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Abstract	Distal radius fractures have a high incidence of associated lesions, and wrist arthroscopy is the most accurate assessment and surgical management of associated soft-tissue injuries such as lunotriquetral interosseous ligament (LTIO) and extrinsic ligaments (EL), which are observed at a high incidence rate (15-20% for LTIO and up to 70% for EL). Arthroscopic management can consist of a simple debridement, shrinkage, controlled reduction, and pinning or suturing of the ligaments. Currently, there is enough evidence in the literature to support the effectiveness and safety of arthroscopically-assisted repair of these ligaments contemporary with radius fracture management, especially for young athletes.

9 Lunotriquetral and Extrinsic Ligaments Lesions Associated with Distal Radius Fractures

[AU1] Didier Fontès

[AU2] Distal radius fractures (both extra- and intraarticular types) have a high incidence of associated lesions, including chondral and soft-tissue injuries such as triangular fibrocartilage complex (TFCC), scapholunate interosseous ligament (SLIO), lunotriquetral interosseous ligament (LTIO) (Fig. 9.1), or extrinsic ligament tears. Final clinical result after a wrist fracture depends on the accuracy of articular reduction, reduction stability, and the initial management of associated lesions.

Incidence of Associated LTIO and Extrinsic Ligaments Lesions with Distal Radius Fractures

By using arthrography, studies noted a high incidence of associated intrinsic ligament injuries. Specifically, in our first prospective series in 1992 [3], we performed a systematic operative wrist arthrogram (Fig. 9.2) during distal radius fractures in a group of 58 patients with a mean age of less than 50 years at a low risk of spontaneous degenerative ligamentous tears. TFCC was torn in two-thirds of all type of fractures. Extraarticular radius fractures were associated with an intracarpal ligamentous tear in 25% and were always a lunotriquetral (LTIO) lesion type. In contrast, intraarticular and radius styloid fractures were frequently associated with a scapholunate lesion (SLIO). TFCC and LTIO ligament were regularly associated to an ulnar mechanism of impaction contemporary of the fracture impaction of the distal radius.

But it has been shown by comparative prospective studies that arthrography has only a 60% sensitivity in

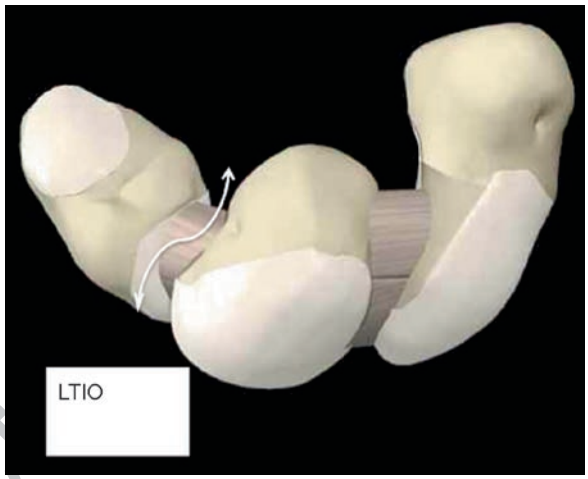

Fig. 9.1 Localization of lunotriquetral interosseous (LTIO) ligament tear

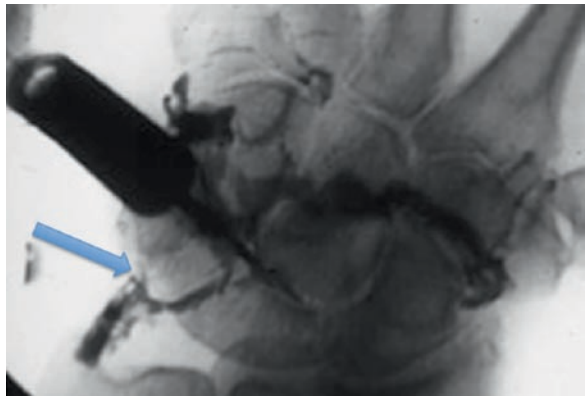

Fig. 9.2 Operative midcarpal arthrography showing a LTIO ligament tear

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detecting those ligament injuries compared with arthroscopy [31], which is now the gold standard of interosseous ligaments exploration.

Arthroscopy provides the advantage of assessment of distal radius reduction and the status of the intercarpal ligaments under direct visualization and magnification and is currently the preferred imaging method of many surgeons. Several arthroscopic reports (Table 9.1) reveal the incidence of associated injuries occurring with distal radius fractures [4, 8, 12, 15, 20, 22]. Arthroscopy in distal radius fractures greatly enhances early recognition of these injuries so that prompt treatment may thus be performed avoiding unexpected sequelae regarding the fracture itself. A complete wrist arthroscopy with examination of both the radiocarpal and the midcarpal spaces is essential in evaluating SLIO and LTIO ligament lesions and carpal instability. Geissler and Freeland [9] proposed an arthroscopic classification of interosseous ligament injury that is commonly used in our clinical descriptions.

Regarding extrinsic ligaments, arthroscopy is unquestionably the best assessment method even if 2D and 3D CT scan can give an orientation in the suspicion of osteoligamentous-associated lesions (Fig. 9.3).

Management of LTIO and Extrinsic Ligaments-Associated Lesions

Lunotriquetral Ligament Lesions

The Geissler classification system grades tears based on instability with a probe in the lunotriquetral joint through the midcarpal portal [8]. Grading of the ligament tear is done through the radiocarpal (Fig. 9.4a) and midcarpal portals (Fig. 9.4b). The primary treatment for isolated, stable lunotriquetral ligament tears (more frequently the dorsal portion of the interosseous ligament) is conservative (Geissler grade 1–2). Cast immobilization in neutral alignment may result in healing of the ligament and pain relief. It is important to diagnose this associated lesion to avoid a too early mobilization of the wrist.

For grade 2 to 3, arthroscopic debridement can be carried out through the 4–5 or 6R portal, scope in 3–4 portal after direct visualization of LTIO lesion through the ulnar side portal. The dorsal and membranous components of the ligament can be visualized and debrided (Fig. 9.4c) knowing that the volar part is most important for the stabilization of this articulation. Arthroscopic debridement alone of isolated lunotriquetral ligament tears may result in symptomatic improvement. Weiss et al. [32] reported that 43 of 43 patients with partial LT ligament tears had complete or improved symptoms after arthroscopic debridement alone. Ruch and Poehling [23] found excellent results in 13 of 14 patients with scapholunate or lunotriquetral ligament tears. However, Westkaemper et al. [33] found poor results in 4 of 5 patients with debridement alone for lunotriquetral ligament tears. Debridement can be associated with a shrinkage using radiofrequency (RF) devices. Electrothermal shrinkage of the dorsal and palmar portions of the LTIO ligaments in patients with mild ligament instability has been reported with good results. Darlis et al. [2] reported on arthroscopic debridement and thermal shrinkage using RF probes for 16 partial SLIO ligament injuries (Geissler grade 1 or 2) with a mean follow-up of 19 months. The outcomes were excellent or good in 88% of patients overall according to the Mayo wrist score. Shih and Lee [25] reported a 79% success rate at a minimum of 2 years' follow-up in 19 wrists with SLIO ligaments treated with electrothermal

[AU3] **Table 9.1**

Study	Nb and type	% TFCC	% SLIO	% LTIO	% Extrinsic
Fontès [4]	30 (intra and extraarticular)	70	40	17	17
[AU4] Geissler et al. [8]	60 (intraarticular)	49	32	15	
Lindau et al. [15]	50 (extra and intraarticular)	78	54	16	
Richards et al. [22]	118 (extra- and intraarticular)	35 (intra) 53 (extra)	21 (intra) 7 (extra)	7 (intra) 13 (extra)	
Mehta et al. [20]	31 (intraarticular)	58	85	61	
Hanker [12]	173 (intraarticular)	61	8	12	70 Dorsal capsule tear

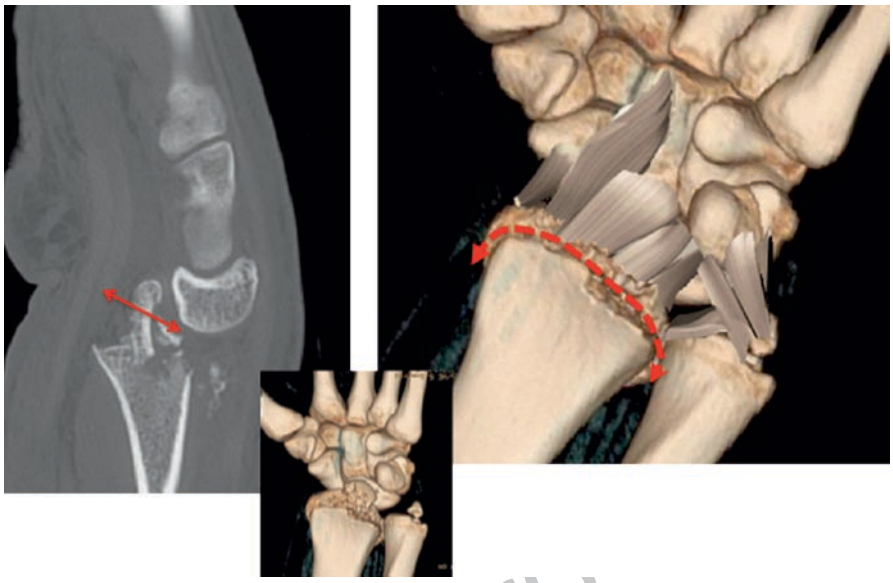


Fig. 9.3 2D and 3D CT scan can help in the evaluation of associated osteoligamentous extrinsic lésions

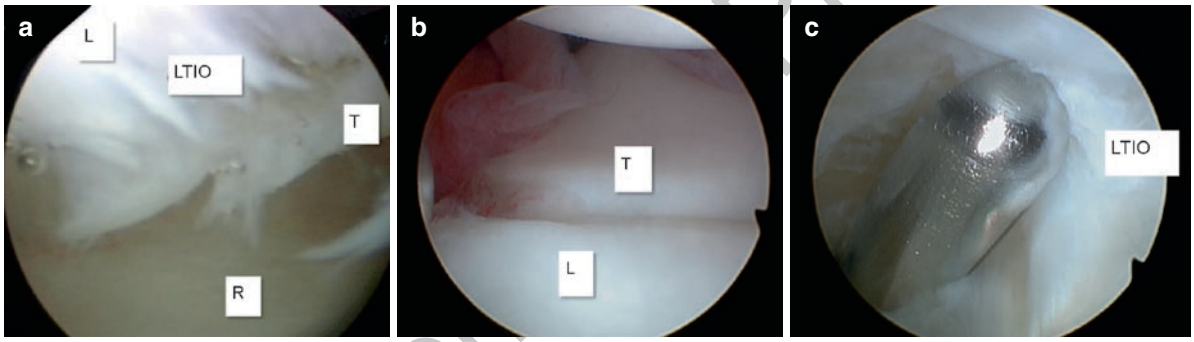


Fig. 9.4 Geissler grade 2 LTIO ligament lesion. (**a**) Fibrocartilage partial lesion of LTIO of a right wrist visualized from 4–5 radiocarpal portal. (**b**) Midcarpal stability testing through RMC midcarpal portal (right wrist). (**c**) Arthroscopic debridement of fibrocartilage partial lesion of LTIO (left wrist, scope in 3–4 portal, full-radius shaver in 6-R portal)

shrinkage. It can be concluded that the electrothermal shrinkage may play a role in the management of partial tears of the SLIO and LTIO ligament. To date, its use is still controversial, because most studies have a short follow-up.

In unstable grade 3 or 4 lunotriquetral ligament tears, we consider, as a first approach, arthroscopic debridement combined with pinning of the lunotriquetral joint. After reduction of LT dissociation with the "joy stick maneuver," two or three K-wires are introduced through a dorsoulnar approach with a meticulous control of sensitive dorsal ulnar nerve branches (Fig. 9.5). Fibrocartilage lesion is debrided in the radiocarpal space and the volar and dorsal vascularized aspect of the ligament is refreshed. Reduction is controlled in the midcarpal articulation and other lesions are treated at the same time (Fig. 9.6a–c). Osterman and Seidman [21] reported pinning of the lunotriquetral joint and debridement and reported that 16 of 20 patients had complete pain relief.

In case of chronic ulnar side pain due to lunotriquetral ligament tears without instability, secondary treatment may involve midcarpal corticosteroid injection and anti-inflammatory local physiotherapy. Arthroscopic treatment of lunotriquetral ligament tears is a reasonable option for injuries that have failed conservative treatment [14] or for Geissler grade 2–4 lesions, but immediate management appears to be more rewarding [15, 22].

In case of failure of these therapeutic options, the secondary treatment of lunotriquetral ligament tears

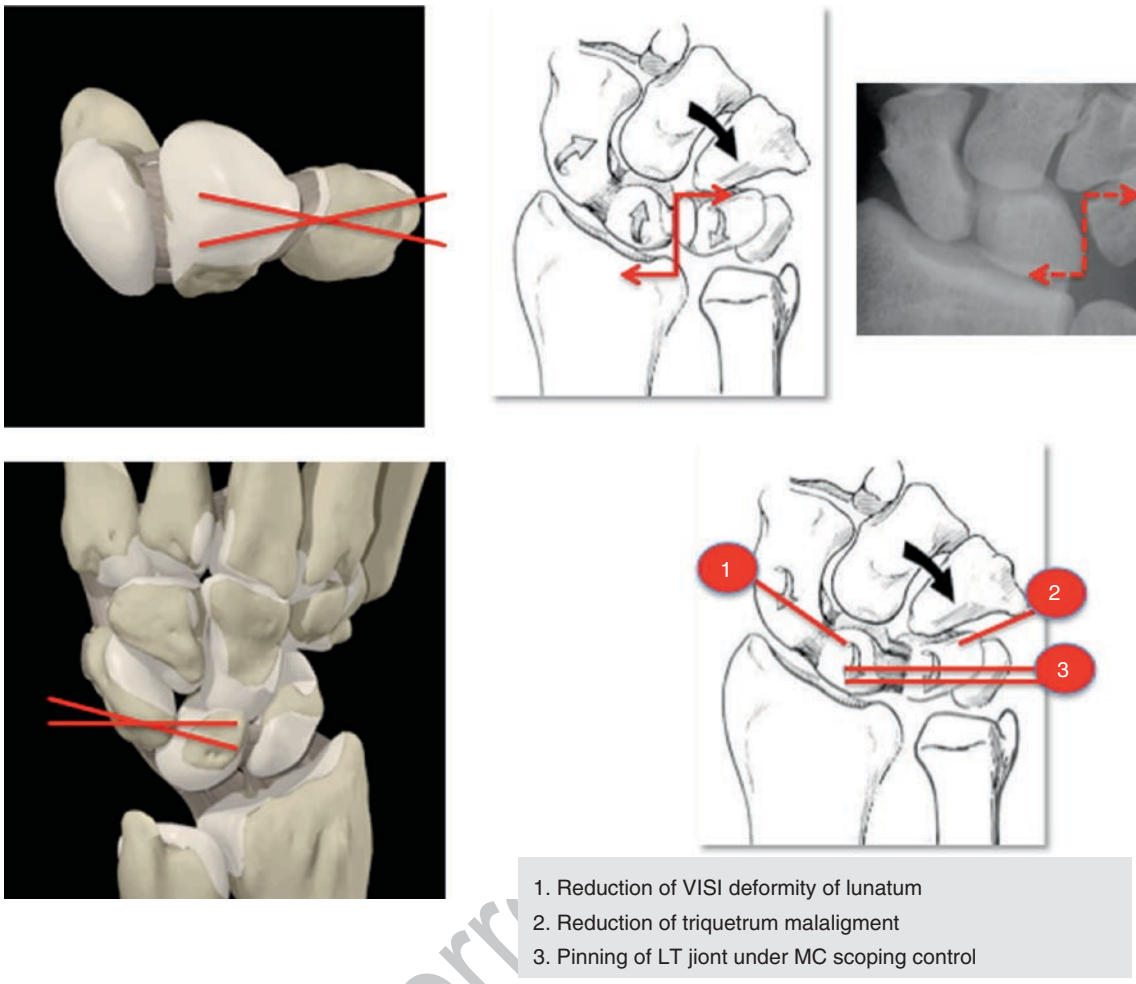


Fig. 9.5 The "joy stick" maneuver for reduction of LT joint dissociation

includes direct lunotriquetral ligament repair, LTIO reconstruction, or lunotriquetral arthrodesis. Shin et al. [26] performed a retrospective review comparing these three procedures. In his series, the probability for remaining free from complications at 5 years was 69% for reconstruction, 14% for repair, and less than 1% for arthrodesis. Nine of 22 patients undergoing a lunotriquetral fusion went on to nonunion and 5 of 22 patients developed ulnocarpal impaction. The authors concluded that both objective and subjective results were better in the direct repair and the reconstruction groups than in the fusion group. VISI deformity will not respond to any type of lunotriquetral isolated procedure. In this setting, procedures such as a midcarpal fusion or proximal row carpectomy may be indicated.

Therefore, prompt diagnosis in the acute setting may achieve primary ligament healing and possibly avoid later unrewarding reconstructive procedures [17, 18].

Extrinsic Ligaments Lesions

Volar Extrinsic Ligament Injury

Volar extrinsic ligament injuries in association with distal radius fractures are exceedingly rarely related. A violent shearing pattern of injury may be more frequently encountered as observed during fracture dislocation of the radiocarpal joint, as described by Jupiter and Fernandez [13]. A pure fracture dislocation of the

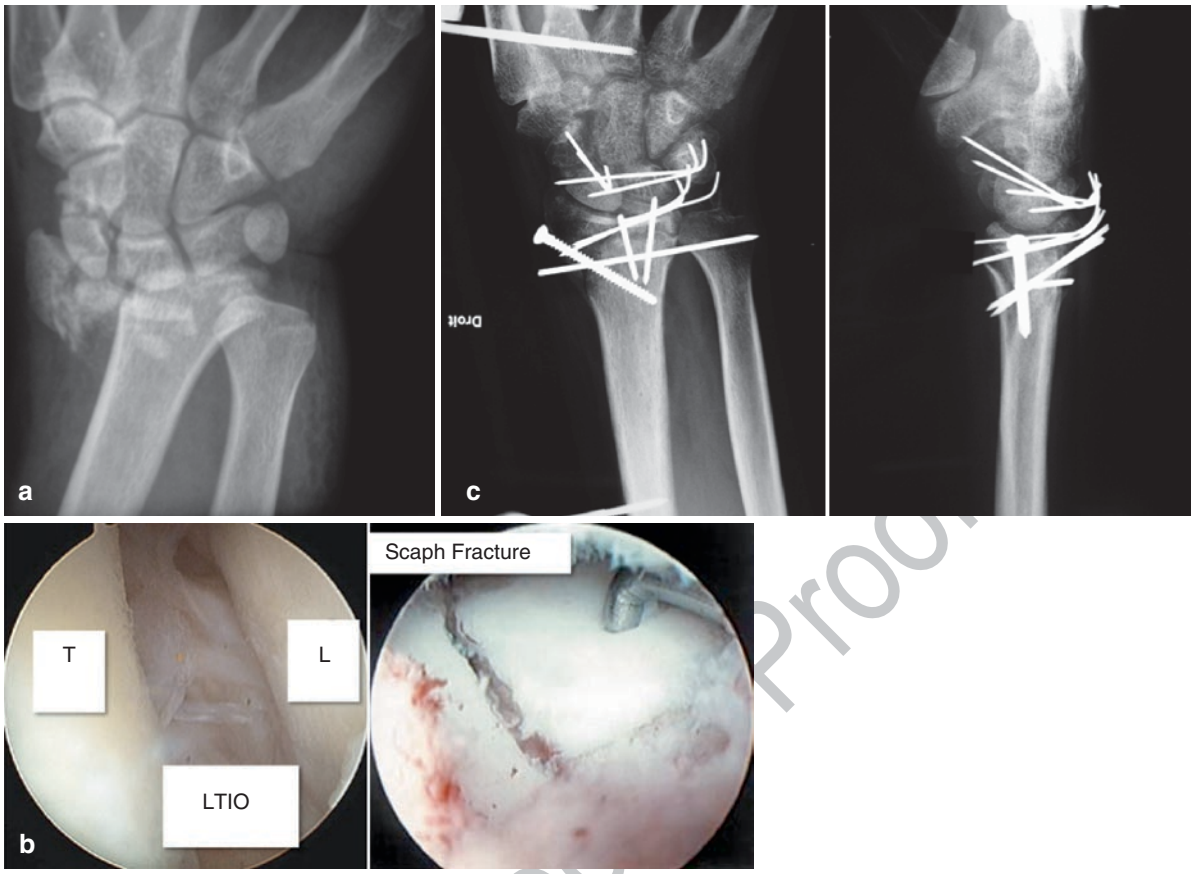


Fig. 9.6 Complex perilunar and transscaphoid lesion benefited of an all inside arthroscopic management. (**a**) Preoperative plain X-ray. (**b**) Midcarpal control of LT dissociation and scaphoid fracture. (**c**) Postoperative plain X-rays

joint may appear to have taken place; however, there is usually a small volar fragment (Fig. 9.3) that carries the origin of one or more volar extrinsic ligaments (radioscaphocapitate, long radiolunate, and short radiolunate). Direct reduction and stabilization of the small bony fragment and the associated volar ligaments reestablishes stability. Pinning across the radiocarpal joint for 6 weeks or suturing of a volar plate may still be a necessary adjunct to avoid subluxation or failure of fixation at the small fragment site. The same may be true for volar extrinsic ligament injuries without the associated fragment [34].

Dorsal Extrinsic Ligament Injury

Until recently, dorsal extrinsic ligaments have not received the attention of the volar extrinsics in the biomechanic descriptions of the wrist. Nevertheless, the dorsal radiocarpal ligament (DRCL) and dorsal intercarpal ligament may be frequently injured in association with distal radius fractures [3, 8]. Too often this injury is only recognized later as a shift into volar flexion of the proximal row, stigmatized by the lunate VISI deformity. There may be no apparent damage to the LTIO or other critical wrist ligaments [30]. When this pattern of injury is recognized, 4–6 weeks of radiocarpal pin stabilization may eliminate VISI pattern deformity. The dorsal extrinsic ligaments are allowed to adhere back to their anatomic site of attachment on the dorsum of the proximal carpal row, primarily the lunate distal pole and triquetrum. On the other hand, in most series, the DRCL is underestimated during the standard arthroscopic exam because it is difficult to visualize through the standard dorsal portals. The DRCL is best viewed through the volar radial portal (Fig. 9.7) due to the straight line of sight [27, 28]. David Slutsky proposed a surgical procedure for DRCL repair [29]. A volar radial portal is established at the proximal wrist crease. The flexor carpi radialis is retracted, and the

radiocarpal space is identified with a 22-gauge needle. A blunt trochar and cannula are inserted, followed by the arthroscope. A hook probe is placed in the 3–4 portal. The DRCL is visualized ulnar to the 3–4 portal (Fig. 9.8a), underneath the lunate. A 2-0 absorbable suture is passed through a curved spinal needle that is introduced through the 3–4 portal. The end of the suture is retrieved with a grasper in the 4–5 portal (Fig. 9.8b). After both ends of

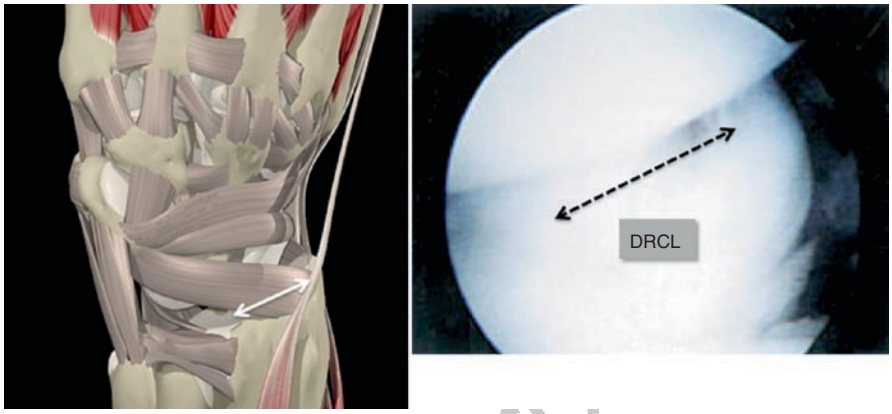


Fig. 9.7 Dorsal radio carpal ligament (DRCL) lesion visualized from volar portal

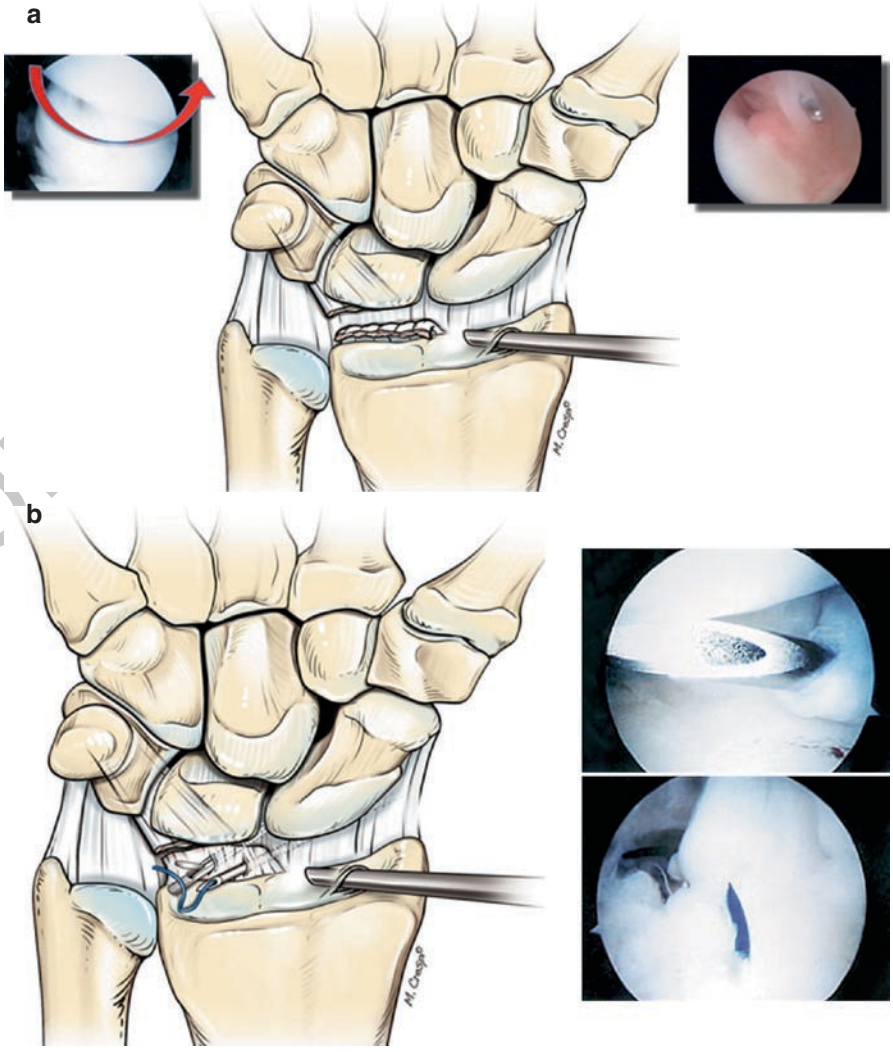
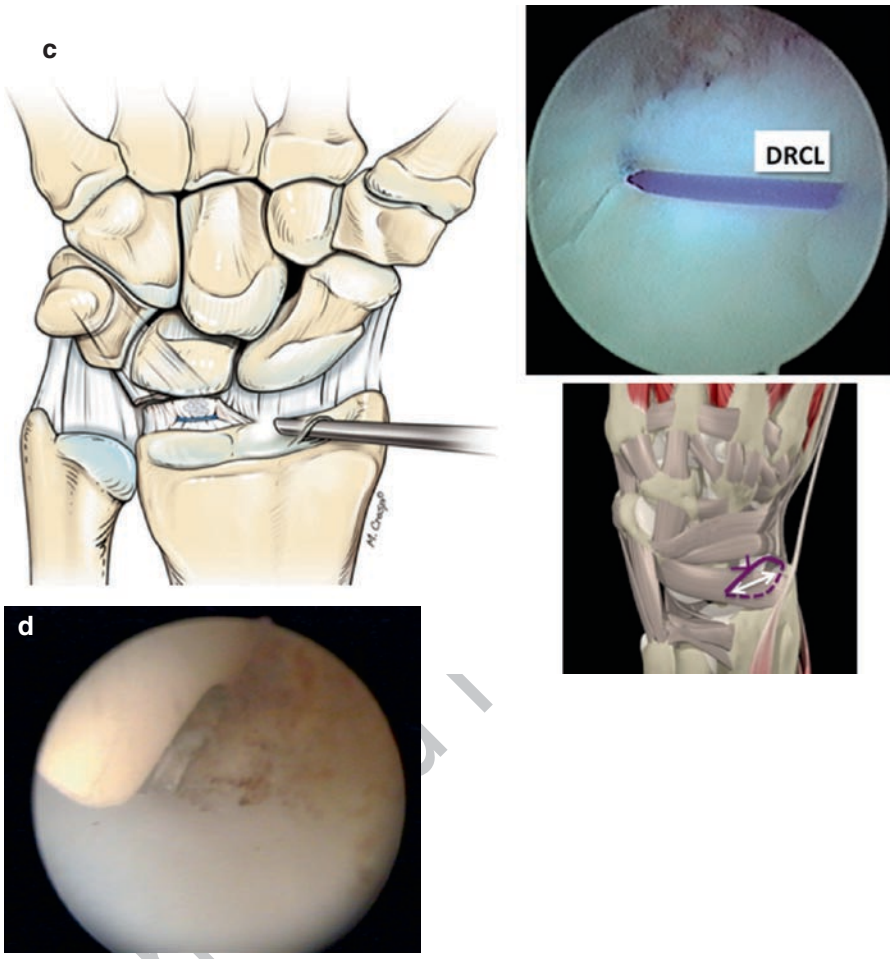


Fig. 9.8 Slutsky procedure for DRCL repair. (**a**) exploration through radiocarpal volar portal. (**b**) Introduction of a PDS suture through a needle introduced in 3–4 portal and exteriorized with a 4–5 portal loop-retriever. (**c**) The suture is tightened. (**d**) After the suture is tightened, complementary shrinkage can be performed with radiofrequency device

Fig. 9.8 (continued)



the suture are withdrawn, dorsal traction can be seen to pull the torn edge of the DRCL up against the dorsal capsule. One suture is usually sufficient. A curved hemostat is used to pull either end of the suture underneath the extensor tendons, and the knot is tied either at the 3–4 or 4–5 portal after the wrist traction has been released (Fig. 9.8c). The repair is augmented with thermal shrinkage (Fig. 9.8d). Following the repair, the patient is placed in a below-elbow cast with the wrist in neutral rotation for 4 weeks, followed by wrist mobilization. Geissler presented a similar procedure for repairing dorsal TFCC 1C lesions with good results [10].

Conclusion

Wrist arthroscopy in distal radius fractures has unique advantageous features, mainly the most accurate assessment of the articular surface reduction and the stabilization [16, 35] of the different fragments and the evaluation of associated soft-tissue injuries (i.e., LTIO and extrinsic ligaments), which are valuable especially in the treatment of complex intraarticular distal radius fractures [3, 7, 18].

Furthermore, it adds minimal risks than those normally expected of the surgical treatment of a distal radius fracture. There is now enough evidence in the literature to support the effectiveness and safety of arthroscopically-assisted repair of LTIO and extrinsic radiocarpal ligaments contemporary with radius fracture management. At this point, however, because of the lack of prospective, randomized studies comparing arthroscopy with other treatment options for distal radius fractures, one cannot be unequivocal in favor of one method vs. another, and, as always, the surgeon should aim to match the treatment option appropriately with each individual patient's objective findings and expectations, especially for young athletes, and the surgeon's own personal experience and expertise in wrist surgery and arthroscopy [11, 24].

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