Arthroscopic-Assisted Outside-In Repair of Triangular Fibrocartilage Complex Tears
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Abstract: With advances in surgical instrumentation and techniques, as well as expanding surgical indications, wrist arthroscopy is now being used to treat a variety of conditions previously managed only with open techniques. Triangular fibrocartilage complex (TFCC) injuries remain among the most common causes of ulnar-sided wrist pain and can result from both acute and chronic mechanisms of injury. The most common mechanism of acute injury to the TFCC is a fall onto an outstretched hand with the wrist in a supinated, extended position. In patients with unrelenting pain, swelling, or mechanical symptoms despite a concerted effort at nonoperative management, which often consists of bracing, therapy, or injections, surgical intervention is often indicated. Treatment historically consisted of open exploration and repair; however, recently, arthroscopic-assisted and all-arthroscopic techniques have been described. We describe a safe, reproducible, and reliable surgical technique for arthroscopic-assisted outside-in repair of peripheral TFCC tears. In addition, a specific focus on surgical anatomy, including pearls and pitfalls for protecting the dorsal sensory branch of the ulnar nerve, is presented.

Triangular fibrocartilage complex (TFCC) injuries are common causes of ulnar-sided wrist pain in the young, athletic patient population. Acute traumatic injuries are often a result of compressive or shear forces of the TFCC between the distal ulna and the proximal carpus. In contrast, chronic degenerative TFCC pathology is thought to occur in the setting of ulnar-positive variance and ulnocarpal impaction syndrome, with or without a preceding traumatic event. Similar to the meniscus of the knee, the articular disk of the TFCC is most vascularized along its peripheral margin, and thus acute peripheral tears (Palmer type IB) are considered most amenable to surgical repair.

Once patients meet the indications for surgery, surgical management of TFCC pathology can be variable and includes both open and arthroscopic techniques.

For acute, peripheral TFCC tears with clinical evidence of distal radial ulnar joint instability, direct repair of the TFCC to the ulnar fovea is indicated. Although both open and arthroscopic techniques are acceptable, with good to excellent outcomes, arthroscopic management may offer a quicker recovery with fewer complications. We describe a safe, reproducible, and reliable surgical technique for arthroscopic-assisted outside-in repair of peripheral TFCC tears.

Surgical Technique

Patient Positioning and Setup
Our preferred approach to arthroscopic-assisted outside-in TFCC repair is performed with the patient in the supine position using a standard hand table (Video 1, Table 1). After the induction of anesthesia (typically regional, although general is acceptable), the operative extremity is prepared and draped in standard fashion. A tourniquet (sterile or unsterile) is placed, and the hand and wrist are padded and placed into the TractionTower Extremity Traction Device (ConMed Linvatec, Largo, FL). Appropriate traction setup with approximately 10 to 15 lb of longitudinal traction is critical to allow adequate exposure for the actual repair. Using the traction to place the wrist in slight volar flexion will help to open up the dorsal side of the wrist to allow for easier portal placement.
Portal Placement and Diagnostic Arthroscopy

A 2.7-mm arthroscope (Smith & Nephew, Andover, MA) is inserted into the 3-4 portal just distal to the Lister tubercle; this will be the viewing portal during the TFCC repair. A 6R portal is also established at this time under direct visualization with needle localization. This portal is placed just radial to the extensor carpi ulnaris and is used initially as an outflow portal and later as a working portal (Fig 1). Diagnostic arthroscopy should be performed both to identify the expected TFCC tear and to identify any concomitant soft-tissue or articular pathology (Fig 2). Often, the use of a small shaver through the 6R portal will be necessary to debride focal synovitis, as well as any redundant tissue in the area of the tear, to improve visualization of the actual TFCC. At this time, the 6U portal can also be established, again under direct visualization using needle localization. The use of a probe through this 6U portal can be helpful in evaluating the stability of the TFCC tear (Table 2).

Table 1. Summary of Surgical Steps

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<th>Room setup</th>
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Arthroscopic-Assisted Outside-In Repair

After a thorough diagnostic arthroscopy, the actual repair portion of the procedure begins. In addition to standard arthroscopic tools, the meniscus Mender II instrument set (Smith & Nephew) is used. Most TFCC tears will require 2 to 4 stitches, and attention should be turned to the most volar stitch first. The desired location for placement of the first (most volar) stitch is identified and should be close to the volar margin of the tear. The curved needle (with its stylet) is inserted approximately 1 cm proximal to the level of the ulnocarpal joint, with the concavity of the needle facing distally. The curved needle is advanced through the skin and capsule and is angled distally to pierce the articular disk 2 to 3 mm radial to the edge of the tear. Next, the straight needle (with its stylet) is inserted just distal to the entry point of the curved needle, again at the level of the ulnocarpal joint (Fig 3A). Care is taken to angle this needle radially so that it pierces through just under the ulnar capsule (Table 2).

Fig 1. Intraoperative photograph showing surgical landmarks for arthroscopic-assisted outside-in triangular fibrocartilage complex tear repair of the right wrist in the supine position using a hand table and traction tower. The probe is in the 6R portal, the arrow is pointing to the 6U portal, and the asterisk indicates Lister’s tubercle. (ECU, extensor carpi ulnaris tendon.)

Fig 2. Arthroscopic photograph showing peripheral triangular fibrocartilage complex tear (asterisk).
Next, the stylet is removed from the straight needle, and a tension lasso is advanced through the straight needle into the joint. The tip of the curved needle is visualized and manipulated so that it passes through the wire loop of the lasso. The stylet within the curved needle is then removed (Fig 3B), and a No. 2-0 PDS II suture (Ethicon, Somerville, NJ) is passed through the curved needle into the joint (Fig 3C and D, Table 2). Once enough PDS suture has been advanced into the joint, the curved needle is withdrawn slowly through the lasso loop such that the needle tip is now outside the loop and the PDS suture is within it. Together, the straight needle, lasso, and PDS suture are removed in a quick single movement, leaving the 2 paired ends of the PDS suture outside the skin, creating the first mattress suture (Fig 4). These steps are then repeated for each stitch, moving from volar to dorsal, until the repair is deemed adequate (Table 2). Once all desired sutures have been passed, the arthroscopic appearance of the tear is reassessed both with and without tension on the sutures, in an effort to determine if the repair construct is reliable and stable.

**Ulnar Incision**

A 2- to 3-cm longitudinal incision on the ulnar side of the wrist is made. This incision often is centered between the exiting PDS suture strands (Fig 5A). Superficial dissection to the retinaculum is performed, with care taken to protect and preserve any branches of the dorsal sensory branch of the ulnar nerve (Fig 5B). Both

<table>
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<th>Table 2. Pearls for Arthroscopic-Assisted Outside-In TFCC Repair</th>
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<td>The surgeon should identify the tear pattern and then switch the arthroscope to the 6R portal with the “eyes” facing down to the ulnar fovea: This shows the intact deep fibers of the TFCC on the ulna, which stabilize the DRUJ; these deep fibers also provide resistance when a probe is used to lift up on the ulnar side of the articular disk.</td>
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<td>The positioning of the curved and straight needles represents the path of the first TFCC repair suture.</td>
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<td>The curved needle should be aimed such that the PDS suture can be inserted on the radial side of the joint—this allows for later passage.</td>
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<td>A more distal entry point should be used when approaching the dorsal aspect of the wrist with the curved needle because of the blocking effect of the ulnar styloid.</td>
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<td>A right-angle clamp should be used to help ensure that the tendon and nerve are not incorporated into the repair construct.</td>
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**Fig 3.** (A) Arthroscopic photograph showing use of suture lasso. (B) Intraoperative photograph showing removal of stylet of needle. (C) Intraoperative photograph showing PDS suture insertion through the needle into the joint. (D) Arthroscopic photograph showing PDS suture through the lasso.
ends of the paired PDS suture are sequentially pulled out (Fig 5C) through the incision and secured with a hemostat; this can be facilitated with a small hemostat or with the L-shaped end of a Senn retractor (Table 2). This process is repeated for each suture (Fig 5D). The goal is that the knots will sit directly on the retinaculum once tied down, without any interposition of the soft tissue. After all suture ends have been pulled through, they are sequentially tied so that they sit directly on top of the retinaculum (Fig 5E and F). The wound is then copiously irrigated, followed by standard closure of the ulnar incision and arthroscopy portals (Fig 6). Table 2 provides a summary of several of the pearls for arthroscopic-assisted outside-in TFCC repair.

Rehabilitation

Postoperatively, the patient is placed in a long-arm splint in full supination and approximately 20° of wrist extension. At 3 to 4 weeks, the long-arm splint is removed and the patient is allowed to move from supination to neutral rotation. At 4 to 5 weeks, the amount of rotation can be advanced to include up to 60° of rotation. At 6 weeks postoperatively, all splinting is discontinued (except during at-risk activities) and active/passive wrist range of motion is begun. At 10 weeks postoperatively, the patient can begin light strengthening and return to sports as tolerated. Of note, patients who participate in high-demand activities such as gymnastics are restricted from returning to athletics until at least 12 weeks after surgery.
Discussion

Multiple surgical techniques for TFCC repair have been described; however, there is no current gold standard. As described in this report, arthroscopic-assisted outside-in repair is a safe, reproducible, and reliable surgical technique for the management of peripheral TFCC tears. Outcomes after arthroscopic TFCC repair have generally been reported as good to excellent.6-8 In 2012 Wysocki et al.9 reported on 26 wrists at a mean of 31 months after arthroscopic TFCC repair. They reported significant improvements in the visual analog scale and Disabilities of the Arm, Shoulder and Hand scores, with no measurable losses in motion or grip strength. Of the 11 high-level athletes included in their cohort, 7 (64%) returned to sports; however, athletes involved in weight-bearing sports were unable to return to activity within the study’s follow-up period. Of note, there was 1 case of a recurrent traumatic TFCC tear that required revision surgery; transient dorsal sensory ulnar nerve paresthesias developed in 2 patients; and finally, transient tendonitis about the wrist developed in 2 patients.

Arthroscopic-assisted outside-in TFCC repair is not without complications,10 although they are rare. The more common risks associated with wrist arthroscopy—and not necessarily limited to TFCC repair—include tendon injuries, neurovascular injuries, infection, cyst formation, and stiffness. With respect to this particular technique, injury to the dorsal sensory branch of the ulnar nerve must be avoided, and caution must be used during the ulnar-sided dissection, as well as with retraction during the repair portion of the procedure. Finally, failure to recognize or treat concomitant pathology, such as ligamentous injuries or ulnar-positive variance leading to ulnocarpal impaction, may result in continued complaints of pain or instability after isolated TFCC repair.

Overall, for patients meeting the appropriate indications, outside-in TFCC repair is an arthroscopic method to restore distal radial ulnar joint stability that allows for a minimally invasive, low-profile fixation construct with excellent biomechanical stability. Additional studies are needed to determine the short- and long-term outcomes of this technique.

References