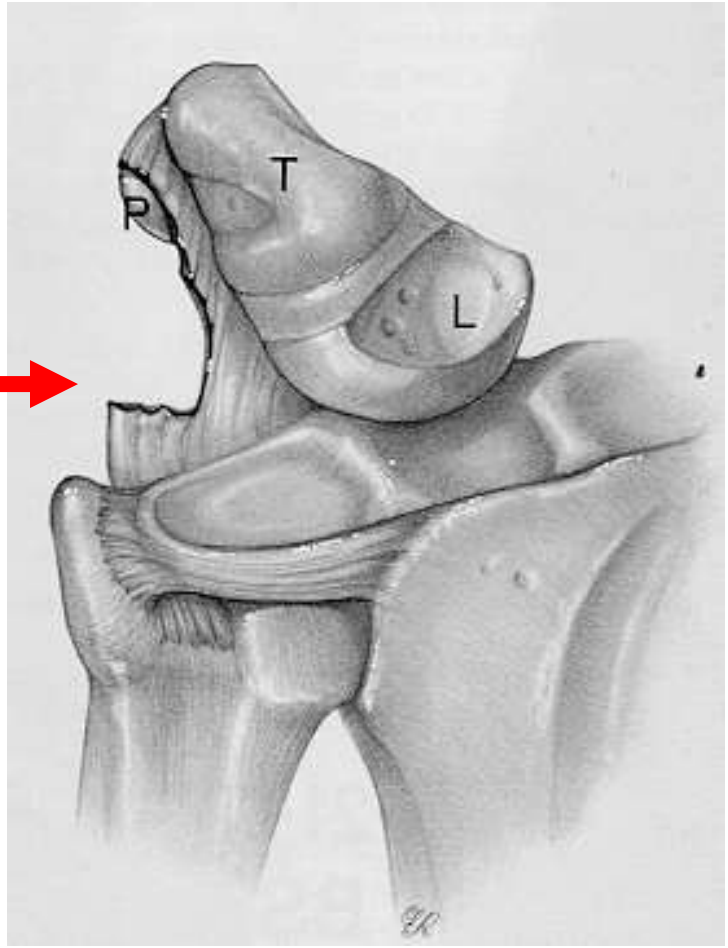
TFCC avulsion from distal ulna



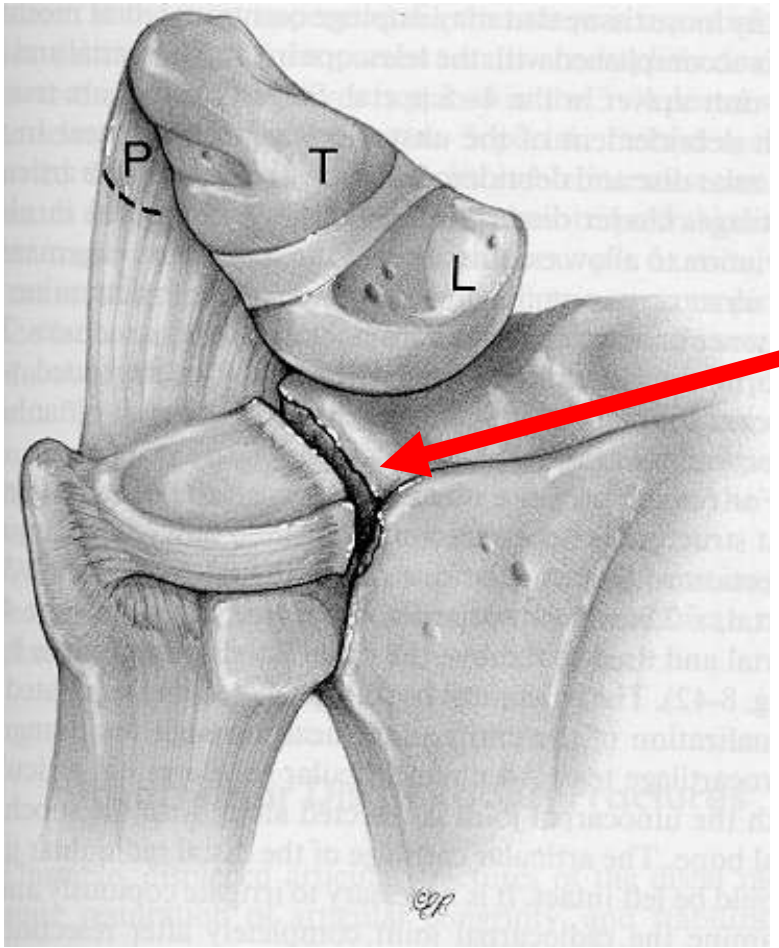
*May be associated with a distal ulna fracture

TFCC Injury: Class 1C

Distal avulsion of TFCC from triquetrum (or lunate)



TFCC Injury: Class 1D



Avulsion of TFCC radial attachment

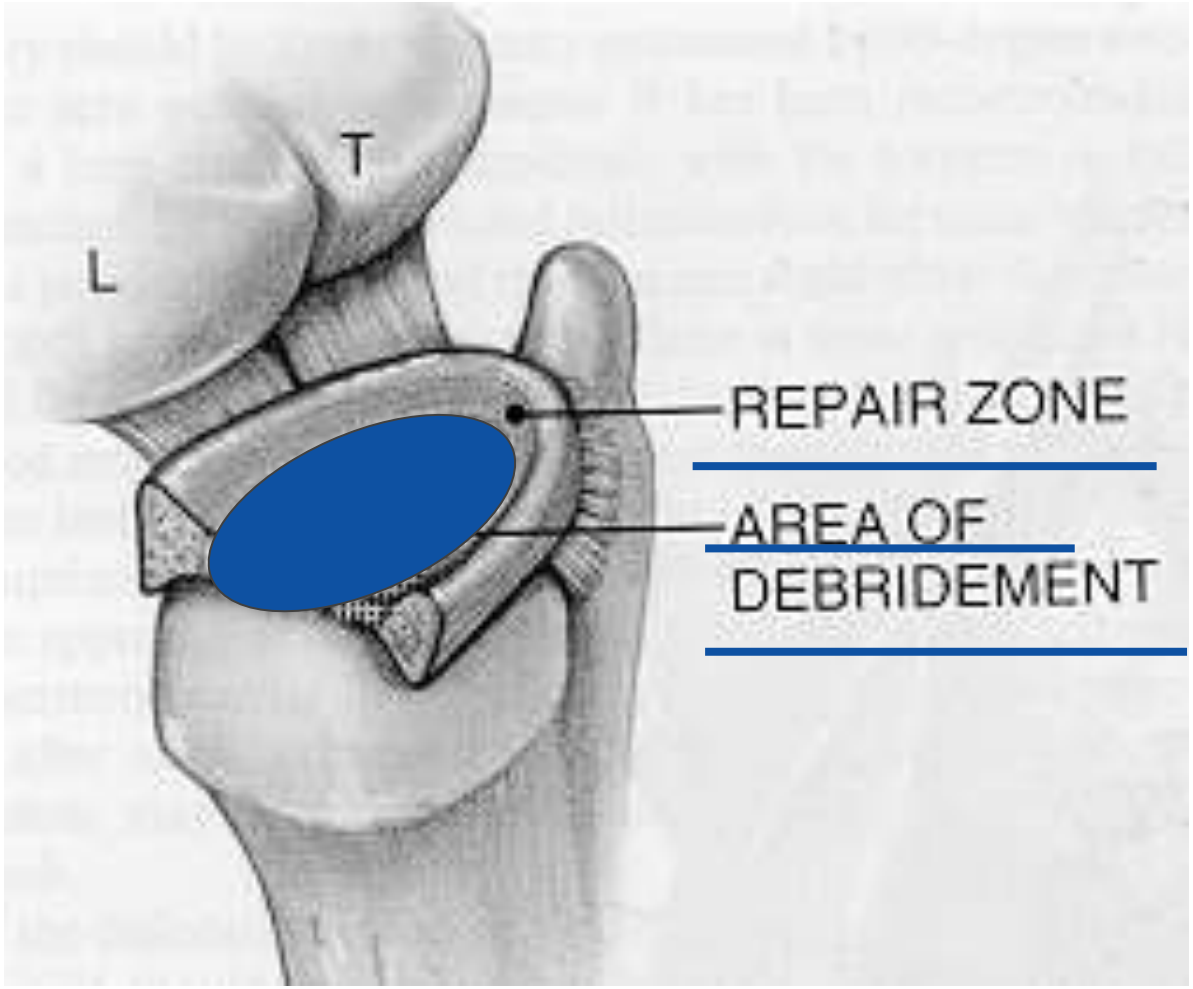
± sigmoid notch fracture

Treatment: Class 1B Injuries

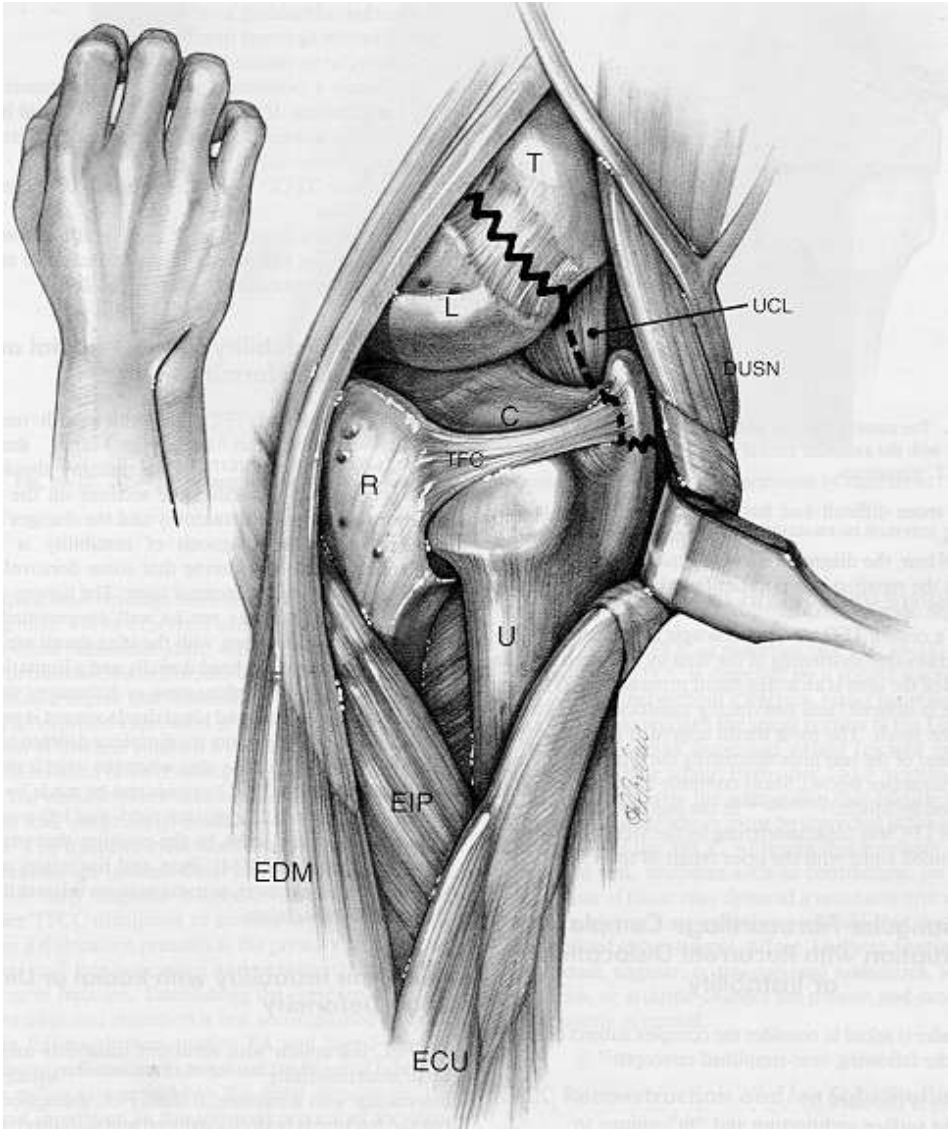
- Begin with conservative care
  - immobilization, long arm cast or splint (Munster)
  - NSAIDS
  - steroid injections
- Surgical Indications
  - Failed conservative Tx
    - 3-4 months

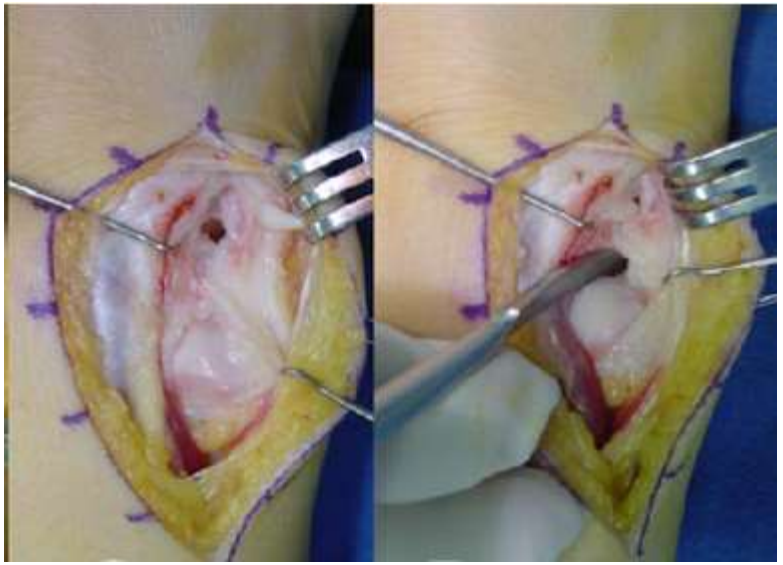
Open vs Arthroscopic

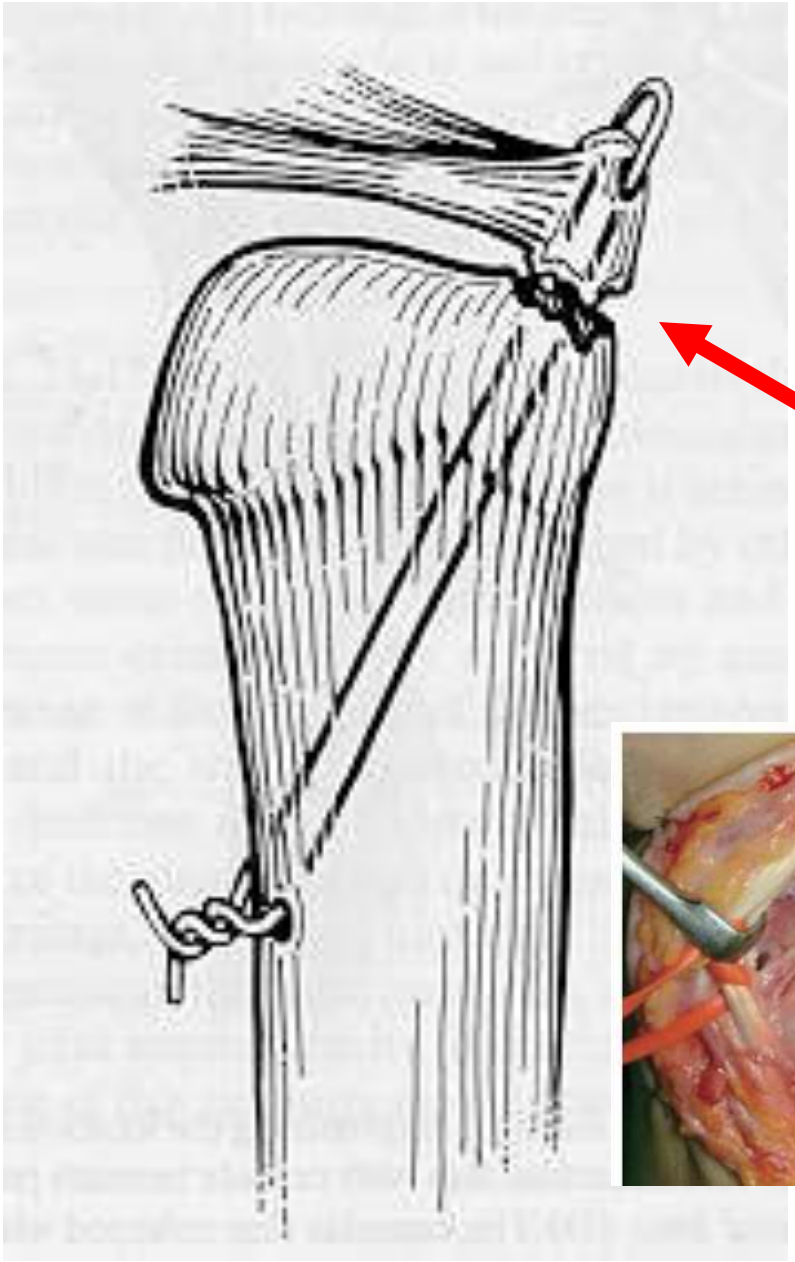
Palmer Classification: TFCC Tears



Open Repair



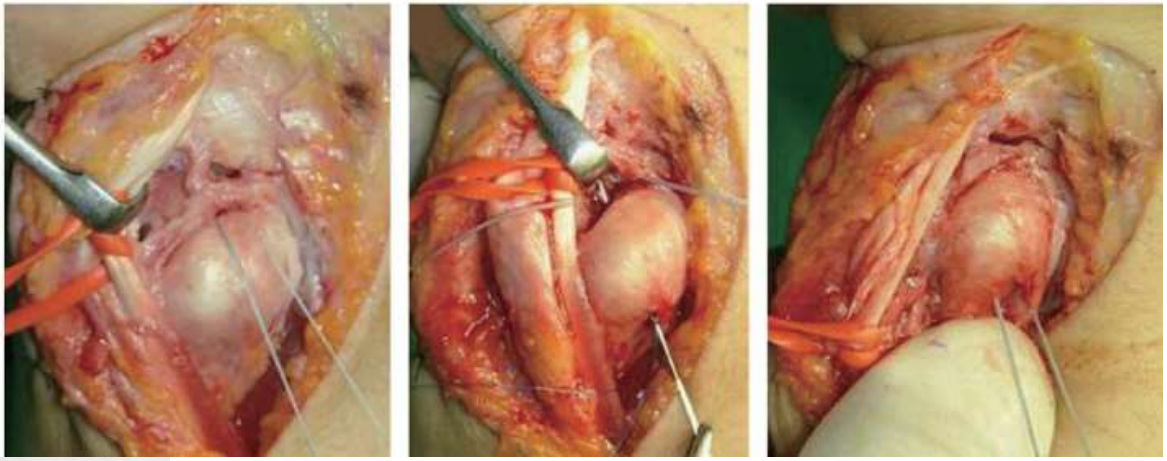




Class 1B

Open TFCC Repair

Intraosseous
wire/Suture Anchor



Palmer 1B: Open Repair

- Proponents: Able to achieve direct foveal repair of the TFCC
- Good Results with Open Repair
  - Nakamura et al. Tech Hand Up Ext. 2004.
  - Chou. Int Orthop. 2001
  - Cooney et al. JHS. 1994
- Complications
  - ECU tendonitis, Ulnar sensory neuritis/injury, Decrease ROM and Grip strength, DRUJ Instability, Progressive degenerative changes…

Why Arthroscopic Repair?

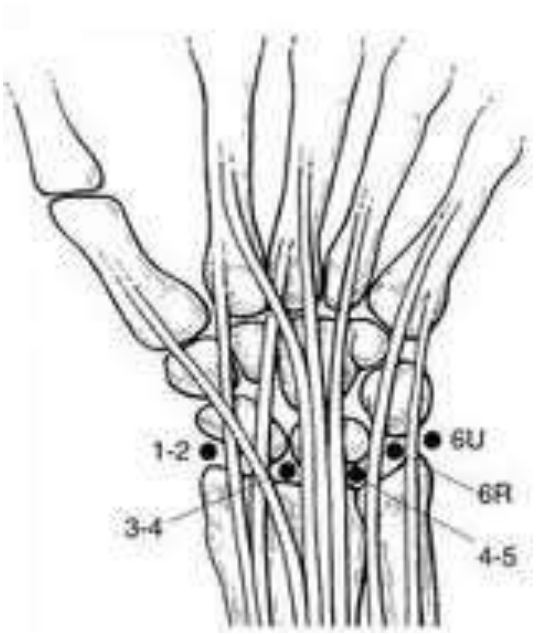
- Improved visualization: Direct assessment of cartilage, competency of TFCC, associated SL/LT injury, more precise suture ± implant placement
- Maintain dorsal capsular structures
- Decreased risk of injury to surrounding structures which some studies show improved functional outcome scores, range of motion, grip strength, and pain relief compared to traditional open techniques

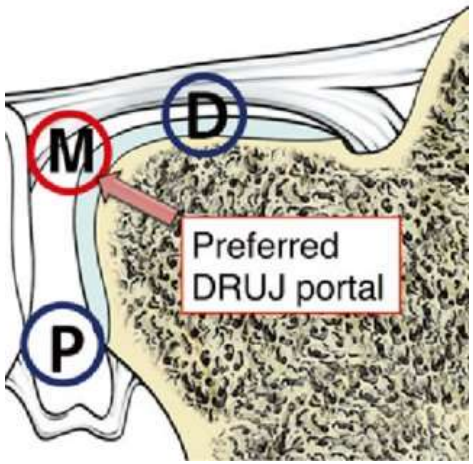
Arthroscopic Technique

- Supine with armboard
- Regional Block
- Tower: 7-10lbs traction
  - Finger traps: Index/Middle
- 1.9/2.3/2.7 Scopes
  - Suture Shuttle device of choice (TFCC repair kit)

Arthroscopic Technique

- Portal Anatomy
  - Based on Extrinsic compartments
    - 1-2: radial cutaneous n.
    - 3-4
    - 4-5
    - 6R
    - 6U: ulnar cutaneous n.
    - DRUJ Portals





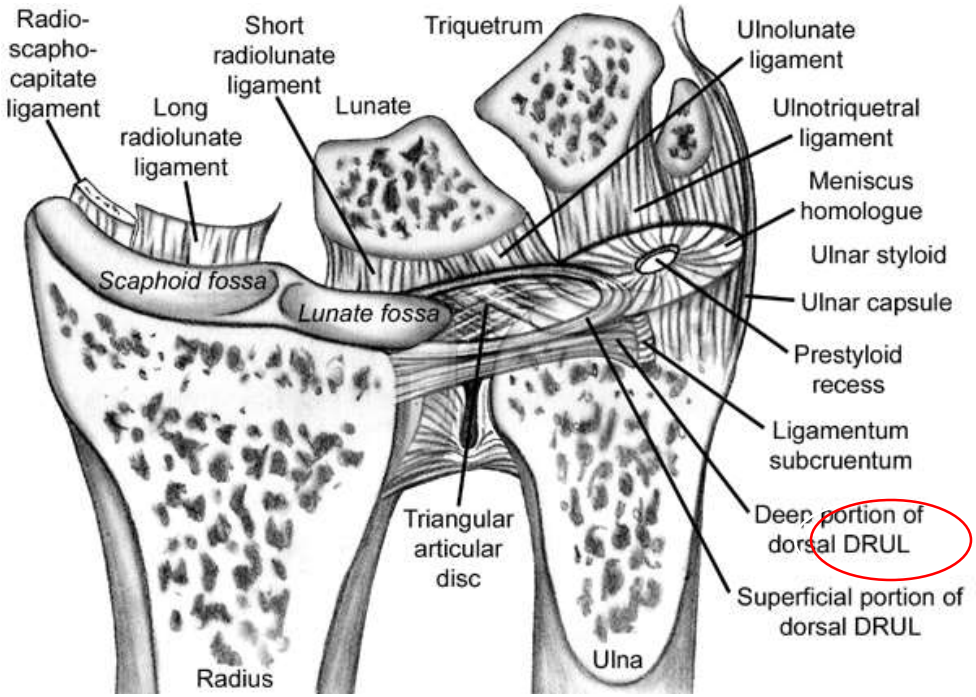
Atzei et al

Wrist Arthroscopy

- Inflate with: 5-7ml
  - If TFCC tear: additional 4-7ml and may bulge at DRUJ
- 11 blade: 2mm incision
- 18g outflow at 6R
- Begin with a thorough diagnostic arthroscopy including midcarpal

Wrist Arthroscopy

- TFCC
  - Ulnar border over sigmoid notch: smooth and contiguous
    - Probe for tension: “trampoline” effect
- 2 normal perforation
  - Prestyloid recess
  - Pisotriquetral space



TFCC Repair Options

Inside out

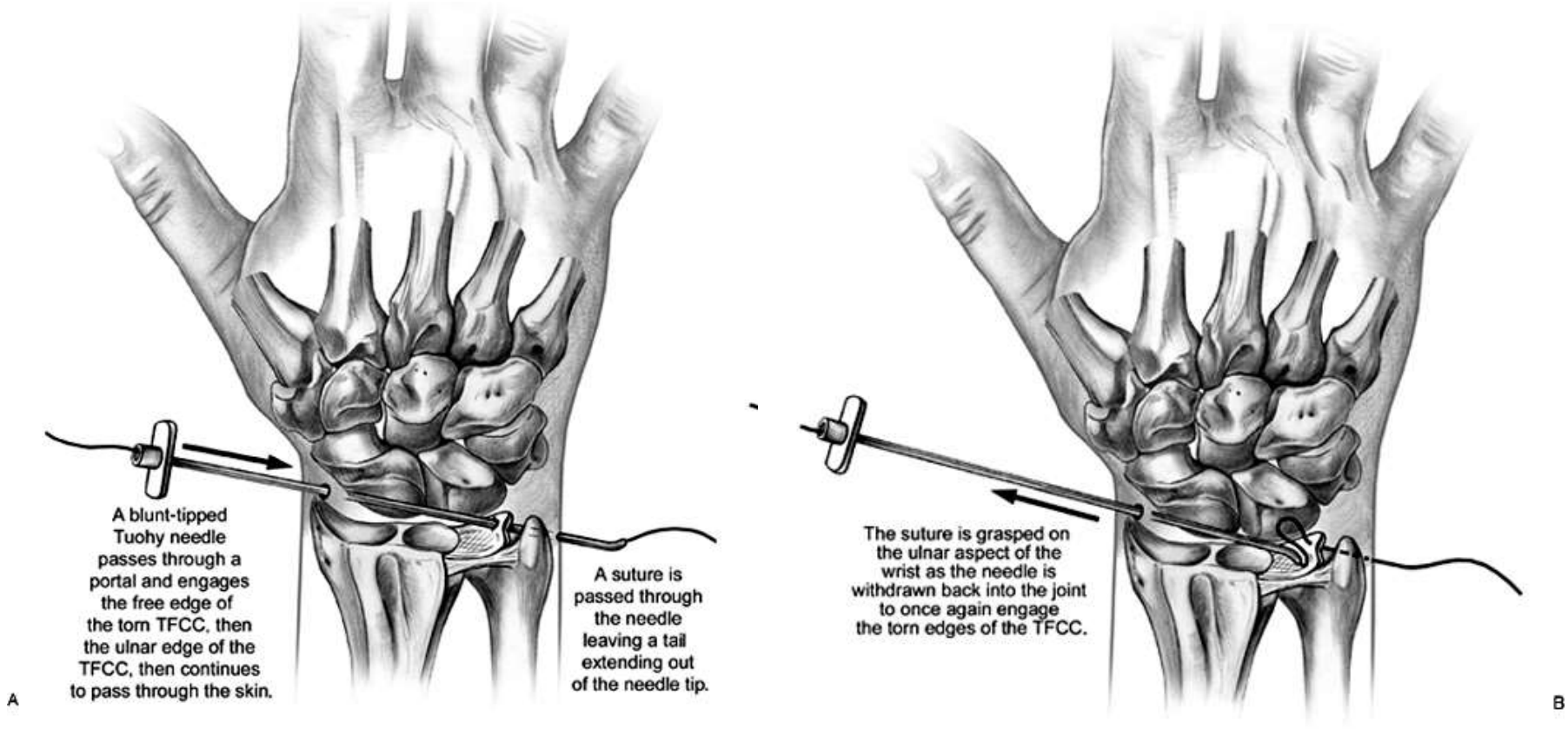
Outside in

All Inside

TFCC Repair Technique: Inside-Out

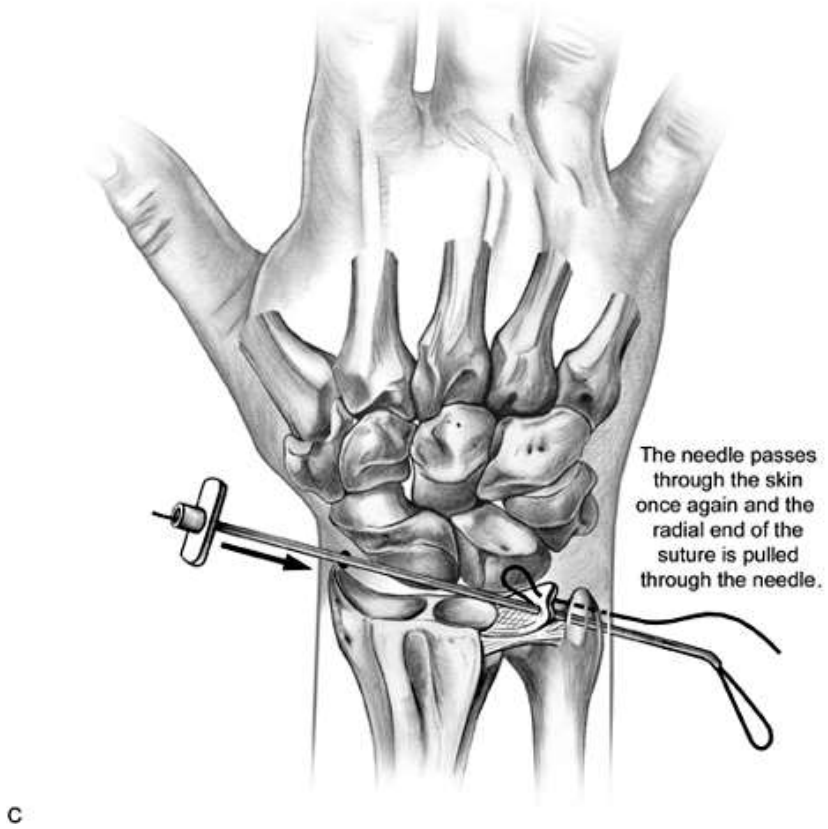
- Inside-out Technique (Dr. Gary Poehling:*Arthroscopy* 1996)
  - Scope 4-5
  - Touhy needle in 1-2
    - Advance through edge of TFCC and out skin palmar to ECU
    - Pulled back and advanced through more palmar of dorsal area of TFCC edge and out skin.
    - Small incision is made to ensure no entrapment of ulnar sensory n. and tied over ulnar wrist capsule
    - Beware of ECU tendonitis from suture knots

TFCC Repair Technique: Inside-Out



Hand Surgery 2004

TFCC Repair Technique: Inside-Out

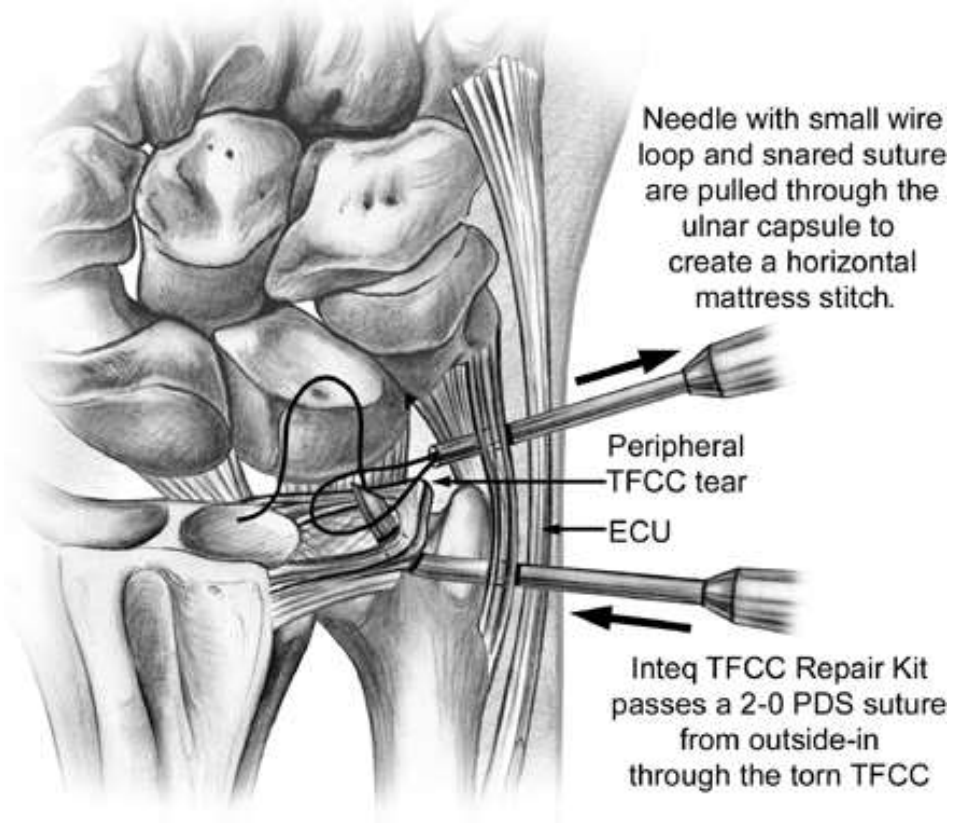


Hand Surgery 2004

Arthroscopic TFCC Repair: Outside-In

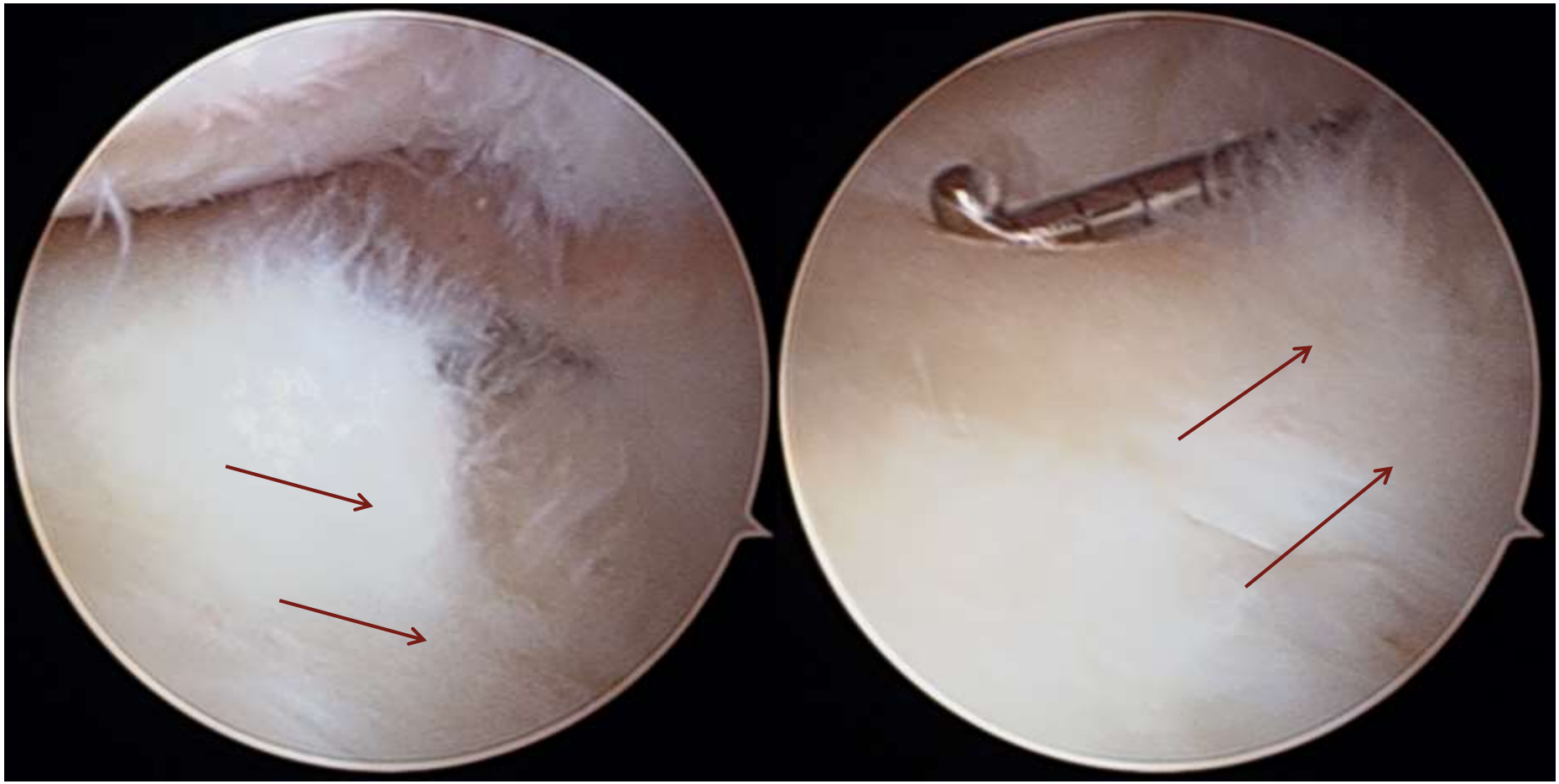
- Outside-In Technique
  - Scope 3-4
  - Repair 4-5/6R
  - 2-3cm incision over ECU sheath (ulnar sensory n.)
  - Shuttle 2-0 PDS (outside in) with 20g spinal needle
  - 2-3 sutures placed over ulnar capsule
    - Mattress/Simple
    - Beware of chronic ECU tenosynovitis

TFCC Repair Technique: Outside-In

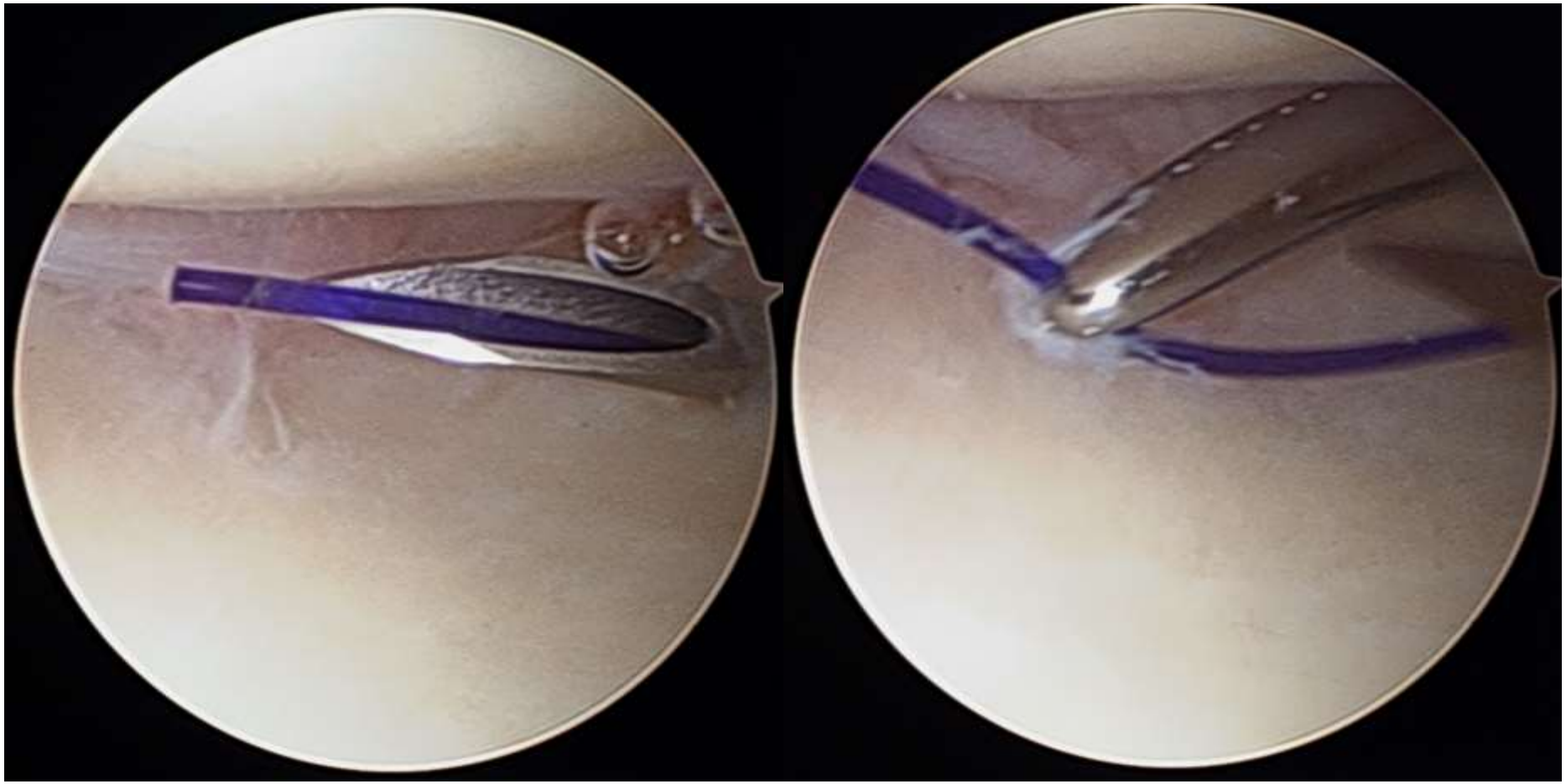


Hand Surgery 2004

Peripheral TFCC Tear

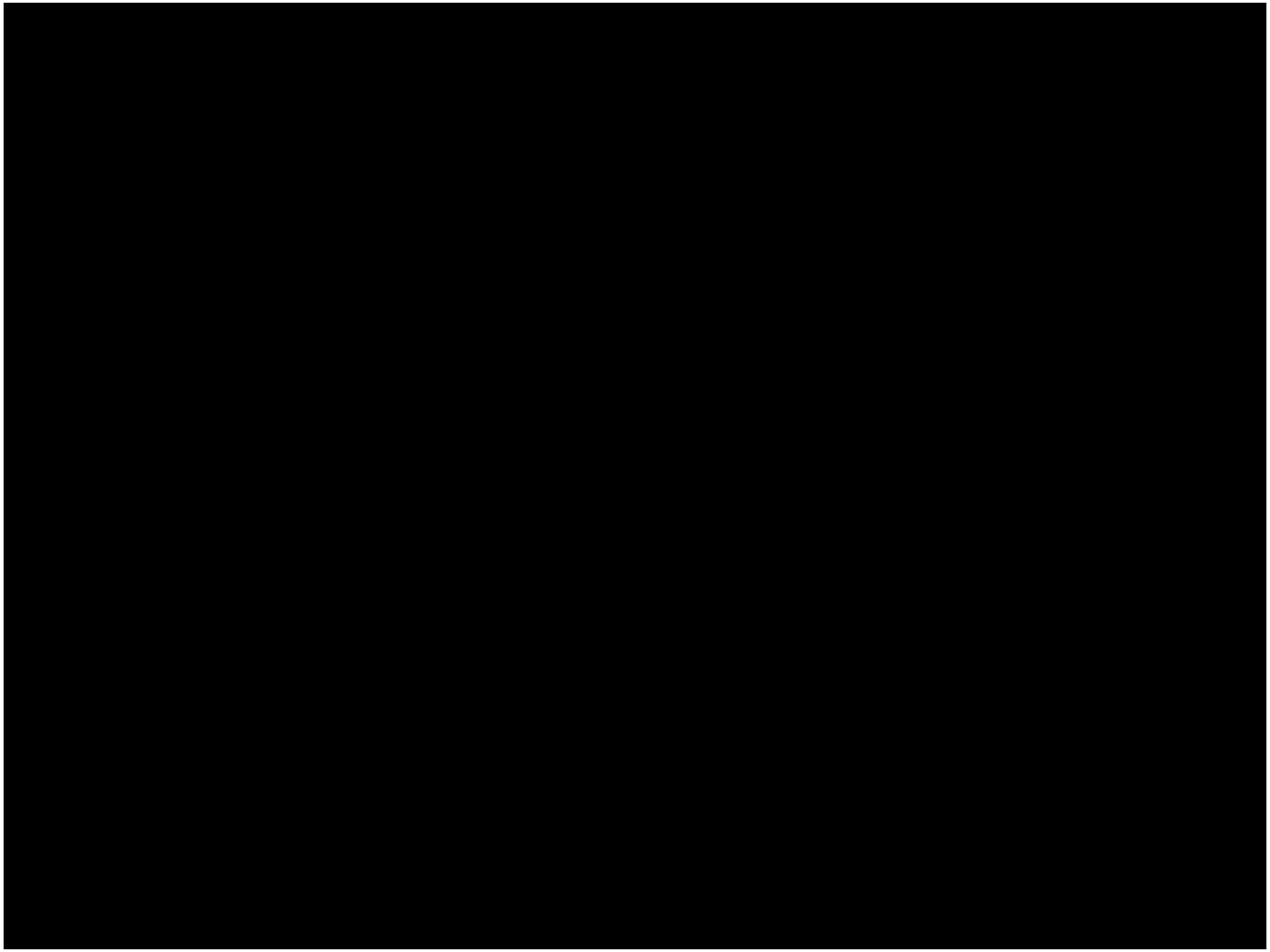


Arthroscopic Peripheral TFCC Repair



Arthroscopic Peripheral TFCC Repair

Peripheral TFCC Repair Video



Arthroscopic Peripheral TFCC Repairs

- Arthroscopic treatment of peripheral TFCC tears has gained favor as it improves visualization of repair and results suggest improved ROM, Grip strength, and less complications over open techniques
  - Anderson et al. JHS. 2008
  - Reiter et al. Arthroscopy. 2008.
  - Ruch and Papadonikolakis. Arthroscopy. 2003.
  - Haugstvedt et al. Scan. J Plast. Recons. Hand Surg. 1999.
  - Corso et al. Arthroscopy. 1997.
  - Trumble et al. Arthroscopy. 1996.

Arthroscopic vs Open TFCC repair?

- DRUJ Instability: Foveal TFCC tears
  - Biomechanical study of DRUJ stability is dependent on deep components of TFCC (Haugstved et al. JHS 2006)
  - Additional studies reporting poor outcomes with arthroscopic TFCC repair in setting of DRUJ instability
    - Estrella et al. Arthroscopy. 2007.
    - Tunnerhoff and Haussman. 2001.
    - Trumble et al. Arthroscopy. 1996.

Literature

- Arthroscopic Treatment of Peripheral Triangular Fibrocartilage Complex Tears with the Deep Fibers Intact. Ruch et al. JHS 2012.
  - Retrospective Case Series of 29 superficial peripheral TFCC tears repaired with outside in technique: 26 available for F/U at mean of 31 mo.
    - 22 pts daily vigorous activity (11 high-level athletes)
    - Mean time to surgery 12 mo
    - MRI: foveal intact, no abutment or degenerative changes
  - No DRUJ instability, degenerative changes or abutment
    - VAS, DASH, ROM, Grip strength, Return to work/sports

- VAS: improved from 5.4 to 0.9 (P .001)
  - Successful(84%), Unsure(4%), Unsuccessful(12%)
- DASH: improved from 38 to 9 (P .003)
- 88% would have the procedure again
- 7 of 11 athletes returned to similar level of play
  - At final F/U: 8 (31%) felt limited in sports/work/both (6 where competitive athletes).
- ROM: No measurable difference: unaffected side
- Complications: parethesia (2), ECU (1), Re-tear (1)
  - All resolved or repaired

Literature

- Clinical Comparison of Arthroscopic Versus Open Repair of Triangular Fibrocartilage Complex Tears. Anderson et al. JHS. 2008. (Mayo)
    - 76 pt (37 scope and 39 open peripheral TFCC repairs treated by 8 fellowship hand surgeons): 90% Power
        - All operated within 4 mo. after failing conservative care
        - Retrospective review and F/U exam/questionnaire
            - Wrist pain, Grip strength, DRUJ instability, VAS, ROM, MMWS, DASH, PRWE (patient reported wrist evaluation).

- No significant differences preop between groups
  - MMWS or Instability
- All improved postop however with no significant differences between the groups
  - VAS, DASH, MMWS, PRWE, Pain, Function/ROM
- Both groups experienced decreased ROM and Grip strength but less in arthroscopic group (no stat sig.)
- Increased postop hyperesthesia of ulnar sensory in open group (no stat sig.)
- No difference in reoperation for DRUJ instability(13)

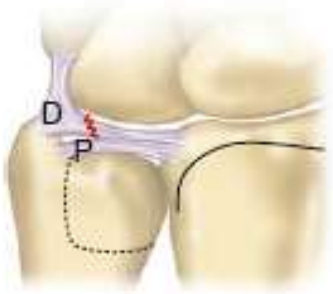
- Clinical difference but not statistically significant:
  - Postop flex/ext arc (116°:scope vs 109°:open)
  - Incidence of nerve injury (8:scope vs 14:open)
  - ECU tendonitis (4:scope vs 10:open)

Arthroscopic vs Open TFCC repair?

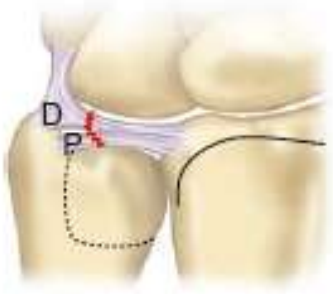
- Argument is that arthroscopic repair is unable to properly debride foveal attachment to achieve the healing bed necessary for TFCC repair

- Iwasaki and Minami. JHS 2009
  - Showed creating osseous tunnel can enhance progressive adhesion of avulsed TFCC

Atzei Modification of Palmer 1B



- Foveal TFCC tear classification and treatment. (Atzei A. Hand Clinics. 2011)
  - Class1: Repairable distal tear
  - Class 2: Repairable complete tear
  - Class 3: Repairable proximal tear
  - Class 4: Non-repairable tear
  - Class 5: Arthritic DRUJ based on arthroscopy

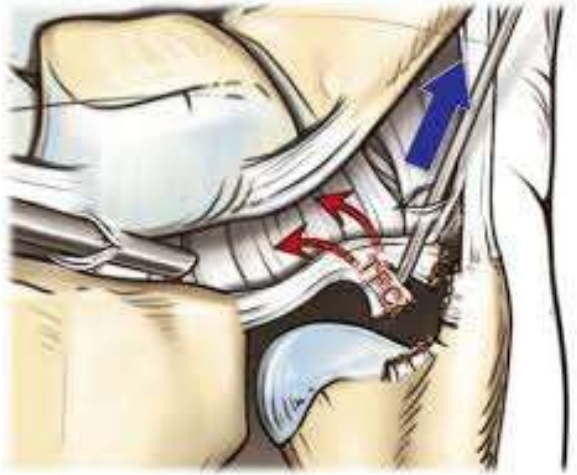


Atzei et al

Atzei:EWAS treatment-oriented classification of TFCC peripheral Tears

	Class 1: reparable distal tear	Class 2: reparable complete tear	Class 3: reparable proximal tear	Class 4: nonreparable tear	Class 5: arthritic DRUJ
Clinical DRUJ instability	None/slight	Mild/Severe		Severe	Mild/severe
Appearance of TFCC distal component (RC arthroscopy)	Torn	Torn	Intact	Torn	Variable
Status of TFCC proximal component (Hook test/DRUJ arthroscopy)	Intact	Torn	Torn	Torn	
Healing potential of TFCC tear's margins	Good	Good	Good	Poor	
Status of DRUJ cartilage (DRUJ arthroscopy)	Good	Good	Good	Good	Poor
Treatment	REPAIR Suture (Ligament-to-capsule)	REPAIR Foveal refixation		RECONSTRUCTION Tendon graft	SALVAGE Arthroplasty or joint replacement

TFCC Tear with Foveal Disruption



Atzei et al

Literature

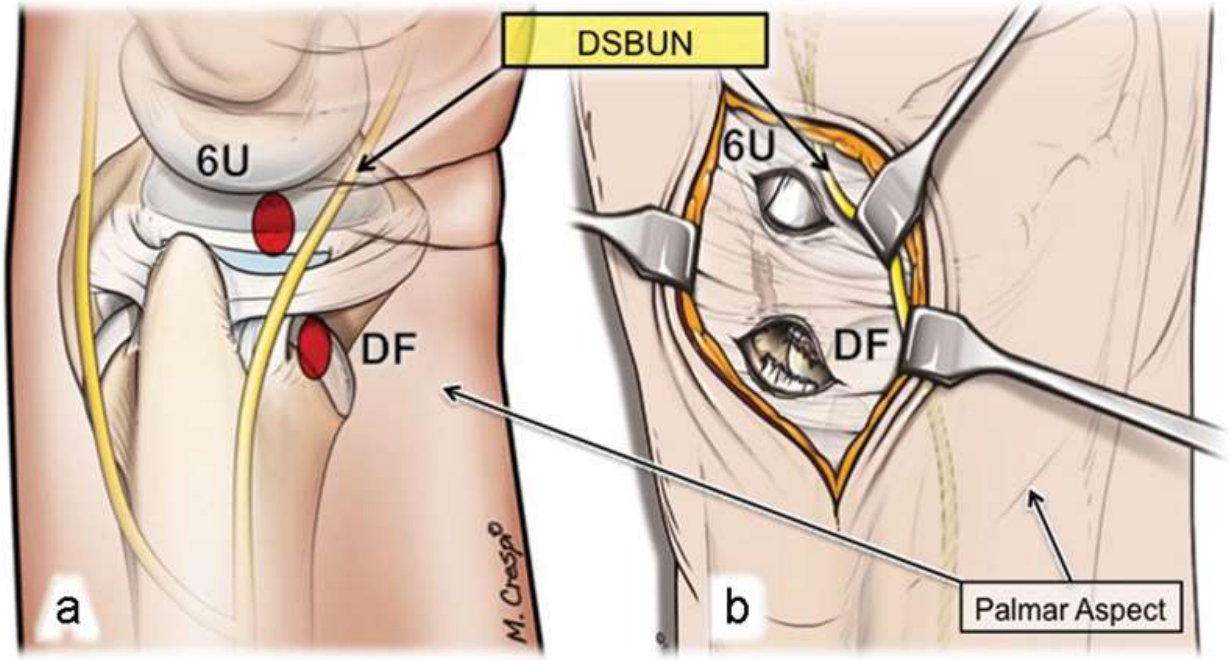
- Arthroscopically Assisted Repair of Triangular Fibrocartilage Complex Foveal Tears.
- Shinohara et al. JHS. 2013 (Japan)
  - Case Series 11pts with mean f/u 30 mo.
  - Mean time to operation 10 mo.
  - All with DRUJ instability: clicking, daily impairment, etc.
    - No ulnar positive/ulnar impaction
  - Hand20 questionnaire, Grip, ROM, DRUJ instability, MMWS (Mayo Modified Wrist Score)
    - Used a transosseous outside in arthroscopically assisted repair technique through a distal DRUJ portal

- Hand20: preop 29 and postop 6 (P .012)
- 7pt pain resolved and mild remained in 4 pt
- Grip strength improved from 84% preop to 98% of unaffected side postop (P .016)
- ROM: flex-ext arc increased from 93% to 100% and pro-sup arc 96% to 97% of unaffected side
- DRUJ instability: 9pt had none and 2 mild
- MMWS: improved from 70 to 94 (P .003)
  - 7 Excellent, 3 good, 1fair

Literature

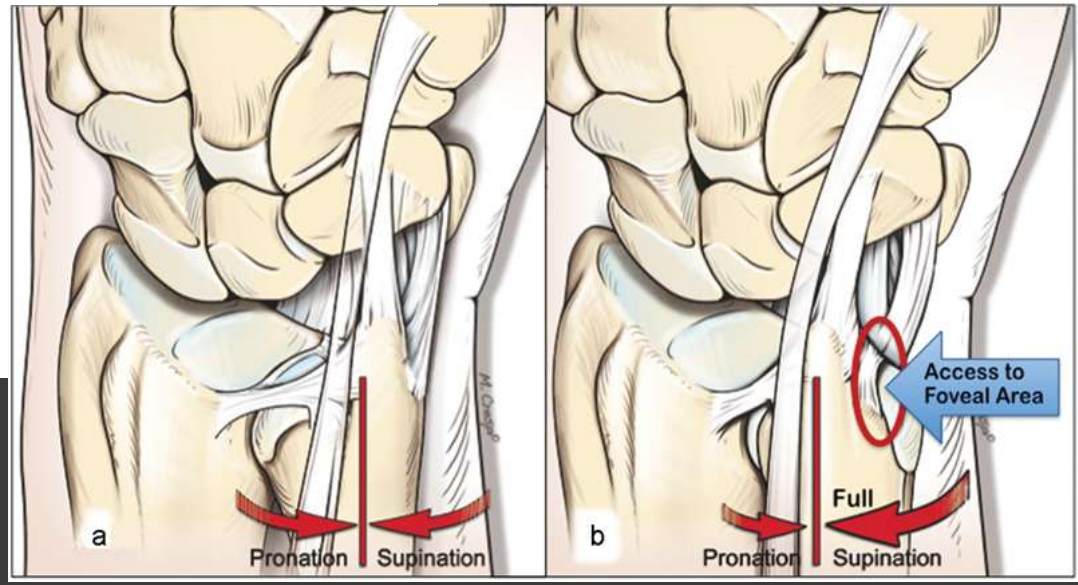
- Arthrosopic Foveal Repair of the Triangular Fibrocartilage Complex. Atzei et al. J Wrist Surg. 2015
  - Retrospective Review of 48pt after an all-inside arthroscopic foveal TFCC repair using a suture anchor
    - Immobilized forearm postop 4 weeks and resume heavy use at 3 months
    - Mean follow up: 33 months

Arthroscopic all-inside repair



Atzei et al

Direct Foveal (DF) Portal



- Resolved DRUJ instability in 44 pt
- Significantly increased ROM, Grip, MMWS, DAS
  - Pain improved significantly in all but remained moderate in 4 and severe in 1.
  - 41 pt (85.5%) resumed previous work/sport activities (15 high level athletes)
  - Complications: 5 patients
    - Neuropraxia dorsal ulnar sensory: all recovered

Other Considerations

- Ulnar Variance: Role as predictor of outcome?
- Nakamura et al. Hand Clin. 2011
  - Arthroscopic transosseous repair was not indicated in pt with excessive ulnar positive variance/abutment
- Ruch and Papadonikolakis. Arthroscopy. 2008.
  - higher DASH with ulnar neutral/positive pts
- Trumble et al./Tunnerhoff and Haussmann/Imbriglia
  - Recommended joint leveling for TFCC tears with ulnar positive variance

The Take Away

- Symptomatic Superficial 1:B TFCC peripheral tears without instability
  - Arthroscopic TFCC Soft tissue to ulnar capsule
- Symptomatic 1:B TFCC foveal tears with instability
  - Arthroscopic transosseous repair
- Positive ulnar Variance/abutment
  - Consider joint leveling procedure
    - Tunnerhoff and Haussmann (2001)
    - Trumble et al (JHS ’97)
    - Minami et al (JHS ‘98)

Future Research

- Better standardization of arthroscopic findings for TFCC peripheral tears and assessment of inter/intra-observer reliability
  - Comparative outcomes of open vs arthroscopic treatment based upon these specific classification
    - ±Ulnar abutment
    - ±DRUJ instability
    - ±Intrinsic ligament injuries
    - ±Distal radius fractures

Thank You

Questions?