CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

TFCC Repair

Anatomy & Pathophysiology

ANATOMICAL COMPONENTS

- The triangular fibrocartilage complex (TFCC) consists of the dorsal and volar radioulnar ligaments, the articular disc, a meniscus homologue, the extensor carpi ulnaris (ECU) tendon, and the ulnolunate and ulnotriquetral ligaments [13].
- The TFCC is subjected to considerable axial loading and shear stresses [9].
- The ulnar attachment of the TFCC is a three-dimensional complex comprising proximal radioulnar ligaments, a distal hammock structure (fibrocartilage disk, meniscus homologue, and ulnocarpal ligaments), and a functional ulnar collateral ligament (UCL) consisting of the ECU tendon subsheath and thickened ulnar capsule [9].
- The distal hammock structure and the UCL constitute the distal component of the TFCC (dc-TFCC), while the radioulnar ligament represents the proximal component (pc-TFCC) [9].
- The dorsal and volar radioulnar ligaments span from the dorsal and volar corners of the distal radius to a broad area of the fovea at the base of the ulnar styloid [9].
- A more superficial component of the radioulnar ligaments runs obliquely and distally to the ulnar styloid [9].
- The deep foveal components are considered the true radioulnar ligaments that stabilize the distal radioulnar joint (DRUJ) [9].
- Frank DRUJ instability can occur when the proximal foveal component is injured, even if the distal component remains intact [9].
- The ulnar styloid provides attachments for portions of the ulnocarpal ligaments, the ECU tendon sheath, and superficial limbs of the radioulnar ligaments [12].
- The deep limbs of the radioulnar ligaments insert into the fovea of the ulnar head [12].
- The tip of the ulnar styloid is devoid of soft tissue attachments [12].
- The ulnotriquetral (UT) ligament arises from the palmar radioulnar ligament and attaches to the palmar and ulnar triquetrum, forming an essential element of the TFCC [6].

CQ HAND + UPPER LIMB
Dr Kieran Hirpara — Specialist Orthopaedic Surgeon
Suite 2, Level 1, Mater Private Hospital Rockhampton, 31 Ward Street, The Range, QLD 4700
Phone 07 4863 6556 · office@cqupperlimb.com.au · cqupperlimb.com.au

BIOMECHANICS AND LOAD DISTRIBUTION

- In a wrist with neutral variance, 80% of compressive loads are transmitted through the radius and 20% through the ulna [13].
- In a wrist with +2 mm ulnar variance, 60% of compressive loads are transmitted through the radius and 40% through the ulna [13].
- The most important stabilizers of the DRUJ during pronosupination are the palmar and dorsal radioulnar ligaments [4].
- Damage to either or both of the palmar and dorsal radioulnar ligaments generates pain and instability during forearm rotation [4].
- Biomechanical analysis indicates that traumatic disruptions of the distal radioulnar ligaments from the fovea occur predominantly from tension, though a combination of forces is required to destabilize the joint [4].

INJURY MECHANISMS AND CLINICAL PRESENTATION

- TFCC injuries typically occur with extension and pronation of the axially loaded wrist [9].
- The most common mechanism of TFCC injury is a fall on an outstretched hand [9].
- Peripheral tears of the articular disk are common athletic injuries involving racket sports, golf, or activities requiring rapid twisting and loading to the ulnar side of the wrist [9].
- Peripheral ulnar-sided tears of the articular disk are common work injuries, often resulting from traction or torquing of the forearm when a motorized drill bit binds [9].
- Patients with peripheral TFCC tears complain of deep diffuse pain across the ulnar side of the wrist [9].
- Patients with peripheral TFCC tears frequently report weakness when gripping and a clicking sensation with forearm rotation [9].
- Pain in peripheral TFCC tears is accentuated by passive pronation and supination of the wrist [9].
- Local tenderness in peripheral TFCC tears is located over the dorsal TFCC between the dorsoulnar head and triquetrum and/or over the ulnar snuffbox in supination at the foveal area [9].
- A dorsally prominent ulnar head relative to the radius can be seen in foveal detachments [9].
- Ballottement of the DRUJ reveals increased translation of the joint associated with pain in TFCC injuries [9].
- A class 1A tear typically manifests as ulnar-sided wrist pain aggravated by power grip, especially with ulnar deviation or forearm rotation [7].
- Class 1A tears are confined to the disc, located 2 to 3 mm ulnar to its radial attachment, and oriented volar to dorsal [7].
- Class 1A tears do not cause DRUJ instability [7].
- Symptoms and physical findings associated with a class 1B tear are similar to those of a class 1A tear, although a click is usually absent [12].

- Point tenderness in class 1B tears is characteristically volar to the ulnar styloid, coinciding anatomically with the fovea [12].
- Tenderness at the fovea is termed the fovea sign [12].
- Evaluation of DRUJ stability in class 1B tears is likely to produce pain even if the DRUJ is stable [12].
- A positive ulnar fovea sign was reported to be 90% sensitive and 88% specific in detecting a split tear of the UT ligament [8].

CLASSIFICATION

- The Palmer classification categorizes TFCC tears into traumatic (class 1) or degenerative (class 2) [1].
- Subtypes in the Palmer classification are based on the specific location within the TFCC [1].
- The class and location of the tear have important implications for treatment [1].
- Type I TFCC tears denote traumatic injuries, while type II lesions are degenerative in origin [9].
- Type I injuries are further classified into four types [9].
- Except for type 1A tears, which imply a central articular disk perforation with a stable margin, the other three types of Type I injuries are considered peripheral tears that may cause instability of the DRUJ or ulnocarpal joint, or both [9].
- Estrella and Ho described a dorsal type of tear located at the junction of the dorsal radioulnar ligament and the joint capsule just radial to the ECU tendon subsheath [9].
- Most peripheral lesions of the TFCC are traumatic in origin, though they may also occur in degenerative status due to chronic repetitive loading [9].
- Type 1B tears are among the most common peripheral tears of the TFCC leading to chronic ulnar wrist pain and impairment [9].
- Type 1B tears broadly include all injuries of the TFCC at the ulnar attachment, with or without an accompanied ulnar styloid fracture [9].
- Class 1A injuries are characterized by central perforation or tear [1].
- Class 1B injuries are characterized by ulnar avulsion with or without ulnar styloid fracture [1].
- Class 1C injuries are characterized by distal avulsion involving the origins of the ulnolunate and ulnotriquetral ligaments [1].
- Class 1D injuries are characterized by radial avulsion involving the dorsal and/or volar radioulnar ligaments [1].
- Class 2A degenerative tears are characterized by TFCC wear or thinning [1].
- Class 2B degenerative tears are characterized by TFCC wear plus lunate and/or ulnar chondromalacia [1].
- Class 2C degenerative tears are characterized by TFCC perforation plus lunate and/or ulnar chondromalacia [1].
- Class 2D degenerative tears are characterized by TFCC perforation, lunate and/or ulnar chondromalacia, and lunotriquetral ligament disruption [1].

- Class 2E degenerative tears are characterized by TFCC perforation, lunate and/or ulnar chondromalacia, lunotriquetral ligament disruption, and ulnocarpal and DRUJ arthritis [1].
- A class 1B injury is a partial or complete avulsion of the TFCC from its ulnar attachments, with or without an ulnar styloid fracture [12].
- A class 1D tear is a partial or complete avulsion of the TFCC from the radius, with or without a bone fragment, and may involve one or both radioulnar ligaments [10].
- Class 1C tears involve the distal attachment of the articular disk to the lunate, triquetrum, and lunotriquetral ligaments [6].
- Complete tears of the ulnocarpal ligaments in class 1C injuries can result in ulnar carpal instability and/or volar translocation of the ulnar carpus in relation to the radius [6].

VASCULARITY AND HEALING POTENTIAL

- The central area of the TFCC is devoid of vascularity and unable to heal [1].
- The peripheral rim of the TFCC is well vascularized, akin to the meniscus within the knee [1].
- Studies showed that the outer 10% to 40% of the articular disk was well perfused and suggested a healing potential of these injured areas upon repair [9].
- Failure to reattach the TFCC to the foveal footprint may induce synovitis, which inhibits the healing of the foveal fibers, setting up a vicious cycle and promoting the persistence of painful DRUJ instability [11].

Classification

- TFCC tear subtypes are defined based on the specific location within the TFCC [1].
- The class and location of a TFCC tear have important implications for treatment [1].
- Class 1A traumatic TFCC injury is characterized by central perforation or tear [1].
- Class 1B traumatic TFCC injury is characterized by ulnar avulsion with or without ulnar styloid fracture [1].
- Class 1C traumatic TFCC injury is characterized by distal avulsion involving the origins of the ulnolunate and ulnotriquetral ligaments [1].
- Class 1D traumatic TFCC injury is characterized by radial avulsion involving the dorsal and/or volar radioulnar ligaments [1].
- Class 2A degenerative TFCC tear is characterized by TFCC wear or thinning [1].
- Class 2B degenerative TFCC tear is characterized by Class 2A features plus lunate and/or ulnar chondromalacia [1].
- Class 2C degenerative TFCC tear is characterized by TFCC perforation plus lunate and/or ulnar chondromalacia [1].
- Class 2D degenerative TFCC tear is characterized by Class 2C features plus lunotriquetral ligament disruption [1].

- Class 2E degenerative TFCC tear is characterized by Class 2D features plus ulnocarpal and distal radioulnar joint arthritis [1].
- Arthroscopy is the gold standard for detection of TFCC tears [1].
- The arthroscopic trampoline test assesses TFCC resiliency by balloting the central portion with a small probe [1].
- The arthroscopic hook test can be used to demonstrate peripheral detachment of the TFCC [1].
- The arthroscopic suction test can show laxity of the TFCC when peripherally scarred in or foveal detachment when the distal radioulnar joint is clinically unstable [1].
- MRI is controversial for TFCC pathology, but newer innovations suggest value in detection and localization [1].

INDICATIONS

- Acute traumatic Palmar type 1A TFCC tears are an indication for arthroscopic TFCC debridement [3].
- Degenerative central tears of the TFCC with ulnar neutral or negative variance are an indication for arthroscopic TFCC debridement [3].
- Failure to respond to conservative treatment with splint and medication for more than 3 months is an indication for arthroscopic TFCC debridement [3].

PREOPERATIVE EVALUATION

- Clinical correlation with provocative signs on the ulnar wrist is required during preoperative evaluation [3].
- Ulnar variance must be checked during preoperative evaluation [3].
- Wrist MRI is used to check for edema of the lunate in cases of ulnar positive variance or suspected impaction [3].

Investigations

CLASSIFICATION AND DIAGNOSTIC MODALITIES

- Subtypes within the Palmer classification are based on the specific location of the tear within the TFCC [1].
- MRI is considered controversial for TFCC pathology, but newer innovations suggest value in detection and localization [1].
- Arthroscopy is the gold standard for the detection of TFCC tears [1].

ARTHROSCOPIC DIAGNOSTIC TESTS

- The arthroscopic suction test can show laxity of the TFCC when it is peripherally scarred in or foveal detachment when the DRUJ is clinically unstable [1].
- Observation for swelling of the DRUJ when injecting saline at the 3-4 portal before inserting the arthroscope suggests a free flow perforation at the TFCC [3].

- The ulnar fovea sign is a provocative maneuver aimed at eliciting tenderness at the ulnar fovea [6].

PREOPERATIVE EVALUATION

- Preoperative evaluation for arthroscopic TFCC debridement includes clinical correlation with provocative signs on the ulnar wrist [3].
- Preoperative evaluation for arthroscopic TFCC debridement includes checking ulnar variance [3].
- MRI of the wrist is used to check for edema of the lunate in cases of ulnar positive variance or suspected impaction [3].
- Preoperative evaluation for TFCC reconstruction with tendon graft includes clinical symptoms and signs of DRUJ instability [5].
- Preoperative evaluation for TFCC reconstruction with tendon graft includes radiographs to check ulnar variance and forearm alignment [5].
- Preoperative evaluation for TFCC reconstruction with tendon graft includes diagnostic arthroscopy or high-resolution MRI to evaluate the potential for TFCC repair [5].
- Preoperative evaluation for Class 1B TFCC tear repair includes positive provocative tests for peripheral TFCC tear [8].
- Preoperative evaluation for Class 1B TFCC tear repair includes DRUJ instability on ballottement test [8].
- Preoperative evaluation for Class 1B TFCC tear repair includes X-ray of the wrist to rule out ulnar styloid fracture [8].
- Preoperative evaluation for Class 1B TFCC tear repair includes MRI of the wrist [8].

CLINICAL PRESENTATION AND PHYSICAL FINDINGS

- Class 1A tears typically manifest as ulnar-sided wrist pain aggravated by power grip, especially with ulnar deviation or forearm rotation [7].
- Class 1A tears may cause pain and mechanical symptoms such as clicking but do not cause DRUJ instability [7].
- Class 1A tears are typically confined to the disc, located 2 to 3 mm ulnar to its radial attachment, and oriented volar to dorsal [7].
- Patients with Class 1C tears complain of tenderness over the ulnar snuffbox and pain with grip [6].
- The arthroscopic appearance of UT ligament split tears is predominantly noted superficially as synovitis [8].
- Debridement of synovitis reveals the longitudinal split tear in the long axis of the UT ligament [8].

Treatment

INDICATIONS AND CONTRAINDICATIONS

- TFCC reconstruction with tendon graft is indicated in irreparable TFCC injuries with symptomatic DRUJ instability [4].
- TFCC reconstruction with tendon graft is indicated in neglected chronic injuries [4].
- TFCC reconstruction with tendon graft is indicated after suboptimal healing following nonoperative or surgical repair [4].
- Skeletal malalignment responsible for DRUJ instability, including ulnar incongruity, malunion of the sigmoid notch, and dorsal tilt or coronal shift of the radius, should be addressed concomitantly with TFCC reconstruction [4].
- Osteoarthritis of the DRUJ is a contraindication to TFCC reconstruction [4].
- Axial instability of the forearm due to interosseous membrane injury is a contraindication to TFCC reconstruction [4].

BIOMECHANICAL RATIONALE

- Biomechanical analysis by Adams et al. concluded that traumatic disruptions of the distal radioulnar ligaments from the fovea occurred predominantly from tension [4].
- Adams et al. proposed that a combination of forces was required to destabilize the DRUJ [4].
- The method aims to restore normal DRUJ kinematics by using a single tendon graft with uniform tension [4].

OPERATIVE TECHNIQUE: GENERAL SETUP AND ARTHROSCOPY

- The procedure is performed under general or regional anesthesia [4].
- An image intensifier is used to locate the isometric point for tunnel drilling [4].
- An arm tourniquet is placed [4].
- Radiocarpal joint arthroscopy is conducted through the standard 3-4 viewing and 4-5 working portals to evaluate and debride the TFCC lesion and associated synovitis [4].
- If the central part of the articular disk is intact, a central perforation of 4-5 mm is created with an arthroscopic knife or RF ablation to expose the ulnar head [4].
- The wrist is taken off the traction tower for subsequent tendon graft and bone tunnel preparation [4].

OPERATIVE TECHNIQUE: VOLAR INCISION AND TENDON HARVEST

- A 2 cm volar longitudinal incision is made midway between the palmaris longus tendon and the radial border of the FCU tendon, extending proximally from the proximal wrist crease [4].
- The palmaris longus tendon is harvested in full length with a tendon stripper [4].
- The flexor tendons and median nerve are retracted radially [4].

- The FCU, ulnar nerve, and artery are retracted ulnarly to expose the distal radius [4].
- The distal border of the pronator quadratus marks the approximate level of the radial tunnel [4].

OPERATIVE TECHNIQUE: DORSAL INCISION AND RADIAL TUNNEL

- A 2 cm dorsal longitudinal incision is made extending proximally from the 4-5 portal [4].
- The extensor retinaculum is split longitudinally over the fifth dorsal compartment [4].
- The EDM is exposed and retracted as a cotton sling [4].
- The septum of the fourth extensor compartment is stripped subperiosteally to expose the edge of the sigmoid notch [4].
- A 1.1 mm guide pin is inserted on the dorsal surface of the distal radius radial to the sigmoid notch, 5 mm proximal to the articular surface of lunate to fossa and 5 mm radial to the sigmoid fossa [4].
- The guide pin is inserted with a volar tilt of 10 to 15 degrees, parallel to the surface of the lunate fossa [4].
- Tendons and neurovascular structures on the volar side are gently retracted while the guide pin is advanced with direct visualization of the tip [4].
- Guide pin position is confirmed by fluoroscopy [4].
- The tunnel is enlarged from 2.0 to 2.5 mm using cannulated drill bits and soft tissue protection at both entry and exit sites [4].

OPERATIVE TECHNIQUE: ULNAR INCISION AND FOVEAL TUNNEL

- A 3 cm longitudinal incision is made over the subcutaneous border of ulna beginning 1 cm proximal to the tip of ulnar styloid [4].
- A 1.1 mm guide pin is inserted at the middiaphyseal point from 1.5 to 2 cm proximal to the tip of ulnar styloid [4].
- The guide pin is inserted at an acute angle of about 60 degrees targeting the fovea of the ulnar head and parallel to the ulna shaft in the sagittal plane under fluoroscopic guidance [4].
- The surgeon can place their thumb on the ulnar styloid as a reference to facilitate entry point decision [4].
- The wrist can be suspended in a vertical position with the forearm in neutral rotation position to monitor the foveal exit site of the guide pin under arthroscopy [4].
- Arthroscopic monitoring ensures the guide pin exits at the isometric point of the insertion of the distal radioulnar ligament [4].

References

[1] Miller S Review Of Orthopaedics. DISTAL RADIOULNAR JOINT, TRIANGULAR FIBROCARTILAGE COMPLEX, AND WRIST ARTHROSCOPY > 2. TFCC tears.

[3] Green S Operative Hand Surgery. AUTHOR'S PREFERRED METHOD OF TREATMENT: ARTHROSCOPIC PARTIAL WRIST FUSION > Arthroscopic TFCC Debridement.

[4] Green S Operative Hand Surgery. AUTHOR'S PREFERRED METHOD OF TREATMENT: ARTHROSCOPIC PARTIAL WRIST FUSION > TFCC Reconstruction with Tendon Graft.

[5] Green S Operative Hand Surgery. AUTHOR'S PREFERRED METHOD OF TREATMENT: ARTHROSCOPIC PARTIAL WRIST FUSION > Arthroscopic TFCC Reconstruction With Tendon Graft.

[6] Green S Operative Hand Surgery. AUTHOR'S PREFERRED METHOD OF TREATMENT: ARTHROSCOPIC PARTIAL WRIST FUSION > Arthroscopic-Assisted Suture Anchor Technique (Atzei) > Arthroscopic Repair of Class IC TFCC Tears.

[7] Green S Operative Hand Surgery. Chronic Perilunate Instability (SL Plus LT Instability) > Palmer's Classification of TFCC Lesions > Class 1A Tear.

[8] Green S Operative Hand Surgery. AUTHOR'S PREFERRED METHOD OF TREATMENT: ARTHROSCOPIC PARTIAL WRIST FUSION > Arthroscopic Repair of Class 1B TFCC Tears.

[9] Green S Operative Hand Surgery. AUTHOR'S PREFERRED METHOD OF TREATMENT: ARTHROSCOPIC PARTIAL WRIST FUSION > TFCC Repair > Classification, Functional Anatomy, Clinical Features, and Indication for Repair.

[10] Green S Operative Hand Surgery. Chronic Perilunate Instability (SL Plus LT Instability) > Palmer's Classification of TFCC Lesions > Class 1D Tear.

[11] Green S Operative Hand Surgery. AUTHOR'S PREFERRED METHOD OF TREATMENT: ARTHROSCOPIC PARTIAL WRIST FUSION > Arthroscopic Repair of Class 1B TFCC Capsular Tears > Arthroscopic Reattachment of Class 1B TFCC Foveal Tear.

[12] Green S Operative Hand Surgery. Chronic Perilunate Instability (SL Plus LT Instability) > Palmer's Classification of TFCC Lesions > Class 1B Tear.

[13] Miller S Review Of Orthopaedics. DRUJ, TFCC, WRIST ARTHROSCOPY.

CQ HAND + UPPER LIMB
Dr Kieran Hirpara — Specialist Orthopaedic Surgeon
Suite 2, Level 1, Mater Private Hospital Rockhampton, 31 Ward Street, The Range, QLD 4700
Phone 07 4863 6556 · office@cqupperlimb.com.au · cqupperlimb.com.au