A guide to Triangular Fibrocartilage Complex anatomy & clinical assessment

The triangular fibrocartilage complex (TFCC) is a sophisticated ligamentous structure located on the ulnar side of the wrist.[1] It is highly susceptible to injury, with a documented incidence rate as high as 78 percent in patients following distal radius fracture.[2,3]

A high prevalence is also found in people who play sports that involve repetitive or forced pronation/supination or axial loading of the wrist, such as golf, football, or baseball.[4-8] The mechanism of injury can vary from low-energy trauma, such as repetitive overuse activities, to high-energy trauma, such as a fall onto an outstretched hand (FOOSH). The TFCC has multiple roles, some of which include: 1) providing stability to the distal radioulnar joint (DRUJ) during end range forearm rotation, 2) dispersing the forces generated between the ulnar head and the carpal bones during weight bearing or ulnar deviation, and 3) providing proprioceptive feedback during functional activities.[1,9,10]

Presentation of symptoms following injury may vary depending on the location and severity of trauma. Symptoms may include decreased range of motion (ROM), decreased grip strength, increased ulnar-sided wrist pain (USWP), impaired proprioceptive function, or a combination thereof. The aim of this review is to share practical information to assist health professionals who are not familiar with TFCC anatomy or assessment, with a particular focus on the components of the DRUJ, as this represents a common clinical presentation.

Some important anatomical structures to consider during TFCC assessment include: the palmar and dorsal radioulnar ligaments (both deep and superficial), the triangular fibrocartilage disc proper or articular disc, and the extensor carpi ulnaris (ECU) tendon and its associated sub-sheath (Figures 1 and 2). While other TFCC structures are acknowledged to be important, the above select structures will be covered in this review to form a strong foundational understanding.

The deep radioulnar ligaments provide DRUJ stability via the ligamentum subcruentum, or foveal insertion. The deep dorsal radioulnar ligament (dDRUL) and deep palmar radioulnar ligament (dPRUL) work in tandem to provide stability during end range forearm rotation.

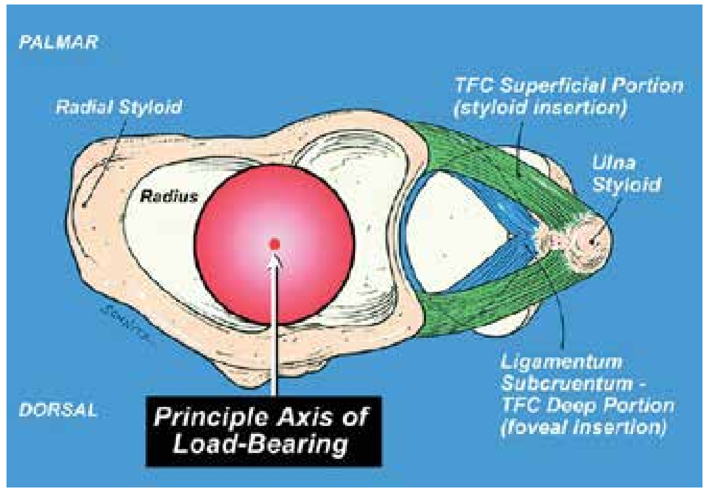

Figure 1: The deep and superficial radioulnar fibres of the TFCC, as pictured in Kleinman [16] pg. 1093.

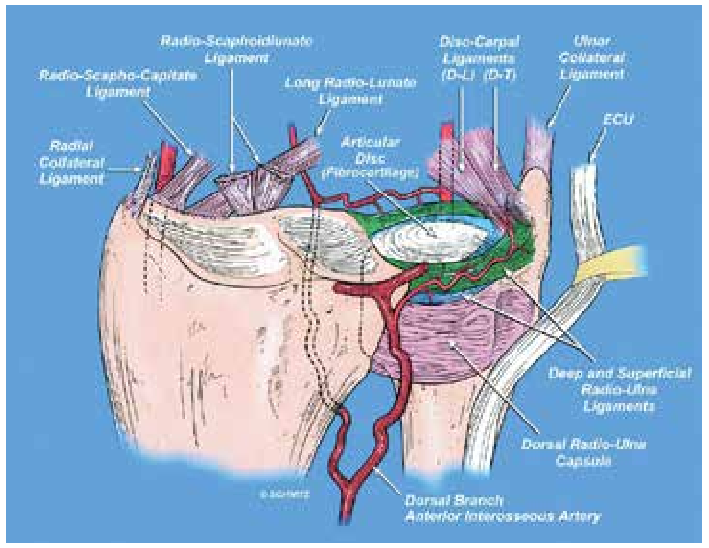

Figure 2: The Triangular Fibrocartilage Complex and surrounding structures, as pictured in Kleinman [16] pg. 1091.

Injury to the deep foveal fibres is likely to cause instability during end range forearm rotation, when compared to the contralateral side. During end range supination, the dDRUL provides stability (is under tension), while the dPRUL is slack. Conversely, when positioned in end range pronation, the dPRUL is under tension, while the dDRUL is slack (Figure 3). In neutral or mid-range forearm rotation, both dDRUL and dPRUL are relatively relaxed. A useful statement to remember when assessing DRUJ stability in clinic is "the side you see is the ligament you test".

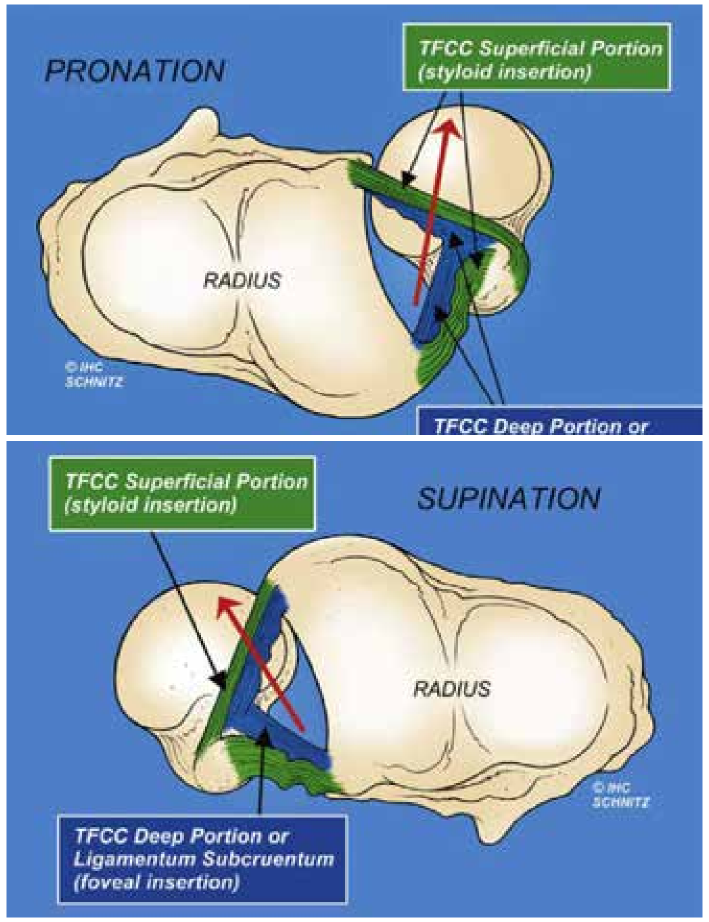

Figure 3: The reciprocal relationship of the deep (in blue) and superficial (in green) TFCC fibres during forearm supination and pronation, as pictured in Kleinman [17] pg. 13. A: tightening of the deep palmar radioulnar ligament (dPRUL) as the forearm is positioned in pronation. The deep dorsal radioulnar ligament (dDRUL) is on slack. B: tightening of the deep dorsal radioulnar ligament (dDRUL) as the forearm is positioned in supination. The deep palmar radioulnar ligament (dPRUL) is on slack.

When the client's forearm is positioned in supination with the elbow and shoulder in flexion (Figure 4), the dorsal side of the wrist is observed by the health professional when facing the client, therefore the dDRUL is being tested and is under tension. Alternatively, when the client's forearm is positioned in pronation with the elbow and shoulder in flexion, the palmar aspect of the wrist is now visible to the health professional, therefore the dPRUL is now being tested and is under tension.

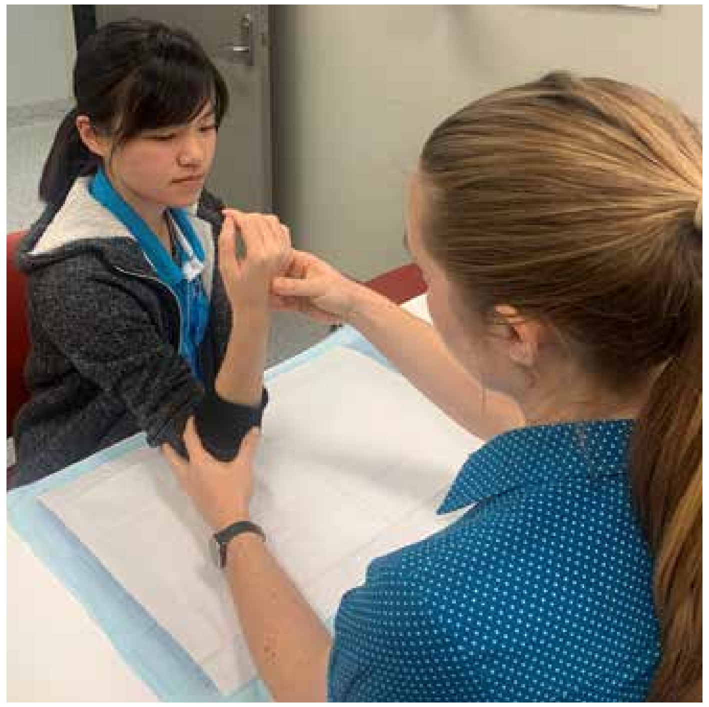

Figure 4: The health professional tests the deep dorsal radioulnar ligament (dDRUL), by positioning the client's wrist in a supinated position.

The superficial radioulnar ligaments are also divided into dorsal and palmar components and provide proprioceptive feedback during functional tasks. Injury to the superficial TFCC fibres may cause significant pain or present as dysfunction or clumsiness during activities that were previously completed without issue.

The articular disc is a cartilaginous structure, with similarities in tissue make-up to that of the articular surface of the knee or shoulder. Its role is to distribute the forces produced between the ulnar head and the ulnar carpus during ulnar deviation or weight bearing. This component of the TFCC is mostly avascular, with injury to this structure likely to present as pain during ulnar deviation or weight bearing. Lastly, the ECU tendon and its associated sub-sheath may be considered when assessing TFCC stability. The ECU contributes to DRUJ stability when the forearm is positioned in supination, by dynamically resisting dorsal subluxation of the ulnar head relative to the distal radius. This assists the dDRUL by further stabilising the DRUJ during heavy lifting activities. Injury to the ECU tendon or sub-sheath may present as USWP, or an audible or palpable 'clicking' produced when the client rotates their forearm.

Clinical assessment of the TFCC can be categorised into 'Mechanism', 'Investigations', and 'Assessment', or M.I.A. Mechanism of injury involves a clear and detailed recount of the event, or events, leading up to and immediately following the presentation of symptoms. Important information may include whether a high energy or low energy injury was reported, or whether symptoms presented after repetitious activity or following FOOSH. Witness reports or collateral information may be useful to triangulate the clients recount of the mechanism.

Figure 5: Dorsal subluxation of the ulnar head relative to the distal radius, suggesting damage to the foveal fibres. Case courtesy of RMH Core Conditions, Radiopaedia.org, rID: 34363.

Investigations may include standard X-ray, Magnetic Resonance Imaging (MRI), or in some cases wrist arthroscopy. X-ray may rule out bony injury, such as a large ulnar-styloid fracture, distal radius or carpal bone fracture. It may also highlight DRUJ abnormality such as subluxation of the ulnar head (Figure 5), or symptomatic ulnar variance (positive or negative) when compared to the contralateral side. MRI has been shown to accurately detect TFCC trauma, when interpreted by an experienced clinician.[11] Wrist arthroscopy represents the 'gold standard' for TFCC assessment, although being invasive in nature; it may present some practical limitations for clients and surgeons.

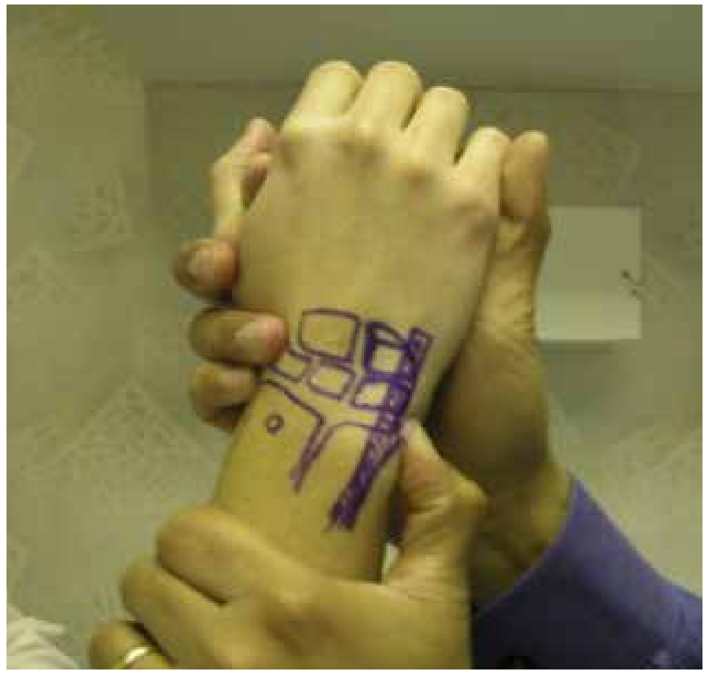

Figure 6: The foveal sign, as pictured in Sachar [13] pg. 1492. The health professional applies pressure over the foveal region, between the ulnar styloid and pisiform. A positive test will produce ulnar wrist pain when compared to the contralateral side.

Assessment or common special tests for the TFCC may include the 'fovea sign', 'DRUJ ballottement test' or the 'ulnocarpal stress test'. The fovea sign involves the health professional applying pressure to the ulnar wrist, above the TFCC foveal insertion (Figure 6).[12,13] A positive test is recorded when notable localised pain is reported by the client, when compared to the contralateral side. This suggests TFCC injury has occurred, although has poor specificity to identify the degree of injury or specific structures involved. The DRUJ ballottement test begins by positioning the client's forearm in end range supination or pronation. With the distal radius held stable by the health professional, the ulnar head is firmly moved in a dorso-palmar plane to create a shearing force at the DRUJ (Figure 7).[12]

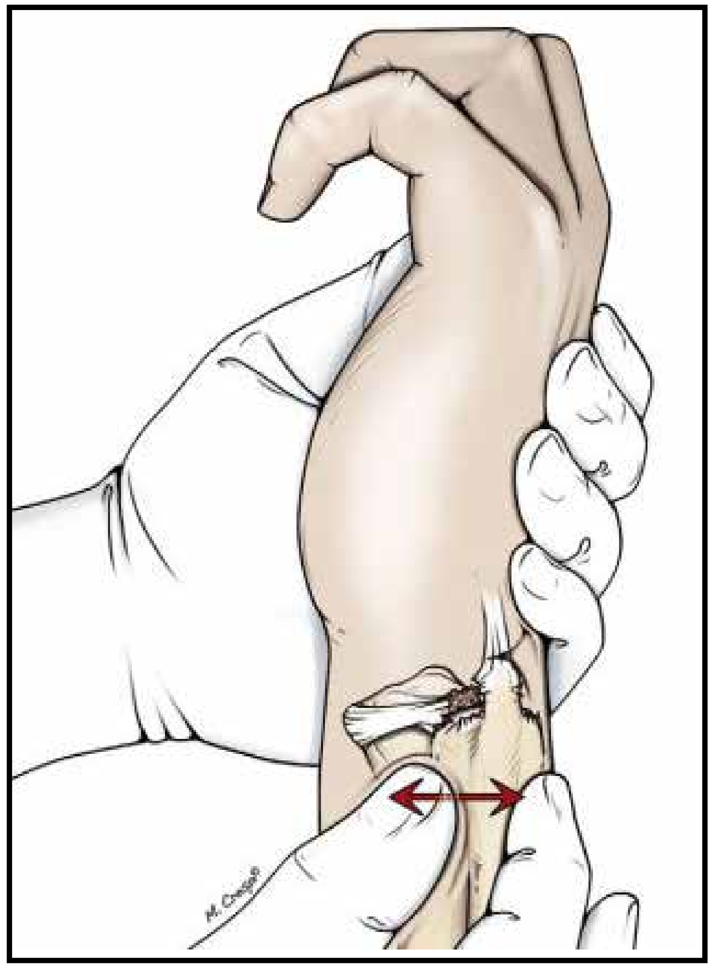

Figure 7: The ballottement test, as pictured in Atzei, Luchetti 12 pg. 265. The radius is held steady by the health professional, while the distal ulna is moved in dorso-palmar plane relative to the radius. The test is completed at end range supination and pronation, and then compared to the contralateral side. A soft end feel suggests disruption to the deep TFCC fibres at the foveal insertion.

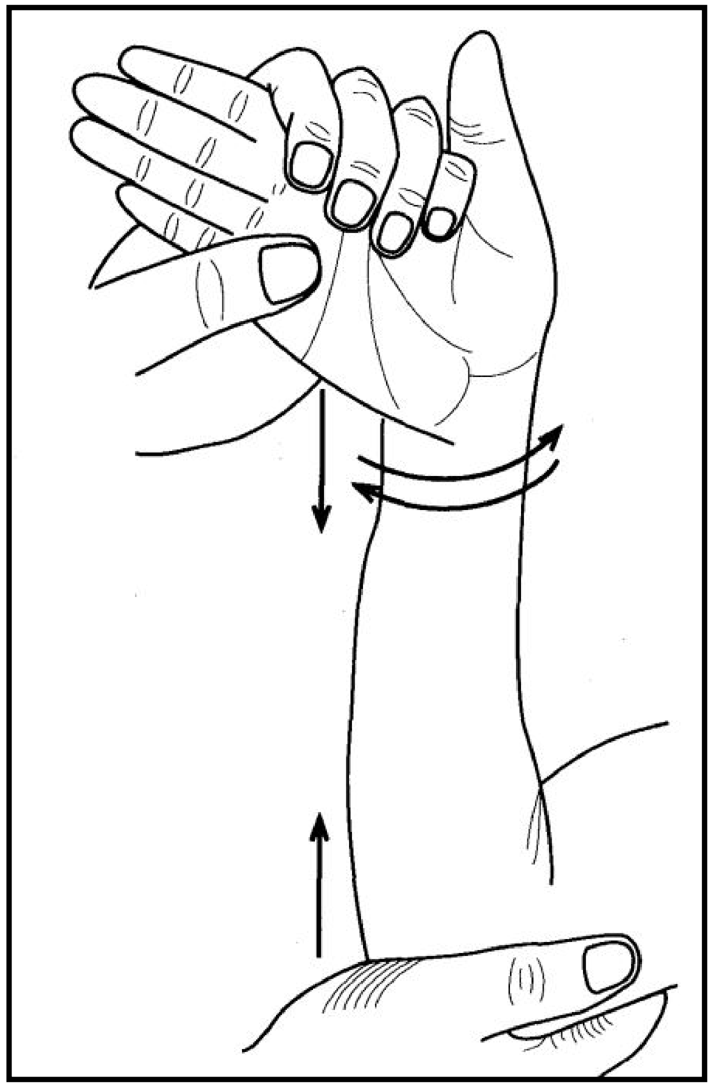

Figure 8: the ulnocarpal stress test, as pictured in Nakamura, Horii, Imaeda, Nakao, Kato, Watanabe 15 pg. 720. The health professional deviates the wrist into maximum passive ulnar deviation, then rotates the forearm between supination and pronation. A positive test will produce ulnar wrist pain when compared to the contralateral side.

Resistance to movement or a 'hard end point' is expected in an uninjured wrist, compared to the contralateral side. The test is then repeated in the opposite forearm position (supination or pronation) on both wrists. A positive test is recorded if some degree of DRUJ instability (soft end point) is assessed in the injured wrist compared to the contralateral side. This would suggest injury to the deep radioulnar fibres.

Pain without increased laxity may suggest injury to the superficial radioulnar ligaments, without deeper foveal involvement. Lastly, the ulnocarpal stress test involves passively ranging the client's wrist into maximal ulnar deviation and passively rotating the forearm from supination to pronation (Figure 8).[14,15] A positive test can be recorded if notable pain is reported, when compared to the contralateral side. This test suggests injury to the articular disc, ligament sprain, or ulnocarpal abutment or impaction.

This brief review of TFCC anatomy and assessment is provided to assist health professionals when conducting ulnar sided wrist assessment for a suspected TFCC injury. This is a complex topic that has been simplified for the purpose of this review. As such, this article is intended to be used as an educational platform, to improve anatomy understanding, share practical information, guide clinical reasoning, and fuel meaningful discussion. It is hoped that this article sparks interest in this important but under-researched injury topic, leading to improved client outcomes.

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Luke McCarron
MSc (Hand), BOcc Thy.
Accredited Hand Therapist, CHT
Orthopaedic Conjoint: Bond University Occupational Therapy / Gold Coast Hospital and Health Service, Gold Coast, Australia
Email: lmccarro@bond.edu.au