Arthroscopic Treatment of Type 1B Triangular Fibrocartilage Complex Tear by “Outside-In” Repair Technique Using Transcapsular Transverse Mattress Suture

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Abstract: Triangular fibrocartilage complex (TFCC) injuries are increasingly recognized as a cause of ulnar-sided wrist pain. Palmer grouped these tears into either traumatic or degenerative, with various subclassifications. Magnetic resonance imaging (MRI), arthrogram, and arthroscopy are the methods used to establish the diagnosis. Several arthroscopic methods of TFCC repair including outside-in, inside-out, and all-inside techniques have been described. The outside-in repair, which involves piercing the TFCC via the ulnar side of the wrist, has been described by several authors, but the technique varies among authors with respect to instrumentation and subtle surgical modifications. The purpose of this article was to present the technique of arthroscopic outside-in repair using transverse mattress suture for type 1B TFCC tear by modifying classic vertical mattress sutures into sutures that pass completely through the disc.

Triangular fibrocartilage complex (TFCC) injuries are increasingly recognized as a cause of ulnar-sided wrist pain. Palmer grouped these tears into either traumatic or degenerative, with various subclassifications. The traumatic lesions (class I) were grouped into 4 types: type A is the central tear in the TFCC disc, type B the tear from the ulnar side, type C the tear in the palmar side of the TFCC, and type D the radial avulsion of the TFCC. The central area of the fibrocartilage disc is avascular and is therefore called the debridement zone (60% of the TFCC). Ten percent to 40% of the peripheral area of the TFCC has extensive blood supply, and is therefore called the repair zone. This vascularity enables surgeons to effect arthroscopic suture repair of peripheral Palmer type IB and ID TFCC tears that has yielded encouraging results in many studies.

History of a fall onto an outstretched, pronated wrist is the classic presentation of a patient with a traumatic peripheral TFCC tear. Patients complain of ulnar-sided wrist pain, classically with activities involving forearm rotation, grip, and axial loads on the wrist. On physical examination, patients typically exhibit tenderness to direct palpation over the ulnar aspect of the wrist, with positive TFCC grind and fovea signs. A palpable click is often present with a TFCC grind maneuver.

Magnetic resonance imaging (MRI), arthrogram, and arthroscopy are the methods that are being used to establish the diagnosis. Arthroscopy can be particularly valuable to the surgeon because it can be used as a diagnostic tool that also enables treatment of the tears. Both open and arthroscopic series have shown good improvement in pain, grip strength, and function with repair of peripheral tears.

Several arthroscopic methods have been described, including inside-out, outside-in, and all-arthroscopic techniques. Outside-in repair, which involves piercing the TFCC via the ulnar side of the wrist, has...
been described by several authors. The outside-in techniques vary among authors with respect to instrumentation and subtle surgical modifications. The purpose of this article was to present the technique of arthroscopic outside-in repair using mattress sutures for type 1B TFCC tear.

**Indication**

The indication for this technique includes any patients exposed to traumatic events: with ulnar wrist pain localized to the fovea, painful rotation of the wrist, sometimes a “clicking” sound, and tenderness over the dorsal TFCC, despite conservative care for at least 4 months. TFCC lesions associated with distal radius fractures, or significant bone or neurovascular pathology to either wrist and total instability of the distal radioulnar joint, were considered contraindications for this technique (Table 1).

### Surgical Technique

**Preoperative Setup**

The patient is positioned supine on the operating room table. After general anesthesia (regional anesthesia can be used), a tourniquet is placed and the arm is secured to a hand table with a strap that will provide countertraction. A finger-trap traction tower (Linvatec, Largo, FL) is applied and set to approximately 10 pounds (Fig 1).

**Instrument Set for Repair**

In addition to the 30° 2.3-mm arthroscope (Stryker, Kalamazoo, IN) and small shaver (Stryker) for debridement of the edge of the tear, two 18-gauge needles were used as cannulas for repair, a no. 3-0 Prolene suture used as a lasso loop to pass easily through one of the needles, and no. 2-0 PDS II polydioxanone monofilament suture (Ethicon, Somerville, NJ) for repair (Fig 2).

**Exposure**

Routine diagnostic arthroscopy is performed with a 30° 2.3-mm arthroscope through standard 3-4 and 6R portals. After the decision is made to repair an

| Indications | Contraindications |
|-------------|-------------------|
| Ulnar-side wrist pain with or without instability | TFCC avulsion |
| History of trauma | Other associated injuries such as |
| Failure of conservative treatment for at least 4 months | total distal radioulnar joint |
| Peripheral TFCC tear (type 1B) | instability or distal radius fracture |
| | Repair might be unattainable |
| | TFCC tear associated with |
| | significant bone or neurovascular |
| | pathology to either wrist |

TFCC, triangular fibrocartilage complex.
ulnar-sided TFCC tear, the arthroscope should be placed in the midcarpal portal before TFCC repair, as this critical component of diagnostic arthroscopy is often forgotten if saved for the end.

**Steps of Repair**

Once the tear has been identified and clearly visualized with the scope in the 3-4 portal and with the assistance of a probe (in the 6R portal) (Fig 3), the scar tissue is removed with a synovial shaver (in the 6R portal) to create a new bleeding surface for proper healing (Fig 4; Video 1). A 2-cm longitudinal incision is made on the ulnar side of the wrist just volar to extensor carpi ulnaris, and blunt dissection is used to protect any branches of the dorsal ulnar sensory nerve within the field, and dissection is carried down to the retinaculum (Fig 5).1

With the arthroscope in the 3-4 portal, the first needle loaded with no. 2-0 PDS polydioxanone monofilament suture (Ethicon) is passed to the ulnocarpal joint through the ulnar-side incision. The needle is then angled distal and radial to penetrate the articular disc several millimeters radial to the edge of the tear (Fig 6). The 2-0 PDS is then advanced into the joint and pulled with small artery forceps outside the joint through the 6R portal to be shuttled later onto the lasso loop.

The second straight needle loaded with a loop of no. 3-0 Prolene is inserted starting at the level of the

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**Fig 3.** The arthroscope in the 3-4 portal of the right wrist joint showing the type 1B TFCC tear, with the probe in the 6R portal pointing to the site of the tear. (TFCC, triangular fibrocartilage complex.)

**Fig 4.** The arthroscope in the 3-4 portal of the right wrist joint showing debridement of the edge of the tear by shaver through the 6R portal.

**Fig 5.** Diagram of the right wrist showing the incision on the ulnar side of the wrist to allow passage and tying of stitch with protection of the dorsal sensory branches of the ulnar nerve. Reprinted from McAdams with permission from Elsevier.1
ulnocarpal joint and angled directly radial to come through the disc in a point dorsal to the first needle, and the loop is advanced through the needle into the joint and then withdrawn with small artery forceps outside the joint through the 6R portal (Fig 7).

The 2-0 PDS is carefully shuttled through the loop and the loop is then withdrawn with the 2-0 PDS from within the joint, creating the first suture (Fig 8). Both ends of each paired suture are sequentially rerouted such that the knot lies directly on the retinaculum with no interposed subcutaneous tissue or potential nerve branches, and the knots are sequentially tied.

The previous steps can be repeated for the second mattress suture if the lesion needs more than one. Standard skin closure of the ulnar incision and arthroscopy portals is performed.

**Postoperative Management**

The patients stay in the hospital for 1 day. A course of antibiotic (first-generation cephalosporin) is prescribed for 14 days.

**Postoperative Rehabilitation Program**

Postoperatively, the patient is immobilized in full supination and 20° wrist extension for 3 weeks in an above-elbow splint followed by another 3 weeks of volar forearm splint, and at that time the patient is encouraged to rotate from supination to neutral rotation. At week 4 the patient is encouraged to rotate to 60° pronation, and at week 6 the patient is encouraged to have full rotation. At 10 weeks, light strengthening is begun, and return to sport is allowed as tolerated. Return to heavy manual labor and to sport is generally started 3 months postoperatively.

**Fig 6.** With the arthroscope in the 3-4 portal of the right wrist, the first needle loaded with no. 2-0 PDS suture is passed from outside through the capsule and then bellow the TFCC exiting radial to the site of the tear. (TFCC, triangular fibrocartilage complex.)

**Fig 7.** With the arthroscope in the 3-4 portal of the right wrist, the second straight needle loaded with a loop is inserted at a point dorsal to the first needle to shuttle the first suture.

**Fig 8.** With the arthroscope in the 3-4 portal of the right wrist, the mattress suture is tied on the capsule through the ulnar-side incision.
Like other arthroscopic techniques, it is less invasive and allows complete evaluation of the wrist joint and exclusion of any associated lesion.

Discussion

Among the various methods of treatment, arthroscopically assisted repair remains attractive to physicians and patients because of the minimal injury related to the surgery and the short recovery time. Therefore, although the arthroscopic procedure may be technically demanding, studies indicate that repair using an arthroscopic approach provides relief of symptoms in most patients.

There are multiple options for arthroscopic repair. Inside-out repairs using zone-specific cannulas or Tuohy needles have been described. There are also outside-in repair techniques, using Mulberry knots; there has also been a report of an all-inside repair using a meniscal fastener.

Health-related quality of life measures are very important in evaluating the effectiveness of upper extremity procedures to improve functional outcome. In this regard, several series have shown good results of arthroscopic repair of peripheral TFCC tears with the outside-in technique. In a multicenter study by Millants et al., 35 patients who had arthroscopic TFCC repairs with an average follow-up of 37 months had good results, 5 had fair results, and 1 had a poor result.

Trumble et al. reported that 22 patients treated with an arthroscopic technique had a mean arc of motion at 36 months that was 86% of the contralateral side and a grip strength that was approximately equal to 82% of the contralateral side. Haugstvedt et al., in their study that included 20 TFCC peripheral tears, reported 70% good to excellent results by Mayo score, with a 90% range of motion and 83% grip strength in comparison with the uninjured side.

Maysara et al., in a study including 37 patients, reported highly statistically significant improvement in results comparing preoperative with postoperative visual analog scale scores for pain ($P < .05$). The mean Modified Mayo Wrist Score was improved from 62.1 preoperatively to 91.2 postoperatively and the Disabilities of the Arm, Shoulder and Hand score also revealed statistically significant improvement ($P < .05$), with the mean preoperative score improving from 29.9 preoperatively to 10.2 postoperation. Other series with mixed patterns of tears have shown similarly favorable results.

Although there are many reports of arthroscopic (outside-in) repair of the type 1B TFCC tear, none describe the transverse mattress suture technique; they only describe the vertical mattress suture that involves passage of one limb of stitch through the TFCC and the other limb through the capsule.

This technique has many advantages (Table 2) as it is easy, the required equipment is available in all operating theaters, and the possibility of suture cut-through is very low. Despite these advantages, there are some disadvantages; for example, the palpable knots underneath the skin may be a source of annoyance to the patients, and risk of injury to the dorsal sensory branches of the ulnar nerve still exists. The pearls and pitfalls of this technique are mentioned in Table 3.

Table 2. Advantages and Disadvantages of the Technique

| Advantages                                                                 | Disadvantages                                                                 |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Only 1 or 2 mattress sutures needed for the repair                        | It being an outside-in repair technique, controlling the exit of the needle just |
| Instruments of repair commonly available                                  | Risk of injury of the dorsal ulnar sensory nerve                             |
| More stable repair compared with simple or vertical mattress suture through | The knots under the skin may be a source of pain to the patients             |
| the capsule                                                               |                                                                               |
| Low risk of injury of the dorsal ulnar sensory nerve compared with the     |                                                                               |
| inside-out technique                                                      |                                                                               |

Table 3. Pearls and Pitfalls of the Technique

| Pearls                                                                 | Pitfalls                                                                 |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------|
| Like other arthroscopic techniques, it is less invasive               | Multiple trials while piercing the TFCC by needle may lead to another tear |
| and allows complete evaluation of the wrist joint and exclusion of    | As it is an outside-in technique, the point of entry of the needle though the TFCC disk may be too radial and may cause some discomfort to the patient. |
| any associated lesion.                                                 | The ulnar-side incision may lead to extensor carpi ulnaris tendon instability. |
| It being an outside-in technique, exploration and identification of   |                                                                               |
| the dorsal sensory ulnar nerve and hence its protection can be        |                                                                               |
| accomplished.                                                         |                                                                               |
| The mattress suture through the TFCC reduces the incidence of         |                                                                               |
| suture cut-through.                                                   |                                                                               |

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