Technical Note

Trans - 6R Portal Repair of Superficial TFCC Tears; A Modified Arthroscopic Outside-in Technique

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Abstract: Different arthroscopic repair techniques have been described for various tear types. Several series have reported successful outcomes for arthroscopic repair of superficial tear of the triangular fibrocartilage complex (TFCC) tears using the outside-in technique. Described techniques entail usage of special instruments for passage of sutures and/or use of many incisions. We describe an arthroscopic technique for repair of superficial part of TFCC through the 6R portal by single hypodermic needle, with no additional skin incisions or special equipment.

Introduction

Several arthroscopic techniques have been reported for repair of the superficial tear of the triangular fibrocartilage complex (TFCC). These techniques are categorized, according to the direction of the suture passage, including inside-out, outside-in, and all-inside arthroscopic techniques.[1] Several authors have described the "outside-in" repair using different techniques.

Reviewing different published techniques of TFCC repair, an additional incision other than the working and viewing portals was used to protect the dorsal branch of ulnar nerve (DBUN) and to place the knot direct over the capsule. In all techniques[1-8], this incision was placed ulnar to the extensor carpi ulnaris (ECU) tendon except for Mathoulin[9] who used an incision at the distal radioulnar joint (DRUJ) portal.

To apply the suture, a meniscal repair kit was used in some techniques.[1,5,6] Others[2-4,6,7,9] used hypodermic needles, which are less traumatizing to the TFCC. The sutures used for repair were fashioned either as Mulberry knots,[2] vertical mattress,[5-7] or transverse mattress suture.[8,10] Table 1 summarizes main differences between techniques.

We introduce a modified outside-in technique in which we used 3-4 viewing portal and 6R as a single working portal with no extra skin incisions.

Indications and contraindications

Indications for this technique include Palmer[11] type 1B TFCC tear, Atzei-EWAS[12] class 1 and selected cases with mixed complex tears, after failed conservative treatment for at least 3 months.

This procedure is contraindicated in patients with diffuse synovitis, cartilage degeneration, and isolated deep part TFCC tear.[13]

Surgical Technique

Under general or regional block anesthesia, the patient is placed in a supine position with shoulder abducted 90°. A non-sterile tourniquet is applied but not inflated unless needed. We use a vertical overhead traction. In addition, we apply 5-10 kg of traction through finger traps applied to the medial four fingers.

Pretraction DRUJ clinical examination is performed and compared to the contralateral side.[12] We routinely use the 3-4 portal as the main viewing portal and the 6R portal as the working portal. We use a 2.7-mm 30° arthroscope (Stryker) and 21 gauge hypodermic needle.

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Table 1. Different Techniques of Outside-in Repair of TFCC Tears

A	Year	Suture Entry	Suture Tie	Incision	Instruments	Suture Materials	Suture Type	Suture Passage Through the Loop
Zachee et al.[2]	1993	6U	6U	6U portal	Two 26 G hypodermic needles	PDS 4/0	Mulberry knots	Knots were done outside the joint (through 6R)
Corso et al.[3]	1997	Floor of ECU compartment	ECU subsheath	1.5 cm along 6R Open ECU sheath	Suture passer, loop suture retriever	PDS 2/0		Inside the joint
Haugstvedt and Husby[4]	1999	6U	6U	Small incision at 6U	Two thick needles	Maxon loop		Inside the joint
Ruch and Papadonikolakis[1]	2005	Floor of ECU compartment	ECU subsheath	1 cm along 6R Open ECU sheath	Meniscal repair kit and a Touhy needle	PDS 2/0		Inside the joint
Micucci and Schmidt[5]	2007	Ulnar to 6R portal	Ulnar capsule	1.5 − 2 cm longitudinal incision ulnar to 6R portal	Meniscal repair kit	PDS 3/0	Vertical mattress	Inside the joint
Frank et al.[6]	2015	Ulnar to ECU	Ulnar to ECU	Ulnar to ECU	Meniscal repair kit	PDS 2/0	vertical mattress	Inside the joint
Bayoumy et al.[7]	2015	Ulnar wrist	ulnar retinaculum	2 cm volar to ECU tendon	Two 24 G hypodermic needles	PDS 2/0	vertical mattress	outside the joint (through 6R)
Bayoumy et al.[7]	2017	Ulnar wrist	ulnar retinaculum	2 cm volar to ECU tendon	Two 18 G hypodermic needles	PDS 2/0	transverse mattress	outside the joint (through 6R)
Mathoulin[9]	2015	DRUJ portal	subcutaneously at the DRUJ portal	DRUJ portal	Two 21 G hypodermic needles	3/0 or 4/0 PDS	Vertical mattress	outside the joint (through 6R)
Soliman et al.[10]	2020	6R	Subcutaneously at the 6R portal	6R portal	One 18 G hypodermic needle	2\0 Fibre Wire	Vertical or transverse mattress	Inside the joint

TFCC, tear of the triangular fibrocartilage complex.

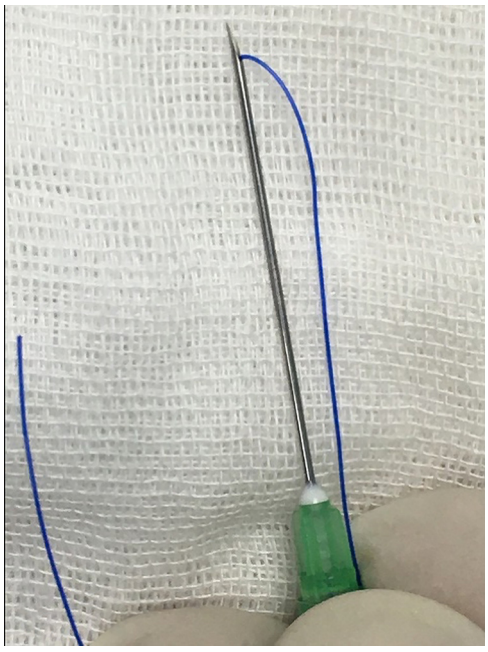

Fig 1. Suture loop with one limb inside the needle and the other limb outside. In this way, the suture is turning over the "heel of bevel," which is blunt and does not cause fraying of suture throughout the procedure.

Diagnostic Arthroscopy

We start by dry arthroscopy technique through the 3-4 portal moving toward the ulnar side of the wrist. Skin transillumination is helpful in localizing the 6R portal, and a 21 gauge hypodermic needle is used to ensure its exact position before creating the portal. The 6R portal is used as a working portal. Tension of the superficial (distal) part of TFCC is assessed by the trampoline test,[14] and the integrity of the deep (proximal) part of TFCC is assessed by the hook test.[12] We perform routine radio-carpal diagnostic arthroscopy to identify any concomitant soft-tissue or articular pathology. Arthroscopy of the midcarpal joint may be considered if additional pathology is suspected.

Instrument Set for Repair

The instrument set includes 2.5-mm full radius oscillating shaver (Stryker), 21 gauge hypodermic needle, 2/0 or 3/0 PDS II (Polydioxanon monofilament - Ethicon) sutures for repair, and small curved artery forceps, which is used to retrieve suture limbs.

Loading of Repairing Suture

The needle is loaded with PDS suture (2/0 or 3/0) then turned back around the blunt edge of the bevel (heel of the bevel). A suture loop with two limbs is created, one limb is inside the needle and the other (free) limb is outside (Fig 1).

Steps of Repair

Step 1: The edges of the tear are refreshed using a 2.5-mm full radius oscillating shaver.

Step 2: A plane is developed between the capsule and the subcutaneous tissue proximally through the 6R portal to the level of the expected needle's entry. This avoids entanglement of soft tissues or cutaneous nerves.

Step 3: The loaded needle is placed 5-8 mm proximal to the 6R portal and somewhere between the EDM and the ECU, according to the configuration of the tear. We insert the loaded needle from proximal aiming distally. The needle is advanced to pierce the articular disc 2-3 mm volar to the tear (Fig 2).

Step 4: The loop of the PDS is advanced to the ulnocarpal joint (Fig 2B).

Step 5: The free limb (which is outside the needle) is retrieved through the 6R portal (Figs 3 and 4).

Step 6: The needle is withdrawn short of getting outside the skin and redirected subcutaneously towards 6R portal to retrieve the other limb of the suture (Fig 5).

Step 7: The needle is withdrawn, and the other suture limb is retrieved to the 6R portal using a curved mosquito.

Now, the two limbs of this suture have been retrieved through the 6R portal. In this manner, one limb is superficial and dorsal to the capsule, and the other limb is volar to the tear (Fig 6). Tensioning of this vertical suture leads to closure of part of the defect. At this point, we do not tie the suture until we pass the required number of sutures needed for the complete closure of the tear (Fig 7). Typical tears usually accommodate 2 or 3 vertical stitches, depending on the extent of the tear (Video 1).

The wrist traction is released prior to knot tightening, and the forearm is maintained in a supination position. Sutures are tied sequentially through the 6R portal by the sliding knot technique under arthroscopic vision to verify closure of the tear (Fig 8). Standard closure of the arthroscopy portals is performed.

Postoperative Care and Rehabilitation

Postoperatively, the patient is placed in a sugar tong slab for 4 weeks during which finger range of motion is advised. The next 4 weeks, a well-molded, below-elbow cast is applied to allow full-elbow flexion and extension and limited pronation and supination. After cast removal, active and active assisted range of motion exercises are started together with scar massage to decrease incidence of suture irritation and adhesions around extensor tendons. Then, the patient can start isometric strengthening, isotonic strengthening, endurance, and finally plyometric exercises. Full activities and contact sports are allowed after 6 months.

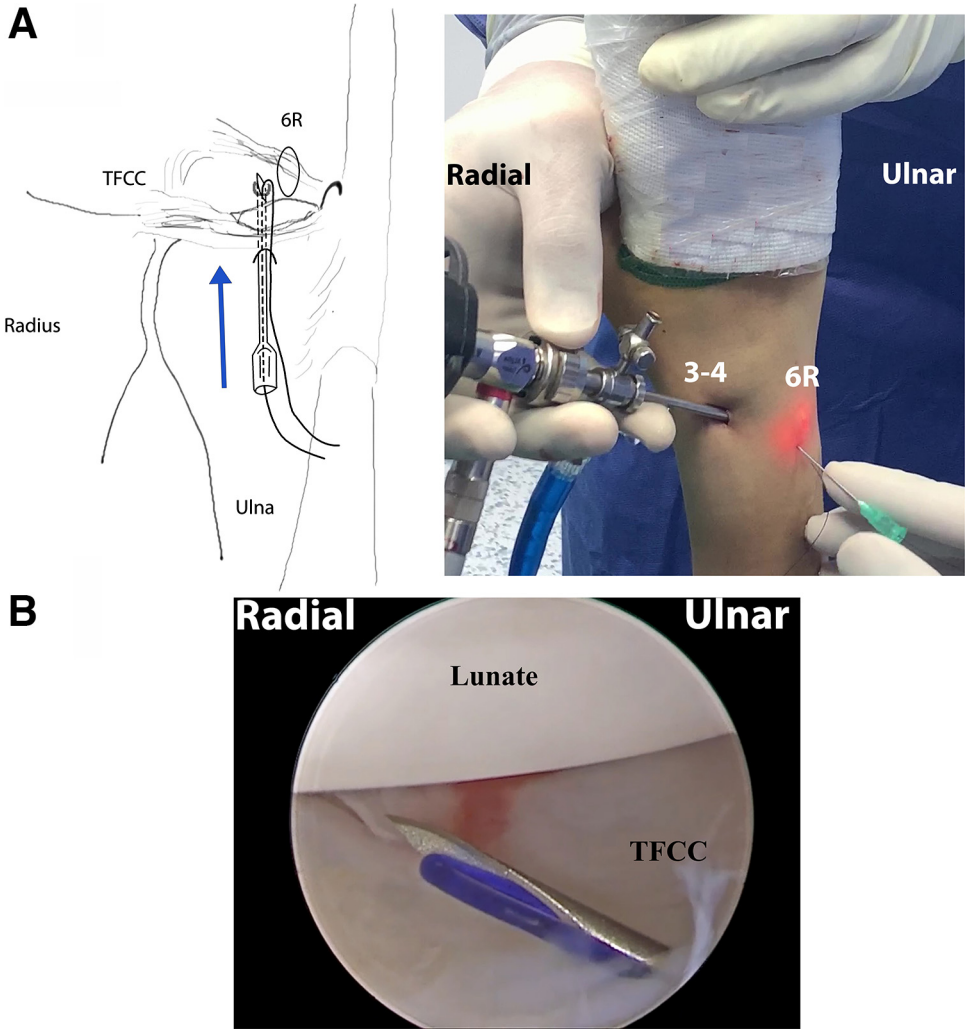

Fig 2. After identification and refreshing edges of triangular fibrocartilage complex (TFCC) tear, needle with suture loop is inserted proximal to 6R portal to pass across the tear under visualization through 3-4 portal.

Potential Risks

Fifth extensor tendon entangling (therefore, through the 6R portal, a plane is established between the capsule and the subcutaneous tissue close to where the needle entrance is anticipated. If the tear required more than 3 sutures, this may cause crowdedness of sutures and subcutaneous irritation; thus, we use PDS being slowly absorbable.

Discussion

Arthroscopic repair has been widely used for most TFCC tear types.[8] Several series have demonstrated good results for arthroscopic repair of peripheral TFCC tears with an outside-in technique.[7,15,16] We reviewed different techniques describing outside-in repair and tried to illuminate the main differences between them and our preferred technique (Table 1).

The ideal repair securely keeps the torn TFCC tightly sutured to the dorsal capsule with no nerve or tendon irritation and with minimal incisions (less scarring).[17]

Adding a separate incision for suturing of TFCC tear has been described by many authors to avoid injury of dorsal cutaneous branch of ulnar nerve and entrapment of extensor tendons and to allow placement of suture directly over the wrist capsule. Many published techniques[2,4-8] used a skin incision ulnar to ECU tendon. They tried to reattach the ligament as close as possible to its anatomical anchoring point. This incision is too close to the sensory branch of ulnar nerve, and even if identified and protected, it can still be irritated by the suture knots, which was reported in their studies.[5-8]

To decrease incidence of irritation of dorsal branch of ulnar nerve, some authors adopted repair of TFCC to the undersurface to ECU tendon sheath,[1,3] which may present a tough anchoring point as well. We think that suture knots located at the floor of the sixth extensor compartment may lead to ECU tendinitis. In addition, tight repair of superficial layer of retinaculum may lead to stenosing tenosynovitis of the ECU, and loose repair may end with ECU tendon instability.

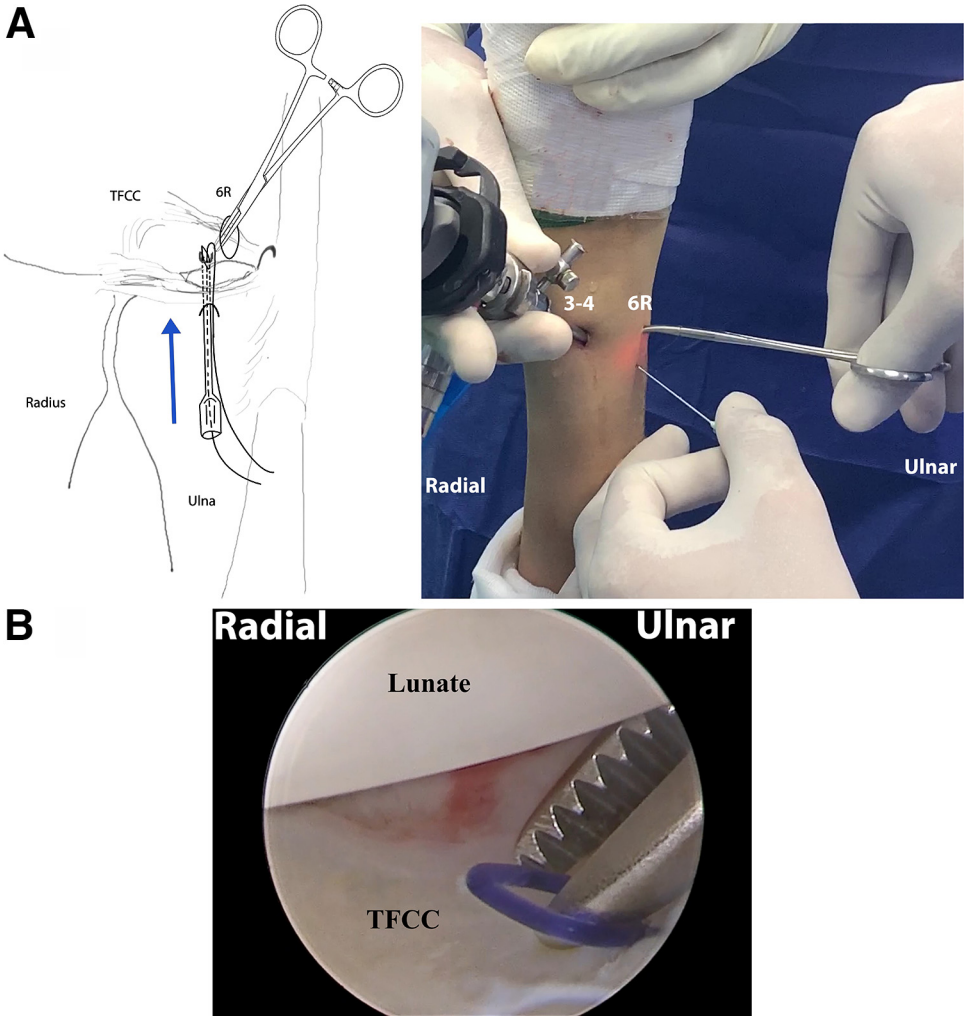

Fig 3. A curved mosquito is inserted through the 6R portal to retrieve the free limb of the suture loop (which is outside the needle) outside the joint.

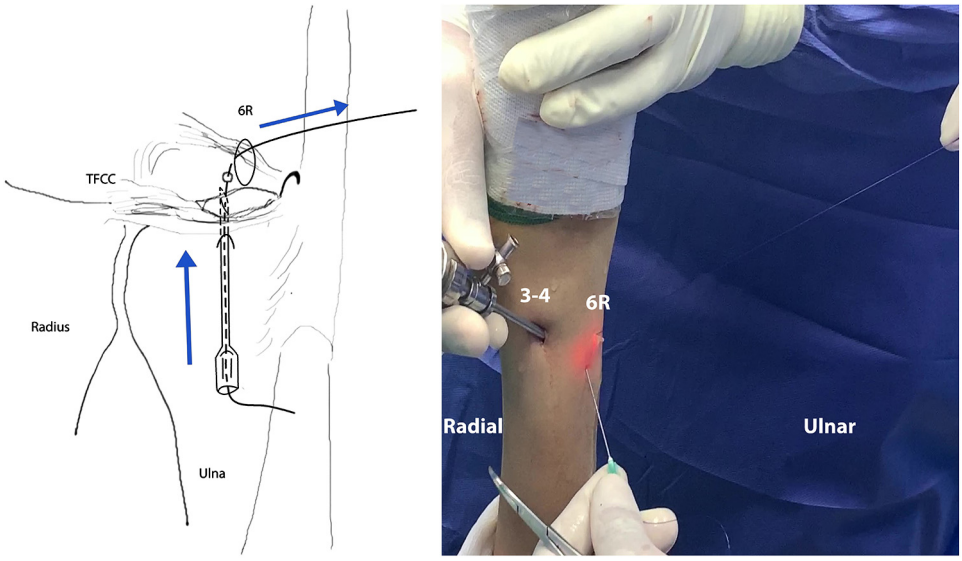

Fig 4. Picture showing the free limb of the suture loop retrieved outside the joint through the 6R portal. TFCC, tear of the triangular fibrocartilage complex.

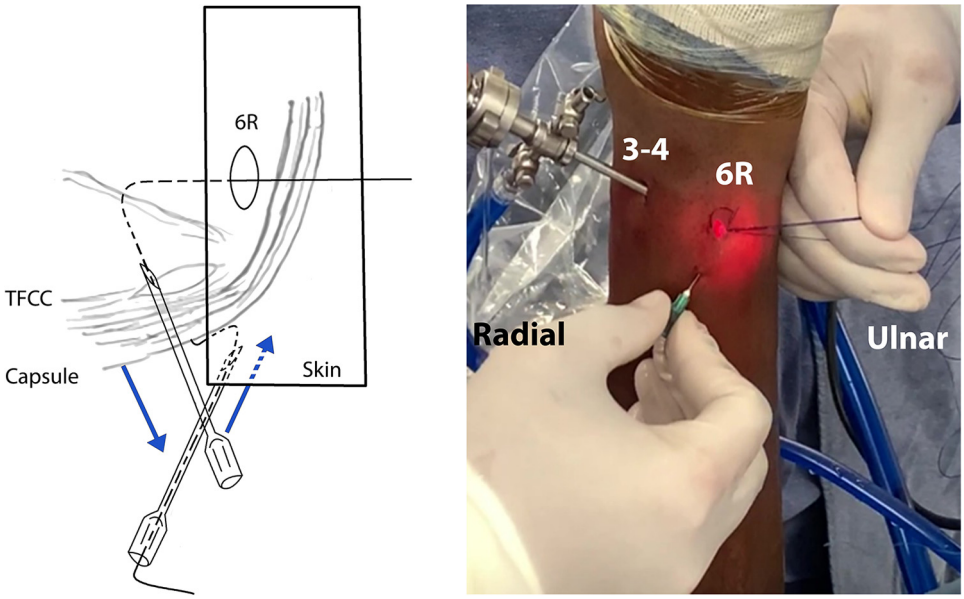

Fig 5. Needle is withdrawn outside the joint until it reaches the subcutaneous tissue level, then redirected toward the 6R portal to retrieve the second limb of the suture loop. TFCC, tear of the triangular fibrocartilage complex.

We think that suture application radial to the ECU tendon avoids previous mentioned complications.[16] Mathoulin[9], in 2015, adopted this approach and used the DRUJ portal for suturing of TFCC tears. He stated that he used to make this portal as part of a routine task to assess the deep part of the ligament and to be sure that the suture is placed directly over the wrist capsule as well.

Many authors have described their sutures as vertical mattress sutures[5-7,9] despite having the same configuration of our suture. A true vertical mattress suture is applied in a far-far and near-near fashion. We believe that a true vertical mattress suture may overtighten the ligament leading to joint stiffness or ulnar side wrist pain. We do not prefer to do transverse mattress suture configuration described by Bayoumy et al.[8] as we think that it may affect the vascularity and healing potential of the ligament. We classify the knot used in this technique as a simple interrupted suture vertical to the plane of the tear.

Hypodermic needles were recommended by many authors for arthroscopic repair of the TFCC tear.[7-10] Compared to other tools, such as meniscal repair needles, suture lasso, and suture retriever, the

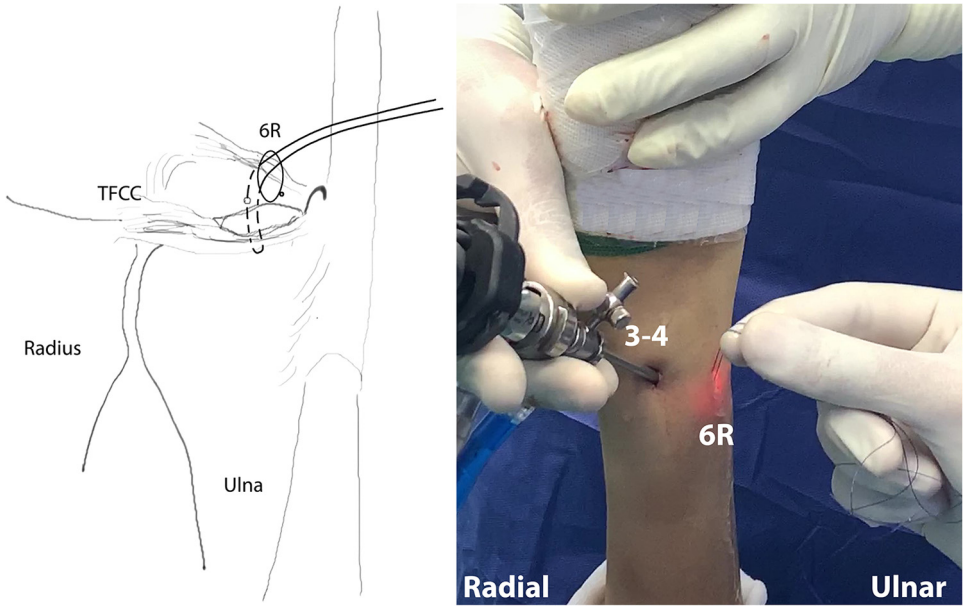

Fig 6. The final configuration before tying of suture: the suture is passing across the tear with the two limbs retrieved through 6R portal. TFCC, tear of the triangular fibrocartilage complex.

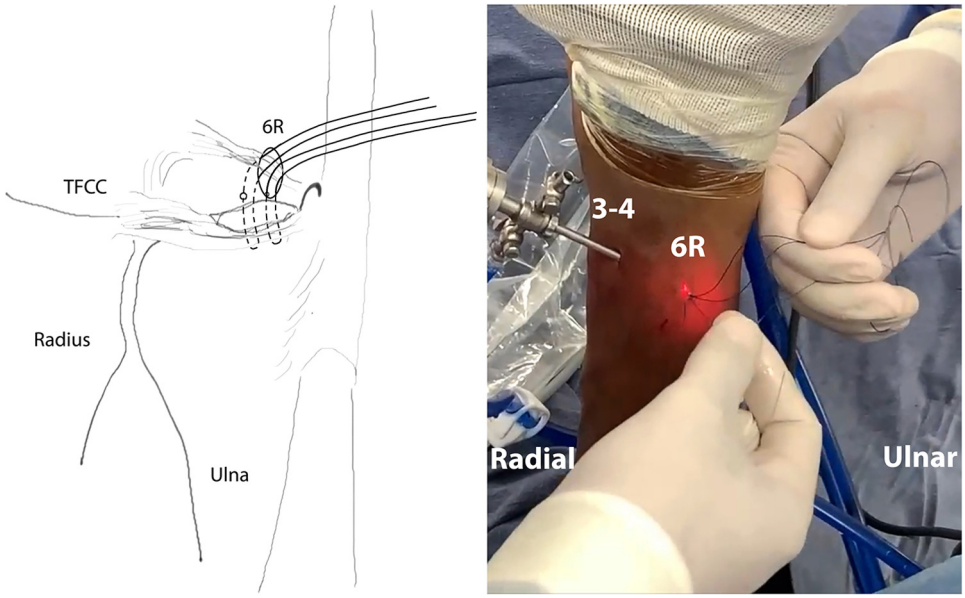

Fig 7. Suture can be repeated as needed to provide good repair for the triangular fibrocartilage complex (TFCC) tear.

hypodermic needle has the advantages of being less expensive, available in all theaters, and can pass the sutures in a less traumatic way through the TFCC.[7,8]

In all techniques using hypodermic needles, authors do insert two needles: one for the suture and the other for the loop to guide the suture through the other side of the tear, which seems to be time and material consuming. Soliman[10] et al. reported that they use a single needle with a single suture. They used the same suture as a repairing suture and a shuttle suture at the same time. We think that this will lead to crowdedness of sutures inside the joint, which may add to difficulty of the technique, as reported in their article. In addition the repairing stiches have a transverse mattress configuration, which may affect vascularity of TFCC and increase incidence of entangling cutaneous nerve branches, as well as extensor tendons, which is why they are used to extend skin incision for identification and protection of structures at risk. In our technique, we omitted the use of a second needle for the loop and we got use of the blunt edge of the needle bevel (heel of the bevel) to guide the suture through its pathway with no hazard of fraying it. This technique ends up with simple vertical sutures that close the TFCC tear without affecting its vascularity and healing potential. Our technique is a quick, easy, reproducible method for suturing superficial TFCC tears with single skin penetration. Advantages and potentials complications are presented in Table 2.

Limitations

Tears located too radially may require repair through the 4,5 portal. Also, injury to the ulno-carpal ligaments would not be accessible by this technique.

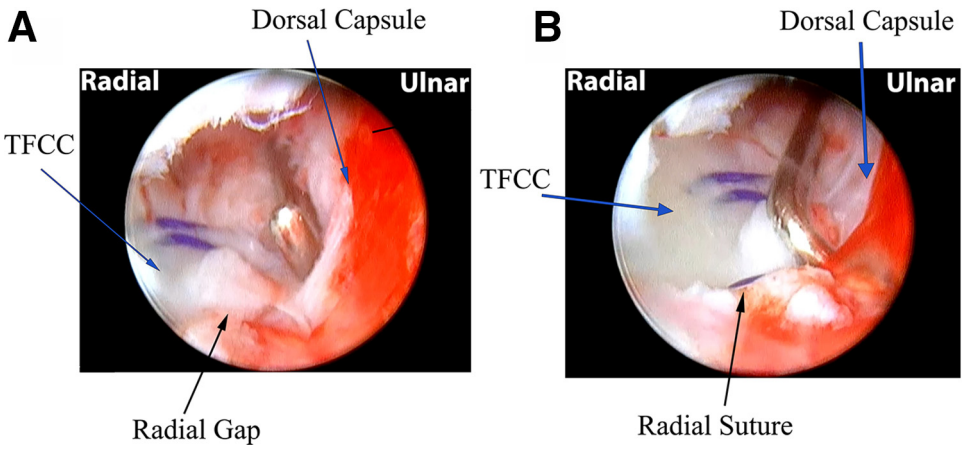

Fig 8. Arthroscopic view (A) closure of the ulnar part of the tear by 2 sutures. (B) Probing of the tear revealed radial gapping that needed a third suture closure. TFCC, tear of the triangular fibrocartilage complex.

Table 2. Advantages, Potentials Complications and Limitations of the Technique

Advantages	Potential Complications	Limitations of Technique
Away from dorsal branch of ulnar nerve	Crowdedness of sutures	Tears of deep part of TFCC
ECU sheath left undisturbed (No instability or tendinitis)	Possible tethering of fifth extensor compartment if the tear is extending too radial	Tears of ulnocarpal ligaments
No additional skin incision		
No suture loop to retrieve suture (Quick and economic)		
Instrument set is cheap and readily available		

ECU, extensor carpi ulnaris; TFCC, tear of the triangular fibrocartilage complex.

References

1. Ruch DS, Papadonikolakis A. Arthroscopically assisted repair of peripheral triangular fibrocartilage complex tears: Factors affecting outcome. *Arthroscopy* 2005;21:1126-1130.
2. Zachee B, de Smet L, Fabry G. Arthroscopic suturing of TFCC lesions. *Arthroscopy* 1993;9:242-243.
3. Corso SJ, Savoie FH, Geissler WB, Whipple TL, Jiminez W, Jenkins N. Arthroscopic repair of peripheral avulsions of the triangular fibrocartilage complex of the wrist: A multicenter study. *Arthroscopy* 1997;13:78-84.
4. Husby, Jan-Ragnar Haugstvedt T. Results of repair of peripheral tears in the triangular fibrocartilage complex using an arthroscopic suture technique. *Scan J Plastic Recon Surg Hand Surg* 1999;33:439-447.
5. Micucci CJ, Schmidt CC. Arthroscopic repair of ulnar-sided triangular fibrocartilage complex tears. *Oper Tech Orthop* 2007;17:118-124.
6. Frank RM, Slikker W, Al-Shihabi L, Wysocki RW. Arthroscopic-assisted outside-in repair of triangular fibrocartilage complex tears. *Arthrosc Tech* 2015;4:e577-e581.
7. Bayoumy MA, Elkady HA, Said HG, El-Sayed A, Saleh WR. Short-term evaluation of arthroscopic outside-in repair of ulnar side TFCC tear with vertical mattress suture. *J Orthop* 2016;13:455-460.
8. Bayoumy MA, El-Sayed A, Elkady HA, Saleh WR, Said HG, Ali AM. Arthroscopic treatment of type 1B triangular fibrocartilage complex tear by "outside-in" repair technique using transcapsular transverse mattress suture. *Arthrosc Tech* 2017;6:e1581-e1586.
9. Mathoulin CL. Chapter 8. Arthroscopic repair of peripheral tears of the triangular fibrocartilage complex. In: Mathoulin C, ed. Wrist arthroscopy techniques. *First*. Georg Thieme Verlag, 2015;43-51.
10. Soliman RA, El-Mahy MM, Atiyya AN, et al. Single-strand repair of EWAS 1 lesion of triangular fibrocartilage complex. *Eur J Orthop Surg Traumatol* 2021;31:327-332.
11. Palmer AK. Triangular fibrocartilage complex lesions: A classification. *J Hand Surg Am* 1989;14:594-606.
12. Atzei A, Rizzo A, Luchetti R, Fairplay T. Arthroscopic foveal repair of triangular fibrocartilage complex peripheral lesion with distal radioulnar joint instability. *Tech Hand Up Extrem Surg* 2008;12:226-235.
13. Choi IC, Park JW. Editorial: Arthroscopic capsular repair of wrist triangular fibrocartilage complex tears: Beware that apparent isolated Atzei Class 1 (isolated distal component) tears may include a proximal component. *Arthroscopy* 2022;38:1463-1465.
14. Wysocki RW, Richard MJ, Crowe MM, Leversedge FJ, Ruch DS. Arthroscopic treatment of peripheral triangular fibrocartilage complex tears with the deep fibers intact. *J Hand Surg* 2012;37:509-516.
15. Wysocki RW, Richard MJ, Crowe MM, Leversedge FJ, Ruch DS. Arthroscopic treatment of peripheral triangular fibrocartilage complex tears with the deep fibers intact. *J Hand Surg* 2012;37:509-516.
16. Haugstvedt JR, Søreide E. Arthroscopic management of triangular fibrocartilage complex peripheral injury. *Hand Clinics* 2017;33:607-618.
17. Piñal F del, García-Bernal FJ, Cagigal L, Studer A, Regalado J, Thams C. A technique for arthroscopic all-inside suturing in the wrist. *J Hand Surg Eur* 2010;35:475-479.