Dorsal Tear of Triangular Fibrocartilage Complex: Clinical Features and Treatment

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Abstract

Background Several different triangular fibrocartilage complex (TFCC) tear patterns have been classified through the use of wrist arthroscopy. A tear of the dorsal aspect of the TFCC has been previously reported, but it is not included in Palmer original classification. Our purpose was to describe this type of tear pattern along with the clinical presentation.

Methods An isolated dorsal TFCC tear was encountered in seven wrists of six patients (three men and three women; average age was 31 years). All patients were evaluated by physical exam, X-ray, plain axial computed tomography with pronation, neutral and supination position, magnetic resonance imaging (MRI) with coronal, sagittal, and axial section and arthroscopy.

Results The clinical findings varied and included the following: tenderness at the dorsoulnar aspect of the wrist was positive in all wrists, fovea sign was positive in five wrists, and tenderness at the dorsal aspect of the distal radioulnar joint was present in one wrist. Pain with forearm rotation was positive in all wrists. The ulnar head ballottement test induced pain in all wrists, whereas dorsal instability of the ulnar head was present in one wrist with this test. The ulnocarpal stress test was positive in five wrists. Axial and sagittal images on MRI revealed the dorsal tear in five wrists. All wrists were treated with an arthroscopic capsular repair. The final functional outcome at an average follow-up of 16.1 months was four excellent and one good wrist according to the modified Mayo wrist score.

Conclusions The aim of this article is to describe our experiences with tears involving the dorsal aspect of the TFCC, which may be misdiagnosed if the surgeon is not cognizant of this injury.

Type of study/level of evidence Diagnostic/level IV

Keywords

- wrist
- triangular fibrocartilage complex
- wrist arthroscopy
- dorsal tear

The triangular fibrocartilage complex (TFCC) is an important stabilizer of the distal radioulnar joint (DRUJ) and a load absorber of the ulnocarpal (UC) joint. A TFCC injury is also recognized as a major cause of ulnar-sided wrist pain. Palmer has classified traumatic TFCC tears into four subtypes depending on the location of the tear.¹ As more recent studies have clarified the anatomical structure of TFCC^{2,3} and

through the use of wrist arthroscopy, it has become evident that not all of the TFCC tear patterns are included in Palmer original classification.

A dorsal tear of the TFCC was first clearly described by Estrella et al in 2007⁴ as being located in the area between the extensor carpi ulnaris (ECU) subsheath and the extensor digiti minimi (EDM)—a precarious site for tear. Abe et al reported

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Fig. 1 A dorsal TFCC tear was created in a cadaveric wrist. The capsule of the right wrist was opened from the dorsal side and the wrist was hyperflexed. The dorsal tear (arrow) can be seen between the disc and the superficial dorsal radioulnar ligament. Abbreviations: disc, disc of the TFCC; L.F., lunate fossa on the radius; lig, superficial dorsal radioulnar ligament.

various patterns among 205 TFCC traumatic tears including 8 dorsal tears.⁵ The dorsal tear is located between the TFCC disc and the superficial dorsal radioulnar ligament (►Fig. 1). They also described that the ulnar head is sometimes entrapped in this tear, limiting rotation of the forearm, and this is well visualized from a volar portal.

The purpose of this study was to describe our experience with the dorsal TFCC tear and clarify its clinical characteristics.

Materials and Methods

This was a retrospective study of a group of patients who were found to have a dorsal TFCC tear at the time of wrist arthroscopy. Informed consent was obtained from all patients, and the study protocol adhered to the ethical guidelines of the 1975 Declaration of Helsinki. This clinical investigation was conducted with the approval of our institutional review board. The preoperative findings were recorded following a retrospective record review.

Between May 2004 and April 2014, we identified 19 wrists of 17 patients with a dorsal TFCC tear. To clarify the clinical features of the dorsal tear, however, we investigated seven wrists of six patients who had recalcitrant ulnar-sided wrist pain with an isolated dorsal tear. Eleven patients and 12 wrists were excluded because some of them were in acute condition or there was additional TFCC tear. There were three men and three women, six right and one left wrist. The dominant hand was involved in six wrists. The age of patients ranged between 15 and 45 years, with an average of 31 years. All patients complained of recalcitrant ulnar-sided wrist pain and were suspected to have TFCC tear. The mechanism of injury included wrist hyperextension from a fall ($n = 3$), and contusion or twisting injury ($n = 2$) during sports activities (bowling, kendo [Japanese fencing]). One patient suffered bilateral wrist injuries from forced hyperextension and hyperpronation of both the wrists during a motor vehicle accident.

Subjectively, all patients complained of ulnar-sided wrist pain with forearm rotation. One patient complained of ulnar head instability during forceful supination. Physical examinations included a positive fovea sign⁶ which consisted of

ulnar-sided wrist tenderness in the ulnar fovea. Provocative testing included the ulnar head ballottement test (i.e., the piano key sign with neutral forearm rotation and 90-degree flexion of the elbow),⁷ a UC stress test,⁸ a lunotriquetral ballottement test (Reagan test),⁹ and a pisiform compression test. All patients underwent a radiographic evaluation including neutral rotation posteroanterior and lateral X-rays. Magnetic resonance imaging (MRI) and an axial computed tomography (CT) section with the forearm in pronation, neutral, and supination position were also performed to evaluate any TFCC tears and ulnar head subluxation.

We did not perform stress views such as stress axial CT of the DRUJ, nor arthrography. All patients underwent an initial trial of conservative treatment such as cast immobilization, splinting, and administration of nonsteroidal anti-inflammatory drugs, all of which failed.

The seven patients were assessed with the use of wrist arthroscopy, and confirmed to have an isolated dorsal tear. The duration of symptoms before surgery averaged 5.7 months, ranging between 2 and 17 months. To ensure interobserver reliability of the arthroscopic examinations, the patterns of TFCC tears were confirmed by the first author (Y. A.) and one or two scrub doctors intraoperatively, and reconfirmed by another hand surgeon who did not participate in the surgery through surgical records and photographs postoperatively. All these surgeons were qualified by the Japanese Society for Surgery of the Hand, or Japanese Orthopaedic Association, and all the surgeons agreed with the diagnosis of the dorsal tear. An arthroscopic repair of the dorsal tear was performed in all wrists. Pain at the final follow-up was evaluated with a visual analogue scale (VAS) and maximum pain was scored as 10. The final functional outcomes were evaluated using the modified Mayo wrist score (MMWS).¹⁰ The average follow-up period was 16.1 months (range: 12–24 months).

Surgical Technique

With the patient under general anesthesia, wrist arthroscopy was performed with the patient's arm positioned on a hand table in the supine position, under tourniquet control, and vertical traction. Generally, two dorsal arthroscopic portals were used: a 3–4 portal (between the extensor pollicis longus tendon and the extensor digitorum communis tendon) and a 4–5 portal (between the extensor digitorum communis tendon and the EDM tendon). A 2.3-mm arthroscope with a 30-degree angle was introduced through the 3–4 portal, and probe, a shaver, and a radiofrequency device were interchangeably inserted through the 4–5 portal. The 6U portal (just ulnar to the ECU tendon) was used as an outflow portal. A volar portal (just radial to the flexor carpi radialis tendon)¹¹ was used to visualize the dorsal portion of TFCC for the first five wrists; however, we realized that the 3–4 dorsal portal was sufficient for investigating the dorsal tear, and it was not used in the latter two wrists. A complete evaluation of the wrist was performed arthroscopically. The chronic dorsal tear was generally covered with synovia, and was not easily recognizable. If a dorsal tear was suspected through preoperative physical examinations and a diagnostic imaging, careful arthroscopic examination with a probe was requisite for detecting the

dorsal tear after resecting the synovitis. After arthroscopic examination of the radiocarpal (RC) joint, DRUJ arthroscopy was performed to investigate a condition of the TFCC foveal attachment.

If an isolated dorsal tear was recognized, an arthroscopic repair was performed through a 1-cm longitudinal dorsal skin incision. The extensor retinaculum was split and the EDM tendon was mobilized. We inserted the two 21-gauge needles with a lasso loop of a 3-0 nylon suture through the dorsal capsule and through the torn dorsal edge of the TFCC in the RC joint. The two looped sutures were retrieved through 4-5 portal using blunt mosquito forceps, and then two sutures—a 3-0 PDS suture and a 3-0 Vicryl suture—were threaded through the loop suture and introduced into the RC joint. Traction on the looped sutures then pulled the PDS and the Vicryl sutures through the TFCC and out through the dorsal capsule. The TFCC was tightly sutured with this technique. The dorsal capsule was then repaired.

Postoperative Protocol

After repair, the wrist was fixed with a long arm cast for 2 weeks with 90 degrees of elbow flexion and neutral pronosupination. A short arm cast was applied for an additional 2 weeks. Gentle range-of-motion exercise including rotation of the forearm was started at 4 weeks after surgery, and grip strengthening was started at 2 months.

Results

Physical Findings

Tenderness at the dorsal site of the UC and pain on rotation of the forearm were present in all wrists. Tenderness over the dorsal aspect of the DRUJ was present in one wrist. The UC stress test and fovea sign were positive in five wrists. The ulnar head ballottement test with the forearm in neutral rotation elicited pain in all wrists; however, dorsal instability of the ulnar head during the ballottement test was obvious in one wrist, as compared with the contralateral wrists. There were no cases of a positive Reagan test or pisiform compression test.

Preoperative Function

The flexion was 66 degrees (56-75 degrees), extension 72 degrees (65-75 degrees), pronation 81 degrees (70-90 degrees), and supination 88 degrees (75-90 degrees). The average grip strength was 74% (23-121%) compared with that of the contralateral wrist.

Radiological and MRI Images

The average ulnar variance was 0.0 mm (range -0.5 to 0.3 mm). CT scans did not show any dorsal ulnar head subluxation as evaluated by Mino radioulnar line method.¹² Axial and sagittal MRI cuts demonstrated a high intensity at the dorsal site of the TFCC that was indicative of a dorsal tear in the five wrists (►Fig. 2).

Arthroscopic Findings

Synovial proliferation was present on the dorsal ulnar aspect of the joint in all wrists, concealing the dorsal tear (►Fig. 3A),

the trampoline effect was weak, and, after synovectomy, the hook test was positive at the torn site in all wrists (►Fig. 3B). DRUJ arthroscopy did not reveal any TFCC foveal tear.

Functional Outcome

The mean flexion was 69 degrees (62-73 degrees), extension 70 degrees (63-74 degrees), pronation 84 degrees (80-90 degrees), and supination 89 degrees (85-90 degrees). Except for one case of bilateral injury, the average grip strength of the contralateral wrist was 97% (84-112%). The average VAS score was 0.53 (0-3). The MMWS in five wrists except for two wrists of one bilateral case was four excellent and one good.

Discussion

The TFCC consists of two anatomical components: the disc and a peripheral portion. The disc is a simple structure that functions as a shock absorber of the UC joint, whereas the peripheral portion is a very complicated structure that comprises the distal radioulnar ligaments, UC ligaments, the meniscus homologue, and the tendon sheath of the ECU tendon, and functions as a stabilizer of DRUJ and UC joint.^{2,5,13,14} Palmer classification of TFCC injury is widely known. The dorsal tear, however, is not included in Palmer classification. The definition of the 1B tear in Palmer classification includes an avulsion from the distal ulna associated with fragmentation of the ulnar styloid, not a tear on the dorsal side. The Mayo⁷ and Bower¹⁵ classifications of TFCC injury have been proposed; however, these do not include a dorsal tear.

Estrella et al described 18 wrists with a dorsal tear, which is usually located in the area between the ECU subsheath and the EDM.⁴ Melone and Nathan analyzed peripheral TFCC tears, classifying them into five stages according to ulnar head instability: stage I is a detachment of the articular disc from the base of the ulnar styloid, stage II is a disruption of the infraretinacular ECU subsheath, stage III includes damage to the UC ligaments, stage IV entails either a partial or complete rupture of the lunotriquetral interosseous ligament, and stage V compromises the midcarpal joint because of disruption of the triquetral-capitate and triquetral-hamate ligament.¹⁴ Stage II is similar to, but not the same lesion as, a dorsal tear. We have previously described various patterns of traumatic TFCC tears including a dorsal tear,⁵ but the clinical features of the TFCC dorsal tear remain unclear.

Histological analyses make a clear distinction between the dorsal superficial radioulnar ligament and the articular disc: collagen fibers run transversely in the radioulnar ligament section, whereas their arrangement in the disc appears woven.¹⁶ Thus, the dorsal tear can occur between these sections. From our clinical investigations, the physical examinations included tenderness at the dorsal site of the UC joint, pain with UC stress test, a positive fovea sign, and a painful ulnar head ballottement test. Ulnar head instability was negative or subtle. These findings, however, are not specific to just a dorsal tear. An axial CT scan may be useful to detect the ulnar head subluxation with TFCC foveal tear; however, this was not efficient in a condition with an isolated dorsal

Fig. 2 Axial and sagittal aspects of MRI are effective in diagnosing the dorsal tear. (A) The axial image disclosed the dorsal tear localized between the extensor digiti minimi and the ECU. (B) The sagittal image revealed the tear distal to and dorsal of the ulnar head.

Fig. 3 In chronic conditions, the dorsal tear was usually concealed by proliferating synovium (A). After synovectomy, the dorsal tear was confirmed by the hook test (B). Arrow on A indicates the synovia and arrow on B indicates the tear.

tear. A coronal MRI is effective in revealing most patterns of TFCC tears; however, for a dorsal tear, the axial and sagittal images are more revealing. Diagnosis using arthroscopy was indispensable but was troublesome because arthroscopy revealed a synovitis which often obscured the dorsal tear. Furthermore, we have encountered a total of 19 wrists with a

dorsal tear, of which 10 were associated with other types of TFCC tear, the so-called double lesion.¹⁷ The incidence of the dorsal tears in our 383 traumatic TFCC tears is 5% (→Fig. 4). Although relatively rare, the dorsal tear should not be misdiagnosed because it may produce persistent pain and weakness of grip.

Fig. 4 The rate of incidence of the dorsal tear in our 383 traumatic TFCC tears under Abe classification (19/383; 5%).

Consequently, hand surgeons should be aware of the dorsal TFCC tear that is relatively unusual tear. Arthroscopic reattachment to the dorsal capsule was successful in our series; however, the best treatment is still uncertain.

Note

This clinical investigation was conducted with the approval of our institutional review board.

Conflict of Interest

None.

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