

# TFCC Injuries

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Hand and Upper Extremity Surgery  
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# Overview

Background

Anatomy

Diagnosis

Treatment

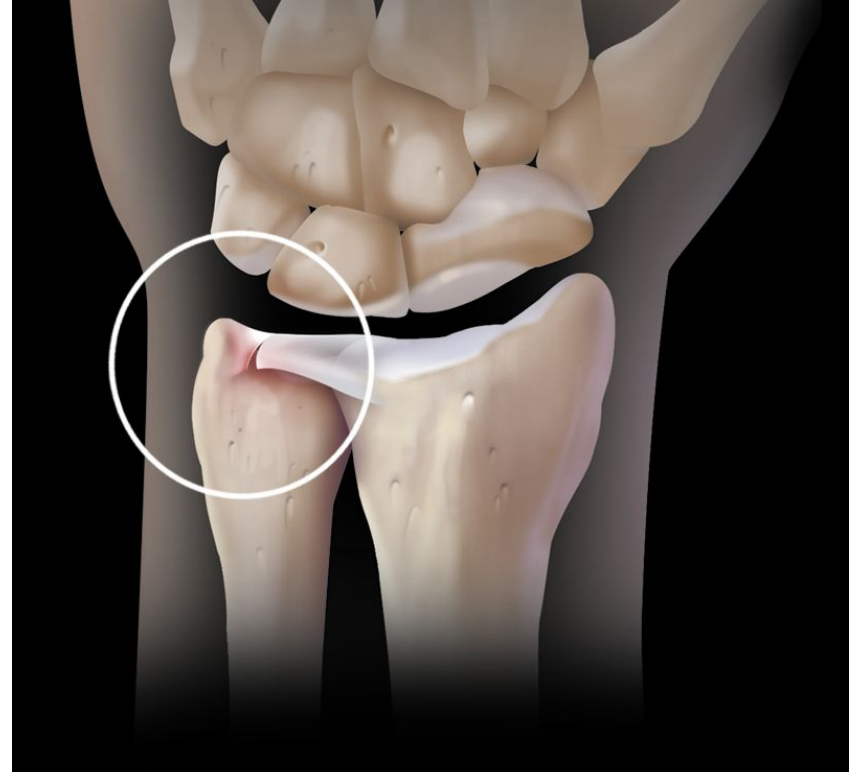
Outcomes

Questions

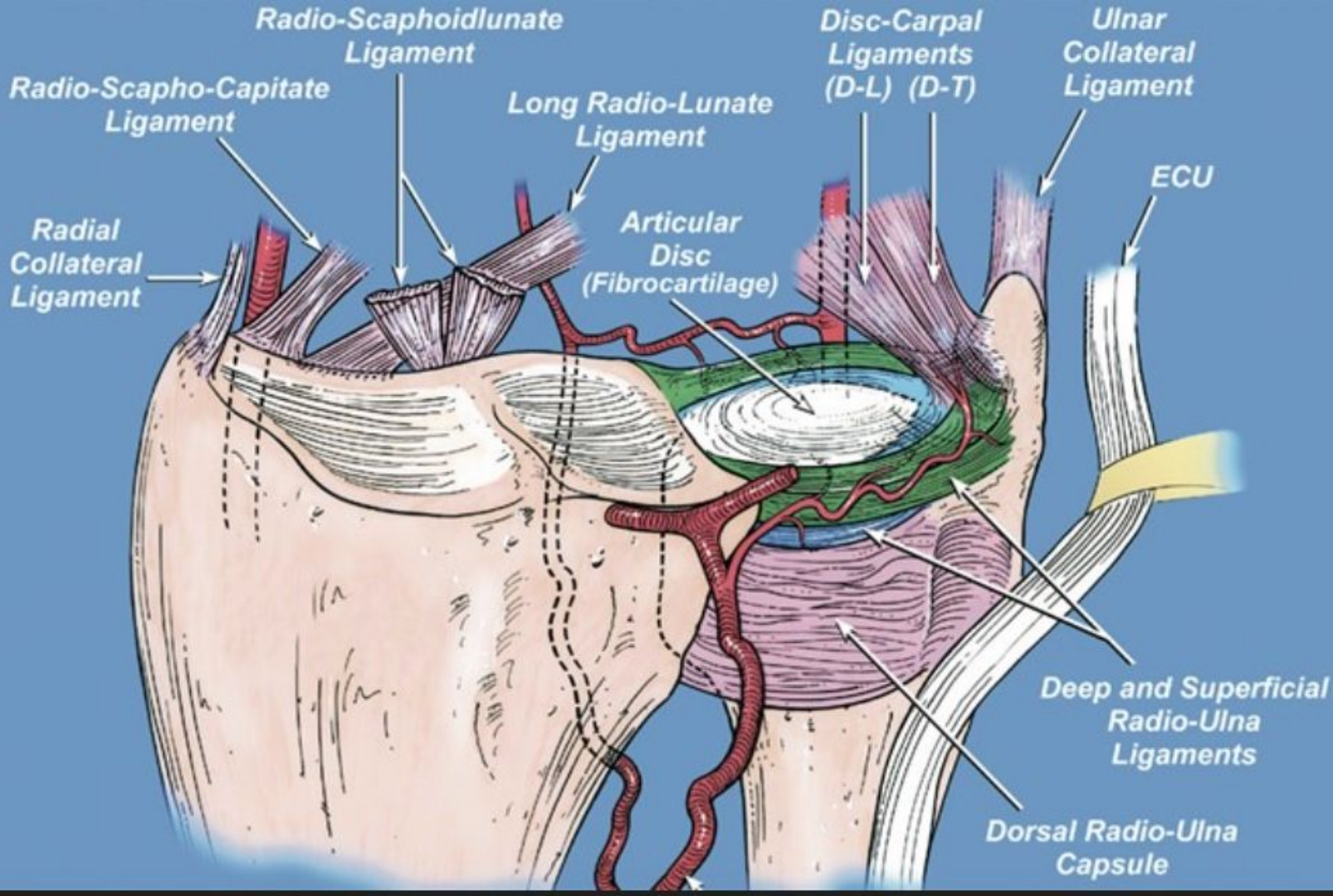
# Background

The triangular fibrocartilage complex (TFCC) functions as a load-bearing surface across the ulnocarpal joint and as a primary stabilizer of the distal radioulnar joint (DRUJ)

Injury may lead to ulnar-sided wrist pain, mechanical symptoms during forearm motion, pain with forceful grip and ulnar deviation, and DRUJ instability







# Epidemiology

Acute tears are most common in the active individual during the second and third decades of life.

Degenerative tears begin in the third decade of life, with increasing frequency and severity with each passing decade.

No completely normal triangular fibrocartilage complex (TFCC) after seventh decade, based on a cadaveric study

Most common in athletes who grip bats, clubs, sticks, etc. In particular, baseball players, golfers, racquet sports, hockey, gymnastics, boxing, pole-vaulting

# Mechanism of TFCC injury

## Type 1 - Traumatic

Most common is fall on extended wrist with pronated forearm

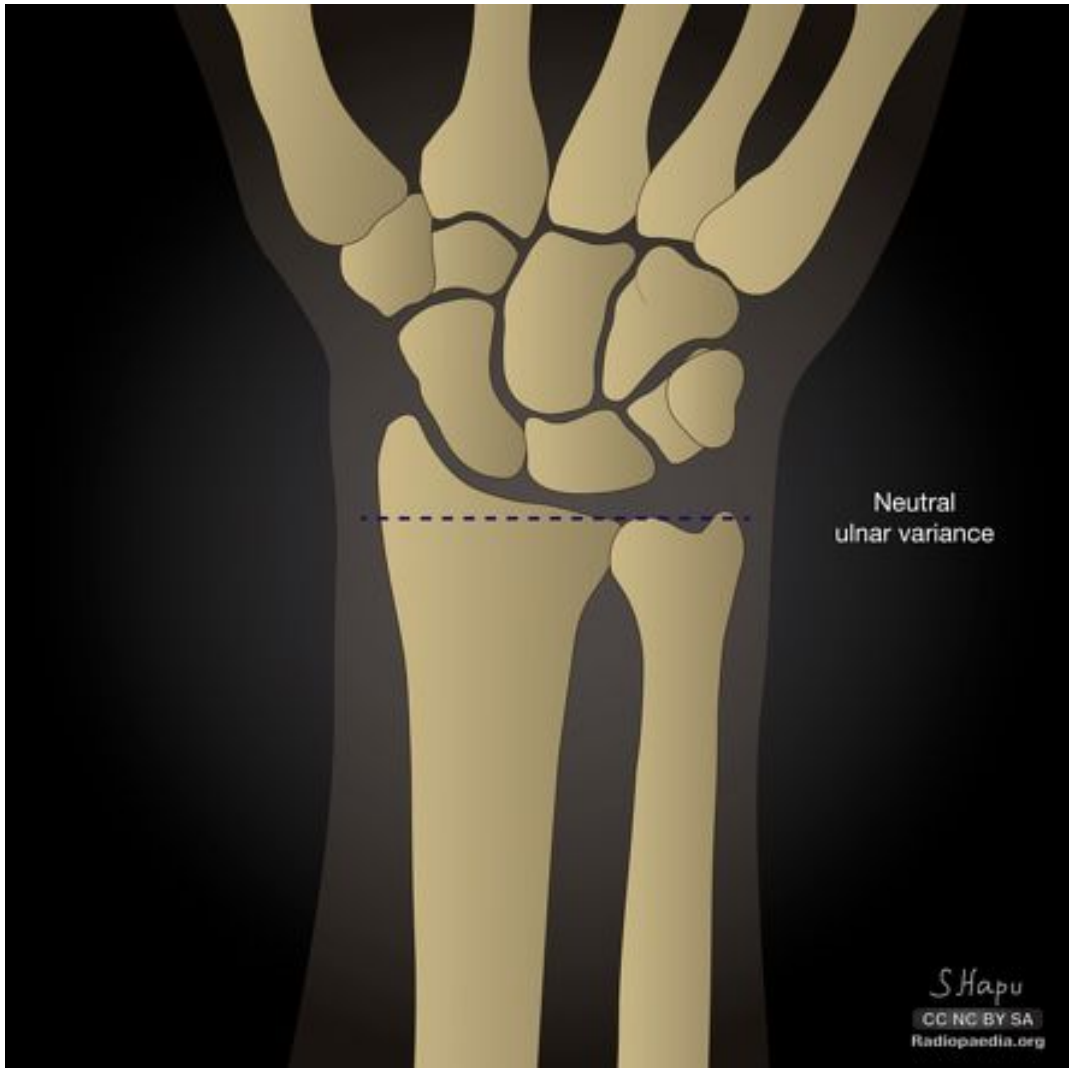
Axial wrist load while in ulnar deviation such as when batting

Rotational or distraction forces

## Type 2 - Degenerative

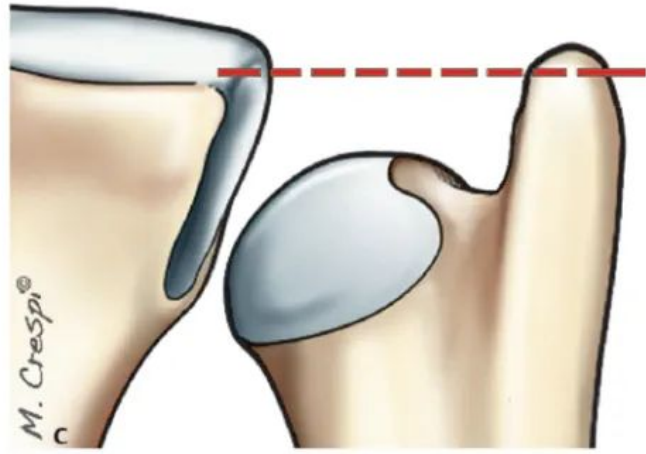
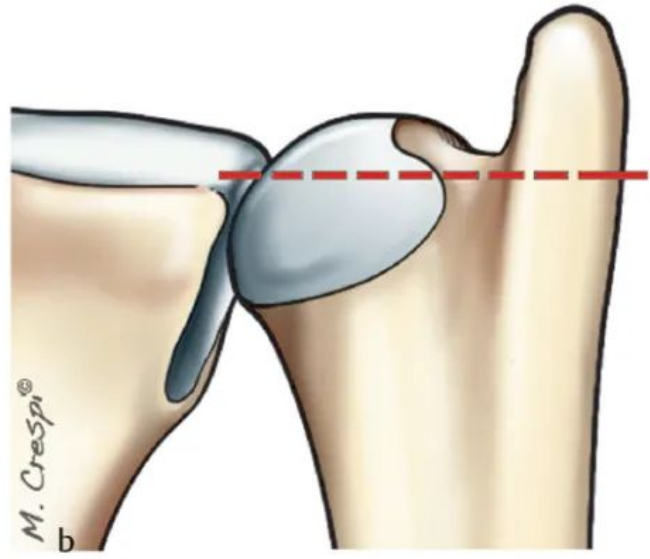
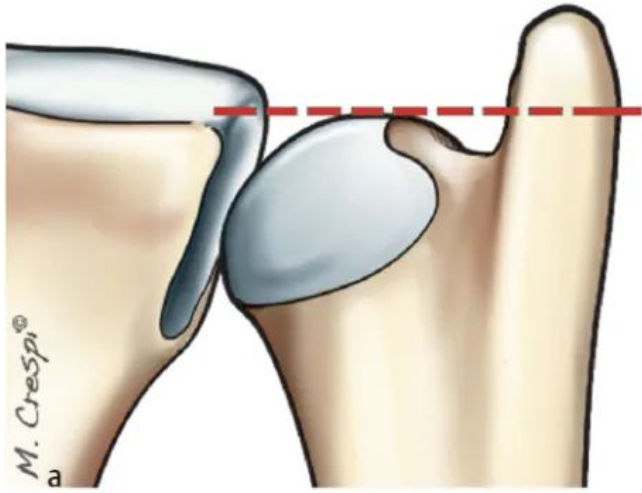
Associated with positive ulnar variance and ulnocarpal impaction





Neutral  
ulnar variance







**A**

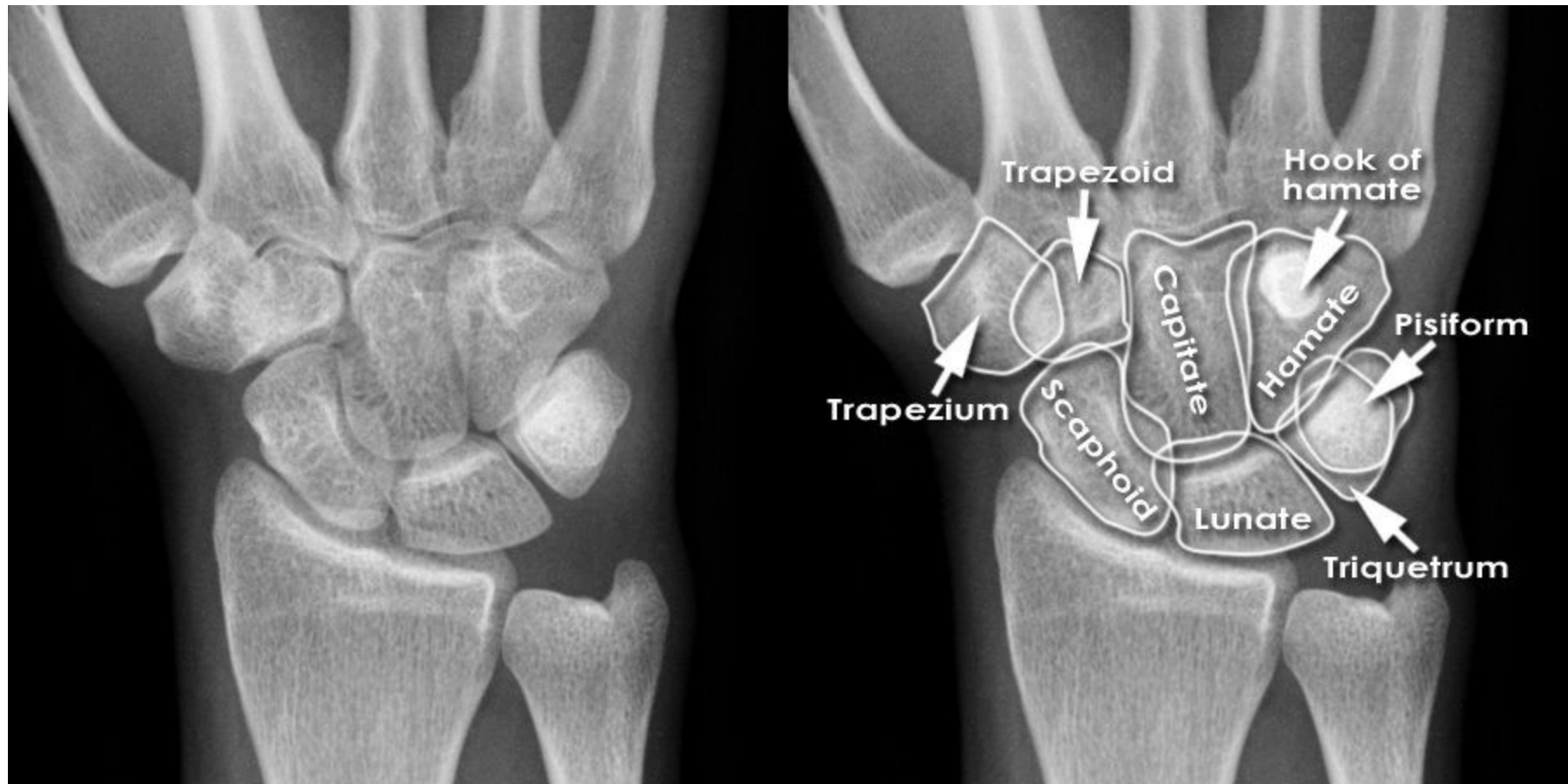


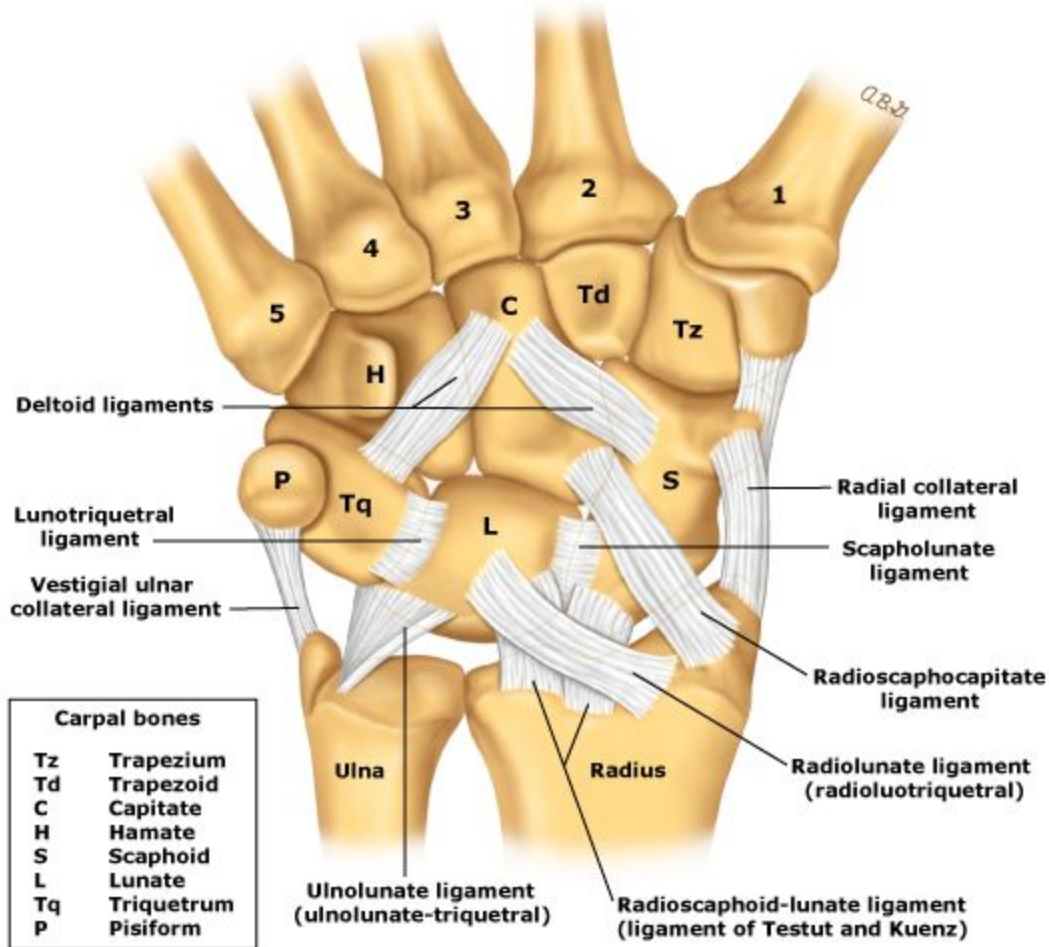
**B**

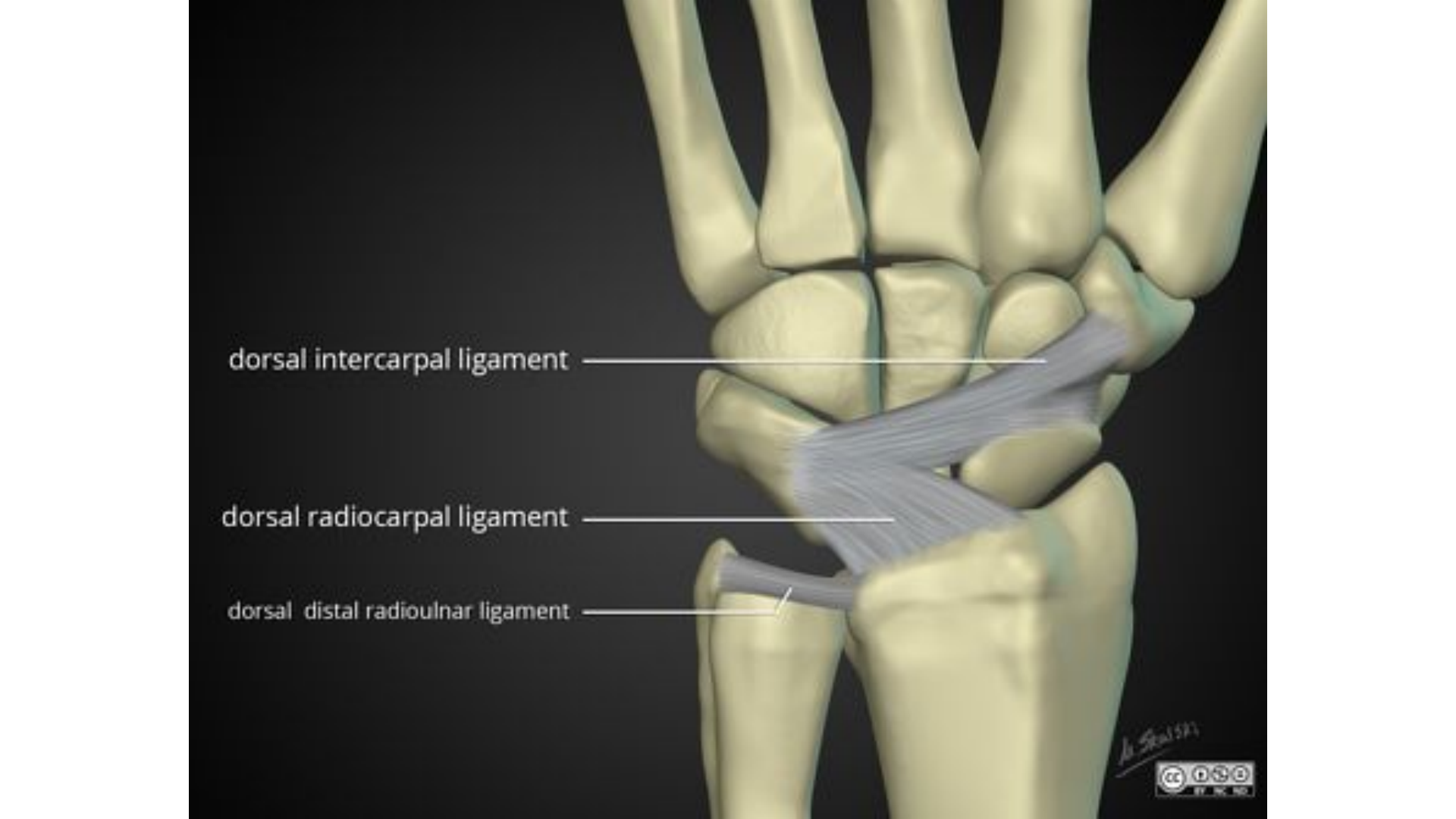


**C**

# Anatomy



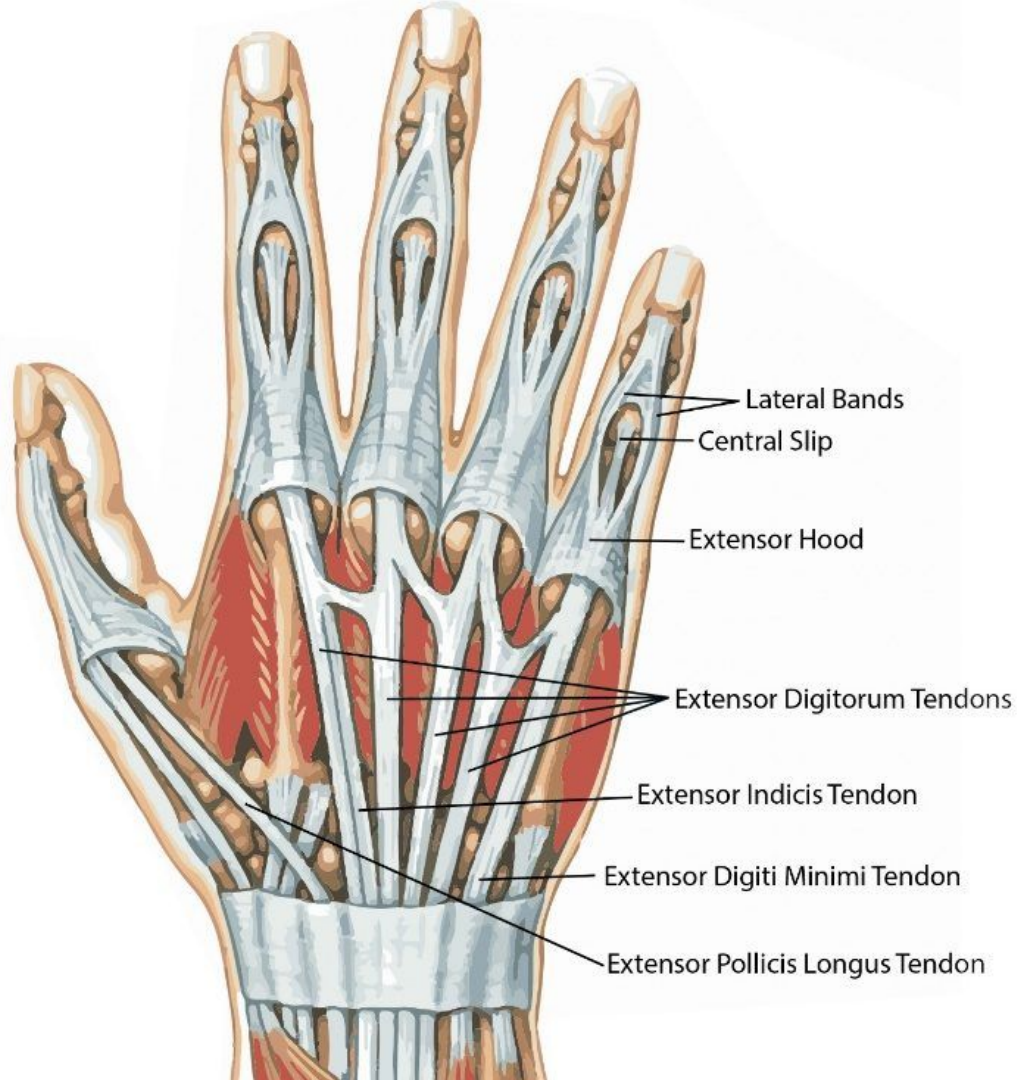


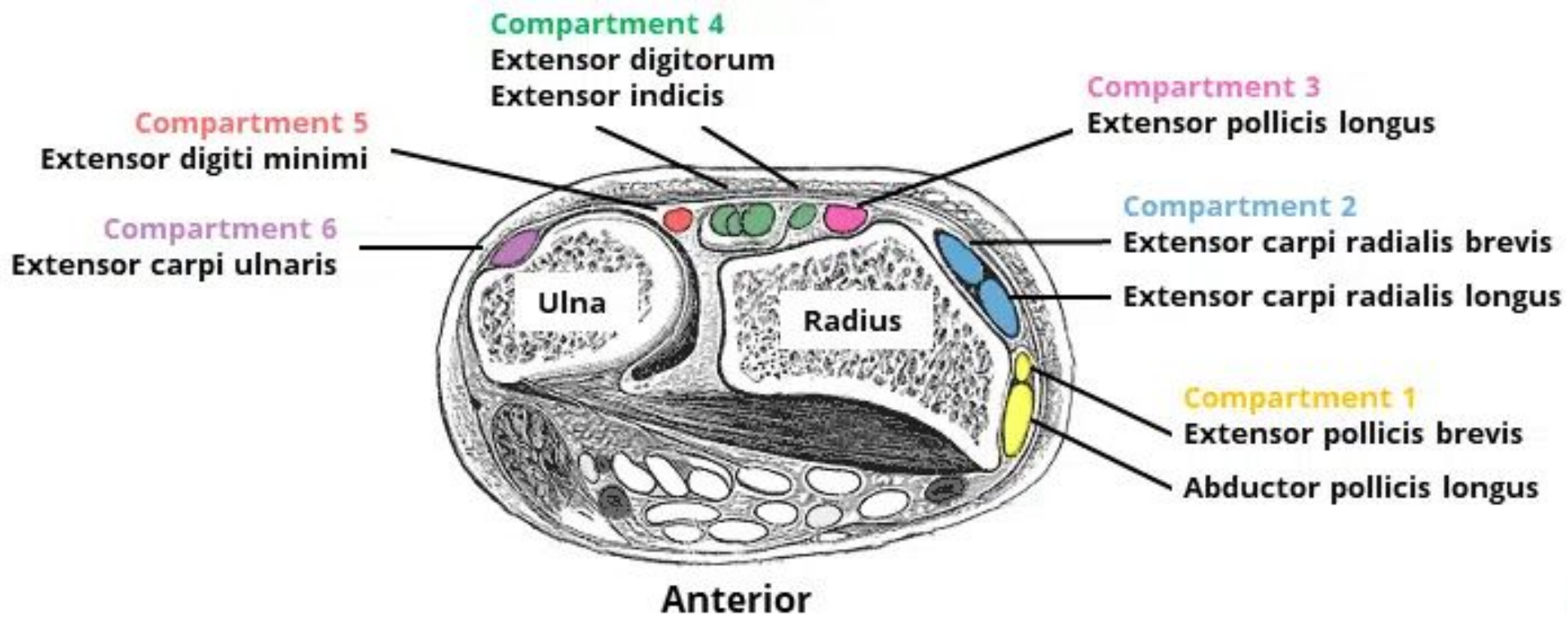
An anatomical illustration of the dorsal view of the human wrist. The bones of the hand and forearm are shown in a light beige color. Three ligaments are highlighted in a light purple color. The dorsal intercarpal ligament is a broad band connecting the bases of the 2nd, 3rd, 4th, and 5th metacarpals. The dorsal radiocarpal ligament is a fan-shaped ligament connecting the distal radius to the bases of the 3rd, 4th, and 5th metacarpals. The dorsal distal radioulnar ligament is a cord-like ligament connecting the distal radius and ulna. Labels with white lines point to each of these ligaments.

dorsal intercarpal ligament

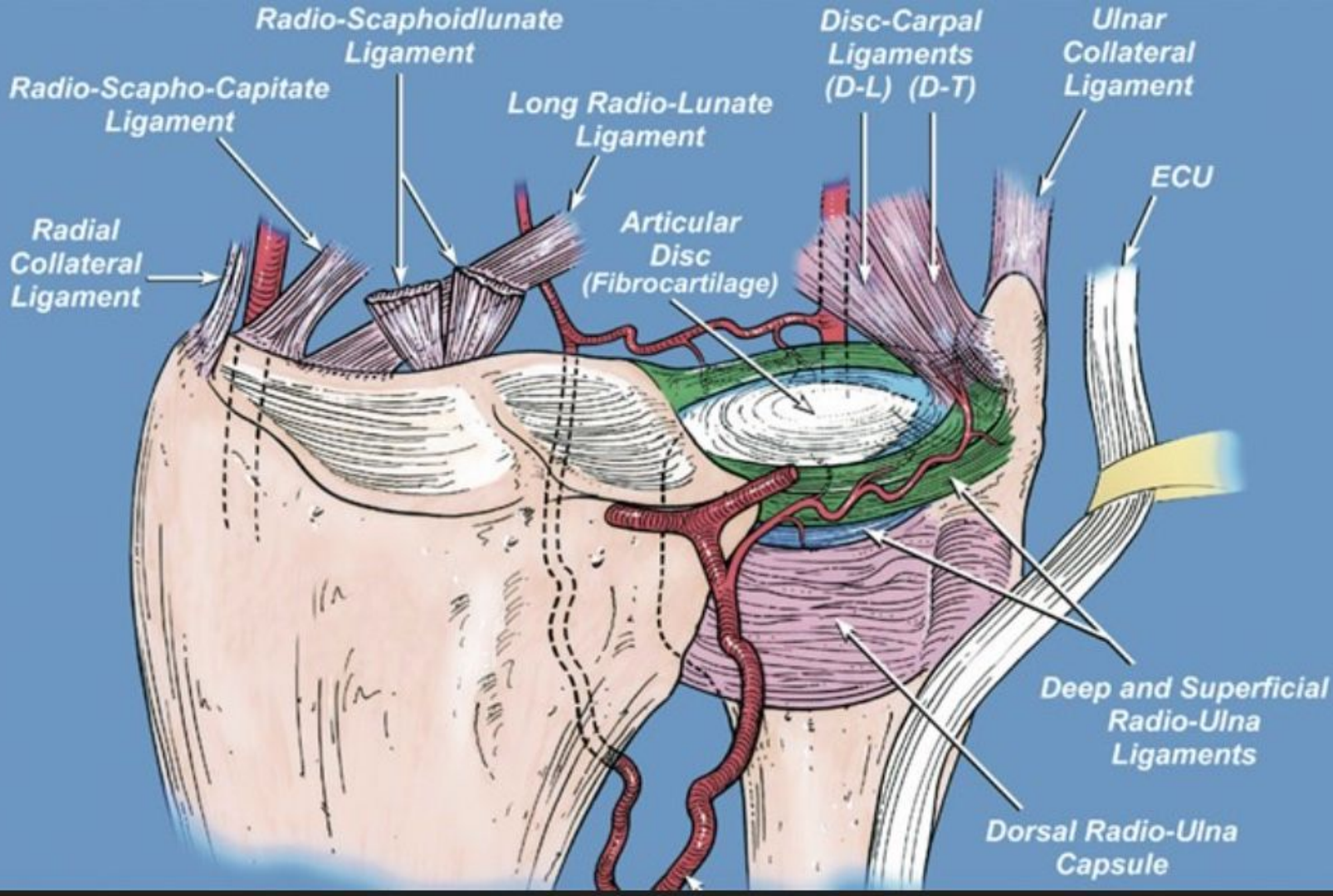
dorsal radiocarpal ligament

dorsal distal radioulnar ligament









# Triangular Fibrocartilage Complex

Consists of:

Dorsal and volar radioulnar ligaments - superficial and deep

Deep ligaments known as ligamentum subcruentum

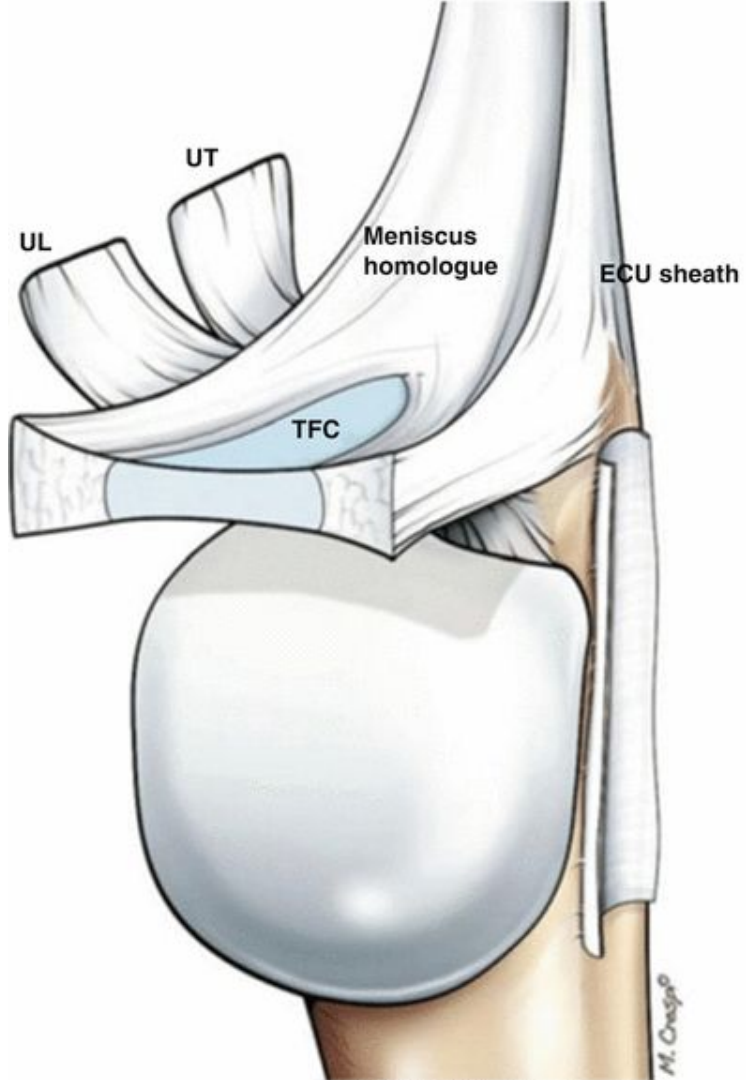
Central articular disc

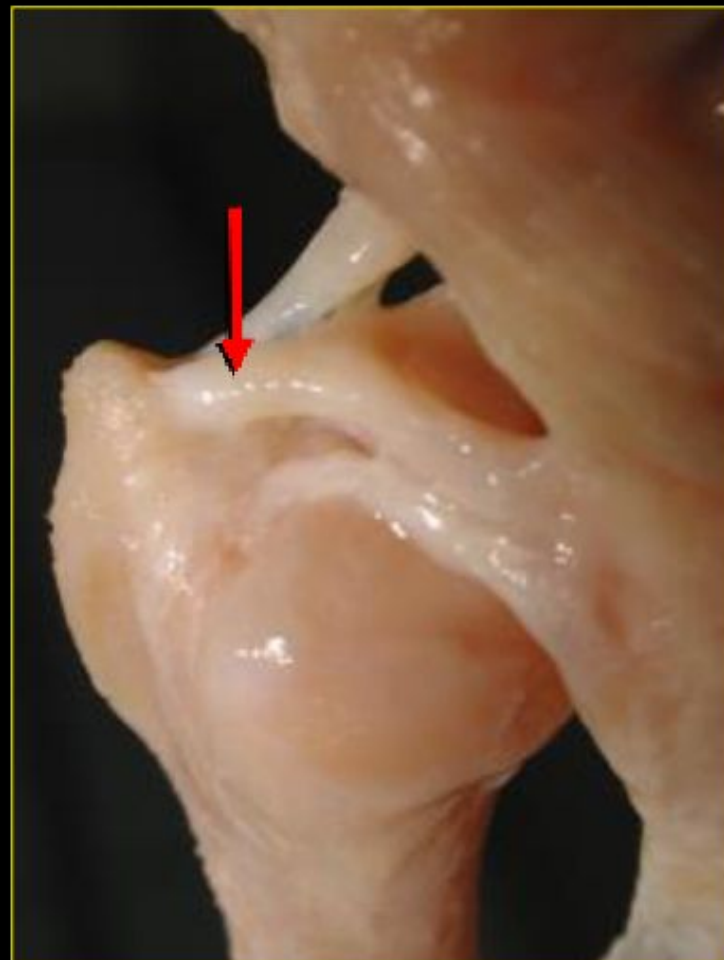
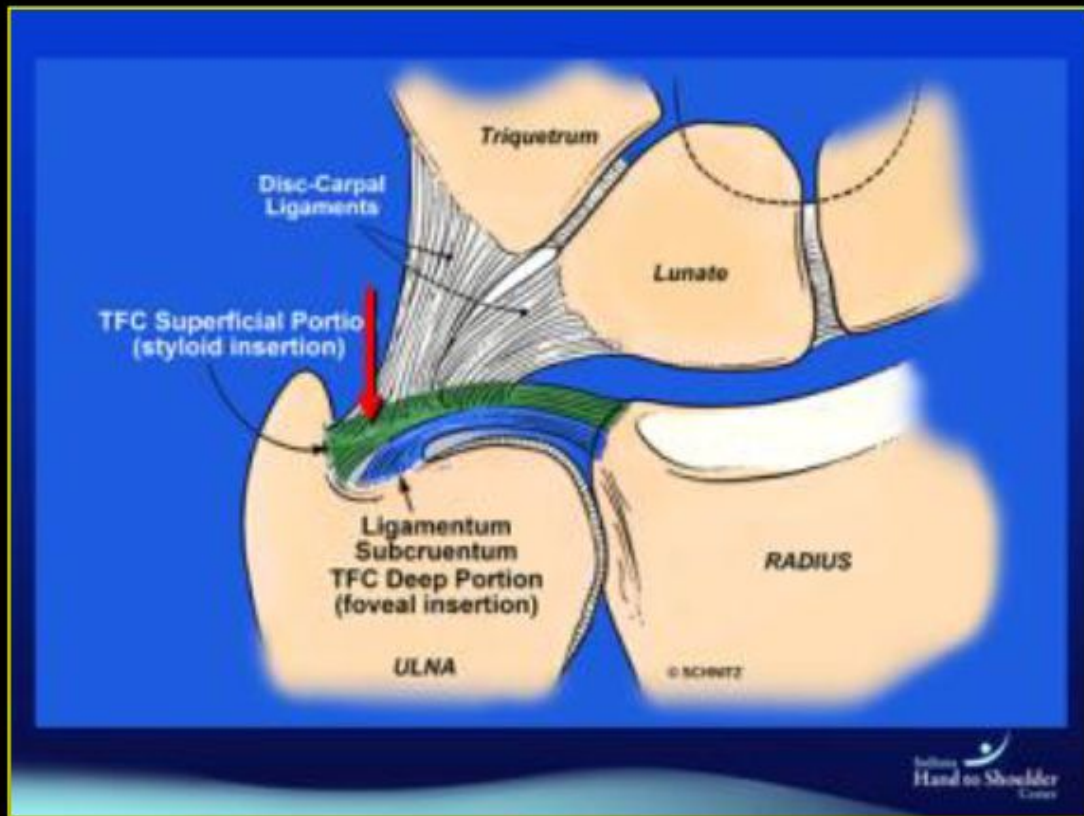
Meniscus homolog

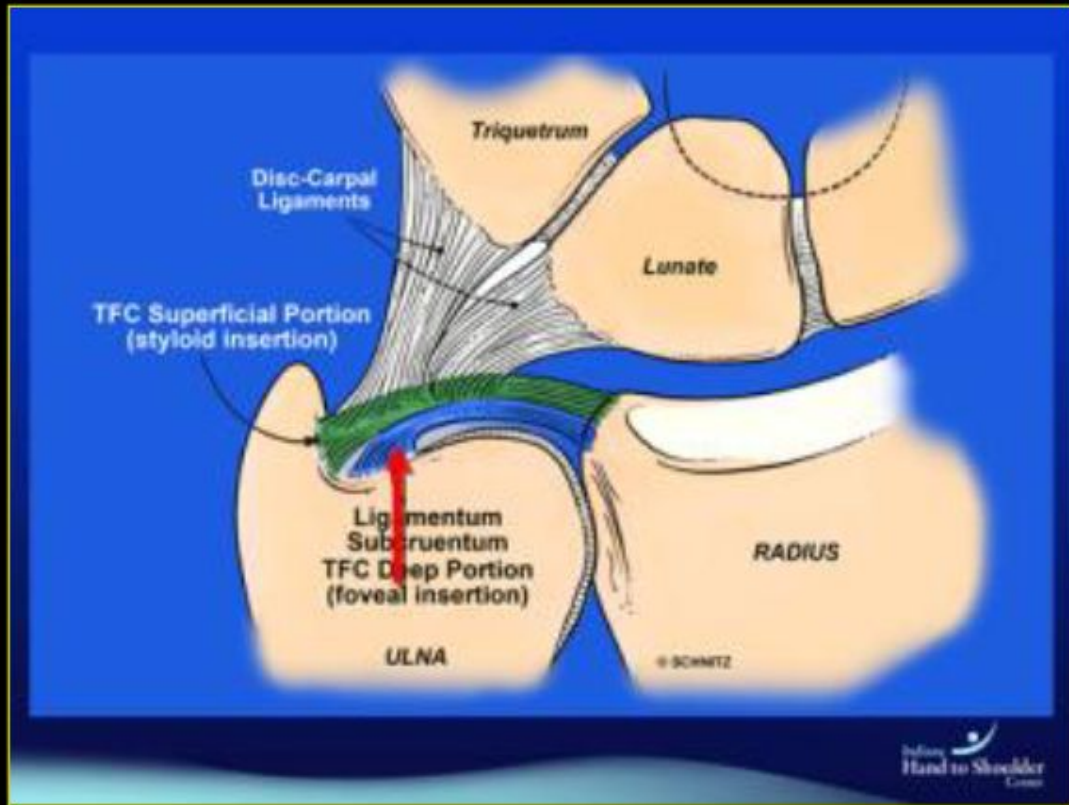
Ulnar collateral ligament

ECU subsheath

Ulnolunate and ulnotriquetral ligaments



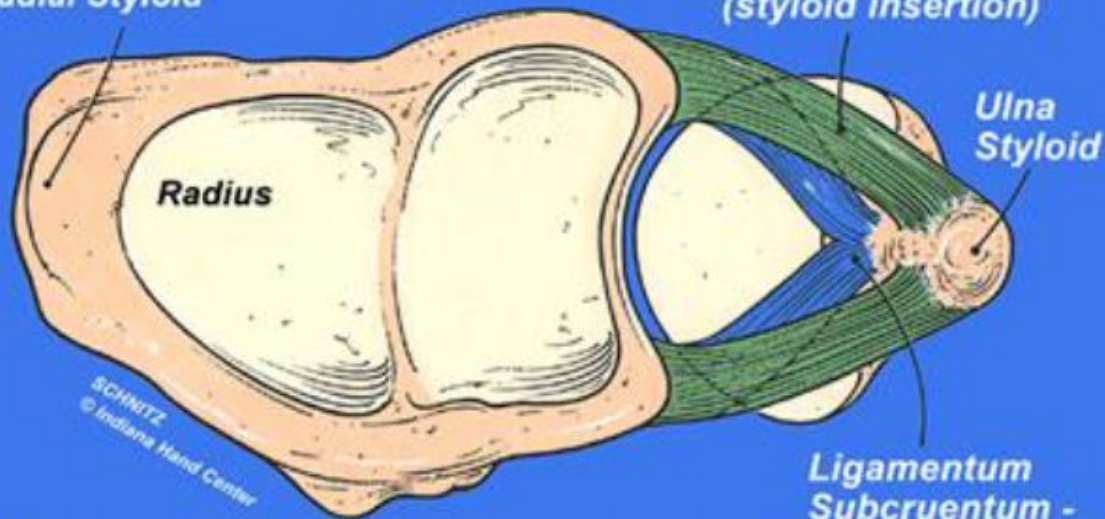




**PALMAR**

*Radial Styloid*

*TFC Superficial Portion  
(styloid insertion)*



*Ulna  
Styloid*

**Radius**

*Ligamentum  
Subcruentum -  
TFC Deep Portion  
(foveal insertion)*

*SCHNITZ  
© Indiana Hand Center*

**DORSAL**

# Presentation

## Symptoms

Ulnar sided wrist pain

Pain/instability with wrist pronosupination

## Physical exam

Positive fovea sign

95% sensitivity and 87% specificity for foveal disruptions of TFCC or ulnotriquetral ligament injuries

Pain elicited with ulnar deviation (TFCC compression) or radial deviation (TFCC tension)



# Diagnosis

## Radiographs

Usually negative

Zero rotation PA view evaluates ulnar variance

## MRI

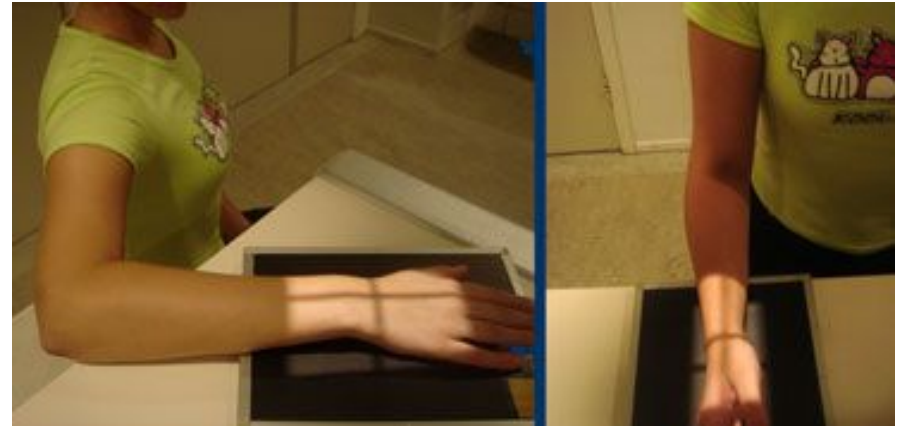
Allows for assessment of ulnar impaction

Sensitivity = 74-100%

## Arthroscopy

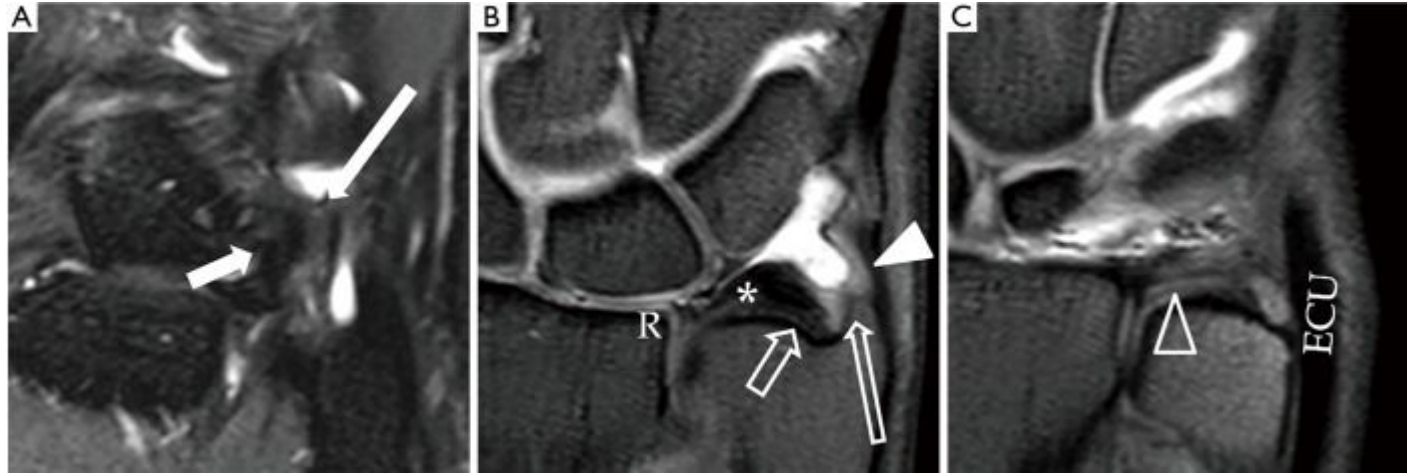
“Gold standard”

Consider in symptomatic patients after failing several months of splinting and activity modification



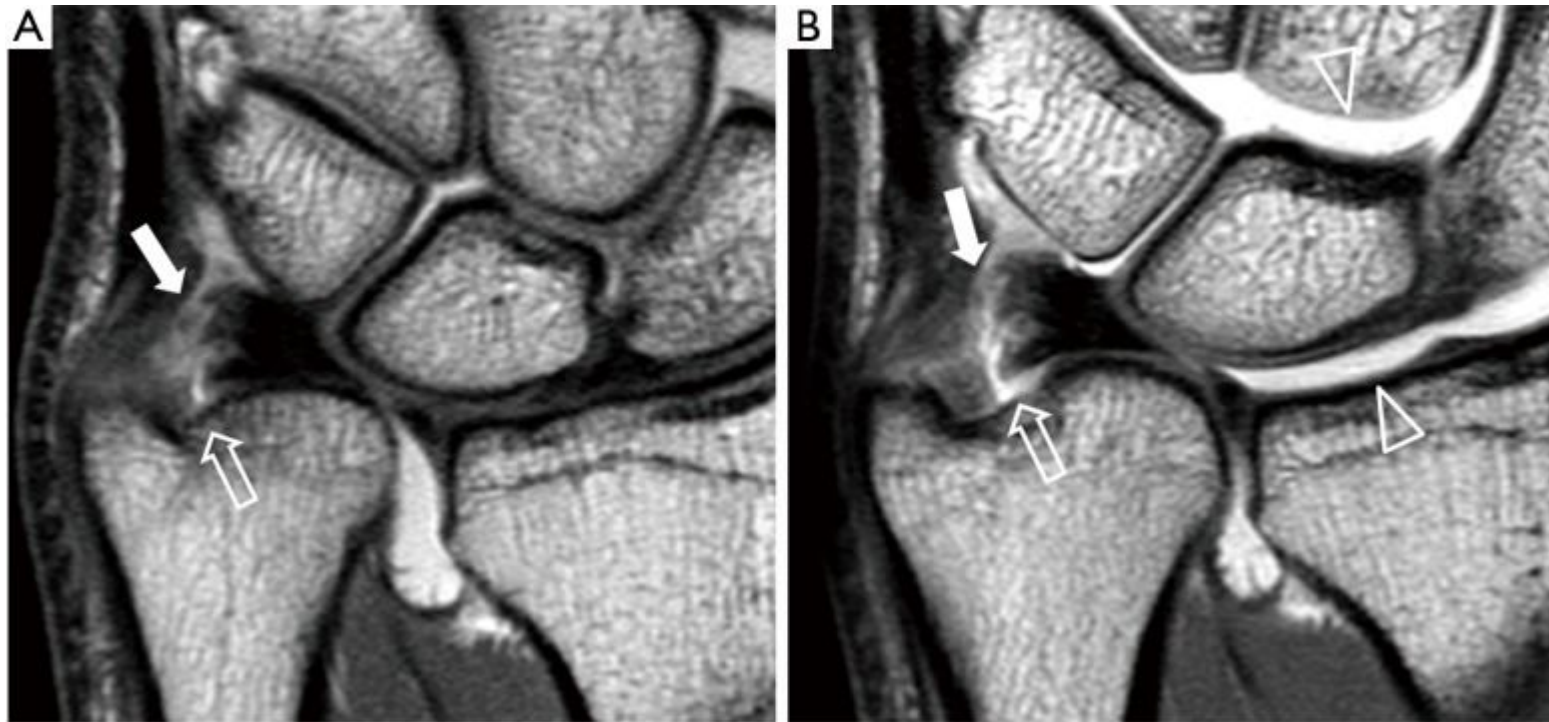


# Normal TFCC



Volar to dorsal - (A) Ulnotriquetral (long solid arrow) and ulnolunate ligaments (short solid arrow); (B) triangular fibrocartilage articular disc (TFC) (asterisk) with radial attachment (R), foveal attachment (short block arrow), ulnar styloid process attachment (long block arrow), meniscal homologue attachment (arrowhead); (C) most dorsal aspect of TFCC with dRUL (block arrowhead) and ECU tendon sheath attachment (ECU).

## Traction can aid in diagnosis



# Palmer Classification

## Class 1 - Traumatic TFCC Injuries

1A	Central perforation or tear
1B	Ulnar avulsion (without ulnar styloid fx)
1C	Distal avulsion (origin of UL and UT ligaments)
1D	Radial avulsion

## Class 2 - Degenerative TFCC Injuries

2A	TFCC wear and thinning
2B	Lunate and/or ulnar chondromalacia + 2A
2C	TFCC perforation + 2B
2D	Ligament disruption + 2C
2E	Ulnocarpal and DRUJ arthritis + 2D



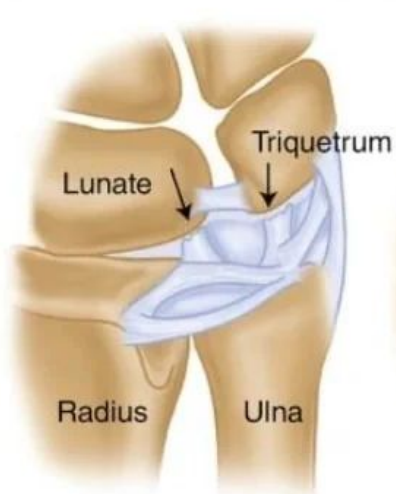
**Class 1A**



**Class 1B**



**Class 1B**



**Class 1C**



**Class 1D**



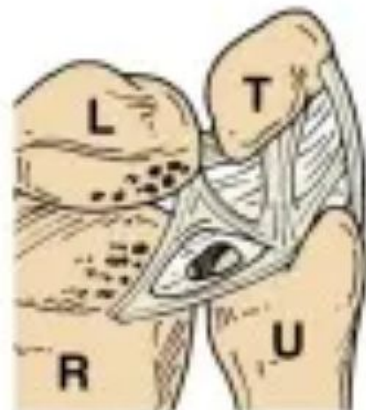
Class IIA



Class IIB



Class IIC



Class IID

# Treatment

## Nonoperative

Immobilization, NSAIDs, steroid injections

First line for all Type 1 and Type 2 injuries



# Treatment

Operative

Arthroscopic debridement

Type 1A

Arthroscopic repair

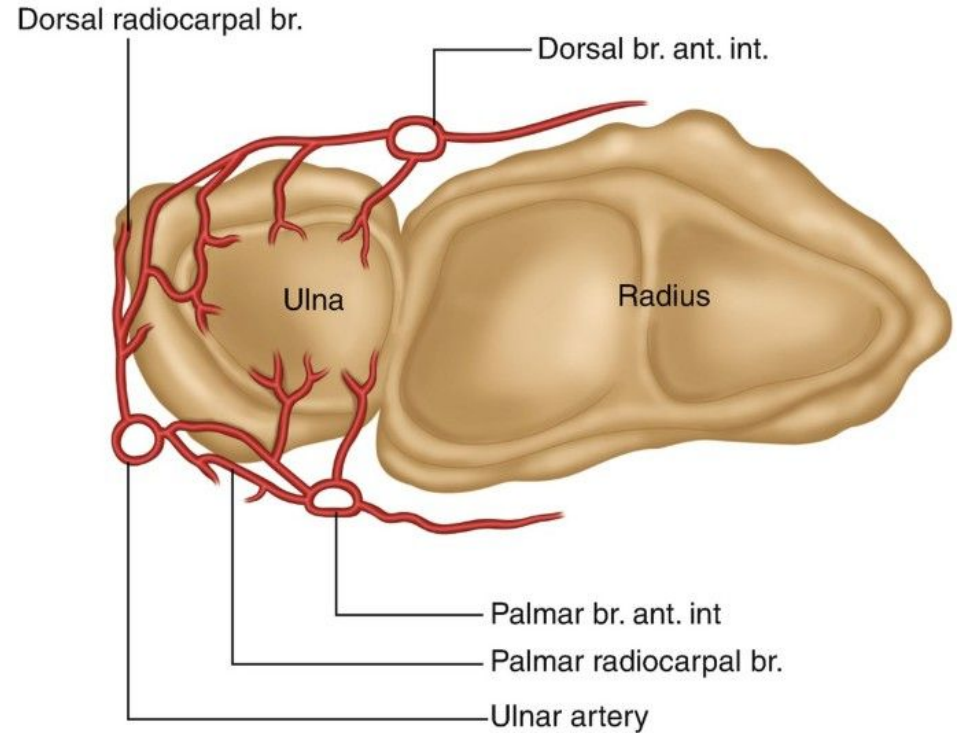
Type 1B, 1C, 1D



Generally acute, athletic injuries more amenable to repair than chronic injuries

Patient should expect to regain 80% of motion and grip strength when injuries are classified as acute (<3 months)

The rich vascular supply to the outer 10% to 40% of the TFCC make peripheral lesions more amenable to surgical repair relative to central or radial-sided tears





# Ulnar Shortening

## Ulnar diaphyseal shortening

Type II with ulnar positive variance is  $> 2\text{mm}$

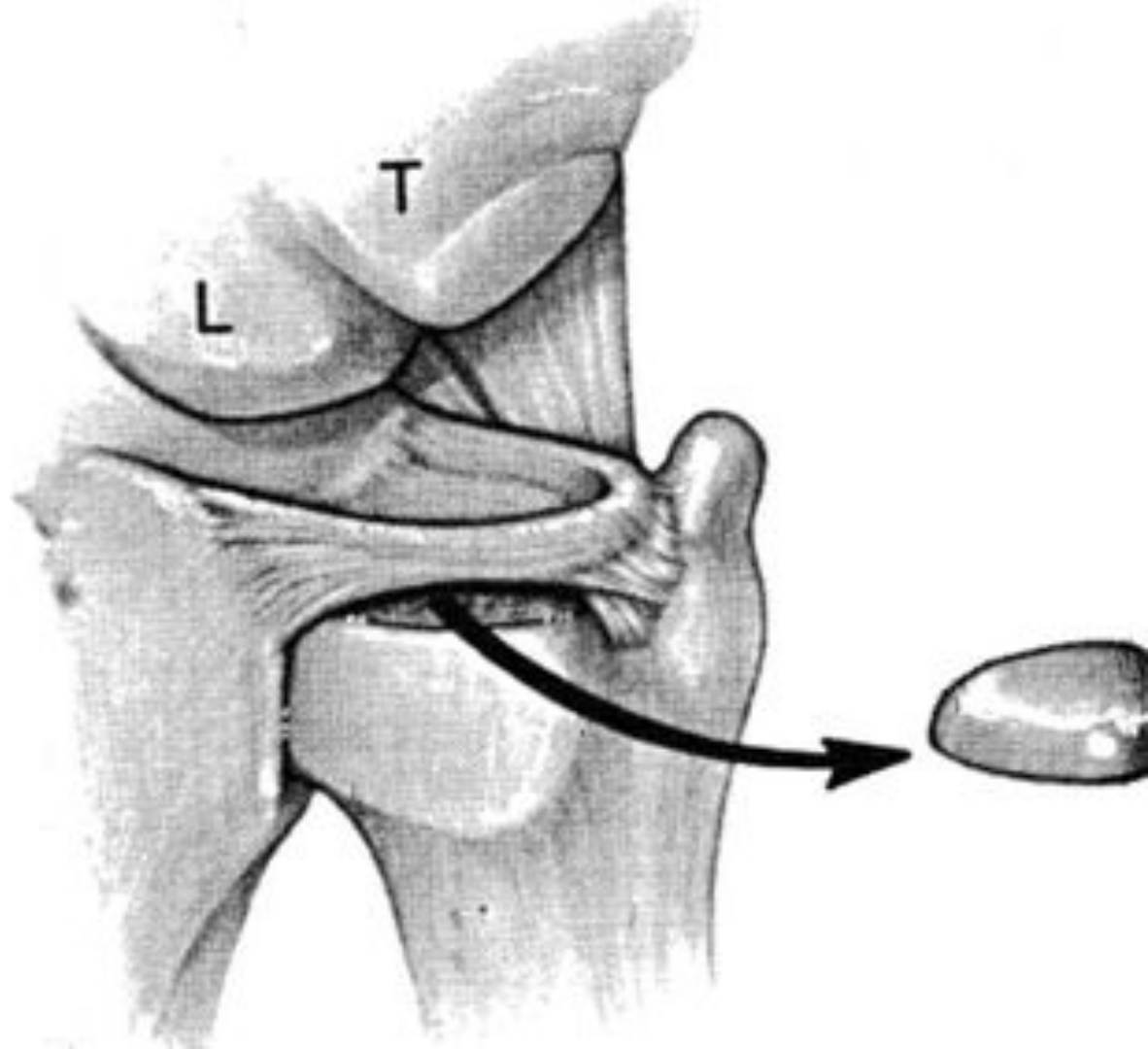
Normal axial loading has 20% of load through ulna, with 80% through radius

2.5 mm ulnar positivity can increase load through the ulna to 40%

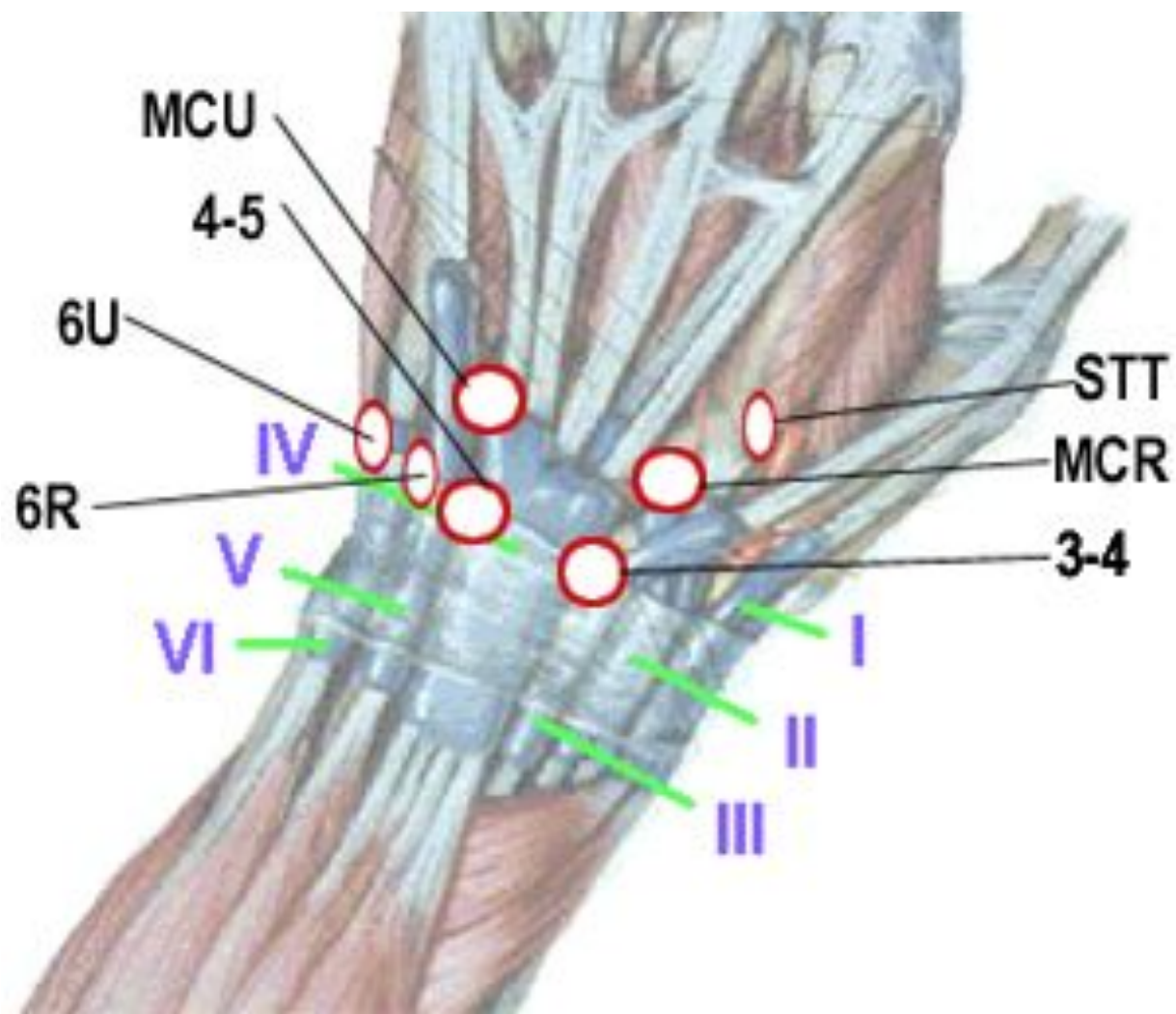
## Wafer procedure

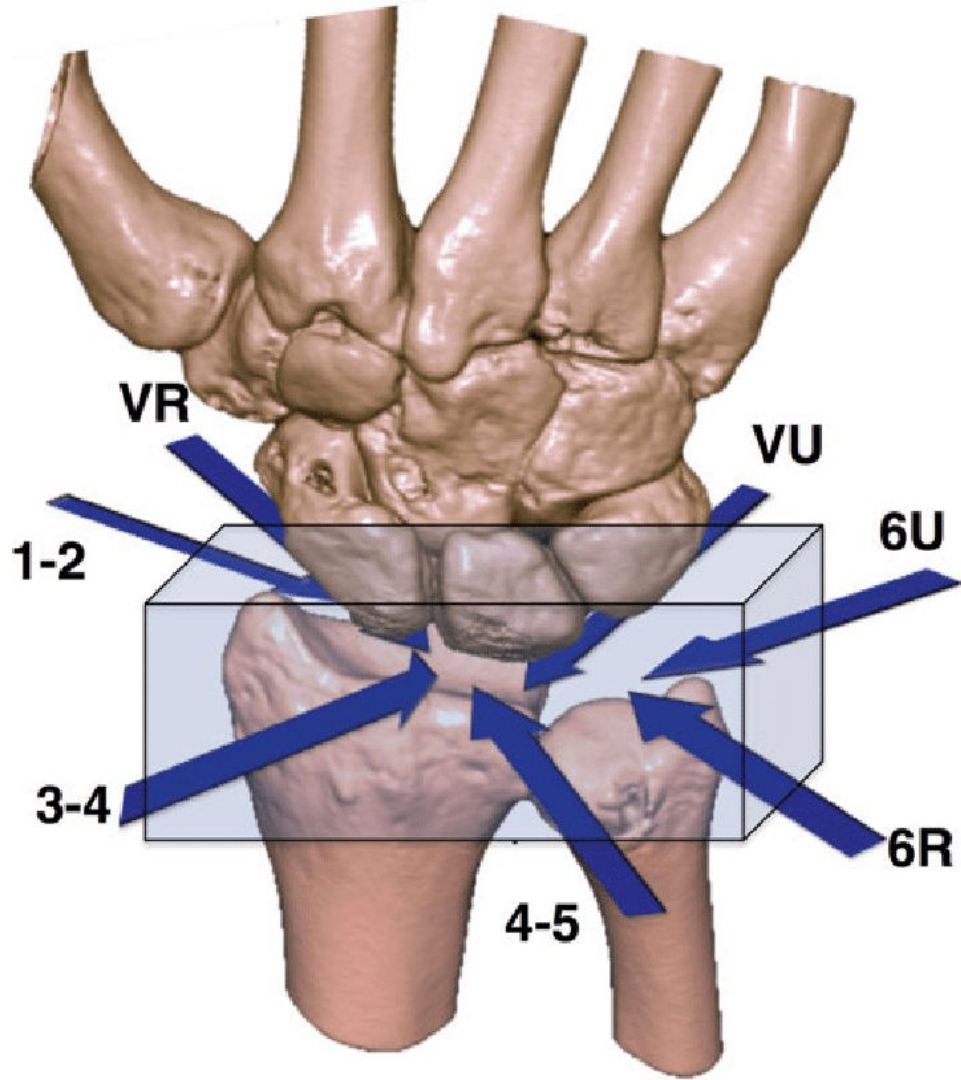
Type II with ulnar positive variance is  $< 2\text{mm}$



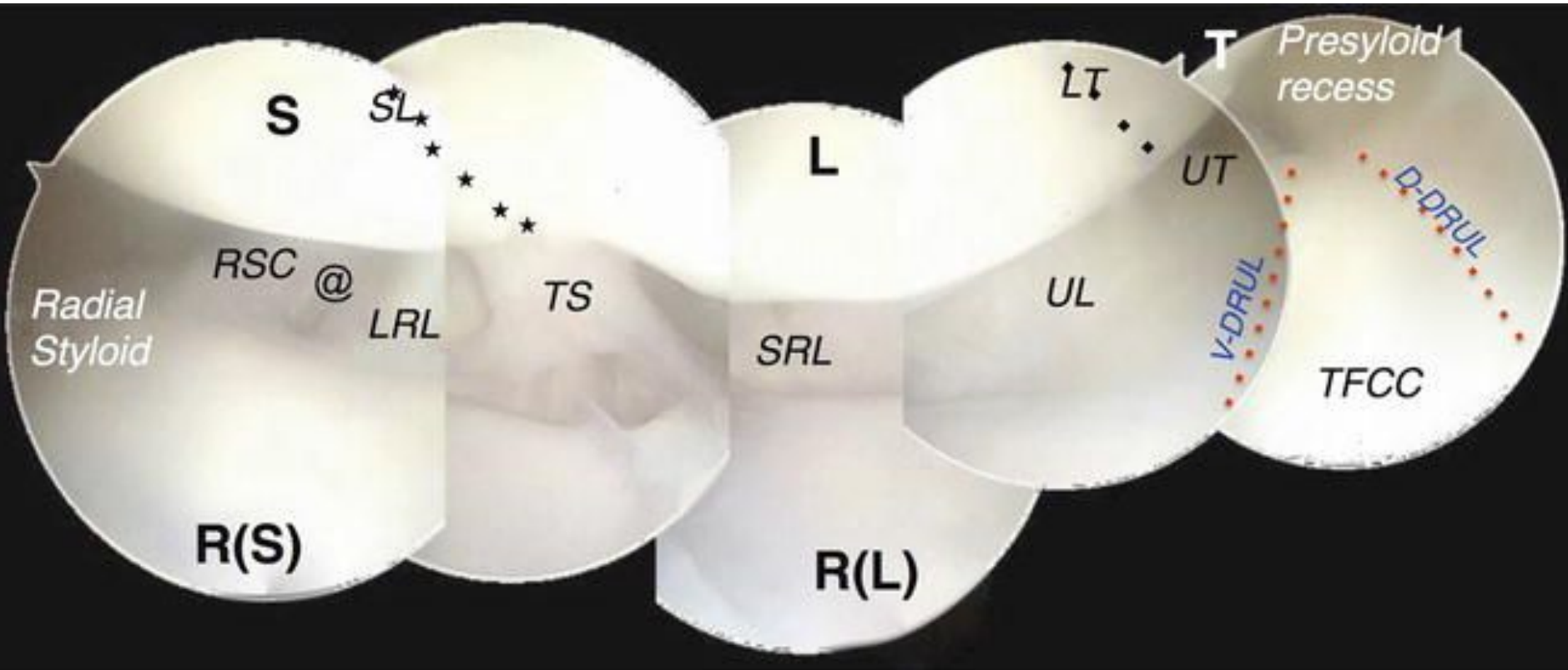




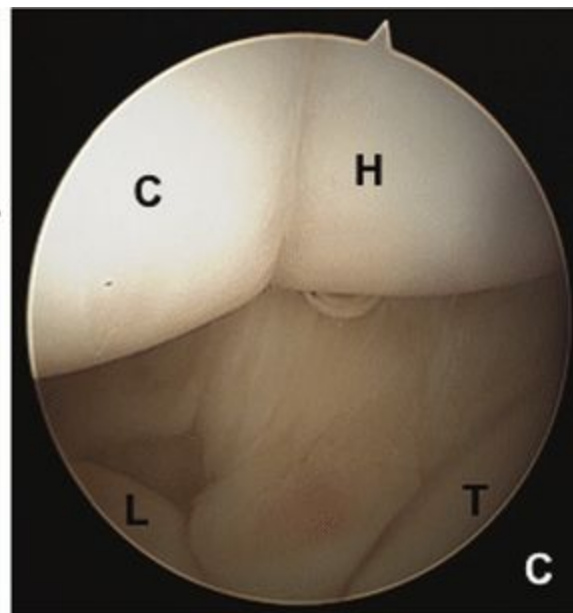
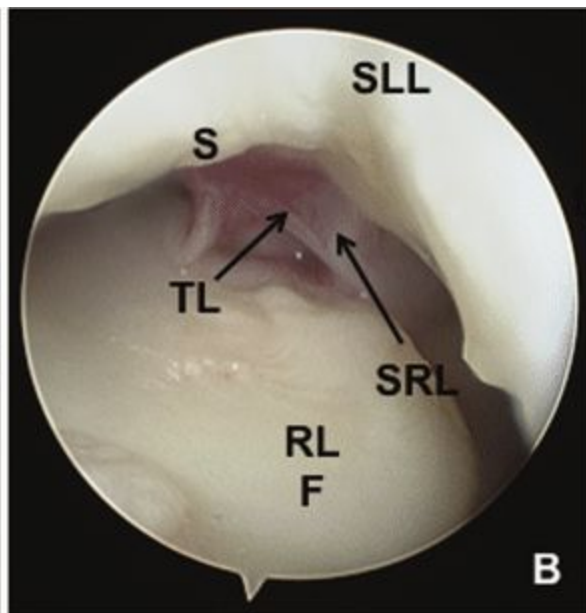
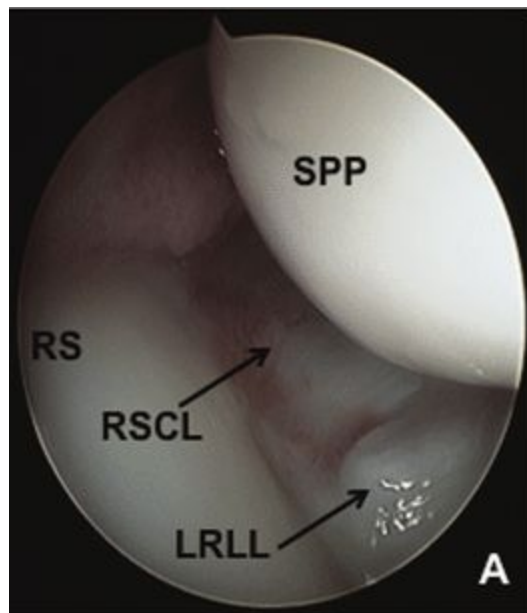




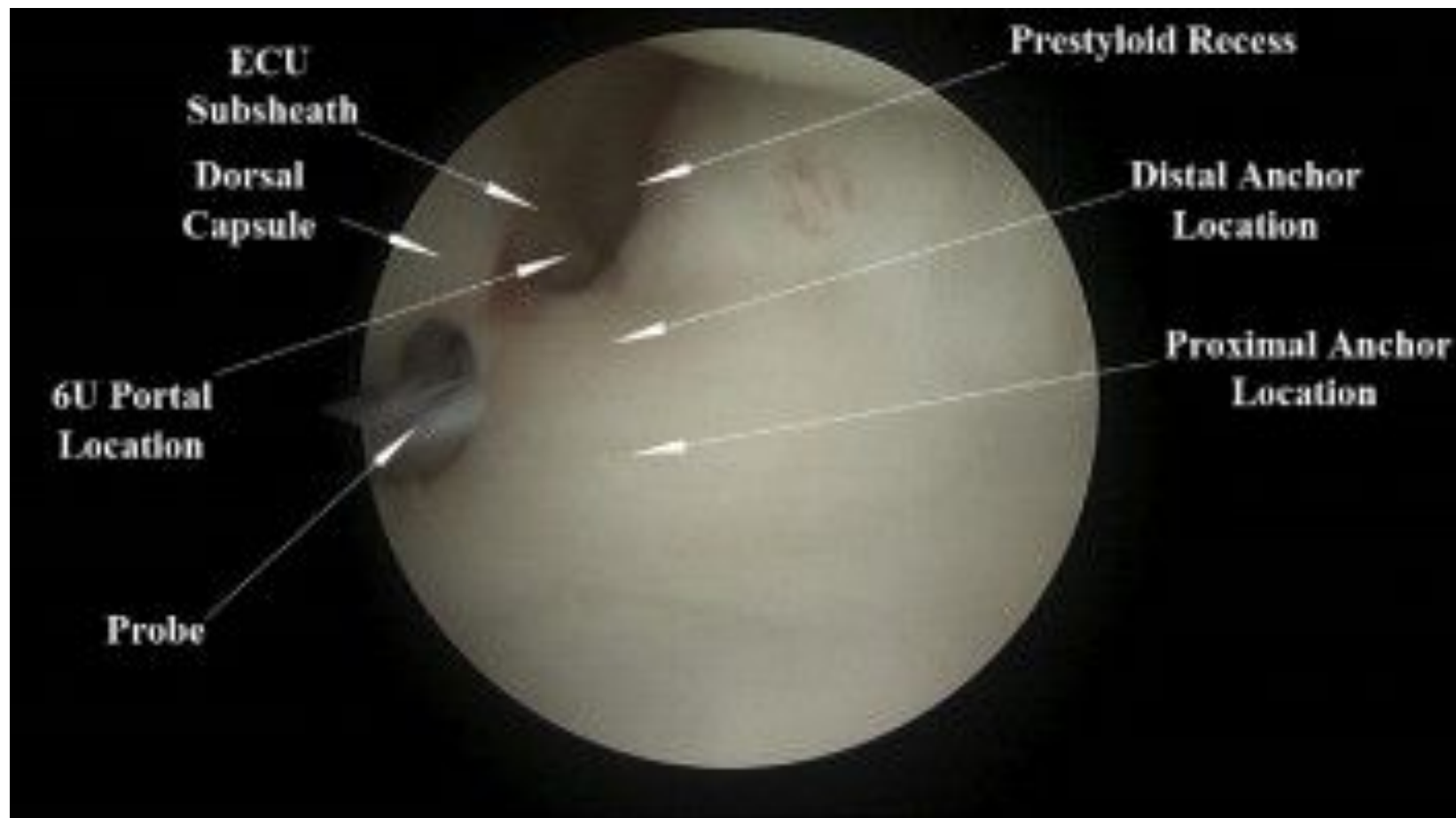




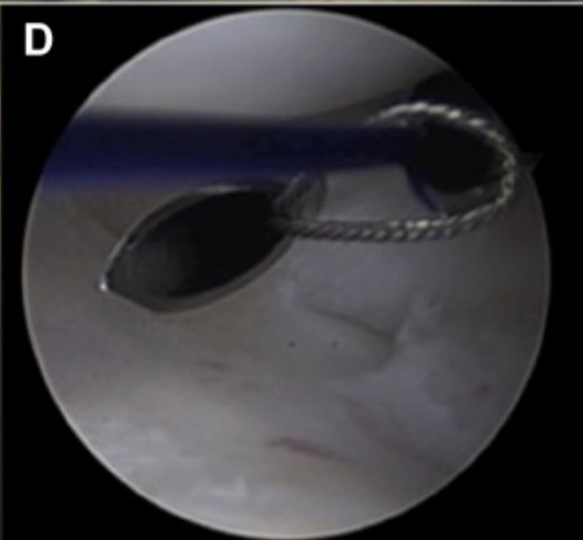
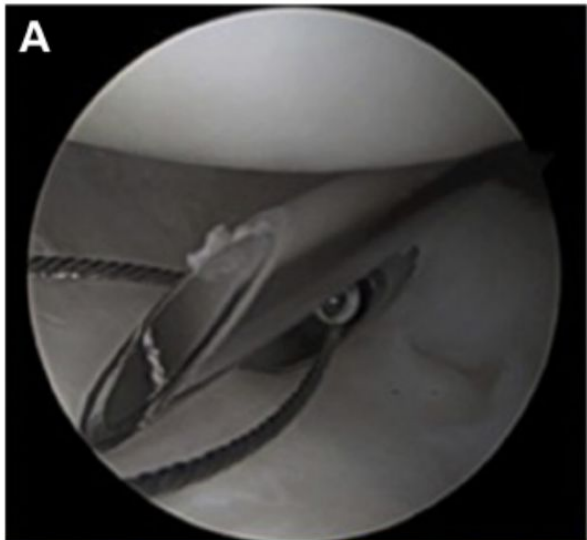


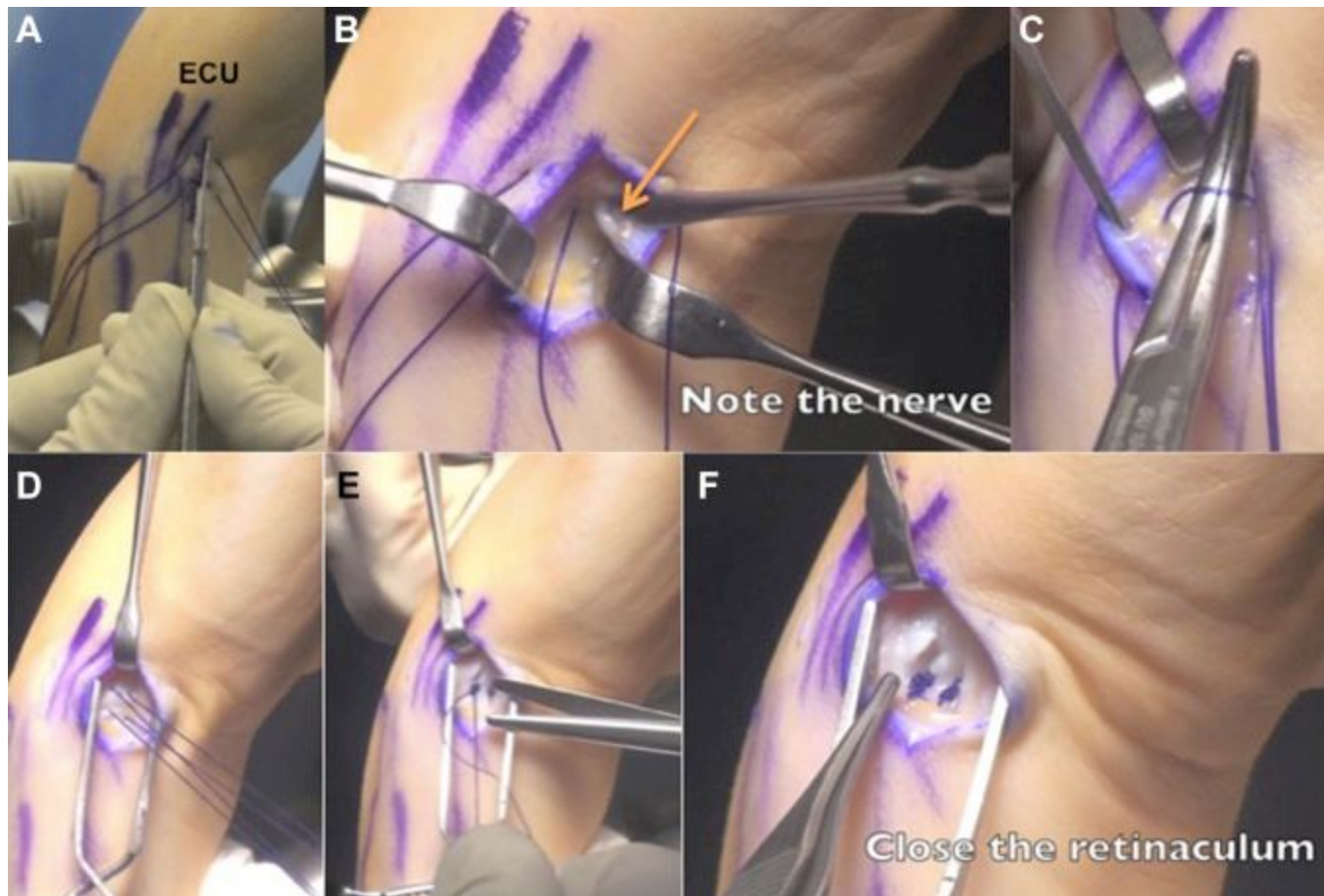


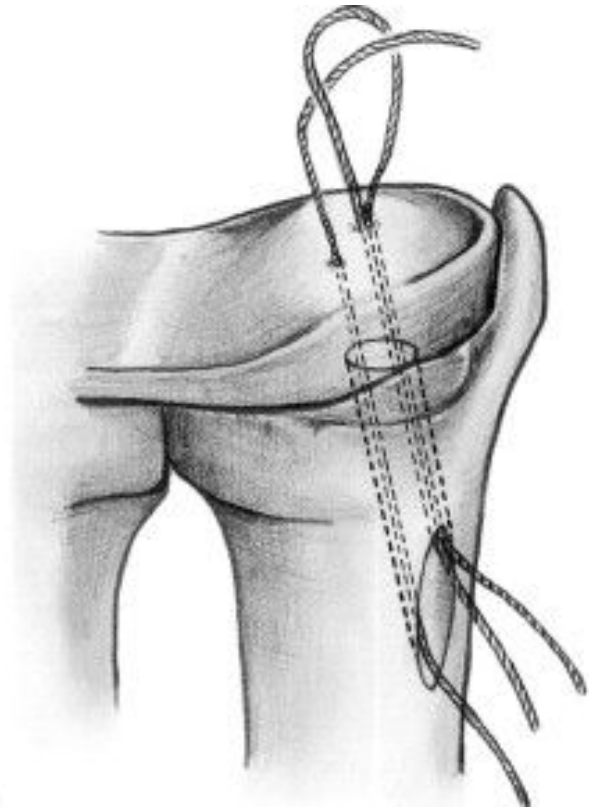




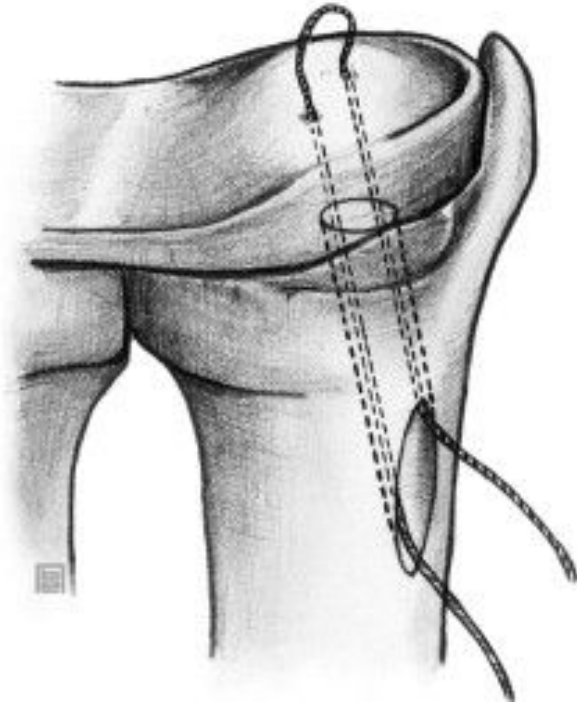




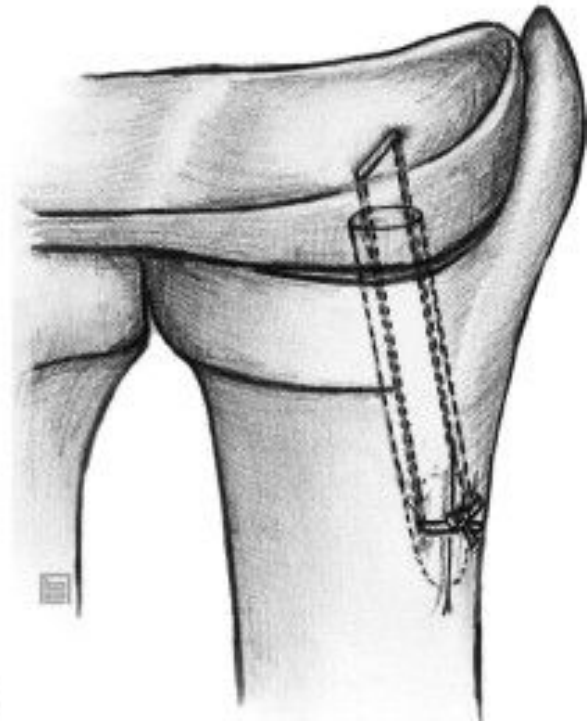




**A**



**B**



**C**

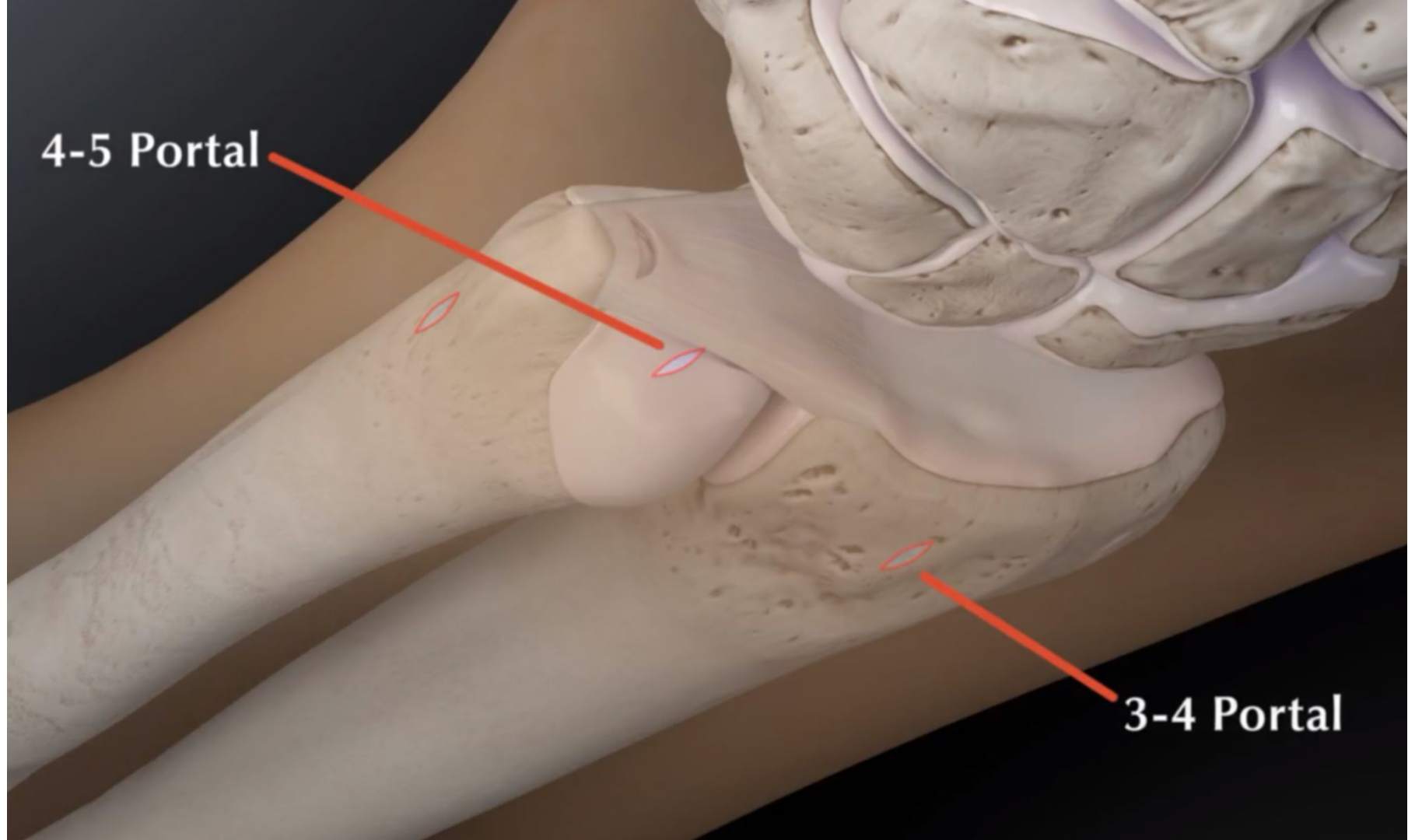


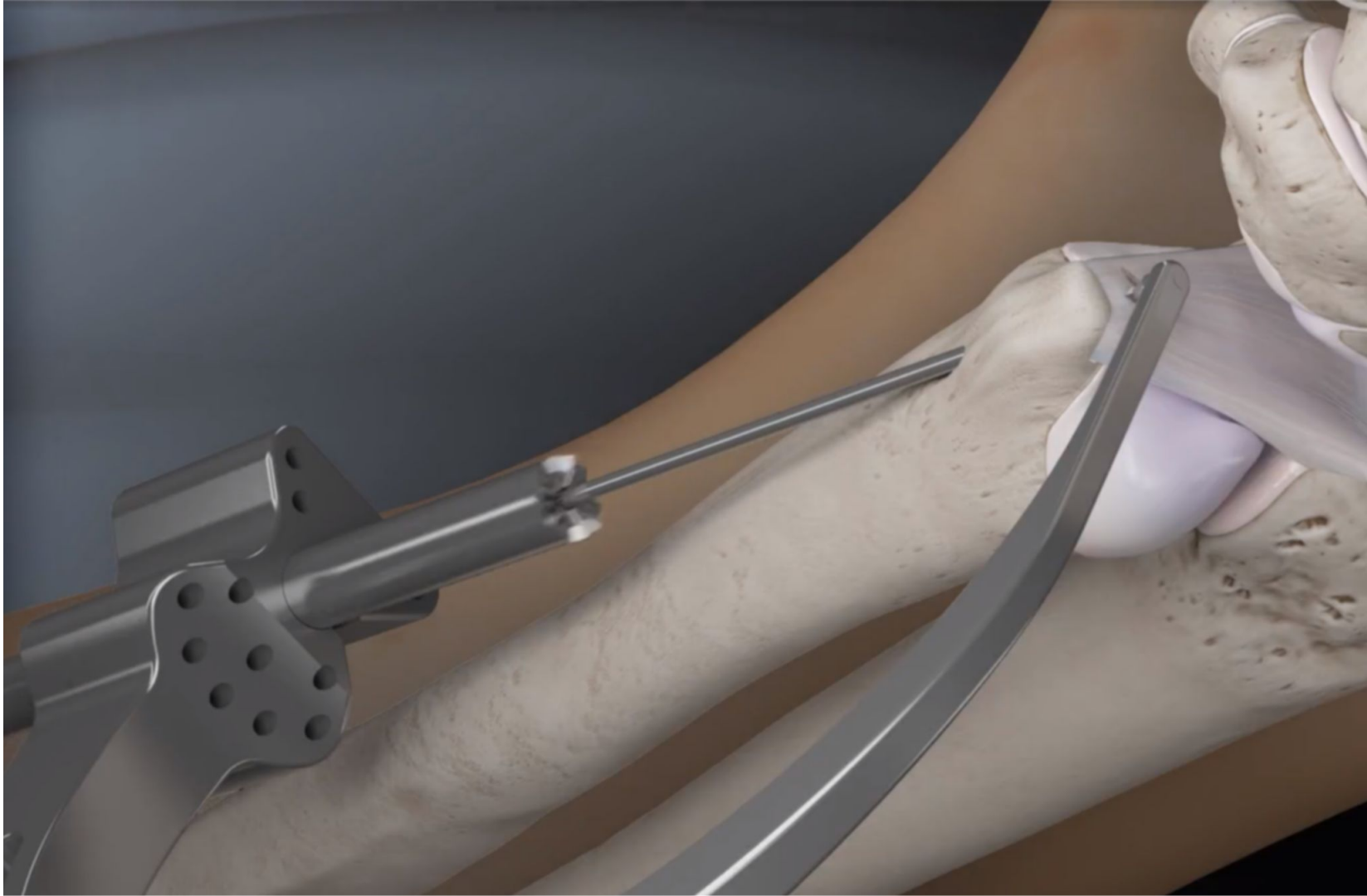


**4-5 Portal**

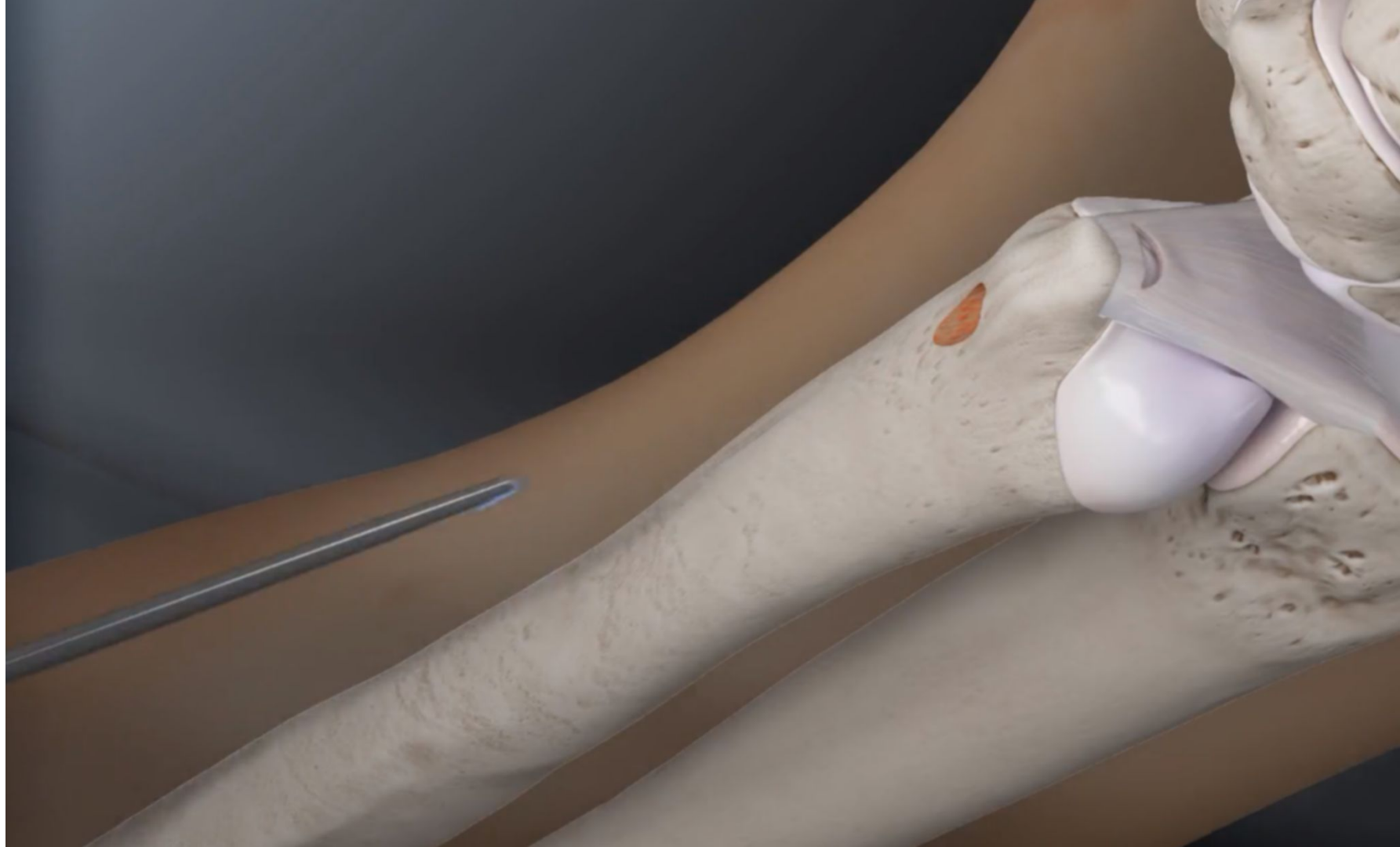


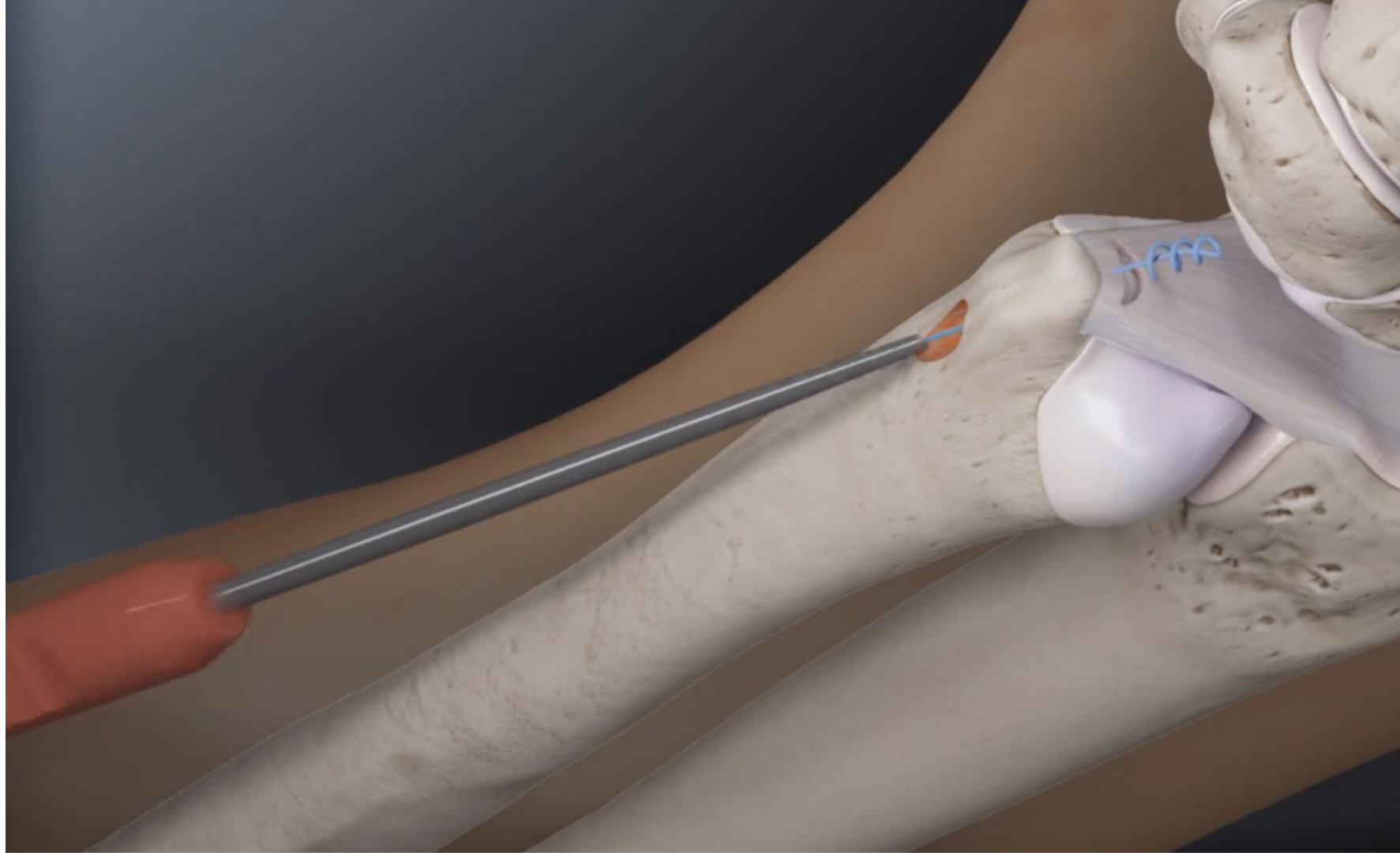
**3-4 Portal**

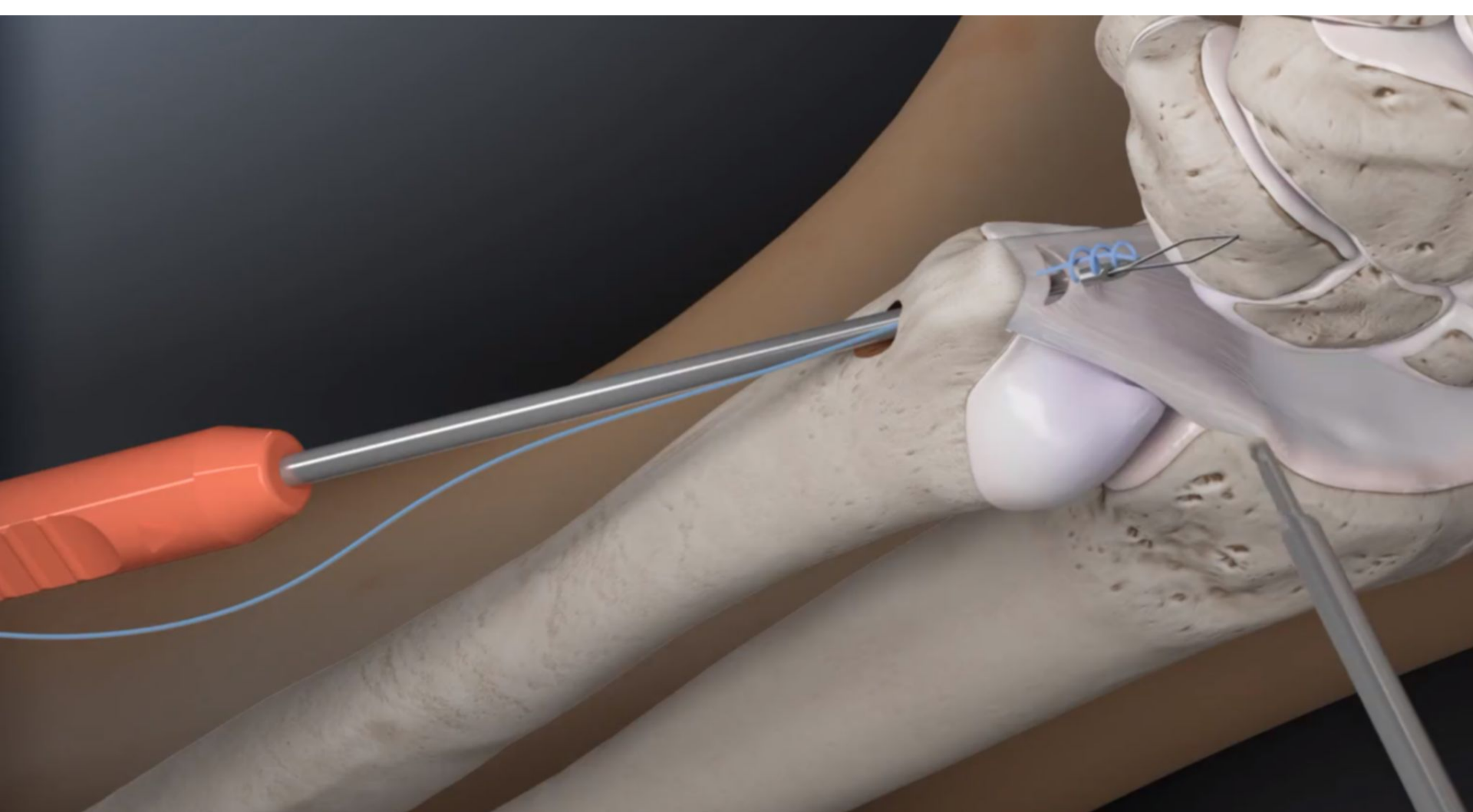


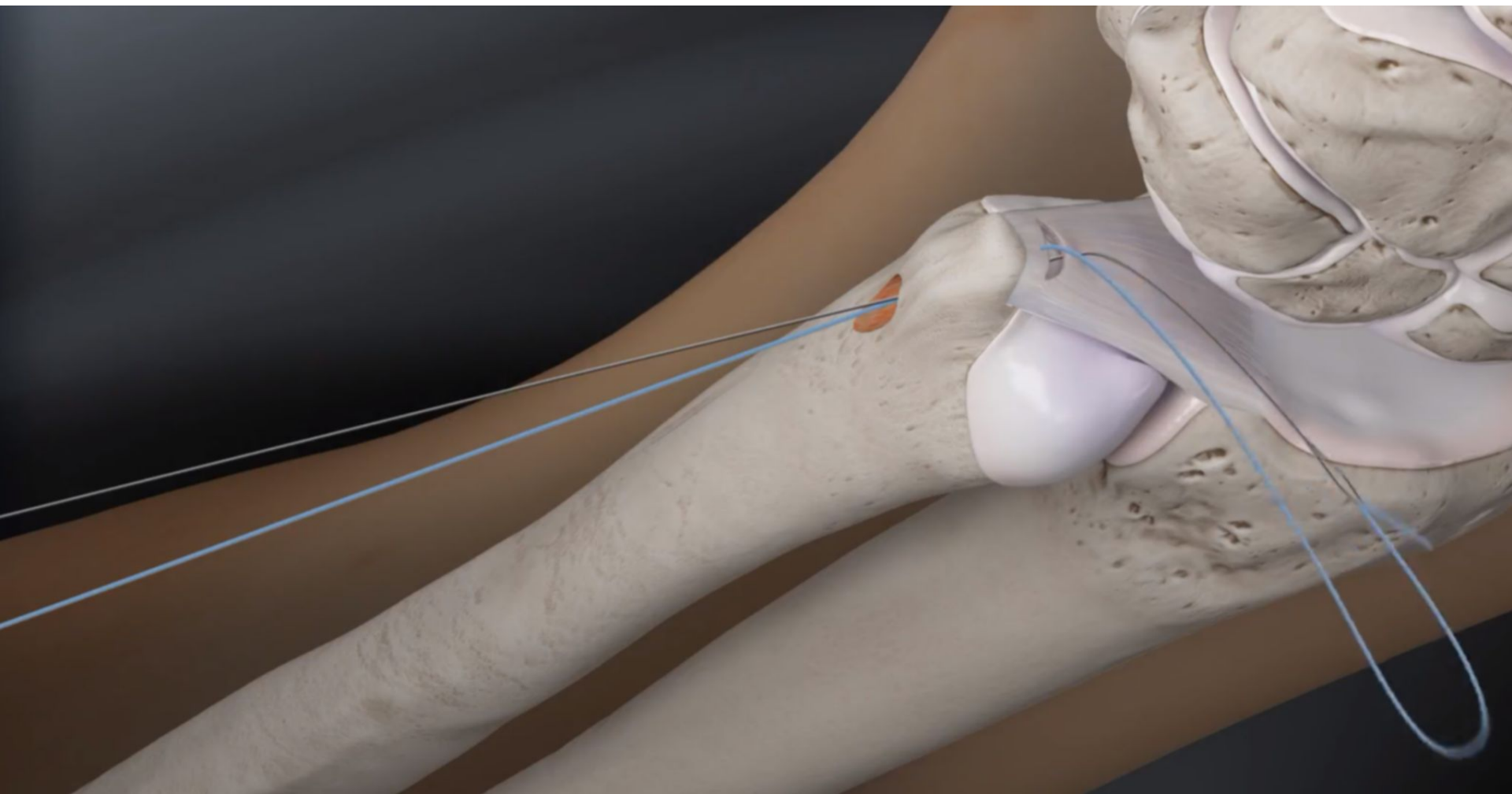


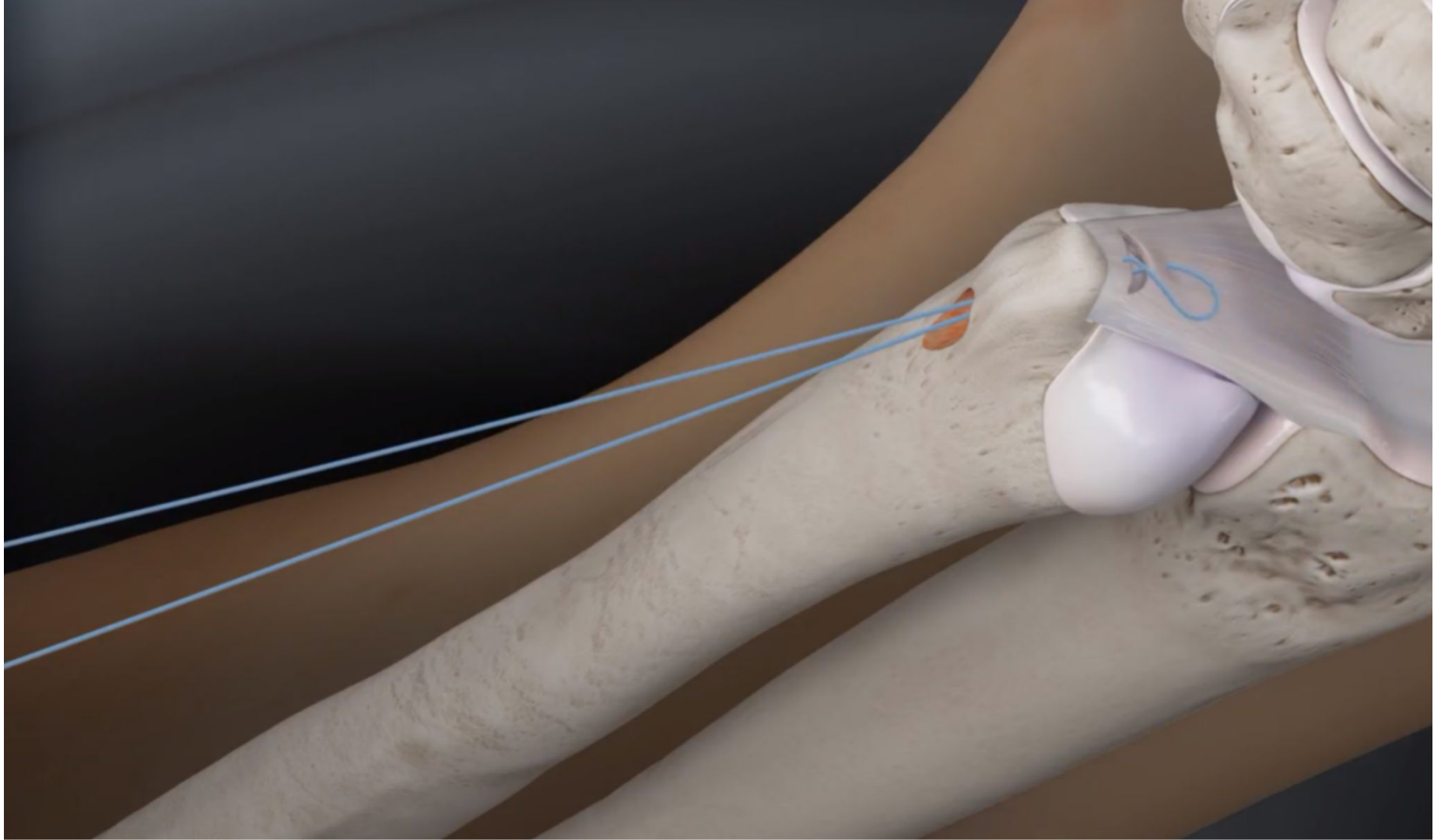




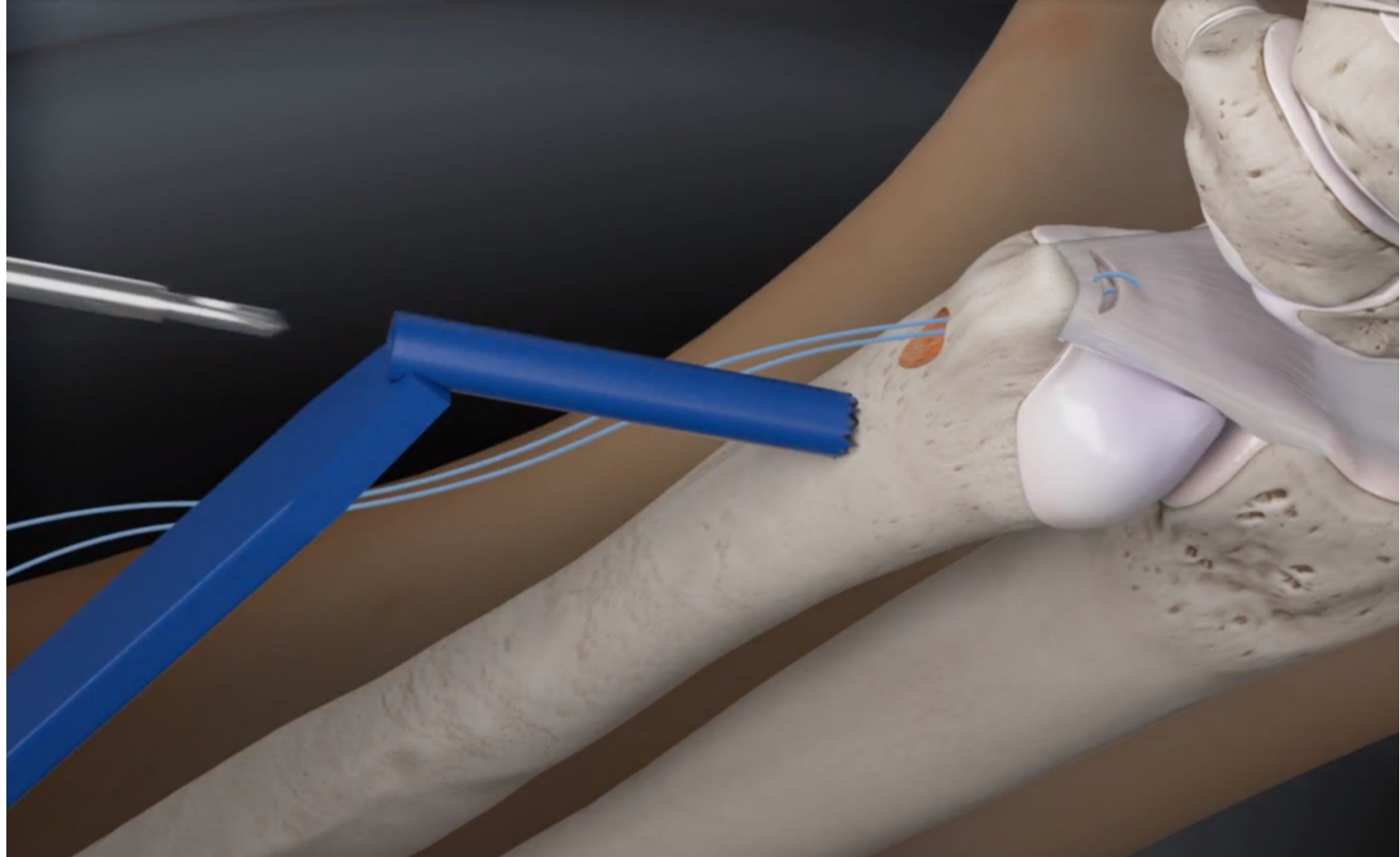


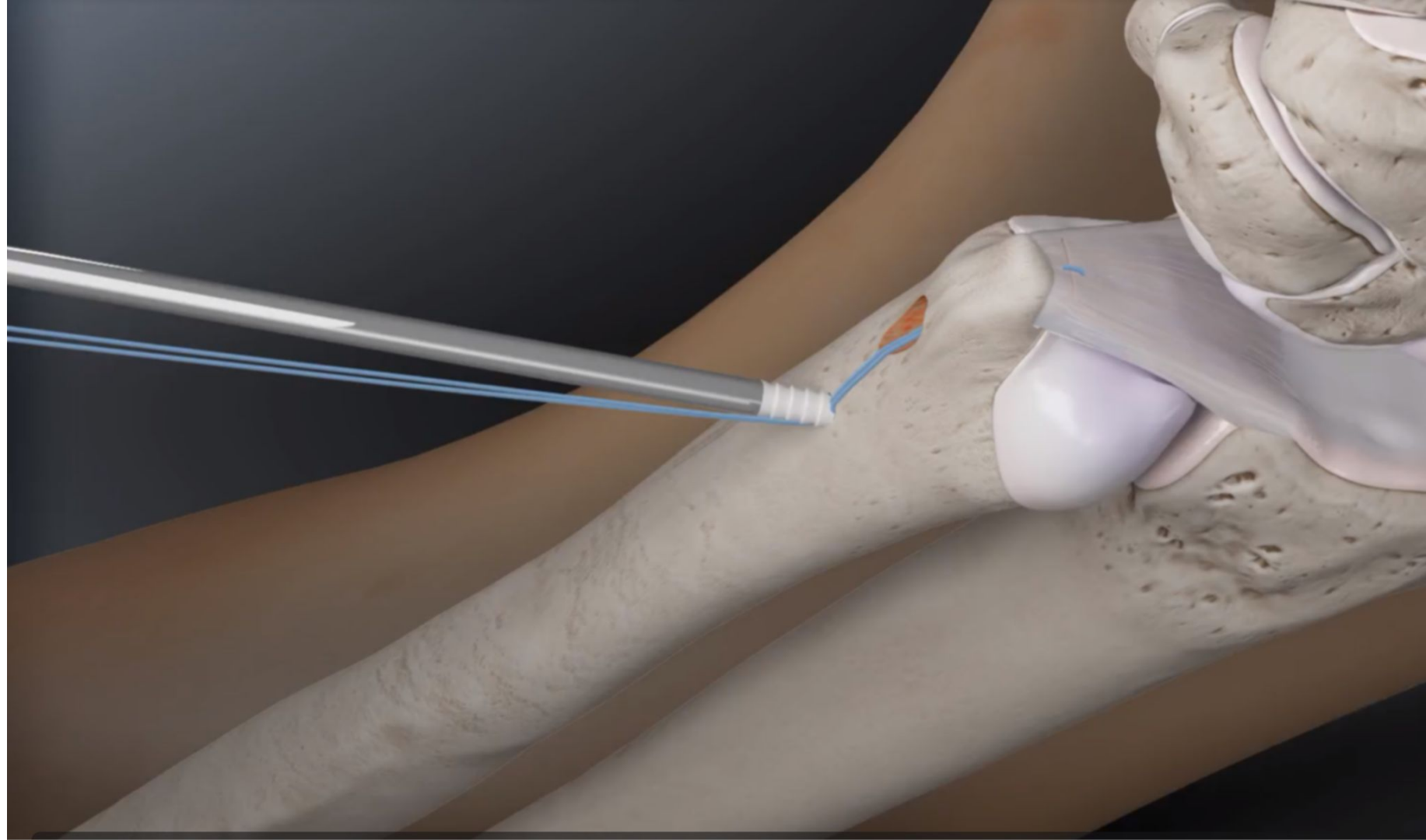


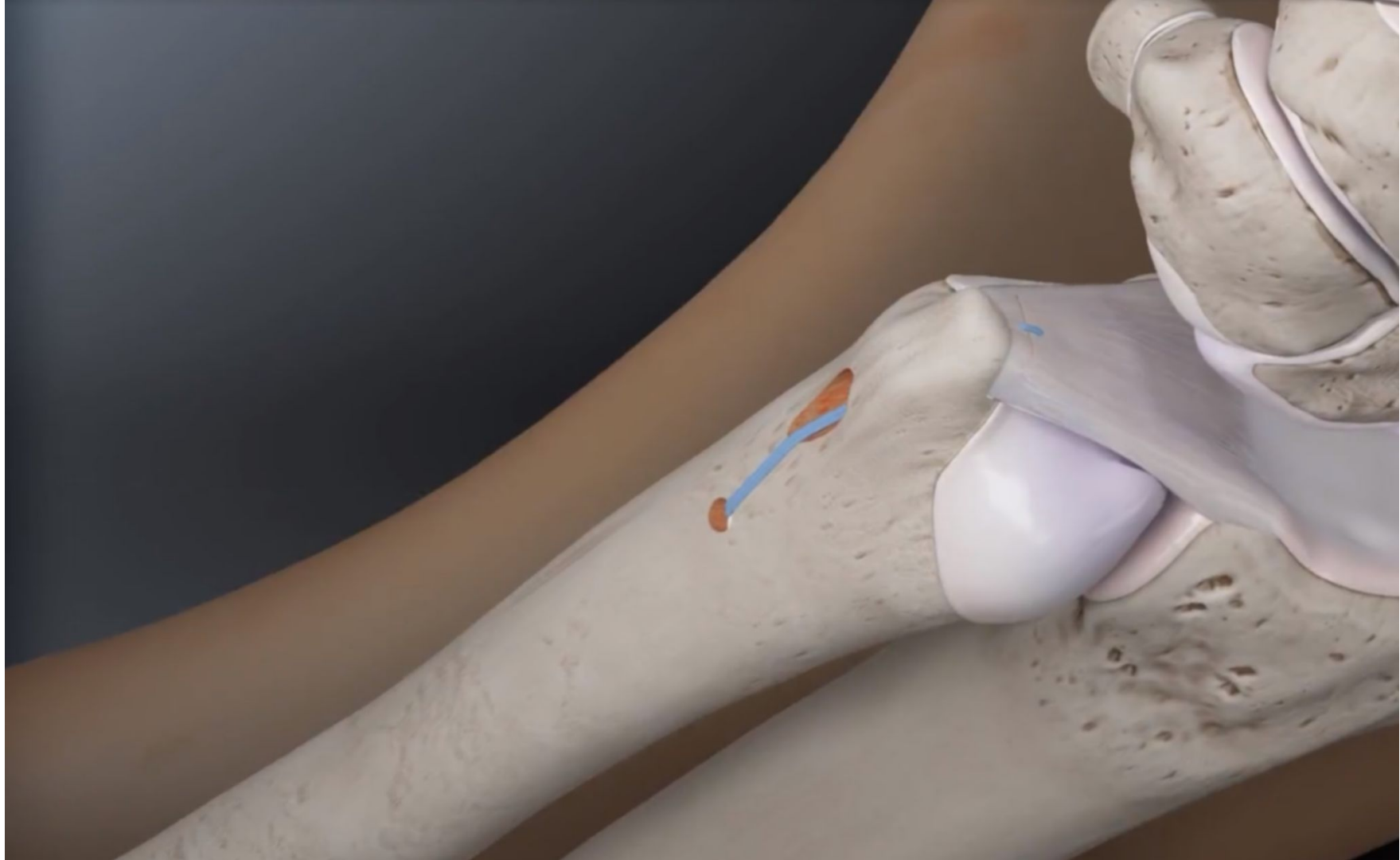












# Outcomes

JHS  
The Journal of Hand Surgery

An International Journal Devoted  
to Surgery of the Upper Extremity

# Arthroscopic Treatment of Peripheral Triangular Fibrocartilage Complex Tears With the Deep Fibers Intact

Robert W. Wysocki, MD   • Marc J. Richard, MD • Matthew M. Crowe, MS • Fraser J. Leversedge, MD • David S. Ruch, MD

Published: February 10, 2012 • DOI: <https://doi.org/10.1016/j.jhsa.2011.12.023>

Retrospective review of twenty-nine wrists were treated arthroscopically for peripheral TFCC tears with outside-in suture repair

Patients were evaluated at greater than 1 year with range of motion, grip strength, standard outcome measures, and a survey assessing return to work and sports

Significant improvement in DASH and VAS scores

Of 11 high-level athletes in the total cohort, 7 (64%) were able to return to sports, including all of those in racquet sports; however, athletes who bore weight through their hands were unable to return to their sporting activity.

# Arthroscopically Assisted Repair of Triangular Fibrocartilage Complex Foveal Tears

Takaaki Shinohara, MD, PhD   • Masahiro Tatebe, MD, PhD • Nobuyuki Okui, MD, PhD •

Michiro Yamamoto, MD, PhD • Shigeru Kurimoto, MD • Hitoshi Hirata, MD, PhD

DOI: <https://doi.org/10.1016/j.jhsa.2012.11.008>

11 patients underwent arthroscopically assisted repair for traumatic TFCC foveal lesions. The mean age at the time of surgery was 27 years. The mean follow-up was 30 months

All patients underwent arthroscopy-assisted foveal reattachment of the TFCC by means of a transosseous outside-in technique


Pain completely resolved in 7 patients, whereas mild pain during activity persisted in 4 patients. Grip strength improved significantly after surgery, from 84% to 98% of the unaffected side. Nine patients had no DRUJ instability and 2 had mild DRUJ instability at final follow-up



# Subjective and objective results of arthroscopic debridement of ulnar-sided TFCC (Palmer type 1B) lesions with stable distal radio-ulnar joint

Authors

[Authors and affiliations](#)

Eloy Cardenas-Montemayor, Jan Felix Hartl , Maya B. Wolf, Franck Marie Leclère, Jens Dreyhaupt, Peter Hahn,

Frank Unglaub

36 patients diagnosed with Palmer type 1B tears underwent arthroscopic debridement. 31 patients (15 males and 16 females) were followed up for an average of 26.7 months ( $\pm 17.4$  months) postoperatively. Their average age was 36.7 years ( $\pm 12.7$  years).

Arthroscopic debridement of Palmer type 1B lesions in stable DRUJ yields satisfactory to excellent results. Our study showed similar results compared with the studies of arthroscopic suture repair with shorter postoperative care and fewer complications.

# The Outcomes of Arthroscopic Repair Versus Debridement for Chronic Unstable Triangular Fibrocartilage Complex Tears in Patients Undergoing Ulnar-Shortening Osteotomy

Joong-Bae Seo, MD • Jong-Pil Kim, MD   • Hyung-Suk Yi, MD • Kwang-Hee Park, MD

Published: March 30, 2016 • DOI: <https://doi.org/10.1016/j.jhsa.2016.02.009>

Arthroscopic debridement

31 patients who underwent debridement vs repair combined with USO for unstable TFCC tears and were followed-up at a minimum of 24 months

Both cohorts showed significant improvements in grip strength and subjective scores at the final follow-up. Grip strength, DASH, and PRWE scores were better in the repair group than in the debridement group. The recovery rate from DRUJ instability observed during the preoperative examination was superior in the AR group

Both are reliable procedures with satisfactory clinical outcomes for unstable TFCC tears in ulnar-positive patients. Repair of the TFCC is suggested if DRUJ stability is concomitantly compromised.


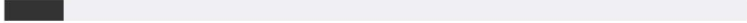
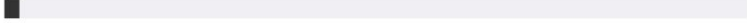
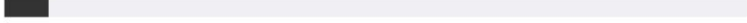
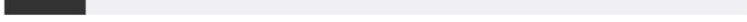
# Questions

Which of the following structures is an anatomical component of the triangular fibrocartilage complex?

---

- 1 Extensor carpi ulnaris tendon sheath
- 2 Lunotriquetral interosseous ligament
- 3 Extensor digiti minimi tendon sheath
- 4 Radioscaphocapitate ligament
- 5 Flexor carpi ulnaris tendon sheath

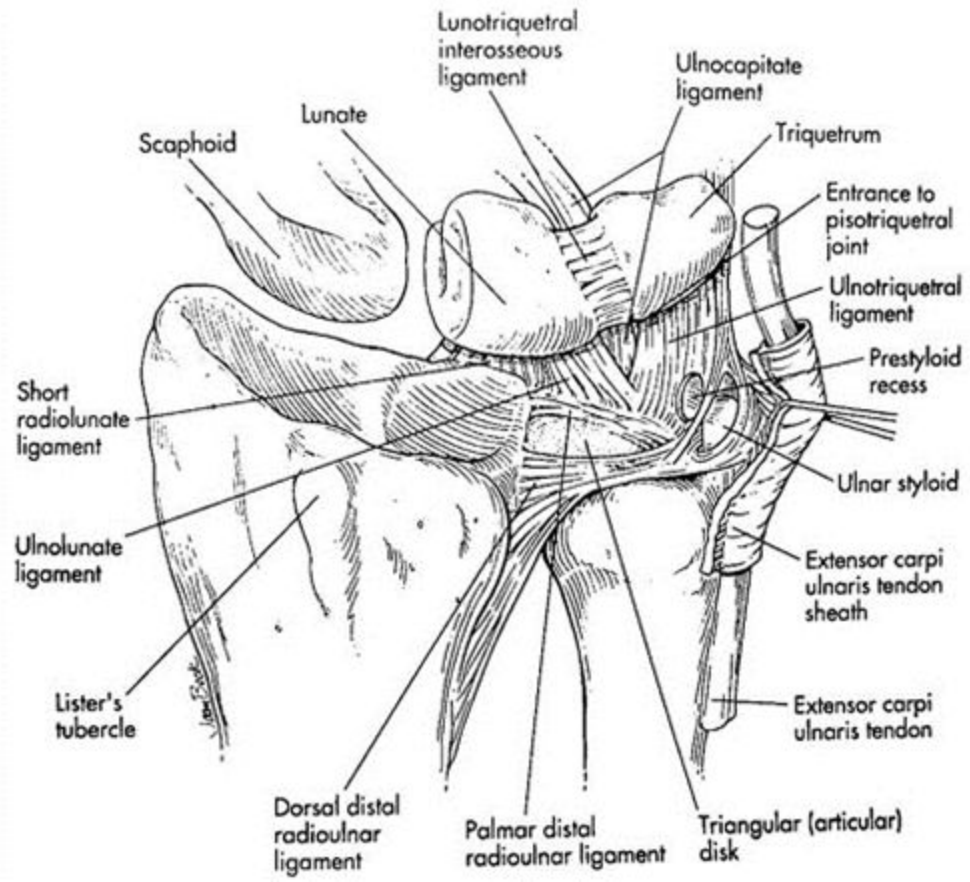
Which of the following structures is an anatomical component of the triangular fibrocartilage complex?

1	Extensor carpi ulnaris tendon sheath		73%	3868/5334
2	Lunotriquetral interosseous ligament		8%	446/5334
3	Extensor digiti minimi tendon sheath		2%	87/5334
4	Radioscaphocapitate ligament		6%	310/5334
5	Flexor carpi ulnaris tendon sheath		11%	588/5334

The extensor carpi ulnaris tendon sheath is part of the triangular fibrocartilage complex (TFCC).

Palmer et al studied the anatomy and function of the TFCC through anatomical dissections and biomechanical testing. The TFCC was found to be composed of the sheath of the extensor carpi ulnaris (ECU), an articular disc, the dorsal and volar radioulnar ligaments, the meniscus homologue, and the ulnar collateral ligament. Biomechanically, they determined that the TFCC functions as a cushion at the ulnocarpal interface, and is a major stabilizer of the DRUJ.

Nakamura et al histologically examined the origins and insertions of the TFCC in fresh-frozen cadaver wrists. They found that the floor of the ECU sheath originated from the dorsal side of the fovea of the ulna, through an arrangement of Sharpey's fibers.





A 34-year-old right-hand-dominant squash player falls onto an outstretched hand during a qualifying match. Since this fateful match, he has had ulnar-sided wrist pain, decreased range of motion, and periodic clicking in his wrist. The physical exam finding in Figure A is noted, in which you are able to manipulate and easily translate the ulna against the radius. This finding is not present on his contralateral wrist. The deep portion of the injured ligamentous structure inserts on what anatomical landmark?

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- 1 Ulnar styloid
- 2 Ulnar fovea
- 3 Dorsal radio-ulnar capsule
- 4 Dorsal oblique band of the interosseous membrane
- 5 Radial styloid



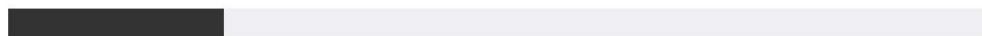
A 34-year-old right-hand-dominant squash player falls onto an outstretched hand during a qualifying match. Since this fateful match, he has had ulnar-sided wrist pain, decreased range of motion, and periodic clicking in his wrist. The physical exam finding in Figure A is noted, in which you are able to manipulate and easily translate the ulna against the radius. This finding is not present on his contralateral wrist. The deep portion of the injured ligamentous structure inserts on what anatomical landmark?

---

- 1 Ulnar styloid
- 2 Ulnar fovea
- 3 Dorsal radio-ulnar capsule
- 4 Dorsal oblique band of the interosseous membrane
- 5 Radial styloid

1

Ulnar styloid



22% 499/2295

2

Ulnar fovea



51% 1164/2295

3

Dorsal radio-ulnar capsule



15% 352/2295

4

Dorsal oblique band of the interosseous membrane



11% 241/2295

5

Radial styloid



1% 24/2295

Mulford and Axelrod comprehensively reviewed traumatic injuries of the DRUJ and describe a step-wise approach to treatment. For acute injuries with mild instability, the authors recommend immobilization in the position of stability for 4-6 weeks. For complex injuries that are irreducible, open reduction and stabilization is required. For complex, reducible injuries with an ulnar styloid fracture, the authors recommend open reduction and internal fixation. Without an ulnar styloid fracture, the authors recommend TFCC repair, pinning the reduced DRUJ, and immobilization for 4-6 weeks.

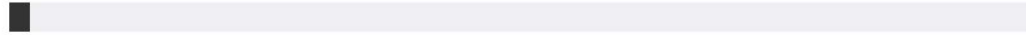
Abe et al. reviewed 29 patients who underwent open or arthroscopic repair of foveal tears of the TFCC. The groups did not differ in pain, ROM, stability, or subjective outcome scores. The authors found that operative time was significantly lower in the arthroscopic group but upheld that either technique is efficacious so long as the TFCC is secured to the ulnar fovea.

A 30-year-old male laborer sustained a right wrist injury 9 months ago. He continues to have symptoms of recurrent ulnar-sided wrist pain that impairs his ability to work. An MRI is performed and shows a triangular fibrocartilage complex (TFCC) injury. Which of the following is an indication to combine a Wafer procedure with arthroscopic TFCC debridement?

- 
- 1 Ulnar styloid fracture
  - 2 Radial styloid fracture
  - 3 2 mm of positive ulnar variance and ulnocarpal impingement
  - 4 2 mm of negative ulnar variance and radiocarpal joint arthritis
  - 5 Scapholunate ligament injury

1

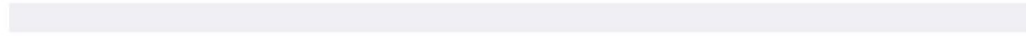
Ulnar styloid fracture



2% 140/5990

2

Radial styloid fracture



0% 26/5990

3

2 mm of positive ulnar variance and ulnocarpal impingement



91% 5441/5990

4

2 mm of negative ulnar variance and radiocarpal joint arthritis



4% 229/5990

5

Scapholunate ligament injury



2% 98/5990



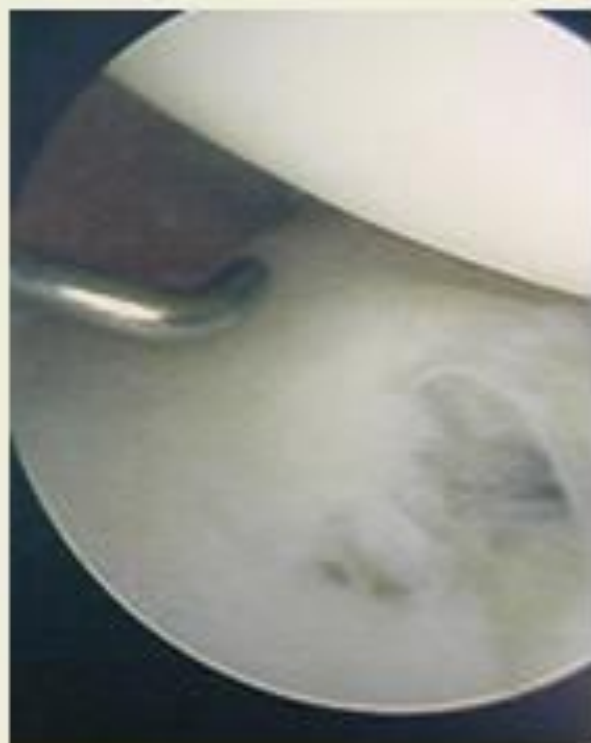




MRI with TFCC tear



TFCC tear seen through the scope



A 20-year-old park ranger trips and falls onto his right wrist with the wrist in extension and pronation. The local urgent care orders both radiographs and a CT, which you review and determine to be normal. The patient complains of ulnar-sided wrist pain. On exam, his tenderness is localized to the fovea. Ulnar deviation also causes him pain. There is no snapping sensation with wrist supination, flexion, and ulnar deviation. He otherwise has 5/5 strength to his first dorsal interosseous muscle with 4mm static two-point discrimination on the ulnar side of the 4th digit. Which of the following injuries is most likely responsible for his symptoms and exam?

- 
- 1 TFCC tear
  - 2 Ulnar styloid fracture
  - 3 Hook of hamate fracture
  - 4 Ulnar nerve injury in Guyon's canal
  - 5 ECU subluxation

1

TFCC tear



90% 1674/1869

2

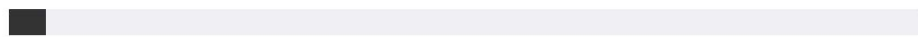
Ulnar styloid fracture



2% 37/1869

3

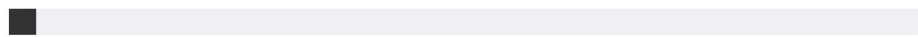
Hook of hamate fracture



4% 73/1869

4

Ulnar nerve injury in Guyon's canal



3% 50/1869

5

ECU subluxation



1% 22/1869

The most common mechanism of injury to the triangular fibrocartilage complex (TFCC) involves

---

- 1 wrist extension and forearm pronation.
- 2 wrist extension and forearm supination.
- 3 wrist flexion and forearm pronation.
- 4 wrist flexion and forearm supination.
- 5 axial load in ulnar deviation.

1

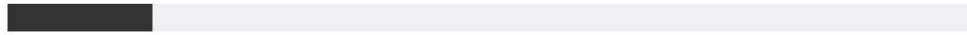
wrist extension and forearm pronation.



55% 716/1298

2

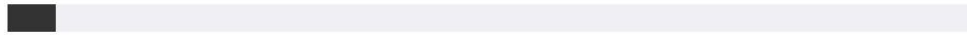
wrist extension and forearm supination.



15% 201/1298

3

wrist flexion and forearm pronation.



5% 67/1298

4

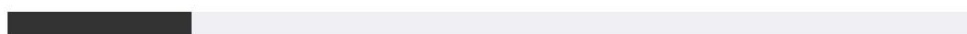
wrist flexion and forearm supination.



4% 55/1298

5

axial load in ulnar deviation.



19% 253/1298