Volar Portals in Wrist Arthroscopy

BY DAVID J. SLUTSKY, MD, FRCS(C)

Volar portals for wrist arthroscopy have certain advantages over the standard dorsal portals for visualizing dorsal capsular structures as well as the palmar aspects of the carpal ligaments. The volar radial (VR) portal is relatively easy to use and is an ideal portal for evaluation of the dorsal radiocarpal ligament (DRCL) and the palmar aspect of the scapholunate interosseous ligament. The volar midcarpal portal may be considered as an occasional accessory portal for visualizing the palmar aspects of the capitate and hamate in cases of avascular necrosis or osteochondral fractures. The volar ulnar (VU) portal is especially useful for the viewing and debridement of palmar tears of the lunotriquetral ligament.

Volar portals for wrist arthroscopy have been described previously but as yet have not gained widespread use.[1-4] Some intracapsular structures that are more easily seen from the volar aspect of the wrist include the dorsal wrist capsule, the dorsal radiocarpal ligament, and the palmar subregions of the scapholunate and lunotriquetral interosseous ligaments (LTILs). There is growing evidence that these structures need to be evaluated in any patient who is undergoing arthroscopy for wrist pain.

Disruption of the dorsal radiocarpal ligament (DRCL) has been implicated in the development of volar and possibly dorsal intercalated segmental instability.[5-8] Sectioning the DRCL or even performing a dorsal capsulotomy alters scaphoid and lunate kinematics during dynamic wrist motion.[9] Although an isolated DRCL tear can cause pain,[10] its effect on wrist kinematics may be magnified if combined with a complete scapholunate interosseous ligament (SLIL) tear. When there is an associated DRCL tear, some investigators would recommend an open SLIL repair as compared with arthroscopic debridement.[11]

The SLIL itself is divisible into 3 anatomic regions: dorsal, proximal, and palmar.[12-14] The role of the palmar region in the pathogenesis of wrist pain was highlighted by the series by Watson and Weinzweig[15] on dorsal wrist syndrome in which 20% of patients who underwent surgical treatment had tears restricted to the palmar SLIL alone.

The LTIL also consists of dorsal, proximal, and palmar subregions.[16] The palmar subregion is the most important for maintaining stability. Sectioning the proximal and dorsal component of the LTIL has little effect on carpal kinematics. Sectioning the proximal and palmar components of the ligament, however, results in a volar intercalated segmental instability, which is increased if there is a coexisting

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rupture of the DRCL.[17] Ligament tears often originate in the palmar subregion. In the study by Osterman and Seidman,[18] of 20 patients who underwent arthroscopy for LTIL tears, the most common site of the tear was palmar and central, with intact dorsal fibers. Ligament avulsion typically occurs volarly off the triquetrum.[19] When viewed from the 4,5 or 6R portals, it often is necessary to debride the proximal portion of the ligament to assess the palmar component.[11] Direct visualization of the LTIL through a volar portal obviates the need for this.

The use of a volar radial (VR) and volar ulnar (VU) wrist portal would seem to have some advantages over the standard dorsal portals in this regard. The 2 unanswered questions then remain as to whether volar portals are safe and whether they provide any additional information over the standard dorsal portals. These are addressed in the following sections.

Anatomy

Arterial injection studies to highlight the vascular anatomy using a gelatin and lead oxide mixture[20] or India ink were performed in 5 fresh frozen cadavers arms. A VR portal was established by introducing a blunt trocar through the floor of the flexor carpi radialis (FCR) tendon sheath at the level of the proximal wrist crease. The trocar was noted to enter the radiocarpal joint between the radioscaphocapitate ligament and the long radiolunate ligament in 4 of 5 specimens (Fig 1). Measurements taken surrounding the VR portal showed that there was a safe zone free of any neurovascular structures that consisted of the width of the FCR tendon plus at least 3 mm or more in all directions (Fig 2). The palmar cutaneous branch is closest in proximity but always lies to the ulnar side of the FCR.[21,22] The palmar radiocarpal arch, which corresponds to the distal border of the pronator quadratus,[23] is at least 1 cm proximal to the portal.

The volar aspect of the midcarpal joint was identified with a 22-gauge needle through the same skin incision and a blunt trocar was inserted. The distance between the radiocarpal and midcarpal entry sites averaged 11 mm (7–12 mm). The superficial palmar branch of the radial artery passes through the subcutaneous tissue over the tuberosity of the scaphoid and is out of harms way with an incision at the proximal

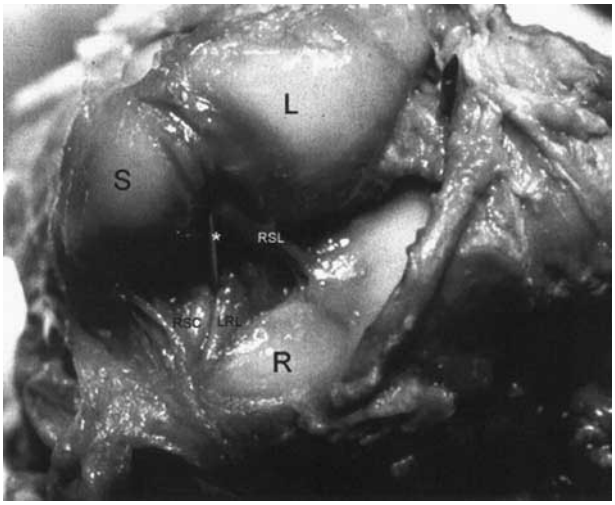

FIGURE 1. Ligamentous interval of VR portal. Radiocarpal joint viewed from the dorsal aspect of a hyperflexed wrist. Note the 22-gauge needle (*) entering between the RSC and LRL. S, scaphoid; L, lunate; R, radius; RSC, radioscaphocapitate ligament; LRL, long radiolunate ligament; RSL, radioscapholunate ligament.

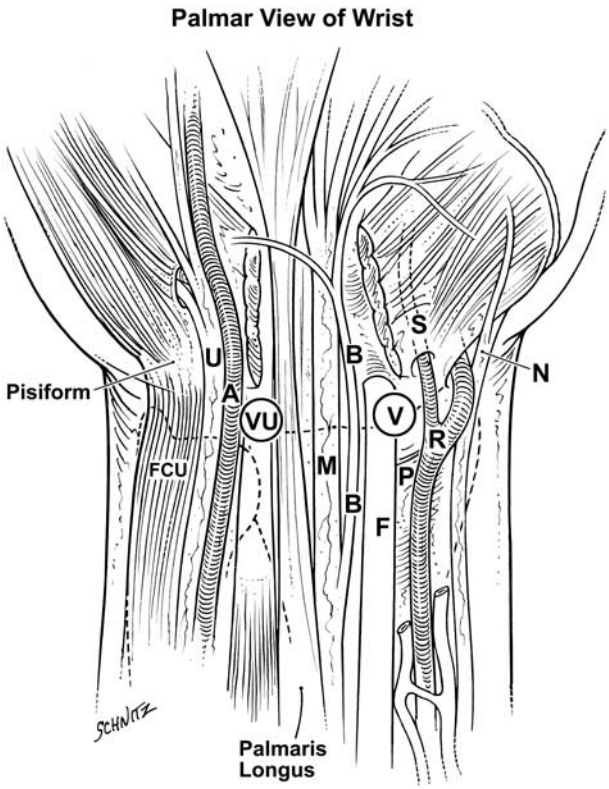

FIGURE 2. Relative positions of the VR and VU portals. N, superficial radial nerve; R, radial artery; S, superficial palmar branch of the radial artery; P, pronator quadratus; F, flexor carpi radialis; V, VR portal; B, palmar cutaneous branch of the median nerve; M, median nerve; A, ulnar artery; U, ulnar nerve.

wrist crease.[24,25] This portal permits views of the palmar capitohamate interosseous ligament, which is important in minimizing translational motion[26] and has an essential role in providing stability to the transverse carpal arch.[27]

A VU portal (Fig 2) was established via a 2-cm longitudinal incision made along the ulnar edge of the finger flexor tendons at the proximal wrist crease. The flexor tendons were retracted radially and a trocar was introduced into the radiocarpal joint. The ulnar styloid marked the proximal point of the VU portal, approximately 2 cm distal to the pronator quadratus. The portal was in the same sagittal plane as the extensor carpi ulnaris subsheath and penetrated the ulnolunate ligament adjacent to the radial insertion of the triangular fibrocartilage. The ulnar nerve and artery were generally greater than 5 mm from the trocar provided the capsular entry point was deep to the ulnar edge of the profundus tendons. The palmar cutaneous branch of the ulnar nerve (nerve of Henlé) was highly variable and not present in every specimen. It provides sensory fibers to the skin in the distal ulnar and volar part of the forearm down to a level 3 cm distal to the wrist crease. Its territory may extend radially beyond the palmaris longus tendon.[28] The distal palmar sensory branch of the nerve of Henlé tends to lie just to the ulnar side of the axis of the 4th ray.[29] This nerve may, hence, be at risk with any VU incision.

Technical Aspects

Under general anesthesia, the patient's hand is suspended from either an overhead pulley or a Linvatec traction tower (Linvatec Corporation, Largo, FL) with 10 to 15 lb of countertraction. The arm is exsanguinated and an upper-arm tourniquet is inflated to 250 mm. The surgeon is seated facing the volar surface of the wrist. To establish the VR portal, a 2-cm transverse or longitudinal incision is made in the proximal wrist crease overlying the FCR tendon. It is not necessary to specifically identify the adjacent neurovascular structures, provided that the surgeon adheres to the anatomic landmarks. The tendon sheath is divided and the FCR tendon is retracted ulnarly. The radiocarpal joint space is identified with a 22-gauge needle and distended with 5 cc of saline. Blunt tenotomy scissors or forceps are used to pierce the volar capsule. A blunt trocar is then introduced followed by a 2.7-mm 30° angled arthroscope (Figs 3 A-C). The midcarpal joint can be accessed through the same skin incision by angling the trocar 1 cm distally and approximately 5° ulnarward. Outflow is established via an 18-gauge needle in the 6U portal. The standard dorsal portals including the 3,4 and 4,5 portals as well as the radial and ulnar midcarpal portals are established in a similar fashion. A hook probe is inserted through the 3,4 portal and is used to assess the palmar aspect of the SLIL and the DRCL (Fig 4). A useful landmark when viewing from the VR portal is the intersulcal ridge between the scaphoid and lunate fossae, which points to Lister's tubercle. The radial origin of the DRCL is seen immediately ulnar to this, just proximal to the lunate, and can be palpated with a hook probe in the 3,4 portal.

The VU portal is established via a 2-cm longitudinal incision centered over the proximal wrist crease along the ulnar edge of the finger flexor tendons. The tendons are retracted to the radial side and the radiocarpal joint space is identified with a 22-gauge needle. Blunt tenotomy scissors or forceps are used to pierce the volar capsule, followed by insertion of a 2.7-mm 30° arthroscope. The ulnar nerve is protected by use of the cannula and a more radial entry site. The median nerve is protected by the interposed flexor tendons. The palmar region of the LTIL usually can be seen slightly distal and radial to the portal. A hook probe is inserted through the 6R or 6U portal.

Own Experience

The VR portal has been used in 31 patients since 1998. Additional pathology was evident in 11 of the 31 patients that was not visible from a dorsal portal. This included 1 case of hypertrophic synovitis of the dorsal capsule (Fig 5), 1 patient with an avulsion of the radioscapholunate ligament that exposed the volar scapholunate cleft (Fig 6), 1 patient with a tear restricted to the palmar region of the SLIL, and 8 patients with tears of the DRCL (Fig 7). In 3 of these patients this additional information directly influenced the subsequent treatment in the way of an arthroscopic repair of the DRCL tears (Fig 8).[10] The other 5 cases were associated with partial SLIL tears and were treated with a dorsal capsulodesis.

The midcarpal joint was accessed from the VR portal in 3 cases. In 1 patient with Preiser's disease, the use of the VR midcarpal portal allowed a more complete assessment of the distal articular surface of

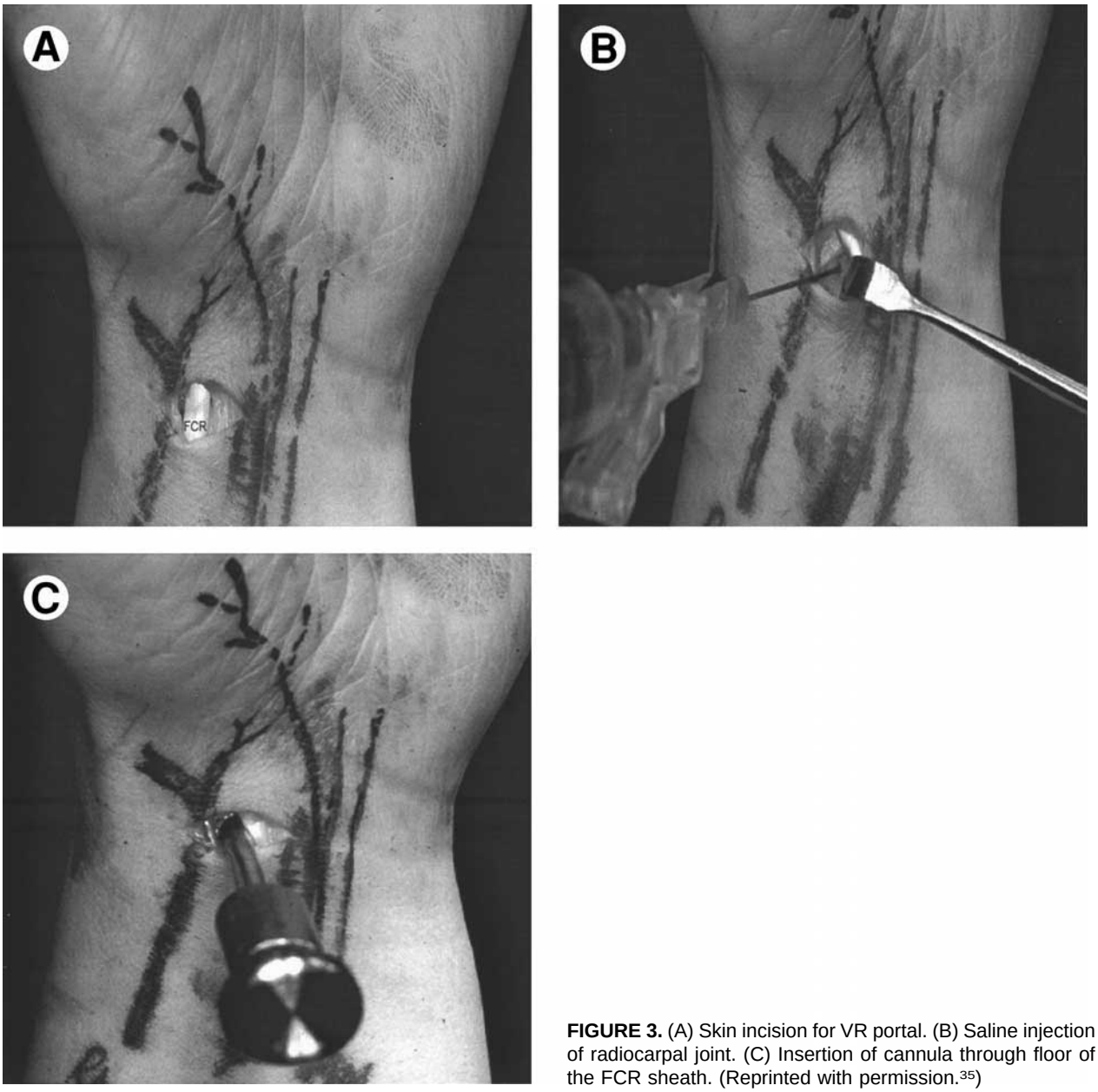

FIGURE 3. (A) Skin incision for VR portal. (B) Saline injection of radiocarpal joint. (C) Insertion of cannula through floor of the FCR sheath. (Reprinted with permission.[35])

the scaphoid. The other patient had an unrecognized osteochondral fracture of the capitate head after a perilunate dislocation. The VR midcarpal portal admirably showed the intact dorsal portion of the SLIL in the patient with the palmar tear (Fig 9).

The VU portal was used in 16 of these patients. Five patients were found to have tears of the LTIL ligament (Fig 10). The palmar region was debrided under direct vision through the VU portal with a motorized shaver introduced through the 6U portal. The dorsal radioulnar ligament and radial insertion of the triangular fibrocartilage were well visualized.

Complications

One patient in whom the VR portal was used underwent a dorsal capsulodesis for dynamic scapholunate instability. At 6 months she still complained of thenar numbness and a generalized loss of finger sensation, although Semmes-Weinstein mono-

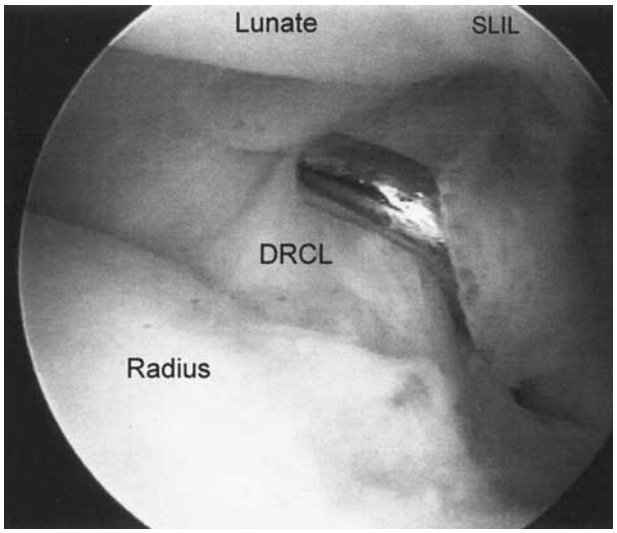

FIGURE 4. Normal DRCL as viewed from the VR portal. Hook probe is inserted through the 3,4 portal. (Reprinted with permission.[35])

filament testing and a nerve conduction study were normal. Another patient in whom both volar portals were used also underwent a dorsal capsulodesis for dynamic scapholunate instability in addition to debridement of a LTIL tear. He complained of persistent hypothenar numbness despite normal nerve conduction studies. Both patients were receiving worker's compensation benefits. There were otherwise no complications from the use of the volar portals in the way of hematoma, abnormal sensation, or other neurovascular injury.

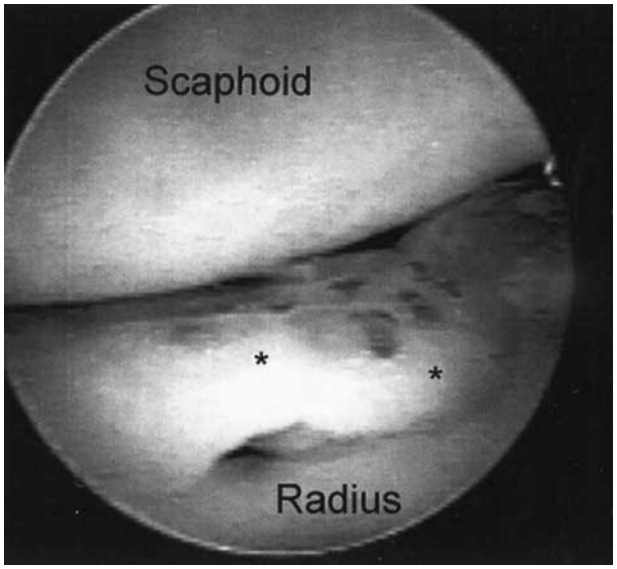

FIGURE 5. Hypertrophic synovitis (*) of the dorsal capsule viewed from the VR portal. (Reprinted with permission.[35])

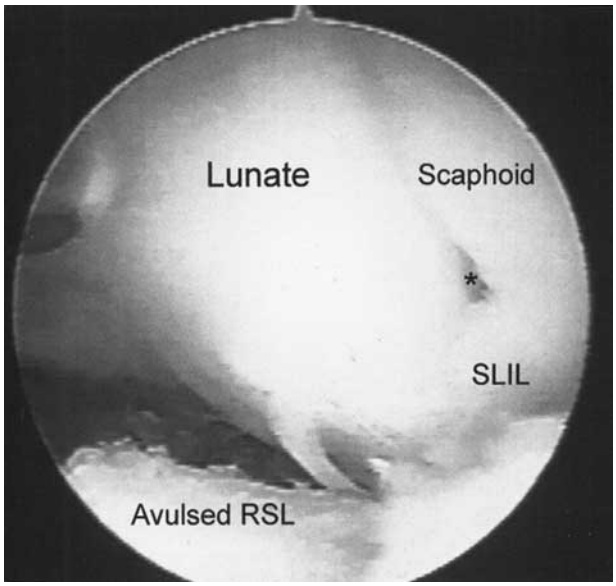

FIGURE 6. Avulsion of the RSL exposing the palmar cleft (*) between the scaphoid and lunate as seen from the VR portal. RSL, radioscapholunate ligament. (Reprinted with permission.[35])

DISCUSSION

A number of reports highlight the safety and use of VR arthroscopy portals. Levy and Glickel[1] described the use of an accessory volar portal after

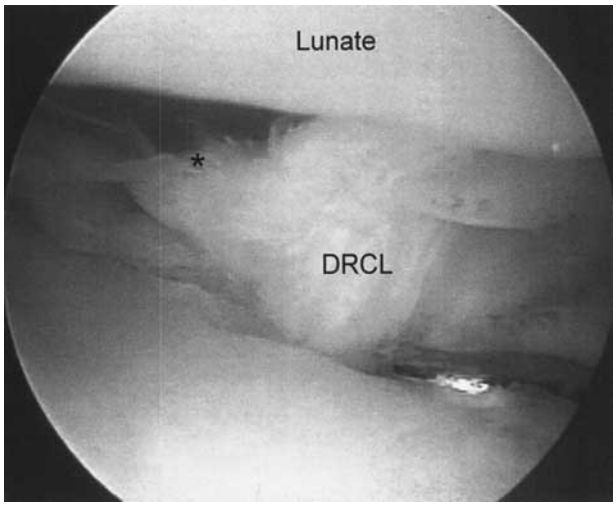

FIGURE 7. Tear (*) of the DRCL as seen from the VR portal. Hook probe inserted through the 3,4 portal. (Reprinted with permission.[35])

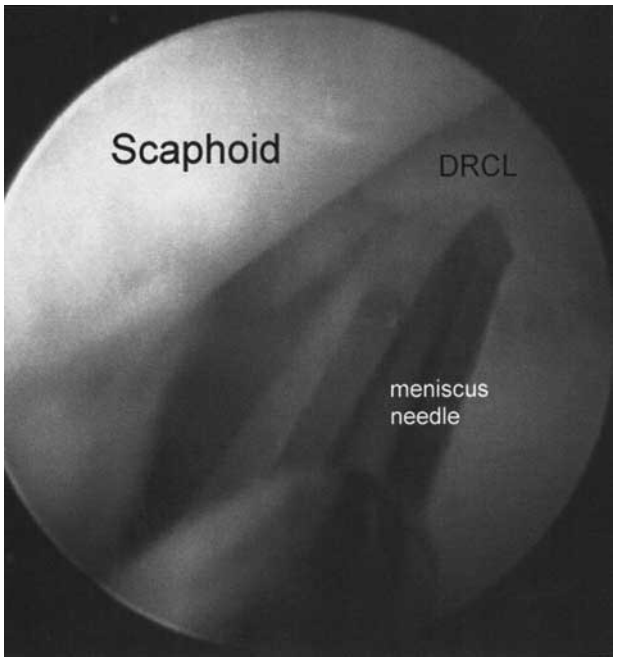

FIGURE 8. Arthroscopic repair of the DRCL with double-armed meniscal needles introduced through a cannula in the VR portal.

plating Bartons' fractures that was accessed through a standard carpal tunnel incision. Tham et al[3] used a VR portal in 14 cases, for synovectomy, radial styloidectomy, and fracture reduction. Osterman and Bednar[30] described the use of a VR portal established via an inside-out technique for arthroscopic release of dorsal wrist contractures. Doi et al[4] used a VR portal in 34 cases of arthroscopically assisted reduction of distal radius fractures. The ligamentous intervals used were either medial or lateral to the long radiolunate ligament. Culp[31] noted that there was the potential for injury to the FCR, the palmar cutaneous branch of the median nerve, and the lateral antebrachial cutaneous nerve, but none of these complications were reported in any of the earlier-mentioned series.

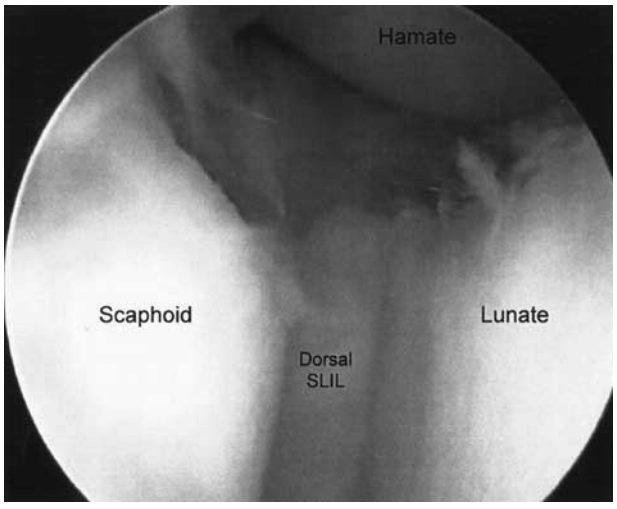

FIGURE 9. Tear of the palmar region of the SLIL, as viewed from the VR midcarpal portal. Note the intact dorsal fibers of the SLIL.

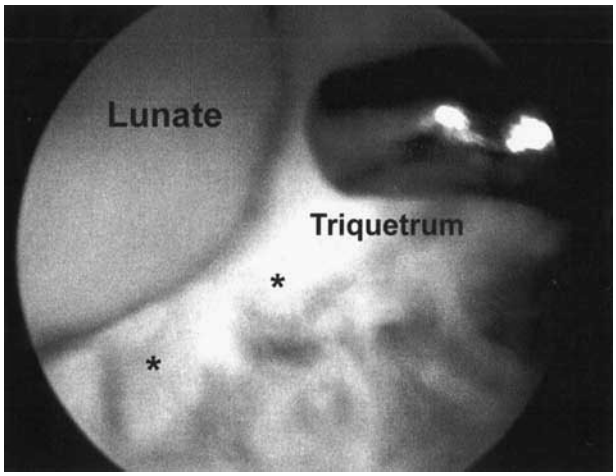

FIGURE 10. Tear of the palmar region of the LTIL (*) as viewed from the VU portal. Hook probe inserted through the 6U portal.

Various authors have shown that the radioscapholunate ligament covers the proximal margin of the scapholunate articulation and conveys a blood supply to the SLIL ligament.[32-34] The palmar region of the SLIL ligament, hence, cannot be visualized from the radiocarpal joint unless the radioscapholunate ligament is torn. This was found to be a consistent finding in the 3 patients with SLIL tears that involved the palmar region.

A surprising finding was the high number of previously unrecognized DRCL tears in the earlier-mentioned group of patients. The capsular ligaments are enclosed in an epiligamentous sheath composed of fibrous strata on their superficial surfaces and synovial strata on their deep surfaces.[12] Prior experience with the use of a VR portal showed that the actual fibers of the DRCL were not always visible except when an associated tear was present.[35]

The management of DRCL tears is still evolving. In 8 of 31 patients with torn ligaments, the DRCL tear alone was responsible for chronic dorsal wrist pain in

2 of the 8 patients. Slater and Laubach[36] performed a study on the arterial blood supply to the dorsal wrist ligaments. They noted that the origin of the DRCL usually was supplied by branches from the 4th extensor compartment artery with contributions from the 2,3 intercompartmental supraretinacular artery and adjacent branches from the dorsal radiocarpal arch. The implication of their study was that tears of the DRCL have the potential to heal. Hence, an arthroscopic inside-out repair method was developed by using double-armed meniscal repair needles introduced through a second cannula in the VR portal. The needles were inserted through the radiocarpal joint and passed through the torn edge of the DRCL, followed by 6 weeks of cast immobilization. This type of DRCL repair was successful in relieving wrist pain in 2 patients.[10] In 4 of the remaining patients who had coexisting SLIL ligament tears, the treatment was primarily directed toward the dynamic scapholunate instability by way of a dorsal capsulodesis. The DRCL tear was not addressed directly because the dorsal incision followed by the creation of a dorsal capsular checkrein to restrain scaphoid flexion rendered any separate treatment of the DRCL tear unfeasible. The results of this treatment were mixed.

It is true that the palmar regions of the SLIL and LTIL and the DRCL can be seen partially from other accessory portals. Previous anatomic studies, however, have shown that the 1-2, 6R, and 6U portals were the most perilous owing to the close proximity of the radial artery and dorsal radial and ulnar sensory nerve branches, which sometimes passed within 1 mm of the portals.[37] My experience is that the volar portals generally are safe, but that no portal, however, is without potential complication.

There appears to be no clinical series on the use of a VU portal as yet. Jantea et al,[2] performing an anatomic study in 7 cadaver forearms, described VU portals medial and lateral to the FCU tendon for access to the radiocarpal joint. The investigators felt the medial portal was too close to the ulnar neurovascular bundle for routine use but recommended a lateral ulnar portal. In 5 of 31 patients with LTIL tears, the VU portal was useful in debriding the palmar component of the tear. Although the dorsal radioulnar ligament and radial tears of the TFC were well visualized, there were no apparent advantages when viewing them from a palmar perspective over the standard dorsal portals.

Conclusion

In summary, use of the VR portal identified additional pathology in over 30% of a small series of patients. Because of the high incidence of previously unrecognized DRCL tears and relative ease of use, the VR portal is worthy of inclusion as a part of a standard arthroscopic assessment of the wrist. The volar midcarpal portal may be considered as an occasional accessory portal for visualizing the palmar aspects of the capitate and hamate in cases of avascular necrosis or osteochondral fractures. The VU portal is mostly indicated as an accessory portal for evaluating and debriding palmar tears of the lunotriquetral ligament.

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