Arthroscopic Treatment of Triangular Fibrocartilage Wrist Injuries in the Athlete

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Background: Triangular fibrocartilage (TFC) injuries are an increasingly recognized cause of ulnar-sided wrist pain and can be particularly disabling in the competitive athlete. Previous studies show that arthroscopic debridement or repair can improve symptoms, but the results of arthroscopic treatment of TFC injuries in high-level athletes have not yet been reported.

Hypothesis: Arthroscopic debridement or repair of wrist TFC injury will allow a high rate of return to full function in the elite athlete.

Study Design: Case series; Level of evidence, 4.

Methods: Between 2001 and 2005, 16 competitive athletes (mean age, 23.4 years) with wrist TFC injuries underwent arthroscopic surgery. Repair was performed in unstable tears, and all others underwent debridement alone. Presurgery and postsurgery mini-DASH (Disabilities of the Arm, Shoulder, and Hand) scores were recorded for each athlete through medical record review and clinical evaluation. The mean duration of follow-up was 32.8 months (range, 24-51 months).

Results: The TFC was repaired in 11 (68.8%) and debrided in 5 (31.3%) patients. The tear was ulnar-sided in 12 (75%), radial-sided in 2 (12.5%), combined radial-ulnar in 1, and central-sided in 1 patient. Mean mini-DASH scores improved from 47.3 (range, 25-65.9) to 0 (all patients) (P = .002), and the mean mini-DASH sports module improved from 79.7 (range, 68.8-100) to 1.95 (range, 0-18.8) (P = .002). Return to play averaged 3.3 months (range, 3-7 months). Associated conditions in the 2 patients unable to return to play at 3 months were distal radioulnar joint (DRUJ) instability with ulnar-carpal abutment (n = 1) and extensor carpi ulnaris (ECU) tendinosis (n = 1).

Conclusion: Arthroscopic debridement or repair of wrist TFC injury provides predictable pain relief and return to play in competitive athletes. Return to play may be delayed in athletes with concomitant ulnar-sided wrist injuries.

Keywords: triangular fibrocartilage; tear; arthroscopy; athlete; repair

Triangular fibrocartilage (TFC) injuries are increasingly recognized as a cause of ulnar-sided wrist pain and may be particularly disabling in the competitive athlete. They may be the result of acute trauma or repetitive use, such as racquet sports.[11] The differential diagnosis includes lunotriquetral instability, distal radioulnar joint (DRUJ) ligament injury, tendinosis of the flexor or extensor carpi ulnaris (ECU) tendons, and ulnar-carpal abutment.

Palmer[9] classified TFC tears as either traumatic or degenerative, with subclassification of the traumatic group based on location of the tear. Management varies depending on the type of tear and generally consists of a trial of immobilization, physical therapy, and cortisone injection. Individuals with traumatic TFC tears (Palmer group 1) who do not improve with nonoperative treatment may benefit from arthroscopic debridement or repair of the TFC. Patients with peripheral, or ulnar-sided (Palmer 1B), tears appear to benefit most from repair, as this is where the TFC is most vascular.[2] Although numerous studies describe high rates of success with arthroscopic TFC repair or debridement,[2,5,13] there are no previous studies that focus on TFC injuries in the elite athlete.

The purpose of this study was to evaluate the results of arthroscopic treatment for TFC injuries in competitive athletes as well as provide return to play (RTP) guidelines after surgery. We hypothesize that arthroscopic debridement or repair of TFC injuries will allow a high rate of return to full function in the elite athlete.

MATERIALS AND METHODS

Between 2001 and 2005, 16 competitive athletes (mean age, 23.4 years) with wrist TFC injuries underwent arthroscopic

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surgery. The senior author (T.R.M.) performed all of the procedures. All patients had failure of nonoperative treatment, which included rest and immobilization, nonsteroidal anti-inflammatory drugs (NSAIDs), physical therapy, and possibly cortisone injection. All patients underwent preoperative magnetic resonance imaging (MRI) evaluation. The inclusion criteria for the study included traumatic TFC injury that failed conservative management in a high-level athlete (varsity high school, National Collegiate Athletic Association [NCAA], or professional level) in a sport that requires a high level of wrist function, no preexisting wrist injuries or conditions, and 2 or more years' follow-up.

Institutional review board approval was attained for medical chart review and clinical follow-up. Clinical follow-up was done by physical examination in all cases except for 4, who had telephone follow-up because they had left the region. For each patient, we recorded the age, gender, side, hand dominance, location of tear (radial, ulnar, combined radial and ulnar, or central), treatment (debridement or repair), presurgery and postsurgery mini-DASH (Disabilities of the Arm, Shoulder, and Hand) scores, and RTP. Return to play was defined as the duration between the surgery and return to full competition.

Statistical testing was done to compare mean mini-DASH preoperative and postoperative scores and mean mini-DASH sports module preoperative and postoperative scores. Statistical significance was set at $P < .05$. Statistical testing was done with the Wilcoxon signed-rank test.

Surgical Technique

All patients were positioned supine with a finger-trap distraction tower set to 10 lb. Routine diagnostic arthroscopy was performed with a 30° 2.3-mm arthroscope through standard 3-4 and 6R portals. Midcarpal arthroscopy was performed in all patients to rule out any concomitant injury. An 18-gauge needle was placed in the 1-2 interspace for outflow drainage, with inflow through gravity.

The decision to perform repair or debridement was based on the stability and location of the TFC injury. If a clear rupture was not identified, repair was performed in patients with a clearly positive "trampoline test" result,[5] indicating redundancy of the TFC after inadequate peripheral healing.

For patients who underwent debridement, a 2.9-mm full-radius oscillating shaver was inserted through the 6R portal, and the TFC was debrided to a stable margin. Any associated synovitis was also debrided, if present.

For patients who underwent repair, debridement is first performed in the same manner. The technique varied depending on whether the tear was ulnar- or radial-sided.

Ulnar-Sided Repair

In ulnar-sided repair, we used a modification of the technique described by de Araujo et al.[3] A 1.5-cm incision is made over the ulnar wrist to identify and bluntly protect the dorsal sensory branch of the ulnar nerve to avoid injury during needle passage or suture tying. A modification of the inside-out repair described by de Araujo et al[3] was used. The arthroscope is placed in the 6R portal to look directly down on the ulnar-sided TFC tear. A 6-inch 20-gauge Tuohy needle is then placed through the 1-2 or 3-4 portal. The 3-4 portal seems to allow easier insertion all the way to the ulnar side of the wrist, although it is a less direct line than the 1-2 portal. Care must be taken not to lever the Tuohy needle during its passage. A 17-gauge Tuohy needle is also available and is more resistant to bending forces, but this benefit is probably outweighed by the larger area of TFC it will pierce and may lead to tearing.

The Tuohy needle is advanced to the ulnar wrist under arthroscopic vision. It then pierces the TFC approximately 3 mm from the peripheral border and exits the ulnar side of the wrist (Figure 1A). The trocar for the Tuohy needle is removed, and a 2-0 PDS suture is fed through the needle from radial to ulnar until it is visualized out of the ulnar side of the wrist (Figure 1B). A small clamp is placed on the end of the suture outside the ulnar wrist, and the needle is withdrawn back into the radiocarpal joint (Figure 1C). The needle is then advanced a few millimeters volar or dorsal to the first pass and pierced through the TFC and back out the ulnar wrist (Figure 1D). The beveled tip of the Touhy needle prevents laceration of the PDS suture during this step. A hook probe is placed around the PDS suture loop, and the suture is pulled out from the needle, leaving 2 free ends of the suture outside the ulnar wrist (Figure 1E). Care should be taken to avoid inadvertently pulling the wrong end of the suture. The needle is removed from the wrist and the sutures tied over the ulnar capsule, with care to avoid injury to the dorsal sensory branch of the ulnar nerve (Figure 1F).

Radial-Sided Repair

For a radial-sided repair, a modified technique first described by Sagerman and Short[12] was used. Patient positioning and arthroscopic setup are the same as described for ulnar-sided tears. After diagnostic arthroscopy, a 1.5-cm longitudinal incision is made over the ulnar wrist to protect the dorsal sensory branch of the ulnar nerve and over the radial wrist proximal to the styloid to protect the superficial radial nerve.

As in ulnar-sided tears, debridement of the TFC tear margin is performed. Debridement is also performed on the ulnar aspect of the distal radius, to stimulate bleeding at the site of the TFC attachment. The arthroscope is placed in the 3-4 portal, and a probe is placed in the 6R portal and used as a retractor. A cannula is inserted through the ulnar incision and through the capsule into the joint. A 0.062-inch K-wire is advanced through the distal aspect of the sigmoid notch and out the radial wrist incision (Figure 2A). The K-wire is withdrawn and readvanced in the same manner starting 2 mm volar or dorsal to the first pass (Figure 2B). With the 2 drill holes in place, the radial border of the TFC is pierced with a meniscal needle in line with the first drill hole and advanced under arthroscopic vision through the drill hole (Figure 2C). A second meniscal needle, attached to the first by 2-0 PDS suture, is passed in the same manner, and both needles are retrieved through the radial wrist incision (Figure 2D and 2E). This pulls the PDS suture in a horizontal mattress fashion, closing the tear. The needles are cut free and the suture is tied over the radial wrist (Figure 2F).

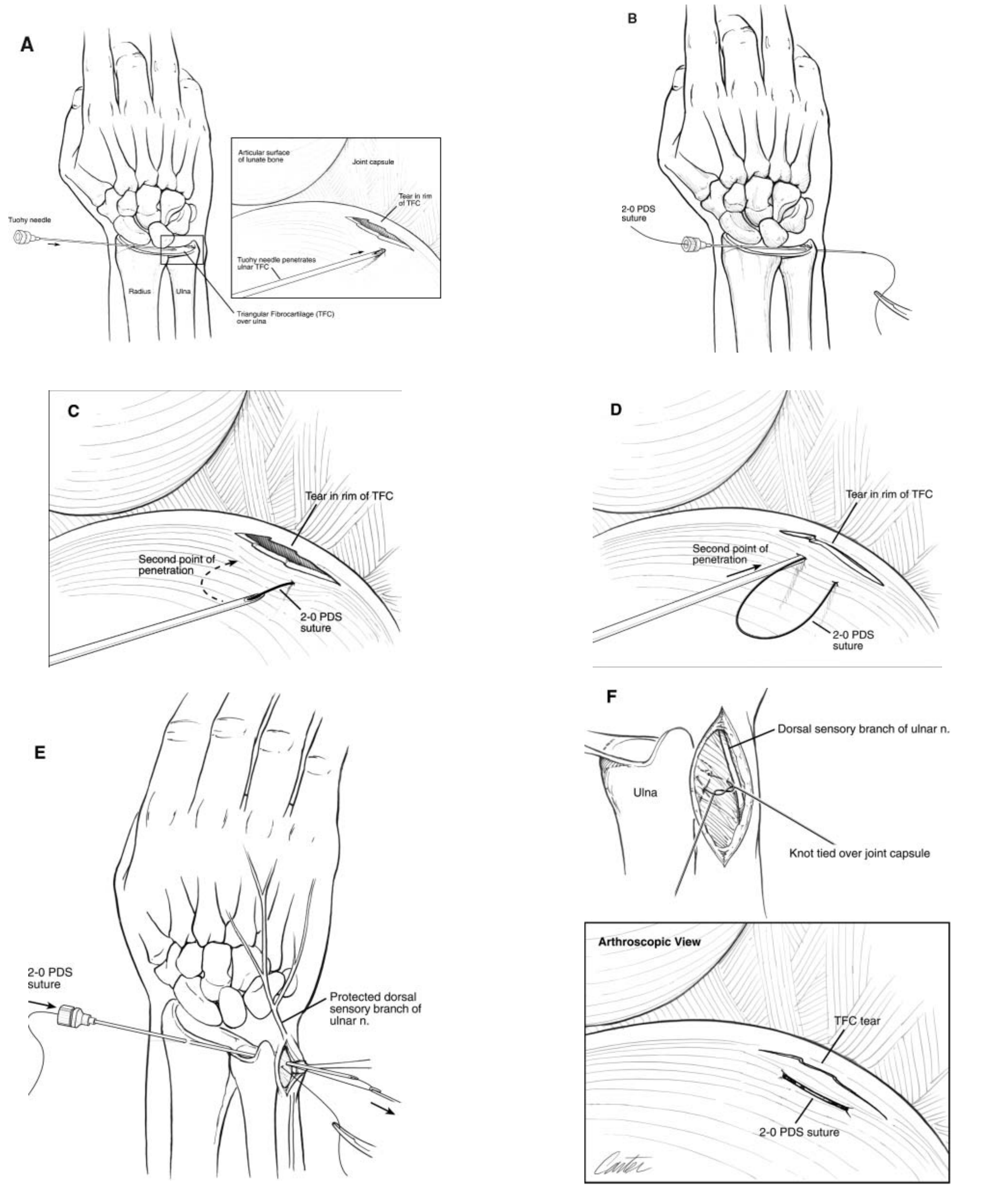

Figure 1. Operative technique for the inside-out repair of ulnar-sided triangular fibrocartilage (TFC) tears using a Tuohy needle. A, the Tuohy needle is advanced to the ulnar wrist. B, a PDS suture is fed through the needle. C, the needle is withdrawn into the radiocarpal joint. D, the needle pierces the TFC at a second point a few millimeters from the first. E, the 2 free ends of the suture are pulled out of the ulnar wrist. F, the sutures are tied over the ulnar capsule.

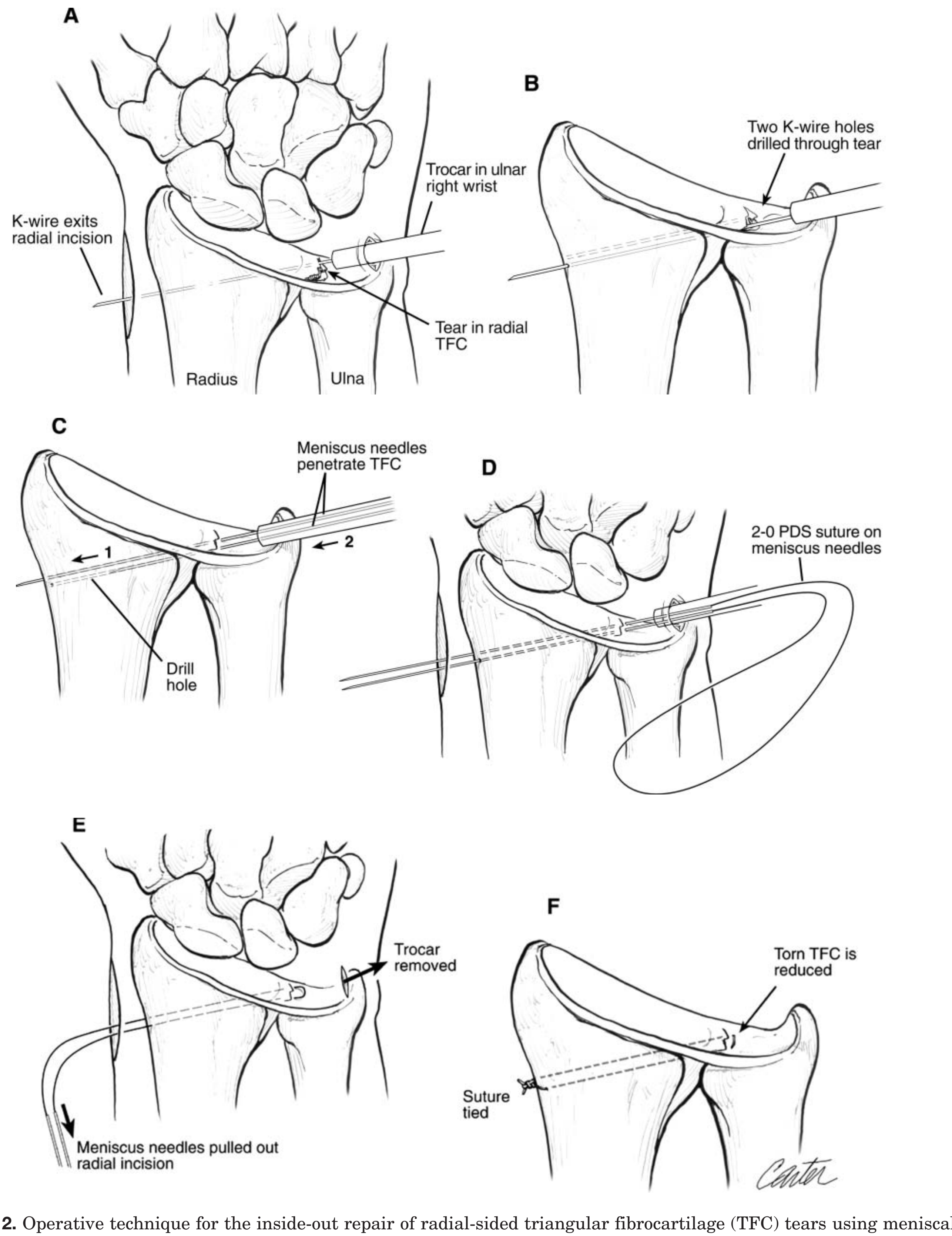

Figure 2. Operative technique for the inside-out repair of radial-sided triangular fibrocartilage (TFC) tears using meniscal needles. A, a cannula is inserted through the capsule into the joint, and a K-wire is advanced out the radial wrist incision. B, the K-wire is withdrawn and readvanced 2 mm from the first pass. C, a meniscal needle is advanced on the TFC. D, a second meniscal needle is passed in the same manner. E, the second meniscal needle exits the radial incision. F, the suture is pulled and tied over the radial wrist.

TABLE 1
Description of Patients Included in the Study[a]

ID	Age-M/F	L/R Side	Handedness	Radial/Ulnar	Duration of Symptoms Preoperatively (d)	Treatment	Pre-DASH	Pre-Sport	Post-DASH	Post-Sport	Sport	F/U (mo)	RTP (mo)
1	19M	L	R	Ulnar	32	Repair	43.2	75	0	0	Football	24	3
2	23M	R	R	Ulnar	51	Repair	45.5	75	0	0	Gymnastics	35	3
3	21M	L	L	Radial	58	Debride	25	81.3	0	0	Basketball	28	3
4	21M	R	R	Central	92	Debride	65.9	93.8	0	0	Gymnastics	24	3
5	21M	R	R	Ulnar	18	Debride	40.9	75	0	0	Gymnastics	34	3
6	16F	R	R	Ulnar	36	Repair	61.4	100	0	0	Gymnastics	27	3
7	42M	L	R	Ulnar	109	Repair	40.9	75	0	0	Golf	33	3
8	25M	L	R	Ulnar	84	Debride	47.7	68.8	0	0	Football	41	3
9	24F	L	R	Ulnar	32	Repair	72.7	100	0	0	Volleyball	36	3
10	20M	L	R	Radial	12	Repair	40.9	87.5	0	0	Football, baseball	36	3
11	23F	L	L	Ulnar	49	Repair	52.3	75	0	0	Tennis	39	3
12	18F	L	R	Ulnar	102	Debride	38.6	68.8	0	12.5	Tennis	24	7
13	20F	R	R	Both	29	Debride radial, repair ulnar	40.9	75	0	0	Volleyball	51	3
14	24F	R	R	Ulnar	84	Repair	52.3	68.8	0	0	Soccer	48	3
15	19M	R	R	Ulnar	12	Repair	38.6	75	0	0	Tennis	24	3
16	18F	R	R	Ulnar	64	Repair	50	81.3	0	18.75	Diving	24	3

[a]ID, identification; M, male; F, female; L, left; R, right; DASH, Disabilities of the Arm, Shoulder, and Hand; F/U, follow-up; RTP, return to play.

Postoperatively, patients were placed in a sugar-tong splint for 10 to 14 days, followed by a short-arm cast for 4 weeks, for a total of 6 weeks of immobilization. After cast removal, progressive range-of-motion and strengthening exercises were begun. Full return to sport was allowed at 3 months postoperatively.

RESULTS

Sixteen competitive athletes who underwent arthroscopic TFC repair or debridement met the inclusion criteria (Table 1). Average follow-up was 32.8 months (range, 24-51), and no patients were lost to follow-up. The average age was 23.4 years (range, 16-42), and 50% involved the left wrist and 50% the right wrist. There were 87.5% who were right-hand dominant, and 12.5% were left-hand dominant. The dominant wrist was affected in 62.5% of cases. The athletes participated in a variety of sports that required a high level of wrist function: football (n = 3), gymnastics (n = 4), basketball (n = 1), golf (n = 1), volleyball (n = 2), tennis (n = 3), diving (n = 1), and soccer goalkeeper (n = 1). Four patients (16%) had associated conditions of the ulnar wrist that were not specifically addressed at the time of arthroscopy. One had DRUJ instability and ECU tendinosis, 1 had DRUJ instability and ulnar-carpal abutment, and 2 had DRUJ instability only. DRUJ instability was defined as excessive dorsopalmar translation compared with the contralateral wrist. The duration from onset of symptoms to surgical treatment ranged from 12 to 109 days (mean, 54 days).

The TFC was repaired in 11 (68.8%) and debrided in 5 (31.3%) patients. The tear was ulnar-sided in 12 (75%), radial-sided in 2 (12.5%), combined radial and ulnar in 1, and central in 1 patient. Mean mini-DASH scores improved from 47.3 (range, 25-72.7) to 0 (all patients) (P = .002). The mean mini-DASH sports module improved from 79.7 (range, 68.8-100) to 1.95 (range, 0-18.8) (P = .002). Return to play averaged 3.3 months (range, 3-7). Associated conditions in the 2 patients unable to return to play at 3 months were ulnar-carpal abutment/DRUJ instability (n = 1) and ECU tendinosis/DRUJ instability (n = 1).

DISCUSSION

Arthroscopic debridement or repair for tears of the TFC has proven successful for patients whose injury fails the usual nonoperative treatments consisting of rest, immobilization, physical therapy, and cortisone injection.[2,13] Peripheral ulnar-sided tears have been more amenable to repair than radial-sided tears because of the increased vasculature at the ulnar TFC attachment site to the capsule.[2] If the tear is central or stable, it is best treated with debridement alone, with good to excellent results in 90% of cases.[2] However, to our knowledge, there are no previous reports of TFC repair or debridement results specific to the high-level athlete.

Our study shows that arthroscopic debridement or repair of the TFC is successful in competitive athletes who require a high level of wrist function for performance. All of the patients were able to return to full competition for their sport. The decision to perform arthroscopic debridement versus repair was based solely on the location and stability of the tear.

There are only a few general discussions in the literature of TFC repair or debridement in the athlete. In his review of wrist injuries in the athlete, Rettig[11] stated that TFC injuries may need a more aggressive approach, with early arthroscopy and repair if the DRUJ is unstable, or arthroscopy if symptoms persist after 2 to 3 weeks when the DRUJ is stable. Nagle[7] reviewed TFC tears in the athlete and stated that athletes present more of a rehabilitation challenge than the nonathlete, but most TFC injuries may be treated successfully in the athlete. Whipple[14] described arthroscopic TFC repair in athletes using a commercial cannulated suture passer and suture retriever kit and stated that athletes may return to function sooner and have a more cosmetic scar formation with arthroscopic compared to open TFC repair. The findings of our study support the expected successful results of TFC repair in athletes reported by these authors.

We used a fairly conservative immobilization and rehabilitation protocol. All patients in our study, whether the TFC was debrided or repaired, underwent 6 weeks of immobilization in a short arm splint followed by 6 weeks of progressive range-of-motion and strengthening exercises with full return to sport allowed at 3 months postoperatively. Rettig[11] stated that golf or tennis athletes typically return to restricted sports in 4 to 6 weeks if a central TFC tear is debrided, and return is 3 to 4 months after repair. Whipple[14] reported that athletes may return to competition as soon as comfort allows after debridement of a central TFC lesion. Our initial experience with elite athletes demonstrated a high rate of recurrent ulnar synovitis if the patient was allowed to return too quickly, even after TFC debridement alone. In this patient population, it is critical that complete healing takes place before the next season or event, and therefore we opted to immobilize the patients who underwent debridement in the same manner as those who underwent repair to avoid recurrent synovitis. It is possible that earlier return to sport may be allowed after TFC debridement alone without excessive risks.

Immobilization options after TFC debridement or repair include a short arm splint or cast, a Muenster splint or cast, or a long arm cast. We used a short arm cast and counseled the patients to avoid resistive pronosupination. In this way, the athlete may return to a fitness program much easier than if the elbow is immobilized in any way. In less reliable patients, we use a Muenster cast for the first 3 weeks, but all patients in this study were deemed candidates for short-arm immobilization.

Options for the repair of the wrist TFC include outside-in, inside-out, and all-inside techniques. Although recent studies have evaluated all-inside techniques,[10,15] most studies involve an inside-out arthroscopic technique. The advantages of the technique used in our study are the low cost and readily available suture-passing device because a Tuohy needle is a part of standard anesthesia supplies. In the inside-out technique, it is important to make an additional 1.5-cm incision on the ulnar wrist to identify and protect the dorsal sensory branch of the ulnar nerve, where nerve injury has been reported in up to 17% of cases.[4,6] As is the case with meniscal repair in the knee, many studies have recently focused on all-inside techniques. Further study is needed to determine if all-inside techniques will accelerate recovery time or if implant-related complications will occur. At this time, we prefer the 2-0 PDS, which will start to resorb within weeks, thus limiting mechanical irritation to the ulnar wrist when the athlete returns to activities.

All of our patients underwent preoperative MRI evaluation. Eight of the 16 were MR arthrograms. Although all 16 patients demonstrated a TFC tear intraoperatively, 4 of the 8 standard MRI results showed "no tear" of the TFC, and 2 of the 8 MR arthrogram findings showed "no tear" of the TFC. Our experience is that peripheral TFC injuries may be more difficult to detect than central or radial tears because of the more complex anatomy and focal synovitis at the ulnar TFC attachment. This was also reported in a study by Oneson et al,[8] in which the sensitivity for detection of ulnar-sided tears was only 25% to 50% compared with 86% to 100% for central and radial tears. The history (acute vs chronic and mechanism of injury), examination results (tenderness to palpation in the recess between the pisiform and ulnar styloid, and a positive ulnar impaction test finding), and response to injection were all more important than MRI in the surgical decision-making process for our patients.

The DASH Outcome Measure is a 30-item questionnaire that quantifies physical symptoms and function of the upper limb and has comparable reliability and validity to other more joint-specific outcome measures.[1] We used the mini-DASH questionnaire because it contains only 11 items and is comparable to, if not better than, the 30-item DASH score.[1] The mini-DASH also has an optional sports module that we used in this study. The sports module identifies changes in technique, level of function, practice and competition playing time, and pain that an athlete may have experienced after being cleared for full participation 3 months postoperatively. This is especially important in this study that involves high-level athletes. If a standard questionnaire was used, all patients would have been reported as a perfect outcome. In this study, the sports module identified limitations that 2 athletes had when they attempted to return to full competition, even though they had returned to all functional activities of daily activity without pain.

Associated conditions were seen in 4 patients. Two patients had DRUJ instability preoperatively on clinic examination, which improved postoperatively and did not compromise the outcome. Two additional patients had DRUJ instability combined with ulnar-carpal abutment (n = 1) and ECU tendinosis (n = 1). The patient with ulnar-carpal abutment was able to return to play 3 months postoperatively but still had ulnar-sided wrist pain for an additional 3 months. The patient with ECU tendinosis was not able to return to play until 7 months postoperatively.

Our current practice for patients with clear associated conditions that contribute to ulnar-sided wrist pain is to address those injuries surgically at the same time as the arthroscopic TFC procedure. Patients in which a concomitant procedure was performed were excluded from this study. The symptoms in the 2 patients included in this study with associated ulnar-carpal abutment and ECU tendinosis were thought to be primarily TFC related, so no additional procedures were performed. We believe this contributed to the lower sports module scores in those 2 individuals.

DRUJ instability is always a concern in the evaluation of ulnar-sided wrist pain. It is our experience that some degree of DRUJ instability is not uncommon in TFC injuries, as the TFC is a significant contributor to overall DRUJ stability and function. Although tendon-weave reconstruction has shown favorable results for DRUJ instability, it is an invasive procedure that would have significant morbidity in the athlete. We were encouraged that the 2 patients in our study with clear DRUJ instability, and no other associated conditions, responded well to TFC repair combined with postoperative rest and immobilization, with no residual DRUJ symptoms and full return to competition at 3 months. This study demonstrates that it is possible to achieve success with TFC repair alone in the athlete even in the setting of DRUJ instability.

This study has several limitations. First, it is a level 4 retrospective study with a small number of patients. Although we have seen hundreds of high-level athletes with ulnar-sided wrist pain at our institution, most did not require surgery. For those who ended up undergoing surgery, many had additional wrist procedures, and they were excluded. Therefore, although it is a relatively small number of patients, our study focuses only on the wrist of high-level athletes in which surgery addressed the TFC and no other conditions. Second, our study does not show if debridement or repair is better in the treatment of TFC injuries in terms of outcome or duration for RTP. We based our surgical technique on the location and stability of the tear and did not compare the 2 groups. Further study is needed, with larger patient numbers to determine if different rehabilitation protocols and clinical outcomes may be expected based on debridement or repair of the TFC injury.

In conclusion, arthroscopic debridement or repair of the TFC is a successful procedure for elite athletes who do not respond to nonoperative treatment regimens. Return to play should be expected 3 months after surgery but may take longer in patients with associated ulnar-sided wrist conditions.

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