Chapter 10 Arthroscopically Assisted Foveal Reinsertion of the Triangular Fibrocartilage Complex

Introduction

The triangular fibrocartilage complex (TFCC) is the primary stabilizer of the distal radioulnar joint (DRUJ). Recent histological and functional studies[1] have elaborated on the three-dimensional structure of the TFCC and identified three components: (1) the proximal triangular ligament; (2) the distal ligament "hammock;" and (3) the ulnar collateral ligament (UCL), attached to the deep part of the sheath of the extensor carpi ulnaris (ECU) tendon. This distal hammock-like structure and the UCL form the "distal TFCC," whereas the proximal ligament is considered the "proximal TFCC" (**Fig. 10.1**). Within this structure lie both "arms" joining the anterior and posterior ulnar fovea and the edges of the distal radius—the real stabilizers of the DRUJ. These two main structures may be injured independently of each other, which can result in a specific clinical picture and DRUJ instability. Several arthroscopically assisted transosseous repair techniques have been described—either at the ulnar metaphyseal region, as described by Nakamura et al,[2] or at the DRUJ itself, as described by Atzei et al.[3] The only entirely arthroscopic technique, which has been described by Geissler,[4] uses three portals and requires expensive disposable instrumentation. This chapter describes two simple, reliable, and reproducible techniques.

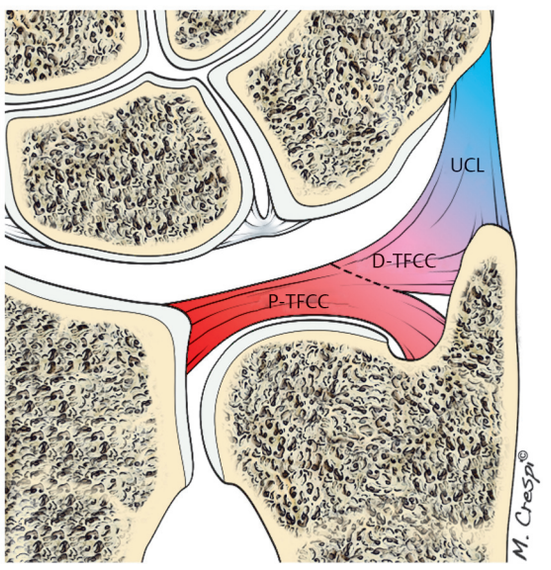

Fig. 10.1 Schematic illustration of the two portions of the triangular ligament. Distal peripheral portion of the triangular fibrocartilage complex (D-TFCC) and the proximal portion that inserts into the fovea of the ulnar head (P-TFCC). UCL, ulnar collateral ligament.

Operative Technique 1 (Anchor)

Patient Preparation

The procedure is performed on an outpatient basis under local anesthesia. The patient is supine with the arm resting on a table with a pneumatic tourniquet. Vertical traction of 5 to 7 kg is applied to the hand.

Exploration

The arthroscope is introduced through the 3–4 radiocarpal portal, which allows visualization of the radiocarpal joint. In isolated foveal avulsion of the TFCC (stage 2 Atzei–European Wrist Arthroscopy Society [EWAS]), the appearance of the TFCC is usually normal. The hook test, which is performed by placing the probe at the styloid recess and applying a radial and distal pull, will raise the TFCC, indicating an avulsion of the TFCC from the fovea (**Fig. 10.2a–c**).

In patients where the foveal avulsion is associated with a peripheral tear (stage 3 Atzei–EWAS), there will also be a loss of the "trampoline" effect, considered a positive "trampoline test."

Extending the Medial Incision

With the arthroscope inserted through the 3–4 radiocarpal portal, a needle is first inserted through the 6U portal medial to the ulnar styloid and distal to the TFCC (**Fig. 10.3a, b**). The arthroscope is then introduced through the DRUJ portal, located approximately 1 cm proximal to the 6R portal (**Fig. 10.4**), underneath the TFCC. The view is often distorted at the zone of injury.

A hypodermic needle is inserted through the direct foveal (DF) portal to identify the avulsion of the TFCC at the fovea (**Fig. 10.5a, b**). This portal is located anterior to the ulnar styloid and on top of/distal to the ulnar head, with the forearm in supination.

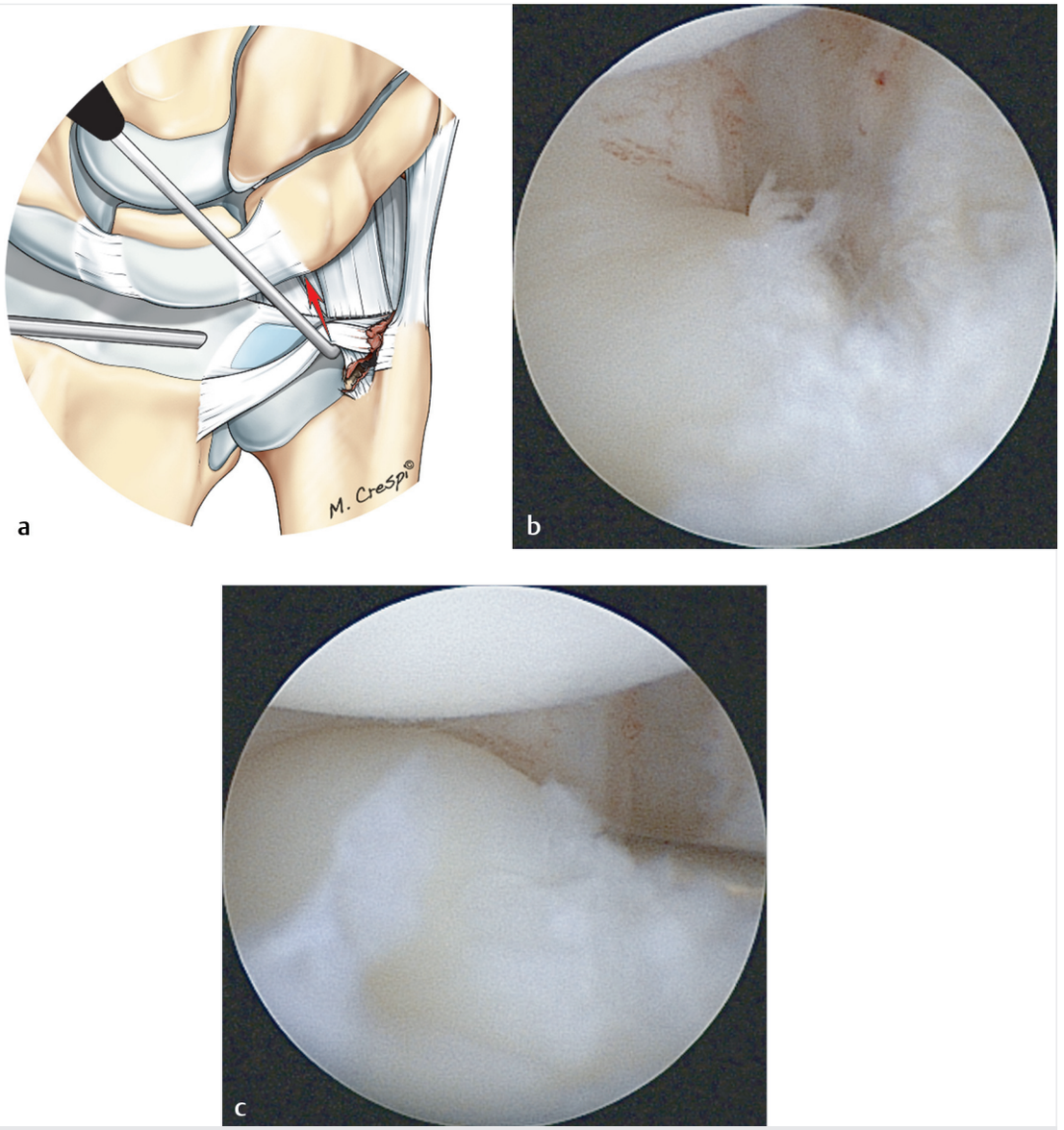

Fig. 10.2a–c
a Drawing showing a foveal avulsion associated with a peripheral tear. The probe at the styloid recess raises the triangular fibrocartilage complex (TFCC) (hook test). The red arrow shows the distal displacement of TFCC when the foveal attachment is disrupted.
b Arthroscopic view showing the avulsion of the TFCC which seems peripheral.
c Arthroscopic view showing a positive hook test, reflecting the foveal TFCC avulsion.

An incision of ~ 1 cm is then made joining the two needles while identifying and protecting the dorsal cutaneous branch of the ulnar nerve (**Figs. 10.6** and **10.7**).

Exploration and Debridement of the Distal Radioulnar Joint

First, a blunt mosquito forceps is used to identify the DF portal (**Fig. 10.8**). Then a full-radius shaver is introduced, and, under arthroscopic control, the area of the foveal insertion of the TFCC is cleaned and debrided (**Fig. 10.9a, b**). Scar tissue and ligament remnants often obscure visibility in this area until progressive cleaning creates better clarity (**Fig. 10.10**).

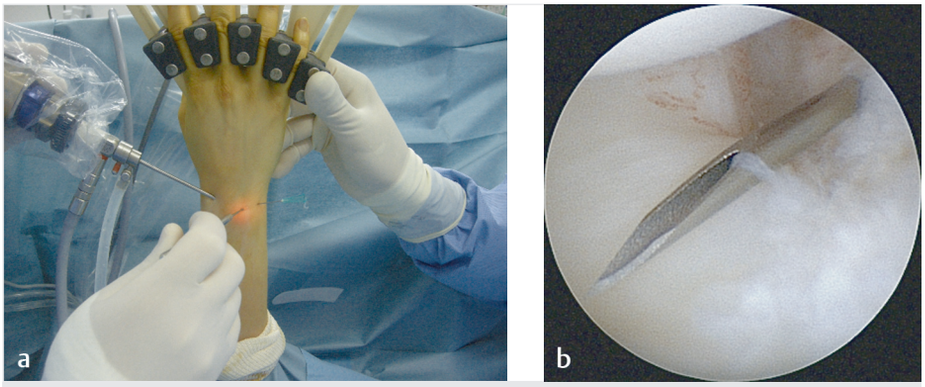

Fig. 10.3a, b
a Intraoperative view showing the passage of the needle through the 6U portal; the scope is in the 3–4 radiocarpal portal, and the probe is in the 6R portal.
b Arthroscopic view showing the needle positioned through the 6U portal exiting above the triangular fibrocartilage complex.

Fig. 10.4 View showing the needle used to find the correct position of the incision for creating the distal radioulnar joint (DRUJ) portal. The scope is in the 3–4 radiocarpal portal, and the other needle is in the 6U portal.

Insertion of the Anchor

With the arthroscope remaining in the same position for viewing the foveal insertion of the TFCC, a drill is used to create a hole in the ulnar head at the fovea (**Fig. 10.11a, b**). Sometimes a blunt forceps is introduced through the foveal portal, and its jaws are opened so the drill can be inserted between the forceps, allowing better visualization (**Fig. 10.12a–c**). An anchor is then inserted through the foveal portal, a direct path (**Fig. 10.13a–c**). We prefer to use a bioabsorbable anchor. With the anchor in place at the foveal insertion of the TFCC on the ulnar head, the sutures are left outside through the medial portal.

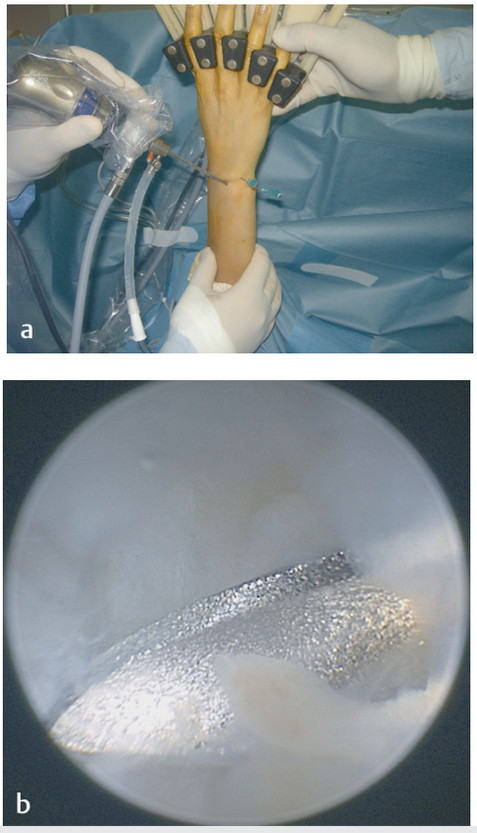

Fig. 10.5a, b
a View showing the needle at the direct foveal (DF) portal, in front of the ulnar styloid and over the ulnar head. The scope is in the distal radioulnar joint (DRUJ) portal, and the other needle is in the 6U portal.
b Arthroscopic view showing the needle positioned at the DF portal and exiting at the fovea, below the triangular fibrocartilage complex.

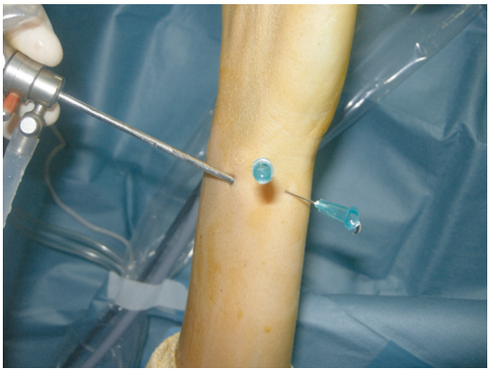

Fig. 10.6 View showing the two needles, one in the 6U portal and in the radiocarpal joint, and the other in the direct foveal portal in the distal radioulnar joint (DRUJ). The scope is in the DRUJ portal.

Fig. 10.7 View showing the incision made between the direct foveal and 6U portals. The scope is in the distal radioulnar joint portal.

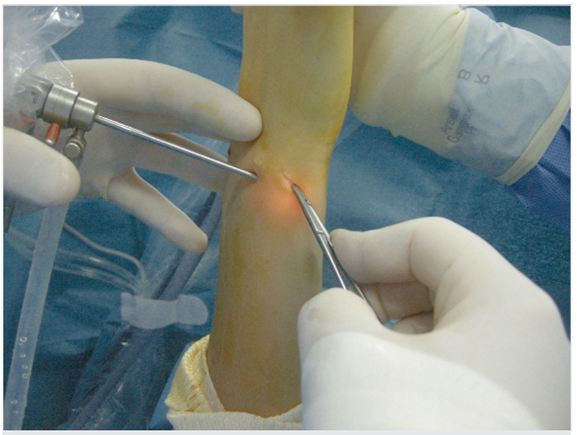

Fig. 10.8 View showing a mosquito forceps passed into the distal radioulnar joint (DRUJ) through the direct foveal portal. The scope is in the DRUJ.

Triangular Fibrocartilage Complex Suture

The arthroscope is then reintroduced into the radiocarpal joint through the 3–4 radiocarpal portal to view the radiocarpal aspect of the TFCC. The distal end of one of the anchor sutures is passed through a hypodermic needle (**Fig. 10.14**). The needle is then passed through the DF portal through the TFCC, directed dorsally or volarly (**Fig. 10.15a, b**). Using a fine mosquito forceps the suture passed through the TFCC is retrieved through the 6U portal (**Fig. 10.16a–c**). This suture is pulled outside and then passed through a loop created at its exit from the anchor and its point of entry into the TFCC (**Fig. 10.17a–e**). The second suture is passed and retrieved in a similar manner at

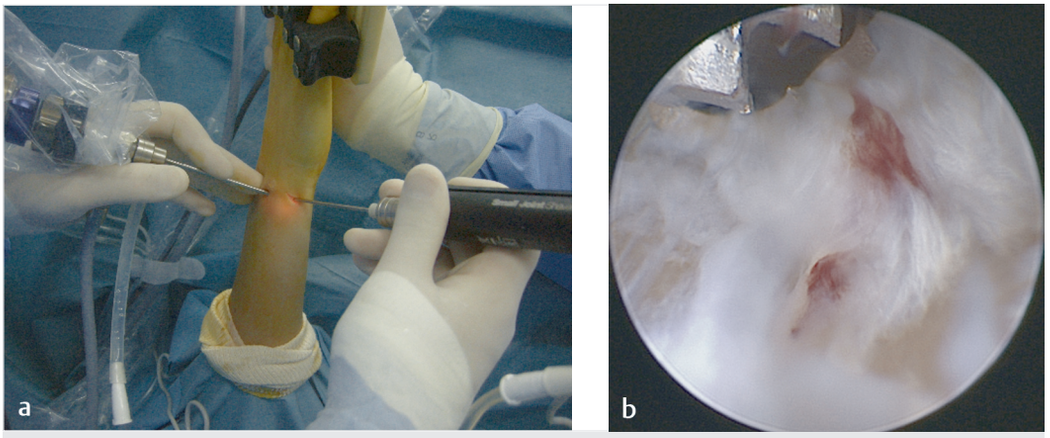

Fig. 10.9a, b
a Intraoperative view showing the shaver introduced through the direct foveal portal in front of the ulnar styloid and over the ulnar head. The scope is in the distal radioulnar joint.
b Arthroscopic view showing the shaver cleaning the fovea below the triangular fibrocartilage complex.

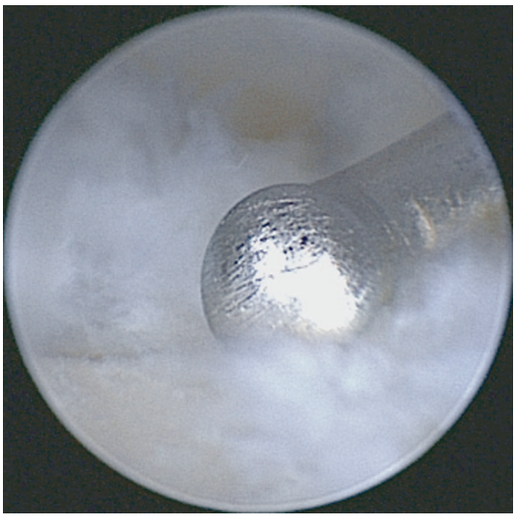

Fig. 10.10 View showing the probe at the cleaned fovea.

the dorsal or palmar portion of the TFCC, depending on the position of the first suture (Fig. 10.18a–c). The second strand is retrieved by a blunt forceps (Fig. 10.19) and then passed in its own loop, as was done for the first strand (Fig. 10.20a–e). This makes it possible to suture the dorsal and palmar parts of the TFCC back to its insertion into the fovea with one single suture. The final knot is made after the traction is released, with the wrist in slight extension and ulnar deviation (Fig. 10.21a–d). One or two sutures are used to close the ulnar incision and are removed at the first dressing change 1 week later.

Postoperative Care

A volar, below-the-elbow splint is applied with the wrist in extension and ulnar deviation. The splint is continued for 6 weeks, at the end of which rehabilitation is started.

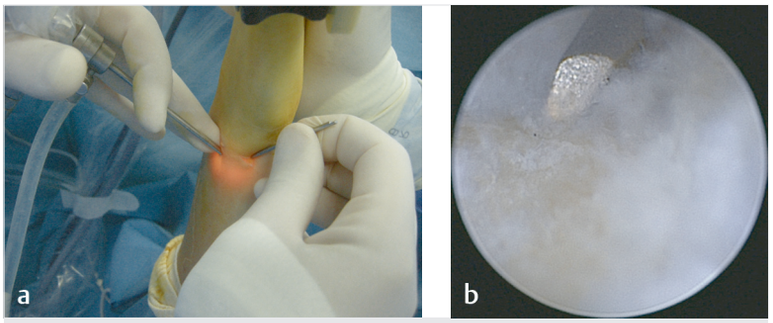

Fig. 10.11a, b
a Intraoperative view showing the drill passing through the direct foveal portal.
b Arthroscopic view showing the tip of the drill at the fovea.

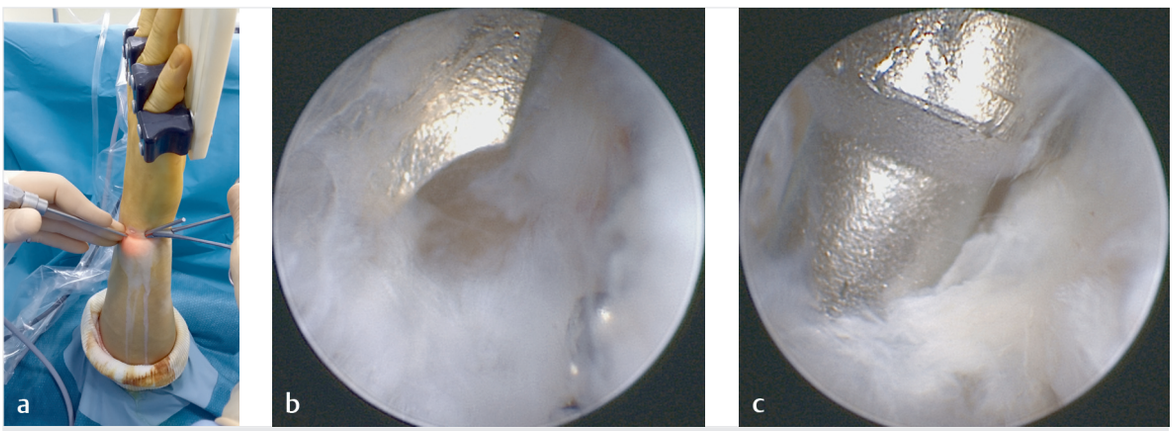

Fig. 10.12a–c
a Intraoperative view showing the drill bit between the opened jaws of the mosquito forceps.
b Arthroscopic view showing the drill bit at the fovea through the jaws of the clamp.
c Arthroscopic view of the fovea being drilled.

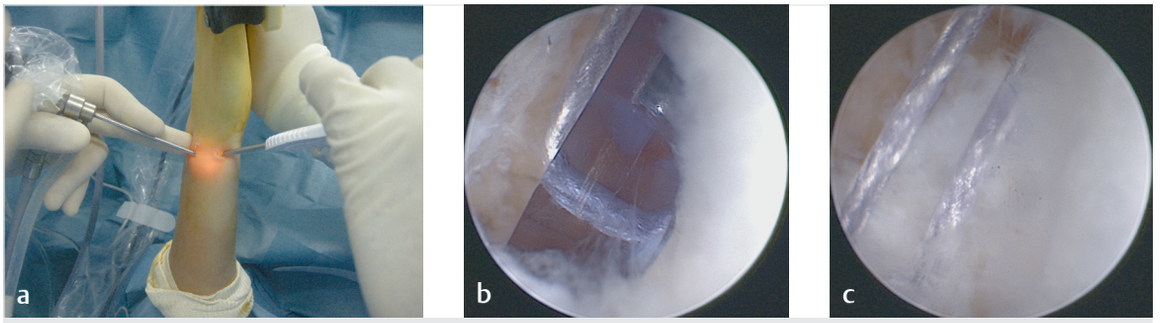

Fig. 10.13a–c
a Operative view showing the installation of the anchor through the direct foveal portal.
b Arthroscopic view showing the arrival of the anchor at the fovea and placed in the bone canal previously made with the adapted drill.
c Arthroscopic view showing the suture attached to the anchor, set in the fovea and leaving the direct foveal path.

Fig. 10.14 Operative view showing the passage of two strands of suture in an intramuscular needle.

Operative Technique 2 (Pushlock, Fontes)

Preparation of the Fovea for Insertion of the Anchor

With the fovea exposed, a drill guide and a no. 2 drill are introduced through the 6R portal (**Fig. 10.22**). A hole is drilled into the fovea to insert the PushLock (Arthrex, Naples, Florida, USA) system. A guidewire and a protective cannula are used to make the drill hole in the head of the ulna.

Placing Sutures in the Triangular Fibrocartilage Complex

A hypodermic needle is then inserted percutaneously (slightly distal to the 6R portal) through the TFCC, ~2 to

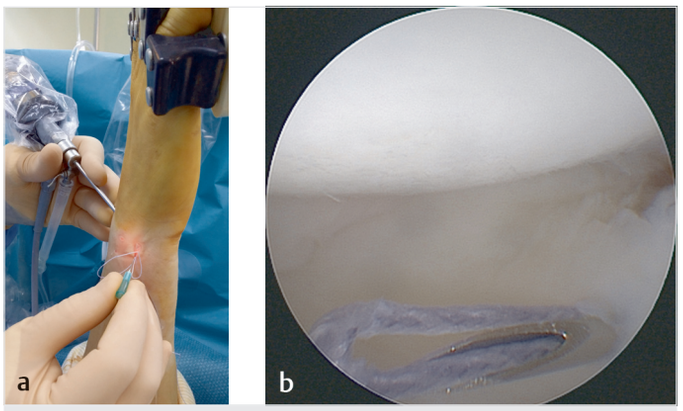

Fig. 10.15a, b
a View showing the passage of the needle through the portion of the dorsal ulnar insertion of the triangular fibrocartilage complex (TFCC).
b Arthroscopic view showing the arrival of the needle and suture in the dorsal ulnar portion of the TFCC.

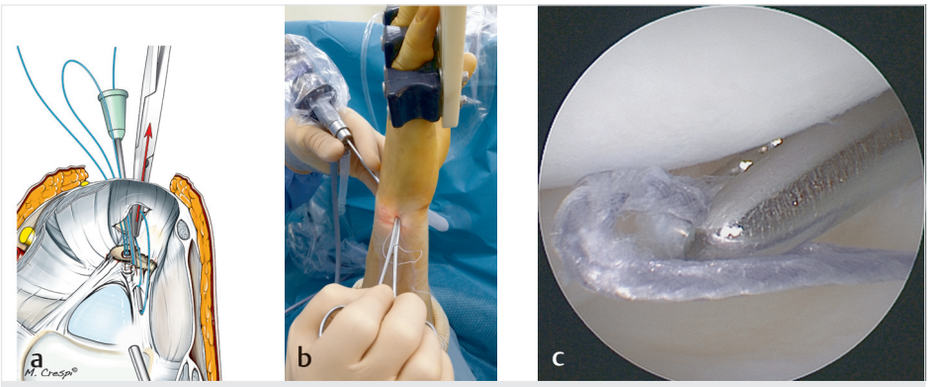

Fig. 10.16a–c
- **a** Drawing showing the recovery of the wire placed in the dorsal ulnar portion of the triangular fibrocartilage complex (TFCC) to the forceps inlet through first 6U portal.
- **b** Arthroscopic view showing the clamp procedure entry through the first 6U portal view.
- **c** Arthroscopic view showing recovery of the wire placed in the dorsal ulnar portion of the TFCC using forceps entry through the first 6U portal.

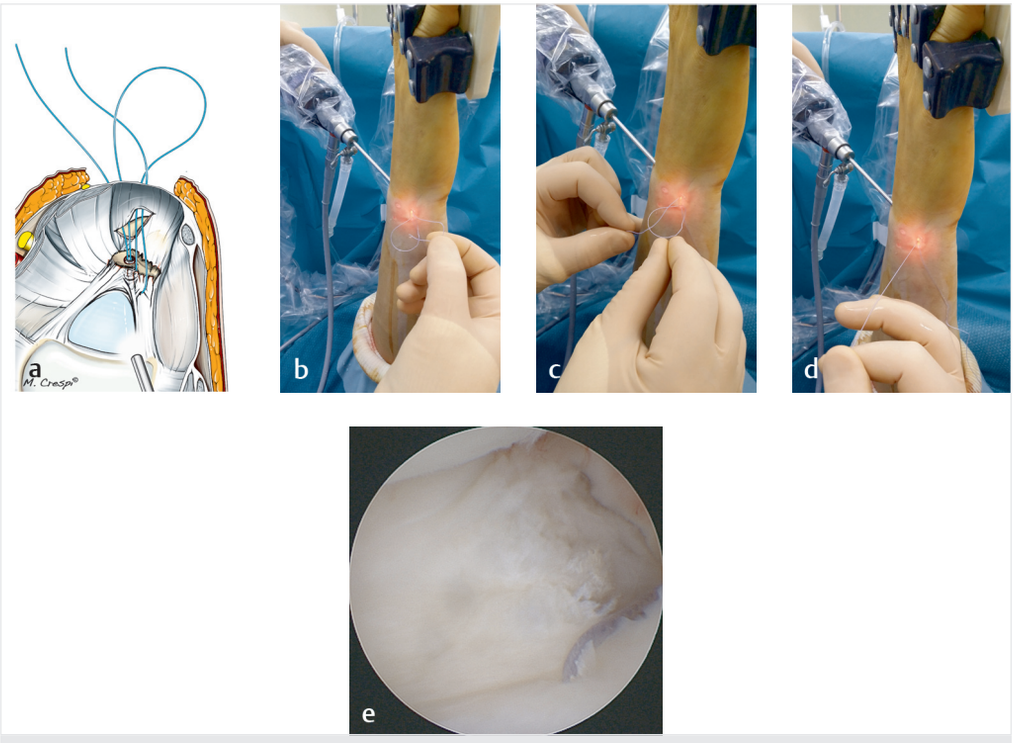

Fig. 10.17a–e
- **a** Drawing showing the yarn passed through the dorsal ulnar portion of the triangular fibrocartilage complex (TFCC), recovered by a clamp, exteriorized through the first 6U portal, and passed through the loop created between the fastener on the anchor and the passage through the TFCC.
- **b** View showing the wire being passed through the loop created between its home on the anchor and the passage through the TFCC.
- **c** Operative view showing the recovery of the wire passed through the loop.
- **d** Operative view showing the wire stretched after passing through the loop created between its home on the anchor and the passage in the TFCC. There is a spontaneous attachment by the loop.
- **e** Arthroscopic view showing that the wire placed in the dorsal portion of the ulnar TFCC is tense after completing a passage through its own loop.

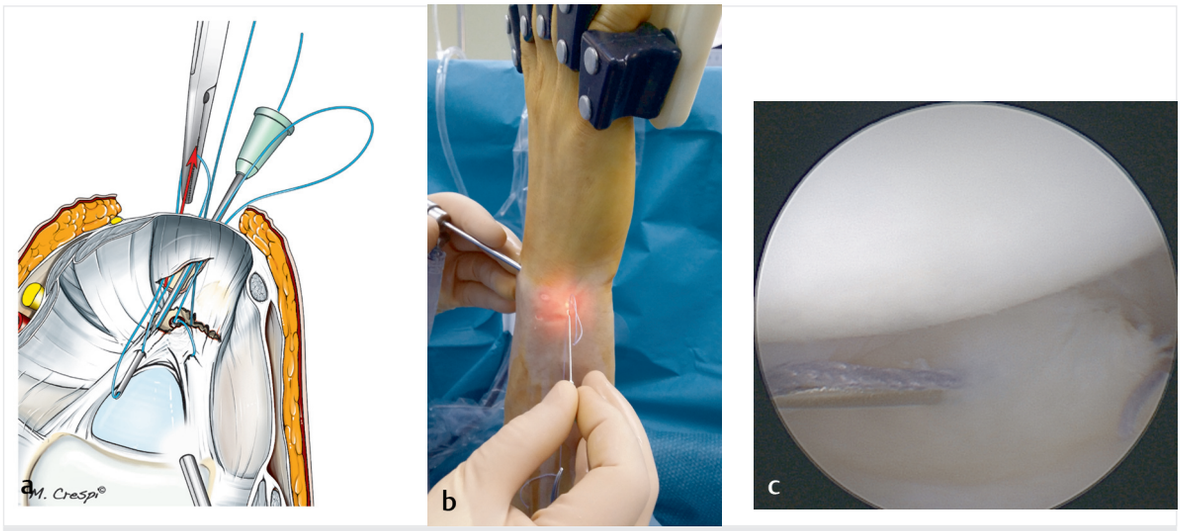

Fig. 10.18a–c
a Drawing showing the second strand of suture passed through the ulnar volar portion of the triangular fibrocartilage complex (TFCC), recovered by a clamp, exteriorized through the first 6U portal and passed through the loop created between the attachment of the anchor and the passage in the TFCC.
b View showing the second procedure of the suture strand into a needle prior to its passage through the portion of the ulnar volar TFCC.
c Arthroscopic view showing the arrival of the needle and suture in the ulnar volar portion of the TFCC.

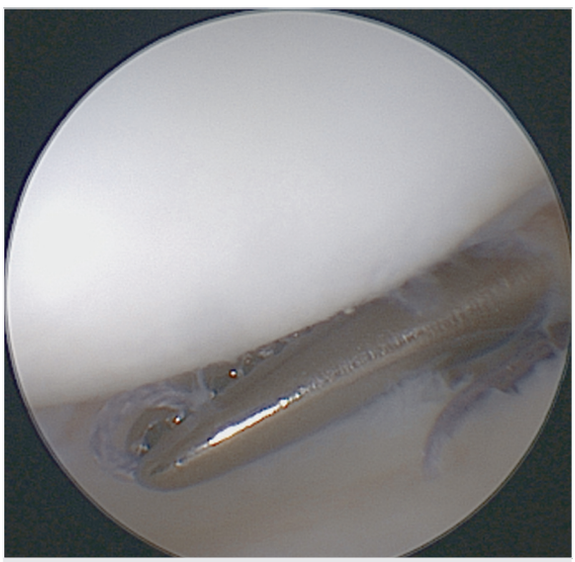

Fig. 10.19 Arthroscopic view showing the principle of recovery of the wire placed in the palmar portion of the ulnar triangular fibrocartilage complex using forceps inserted through first 6U portal.

3 mm from the free edge of the tear. A 2–0 absorbable monofilament suture is passed though the needle and retrieved through the 6R portal using a fine mosquito forceps (**Fig. 10.23**). The extra-articular strand is left within the needle and then retracted a few millimeters. The needle is reintroduced at 3 mm from the first passage, with care not to cut the suture, which thus forms a loop at its end. This loop is then simply pulled through the 6R portal with a mosquito forceps and released from the needle, which is then removed. This makes a U-shaped loop in the TFCC (**Fig. 10.24**).

Change of Suture and Fixation in the Pushlock System

It is possible to use polydioxanone sutures (PDS) (Ethicon, Somerville, New Jersey, USA) for the next step, but we prefer to change to braided semiabsorbable sutures by performing a "shuttle-relay" (**Fig. 10.25**). Care must be taken not to shear the triangular complex during this maneuver. This type of suture can be used at the very beginning of the procedure, but the braided suture does not work well when wet (the procedure can also be performed using dry arthroscopy).

The suture is introduced into the eye of the Pushlock, and it is impacted into the hole in the center of the fovea while the suture is pulled and gradually blocked without any need for a knot (**Fig. 10.26**).

Final Fixation

The two strands are then simply cut flush with the suture anchor. The TFCC is reinserted onto the ulna, restoring the

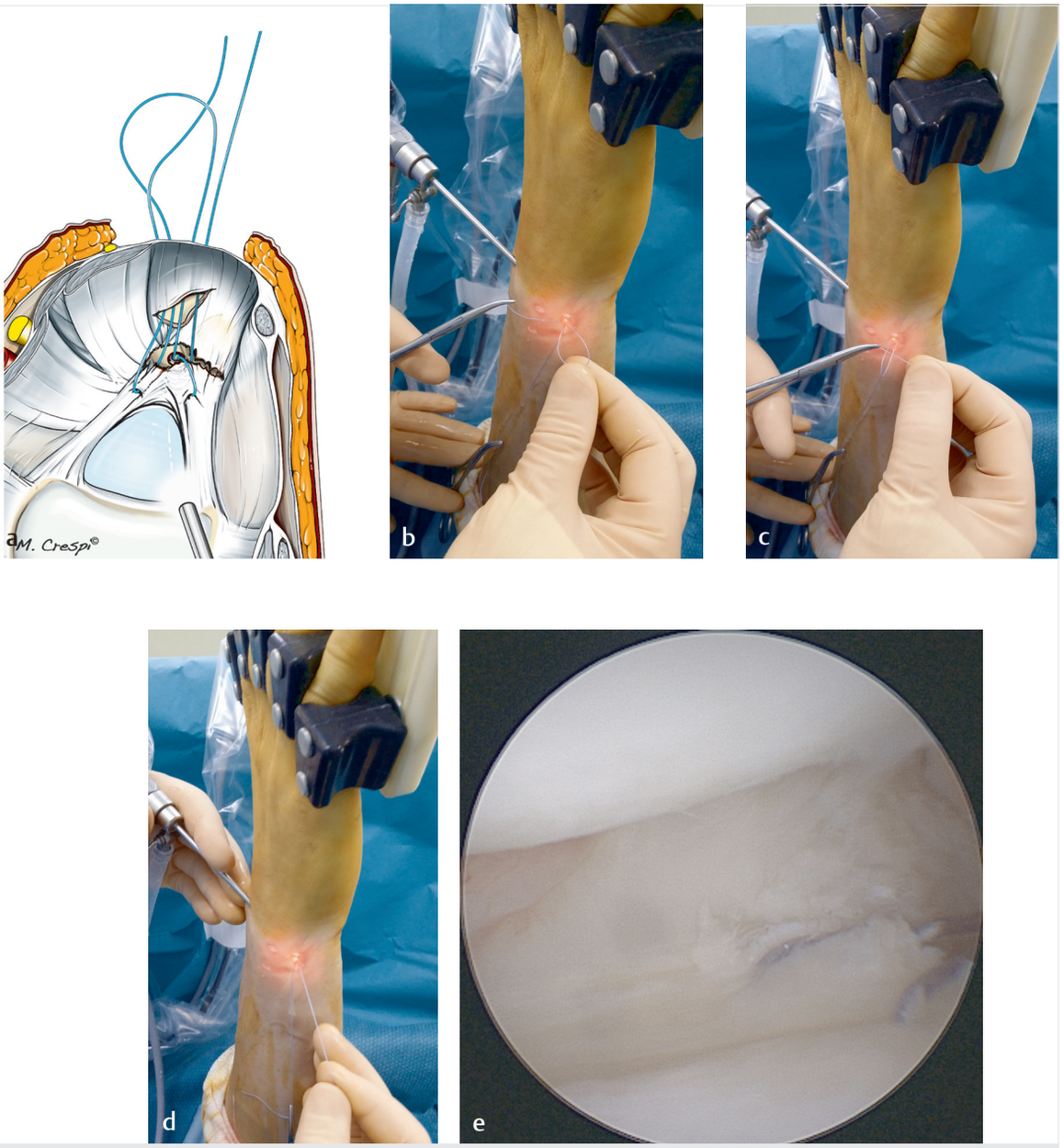

Fig. 10.20a–e

a Drawing showing the suture passing through the ulnar volar portion of the triangular fibrocartilage complex (TFCC), recovered by a clamp, exteriorized through the first 6U portal, and passed through the loop.

b Operative view showing the suture being passed through the loop created between the anchor and its passage in the TFCC.

c Operative view showing the recovery of the suture passed through the loop.

d Operative view showing the operating wire stretched after passing through the loop created between its home on the anchor and the passage through the TFCC. There is a spontaneous attachment to the loop.

e Arthroscopic view showing that the wire placed in the ulnar palmar portion of the TFCC is tense after completing its passage through its own loop.

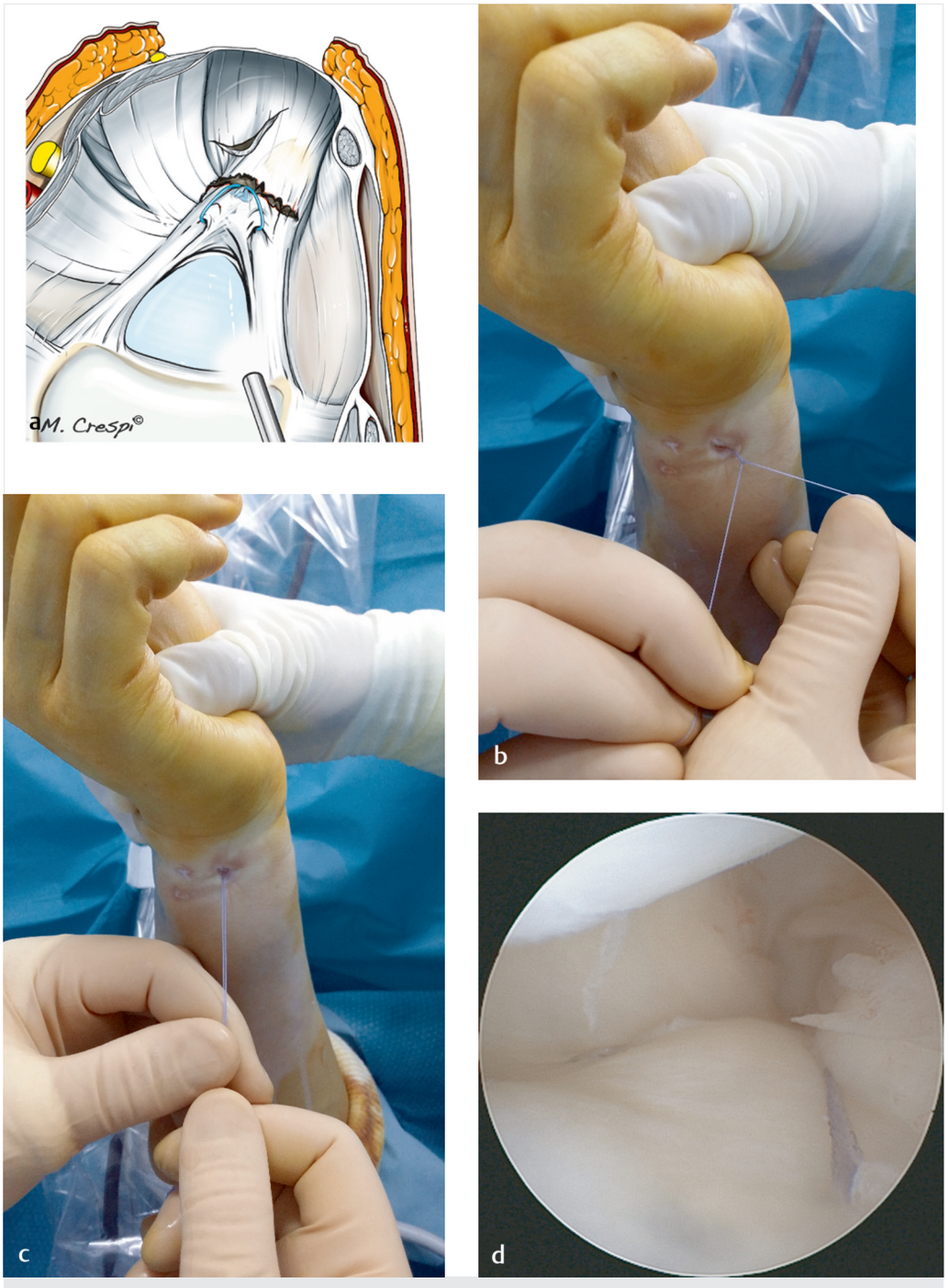

Fig. 10.21a–d

a Drawing showing the foveal reinsertion of the triangular fibrocartilage complex (TFCC) suture with the palmar and dorsal portion of the ulnar insertion of the TFCC, by suturing the two strands with a single suture through the implementation of two loops.

b Operative view showing the embodiment of the surgical knot. Traction was released and the wrist put in extension and in ulnar deviation.

c Operative view showing the end of the suture.

d Arthroscopic view showing the appearance of the foveal TFCC after rehabilitation.

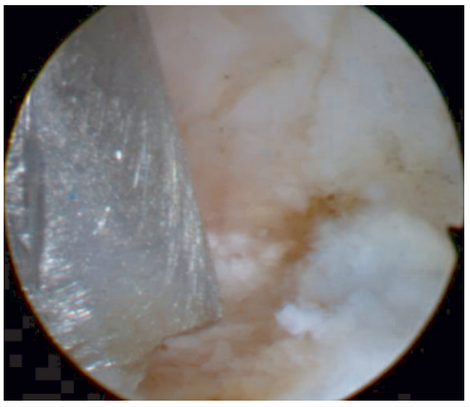

Fig. 10.22 Arthroscopic view showing drilling with a 2 mm drill after exposure and denudation of the fovea.

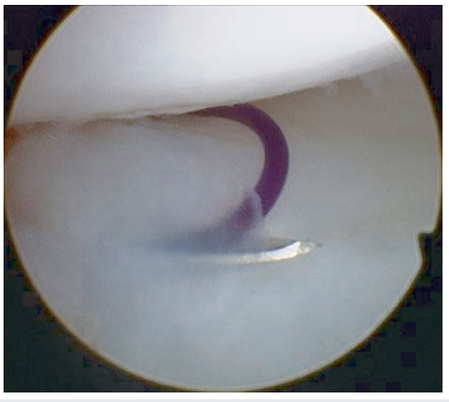

Fig. 10.23 Arthroscopic view showing the introduction of a needle into the triangular fibrocartilage complex to within 3 mm of the edge of the lesion with a wire PDS 2–0 suture recovered via the 6R portal while the needle is left in place and the extra-strand articular PDS is secured to a clamp.

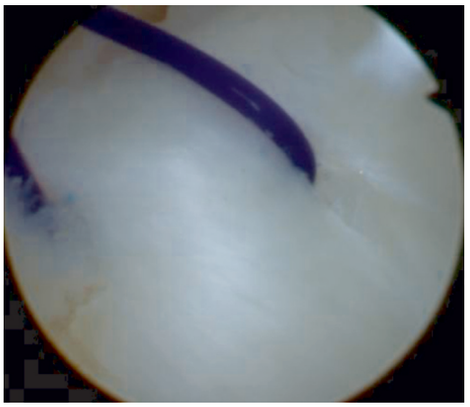

Fig. 10.24 Arthroscopic view showing the attachment of the triangular fibrocartilage complex. The needle and thread were reintroduced carefully so as not to cut the loop, then the needle was withdrawn via the 6R portal, freeing the wire just enough to make a point in U.

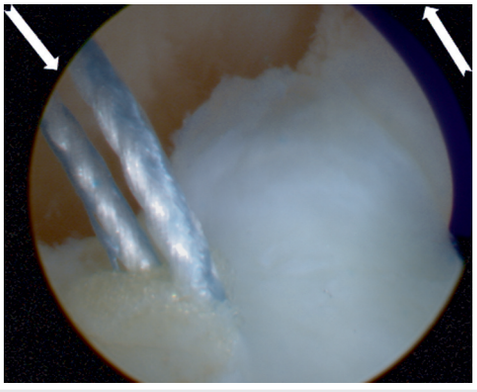

Fig. 10.25 Arthroscopic view showing the embodiment of a "shuttle relay" by means of a semiabsorbable braided wire. The two arrows show the reverse movement of the two sutures.

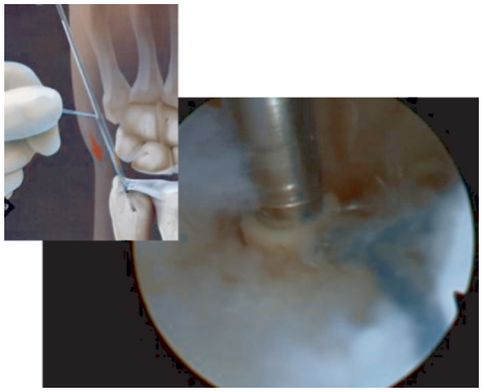

Fig. 10.26 Arthroscopic view showing the thread introduced into the PushLock (Arthrex, Naples, Florida, USA) eyelet, which is impacted in the ulnar orifice while the thread is tensed.

trampoline effect. If there is a dorsal extension of the tear, a few additional sutures may be required.

Closure and Postoperative Care

The portals are closed with simple Steri-Strips (3M, St. Paul, MN). An above-the-elbow splint with the wrist in the neutral position and the forearm in the midprone position is applied and maintained for 3 weeks. A simple wrist splint is then used for an additional 3 weeks. A rehabilitation protocol is then prescribed. Sporting activities are gradually reintroduced after the third postoperative month.

Conclusion

Isolated foveal avulsions of the TFCC, or those associated with a peripheral lesion, cause distal radioulnar instability. Arthroscopic repair of such tears is effective. The dorsal branch of the ulnar nerve must be protected. A small 1 to 2 cm incision on the ulnar aspect of the wrist allows the surgeon to identify and protect the nerve.

References

1. Nakamura T, Yabe Y, Horiuchi Y. Functional anatomy of the triangular fibrocartilage complex. J Hand Surg [Br] 1996;21(5):581–586
2. Nakamura T, Ikegami H, Sato K, Nakamichi N, Okuyama N, Takayama P. Arthroscopic repair of the ulnar tear of the TFCC. Riv Chir Mano 2006;43(3):291–293
3. 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(4):226–235
4. Geissler WB. Arthroscopic knotless peripheral ulnar-sided TFCC repair. Hand Clin 2011;27(3):273–279