



All-Dorsal Arthroscopic Ligamentoplasty (ADAL) in Scapholunate Instability Management: Surgical Technique

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Abstract: In advanced scapholunate instability, a scapholunate repair by open or arthroscopic ligamentoplasty is indicated. Although the radiographic results and functional scores are more or less satisfactory for open ligamentoplasty, it is often responsible for a decrease in joint amplitude postoperatively. Arthroscopic techniques are therefore of great interest, since they respect the joint capsule, but they remain technically difficult and demanding surgeries, requiring a good deal of experience in arthroscopy and using bone tunnels that are potentially a source of complications, as well as pinning to the palmar side of the wrist, which is potentially dangerous for the palmar structures of the wrist. We present a surgical technique of scapholunate ligamentoplasty under arthroscopy, focusing only on the dorsal scapholunate complex: all-dorsal arthroscopic ligamentoplasty. The advantages of all-dorsal arthroscopic ligamentoplasty are that it requires little material, does away with palmar approaches, and focuses only on the dorsal side, simplifying surgery and avoiding the creation of bone tunnels potentially at risk of fracture or avascular necrosis.

The various manifestations of dissociative carpal instability appear to result from a combination of acute injury interosseous scapholunate ligament to one or more critical stabilizers, such as the dorsal intercarpal ligament.¹ Although injury to other secondary stabilizers can lead to scapholunate instability, it appears that the primary stabilizers are primarily dorsal (“three-lock theory”: dorsal part of the scapholunate

interosseous ligament, dorsal capsuloligamentous scapholunate septum, and intercarpal ligament).^{2,3} In advanced scapholunate instability, in the absence of osteoarthritis, a scapholunate repair ligamentoplasty is indicated. This can be performed openly^{4,5} or by a more recently developed arthroscopic technique.^{6,7} The common goal of these ligamentoplasties is to reproduce the intrinsic biomechanical action of the scapholunate interosseous ligament but also to recreate the action of the extrinsic ligaments of the scapholunate complex.

Although the radiographic results and functional scores are more or less satisfactory for open ligamentoplasty, it is often responsible for a decrease in joint amplitude postoperatively. The need for capsulotomy with these open techniques disinserts the extrinsic and intrinsic ligaments of the scapholunate complex, with a relative stability that will never be comparable to the level present prior to capsulotomy.^{1,8} Arthroscopic techniques are therefore of great interest, since they respect the joint capsule, but they remain technically difficult and demanding surgeries, requiring a good deal of experience in arthroscopy and using bone tunnels that are potentially a source of complications, as well as pinning to the palmar side of the wrist, which is potentially dangerous for the palmar structures of the wrist. In view of these data found in the literature, we present a surgical technique of

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scapholunate ligamentoplasty under arthroscopy focusing only on the dorsal scapholunate complex: all-dorsal arthroscopic ligamentoplasty (ADAL) (Video 1).

Surgical Technique (With Video Illustration)

Patient Preparation

The procedure is performed on an outpatient care basis with the patient under regional anesthesia and the use of a tourniquet. The patient's arm is secured to the arm board and finger traps are used to apply 5 to 7 kg (11–15.5 lbs) of traction along the arm's axis.

Graft Harvesting

First, harvesting of the ipsilateral palmaris longus is performed using a stripper (Tendon Stripper, Arthrex, Naples, FL) (Fig 1).⁹ The graft is harvested through a small incision at the distal flexion crease of the wrist joint at the base of the carpal tunnel. The palmaris longus is then prepared with sutures on each free end (VICRYL 3.0; Ethicon, Somerville, NJ) with the sutures left voluntarily long.

Reduction of the Deformation

Two 1.5-mm diameter wires are inserted dorsally and percutaneously, one in the scaphoid and the other in the lunate. The 2 wires are then held together with a strong forceps (Fig 2). A 3.0- or 3.5-mm diameter cannulated drill bit with a soft-tissue protector is then inserted around a prepositioned wire within the 3-4 portal in the proximal pole of the scaphoid to drill the first cortex under arthroscopic control (Fig 3).

Arthroscopic Exploration

The scope (30°, 2.4 diameter, Karl Storz, Tutlingen, Germany) is introduced into the 3-4 portal and the shaver (2.9, Karl Storz) into the 6R portal. The first phase of the arthroscopic procedure consists of complete synovectomy with a shaver, reversing the shaver and scope positions and ensuring the absence of arthrosis. The scope is then introduced through the midcarpal ulnar portal and the shaver through the midcarpal radial portal to debride the joint. The shaver and scope are reversed to debride the remainder of the joint. We confirm the presence of scapholunate instability without midcarpal or radiocarpal osteoarthritis. Once the indication is confirmed, we perform an aggressive periscaphoid and perilunate shaving in the midcarpal and radiocarpal.

Preparation of the Graft

Three elements are prepared on the anchor: a 1.9 FiberTape with its ends left long; one of the ends of the tendon graft; and a 3/0 polydioxanone (PDS) suture (Fig 4). The same procedure is performed on the lunate using the 4-5 portal. Before being anchored in the

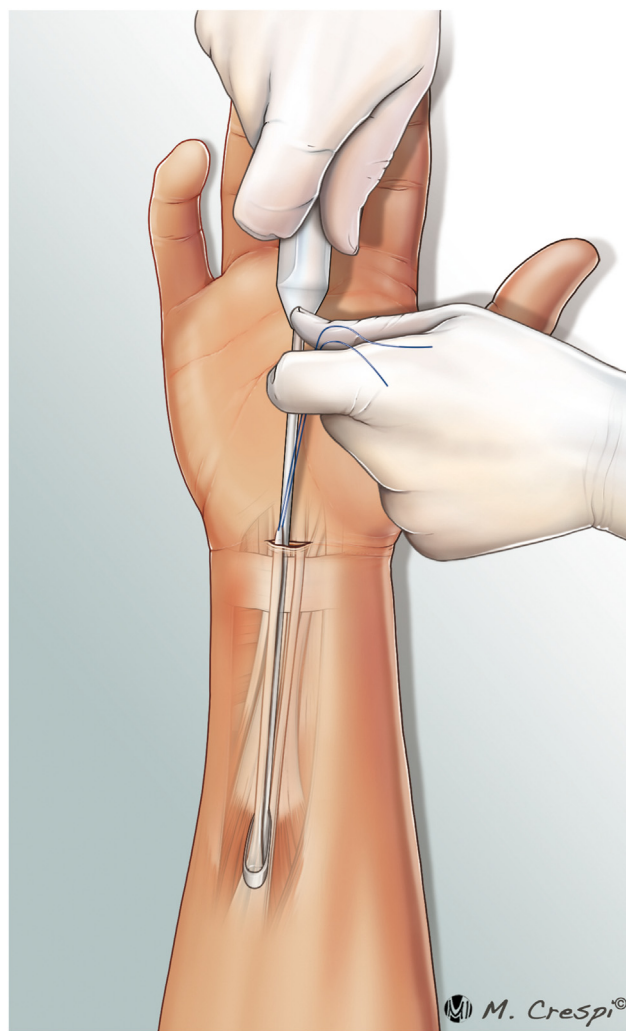


Fig 1. Illustration (palmar view) of tendon harvesting by the mini-invasive approach. Harvesting of the ipsilateral palmaris longus is performed using a stripper (Tendon Stripper; Arthrex Naples, FL) through a small incision at the distal flexion crease of the wrist joint. Special attention should be paid to avoid any risk of confusion with the median nerve. Although extremely rare, and often the consequence of inattention, this complication would be disastrous for a benign pathology.⁹

lunate, the graft is twisted and then passed intra-articularly from portal 3-4 to 4-5 using forceps (Fig 5). The 3/0 PDS suture is passed in the same direction but independently of the “tendon–FiberTape” transplant. Then, a radial accessory scaphoid portal is performed under counter arthroscopy and the tendon–FiberTape graft is anchored using the same procedure from the 4-5 portal to this accessory portal (Fig 6).

Repair of the Dorsal Capsuloligamentous Complex

The 3/0 PDS sutures at the 2 ends left respectively in the 3-4 and 4-5 portals are used to repair the dorsal

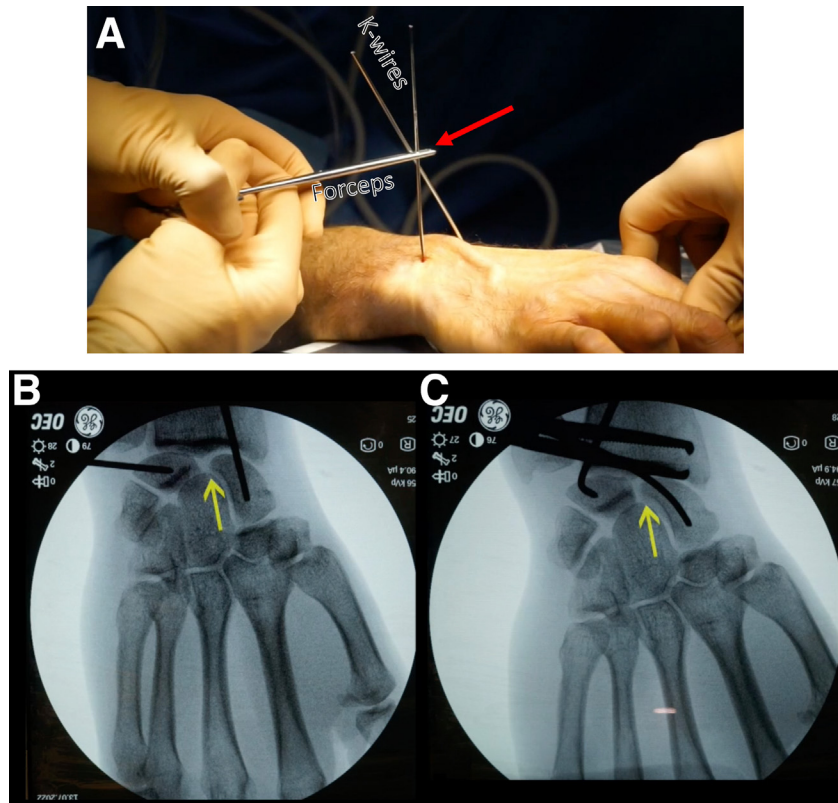


Fig 2. Maneuver to reduce scapholunate instability. (A) Intraoperative view: Two wires are inserted, one into the lunate and one into the body of the scaphoid. These 2 wires are then held in place with a strong clamp (red arrow). (B) Fluoroscopic view before reduction. The yellow arrow indicates the scapholunate gap. Note the distance between the scaphoid and the lunate. (C) Fluoroscopic view: reduction of the scapholunate space after holding the 2 pins with forceps.

scapholunate capsuloligamentous complex. For this purpose, the end left in 4-5 is passed extra-articularly but under the tendon from the 4-5 portal to the 3-4

portal. Thus, the two ends are knotted through the 3-4 portal, achieving a folding of the dorsal capsular complex (Fig 7).

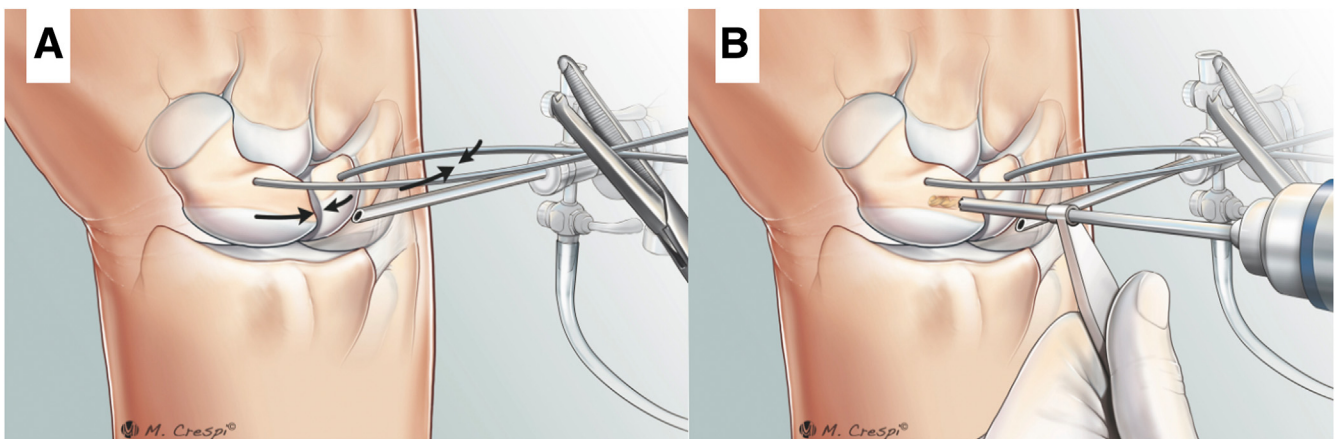


Fig 3. Illustration (dorsal view) of the preparation of the proximal pole of the scaphoid (6R scope, instrumentation via the 3-4 portal). (A) Reduction of scapholunate instability using 2 crossed and pinched joystick wires. The arthroscope can also be used in the midcarpal level to better visualize the reduction of the scapholunate gap. (B) Drawing of the proximal pole of the scaphoid on a cannulated guide. The use of a soft-tissue protector is essential.

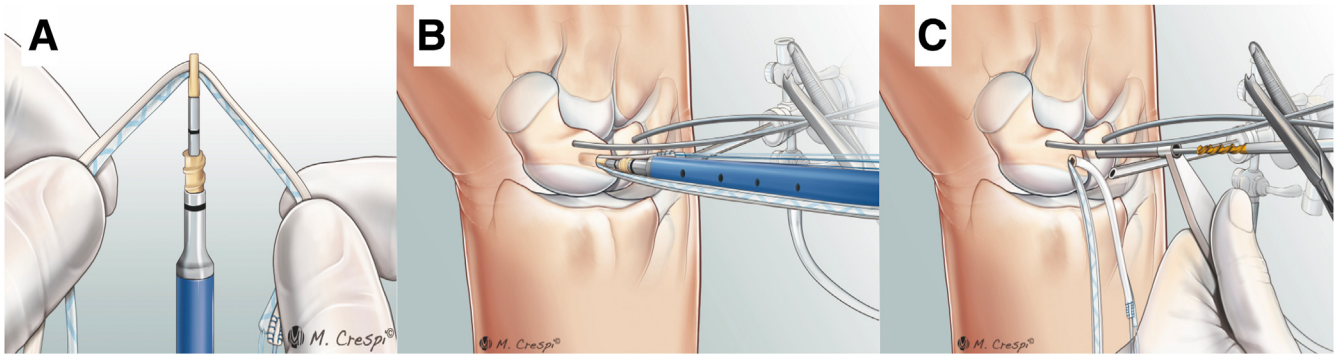


Fig 4. Illustration (in dorsal view) of the first transplant anchorage (scope in 6R, instrumentation via portal 3-4). (A) The transplant is then anchored at one end to a SwiveLock-type anchor, which is itself already armed with a FiberTape wire. A 3/0 PDS suture will be added, based the same principle, for capsulodesis. (B) The transplant is anchored to the proximal pole of the scaphoid through the 3-4 portal under arthroscopic control. (C) The other end of the tendon is left outside the patient, and we can start the drilling of the lunate with a cannulated drill. (PDS, polydioxanone.)

Discussion

Arthroscopy is an important tool in the management of scapholunate instability, whether for therapeutic purposes or to check for associated lesions that could potentially contraindicate ligamentoplasty (such as the presence of osteoarthritis that was not diagnosed on preoperative examinations). In addition, the minimally invasive nature of this technique means that the extrinsic capsuloligamentous attachments to the dorsal pole of the lunate, which seem to be the guarantor of scapholunate stability, are not removed.⁸

There is a certain inadequacy concerning the satisfactory reduction of radiologic angles but a definite decrease in joint amplitudes when performing open ligamentoplasties with a decrease in results over time.^{4,10} Unfortunately, there are no studies assessing the long-term effectiveness of arthroscopy, probably because of the recent development of these surgical techniques. We can ask whether the capsular opening, which is necessary during open surgery, leads to

additional stress on the scapholunate stability, thus leading to relaxation of the ligamentoplasty. Although there are few studies and a short follow-up, these techniques offer superior joint range preservation compared with other scapholunate repairs.⁶ Preservation of the extrinsic attachments thus offers the theoretical advantage of not adding additional distension, although studies with a longer follow-up are needed.

Some ligamentoplasties offer the possibility of repairing the anterior side, often affected in advanced scapholunate instabilities.^{6,7,11} This is not the case with the classic all-dorsal technique (internal brace) or with arthroscopy. However, the various anatomical studies report that the main stabilizing elements of scapholunate stability are located dorsally.^{2,12} and that an efficient repair of the dorsal capsuloligamentous complex can allow the management of pure anterior scapholunate instabilities (3-lock theory).³ All-dorsal capsulotomy therefore offers good radiologic and functional results while focusing only on the dorsal elements of

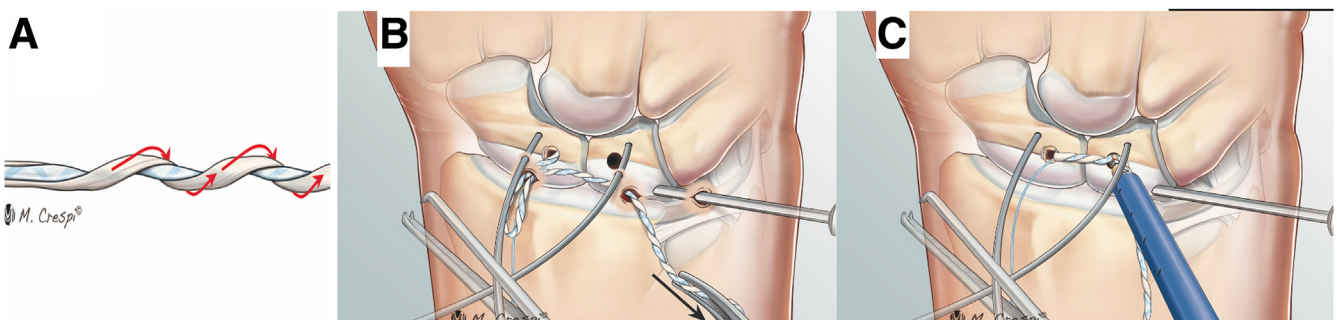


Fig 5. Illustration (in dorsal view) of the anchoring of the transplant to the lunate (6R scope, instrumentation 4-5). (A) The transplant is then twisted on itself with the FiberTape. (B) The FiberTape is passed intra-articularly from the 3-4 to the 4-5 portal using forceps. The same applies to the 3/0 PDS suture, which is passed independently of the tendon–FiberTape graft. (C) The tendon–FiberTape graft and the 3/0 PDS suture are then anchored in the lunate with a SwiveLock anchor via the 4-5 portal. (PDS, polydioxanone.)

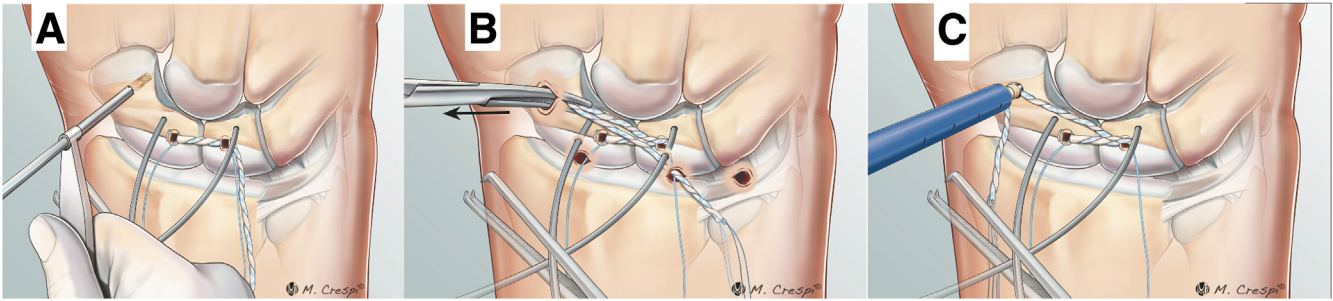


Fig 6. Illustration (dorsal view) of the anchoring of the transplant at the distal scaphoid (no arthroscopic control required). (A) After the accessory scaphoid portal is performed, a drill according to the same procedure is performed. (B) Passage of the graft intra-articularly from the 4-5 portal to the accessory portal. No arthroscopic control is needed. (C) Anchoring of the transplant distally

the scapholunate complex (notably the dorsal portion of the interosseous scapholunate ligament and the intercarpal dorsal ligament). However, in our opinion, capsulotomy represents its greatest disadvantage and could theoretically lead to relaxation of the repair. Although technically more demanding, arthroscopic repair of these ligamentous structures allows preservation and repair of the ligamentous structures, in addition to the discreet aesthetic aspect. Compared with other arthroscopic techniques,^{6,7} these techniques allow the creation of a palmar and dorsal box around the interosseous scapholunate ligament but do not recreate the action of constant support of the carpus by the oblique position of the intercarpal dorsal ligament, whereas a part of the all-dorsal technique is dedicated to this.

The theoretical advantage of capsulotomy is that it allows better reduction of the bony elements, since

resection of the periscaphoid and perilunate fibrosis is facilitated in the open. However, some authors have already demonstrated that aggressive shaving of this fibrosis allows satisfactory reduction of these elements, even in advanced scapholunate instability.³

The advantages of ADAL are that it requires little material, does away with palmar approaches, and focuses only on the dorsal side, simplifying surgery and avoiding the creation of bone tunnels potentially at risk of fracture or avascular necrosis.^{6,7} The combined use of tendon and FiberTape (Arthrex) reduces the risk of relaxation of the repair. The disadvantages of this surgery are the need for extensive experience (Table 1) in arthroscopy, even if it is less technical than that previously described. In our practice, we reserve it for when the radiolunate angle is greater than 10° ; otherwise, a wide arthroscopic dorsal capsuloligamentous repair (WADCLR) is performed.³

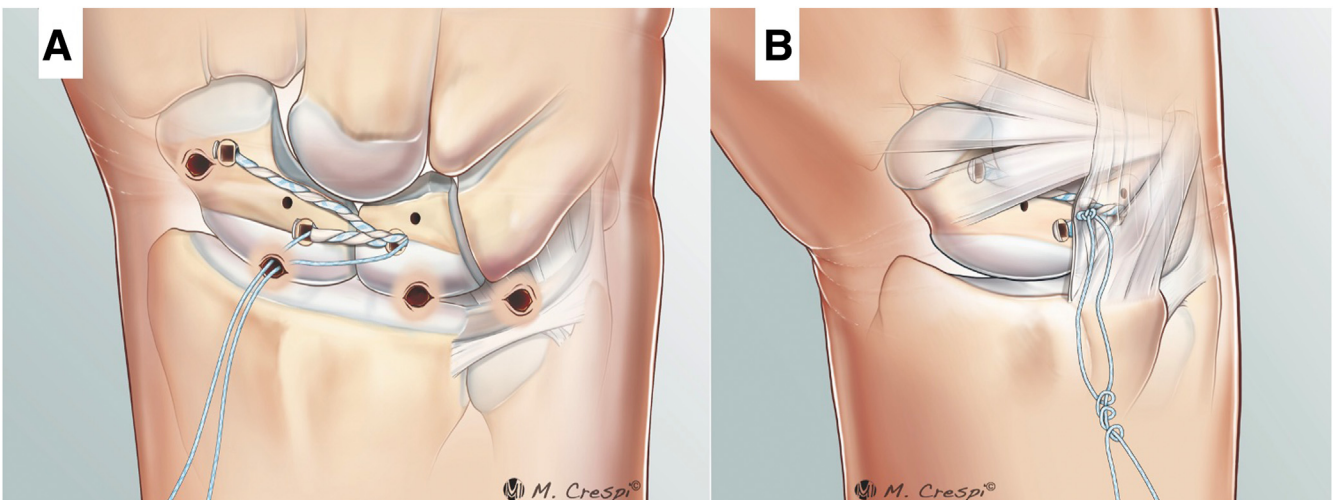


Fig 7. Illustration (dorsal view) of dorsal capsuloligamentous complex repair (no arthroscopic instrumentation required). (A) Passage of the 3/0 PDS end from the 4-5 portal to the 3-4 portal by an extracapsular but subtendinous passage. The 2 ends are found at the level of portal 3-4. (B) Suture of the 2 ends together to apply the posterior capsule to the dorsal scapholunate capsuloligamentary complex. (PDS, polydioxanone.)

Table 1. Surgical Pearls and Pitfalls

Pearls	Pitfalls
<ul style="list-style-type: none"> - Forceps should be used to create a tunnel between the extensor tendons and the dorsal capsule by dissection. - Aggressive shaving is recommended before performing any steps to increase the quality of the reduction of the scapholunate deformity. - Do not hesitate to enlarge and widen the standard lanes to facilitate the introduction of anchors - The bone tunnel in the body of the scaphoid must be made in the axis of the body of the scaphoid and not in the axis of the proximal pole to avoid fracturing it. 	<ul style="list-style-type: none"> - Good reduction of the scaphoid and lunate will only be achieved after aggressive shaving around these structures. - if the incision is not made large enough, a tendon may be trapped in the dorsal suture. Always check the flexion of the fingers preoperatively. - Not using soft-tissue protection can make the procedure very difficult and expose the patient to complications.

Conclusions

The ADAL is therefore an interesting therapeutic solution in the management of severe scapholunate instability because it is performed under arthroscopy, and its repair is more oriented toward the dorsal intercarpal ligament.

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