Radiologic Evolution after Scapholunate Dorsal Capsulodesis for Chronic Tears

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Abstract

Background Many debates are still ongoing for the management of chronic scapholunate (SL) injuries. We have proposed an arthroscopic technique of dorsal capsulodesis with good clinical results. We now propose a radiological follow-up.

Purpose To determine if arthroscopic dorsal capsulodesis can improve the radiographic SL angle and maintain this correction over time.

Methods From January 2020 to January 2021, we included every patient with an SL instability and sorted them according to the European Wrist Arthroscopy Society (EWAS) classification. All patients had bilateral X-rays with a measurement of the radiolunate (RL) and SL angles for both the pathologic and healthy side. We also included patients with lunotriquetral or triangular fibrocartilage complex lesions. The exclusion criteria were the presence of arthritis and persistent intraoperative SL instability after capsulodesis. An arthroscopic dorsal capsulodesis was performed in all patients as originally described by Mathoulin. The RL and SL angles were then again measured on the immediate postoperative X-ray, and then again at 3, 6, and 12 months postoperatively. The statistical analysis was done using a paired Student's *t*-test with 145 degrees of freedom and $\alpha = 0.05$.

Results We included a total of 146 patients with a 1-year follow-up. Both the RL angle and the SL angles approach the healthy side at 12 months postoperatively. The RL angle has increased from −7.23 degrees to 4.37 degrees; the difference is still statistically significative, but it is almost equal to the healthy side (5.16 degrees). The SL angle has lowered from 74.55 to 54.95; the difference is still statistically and radiologically significative (6.788 degrees) but has been lowered by 74.3%.

Conclusion This study shows that this technique can normalize the dorsal intercalated segment instability (DISI) over time without the need for any pinning or invasive ligament reconstructive surgery.

Level of Evidence Level IV, cohort study.

Clinical Relevance Dorsal capsulodesis should be considered in all reducible SL injuries, even when DISI is present.

Keywords
- scapholunate interosseous ligament
- wrist arthroscopy
- SLAC
- DISI
- dorsal
- capsulodesis

Many debates are still ongoing for the management of chronic scapholunate (SL) injuries, and there is still no standardized management. Even before any arthritis appears (scapholunate advanced collapse [SLAC]), authors still debate over the indications for arthroscopic repairs and various arthroscopic or open ligament reconstructive surgery.[1]

We have already proposed a simple arthroscopic technique of isolated dorsal capsulodesis.[2]

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Since this technique has been described and perfected by Mathoulin,[2–6] we have operated on several hundred patients presenting with an acute or even chronic tear of the scapholunate interosseous ligament (SLIL). Previous published research has shown that at 4-year follow-up, the majority of patients had good to excellent Mayo Wrist Score.[5]

We now propose a series of arthroscopic scapholunate dorsal capsulodesis with a radiological follow-up up to 1-year postoperatively.

Our assumption is that even in chronic cases and in advanced reducible staged of the European Wrist Arthroscopy Society (EWAS) classification[7] (stages 3 and 4), the dorsal intercalated segment instability (DISI), measured by the SL and radiolunate (RL) angles, would normalize over time, without the need for additional pinning or invasive ligament reconstructive surgery and that this correction would maintain over time. We believe that time from injury and the presence of associated triangular fibrocartilage complex (TFCC) and/or lunotriquetral ligament (LTL) lesions would not change the final result.

Material and Methods

From January 2020 to January 2021, we included every patient with an SL instability with an SL angle greater than 60 degrees and a negative RL angle. We reported the time from injury at the time of surgery. All patients were sorted according to the EWAS classification.[7] They all had bilateral wrist X-rays with a measurement of the RL and SL angles for both the pathologic and healthy side. The lateral radiographs were excluded if there were no alignment between the center of the base of the third metacarpal, the capitate, and the lunate. The RL and SL angles were measured on lateral X-rays with Osirix MD (Pixmeo SARL, Bernex, Switzerland). The RL angle is the angle between the axis of the radial diaphysis and the midaxis of the lunate. It is negative if the angle is dorsal and positive if the angle is palmar. The SL angle is the angle between the long axis of the scaphoid and the midaxis of the lunate (►**Fig. 1**). Patients were then scheduled for an arthroscopic dorsal capsulodesis according to the technique described by Mathoulin.[2] We also included patients with LTL or TFCC lesions.

Our team was composed of five surgeons. According to Nakamura's surgeon level of expertise,[8] F. B. was level 2, L. M., A. H., and M. G. were level 3, and C. M. was level 5.

The surgery is performed as described by Mathoulin in 2011,[2] on an outpatient basis, under locoregional anesthesia, with a tourniquet at 250 mm Hg. The elbow is placed at a 90-degree angle and the hand is pulled upward with an

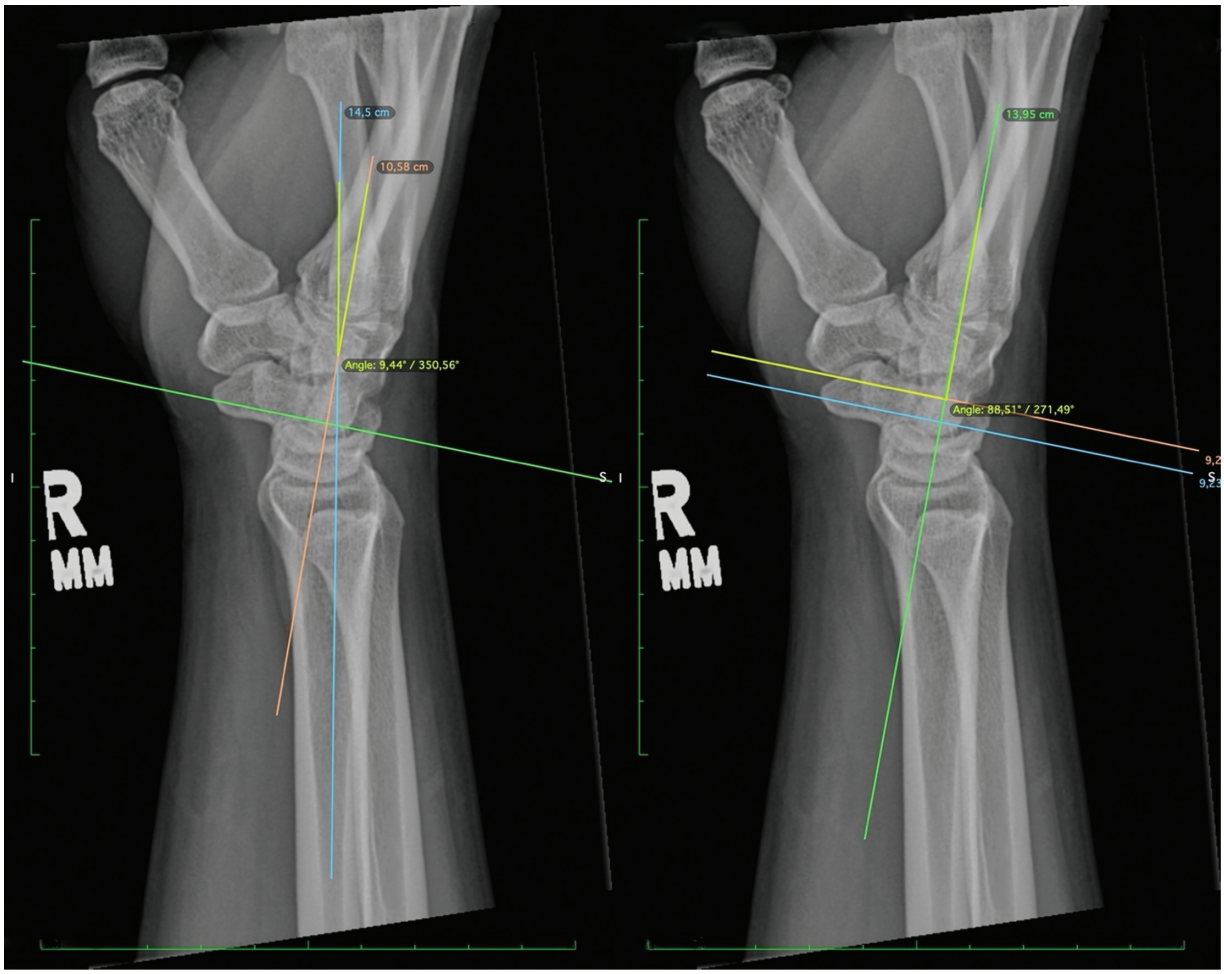

Fig. 1 Measurement of the radiolunate angle (left) and scapholunate angle (right).

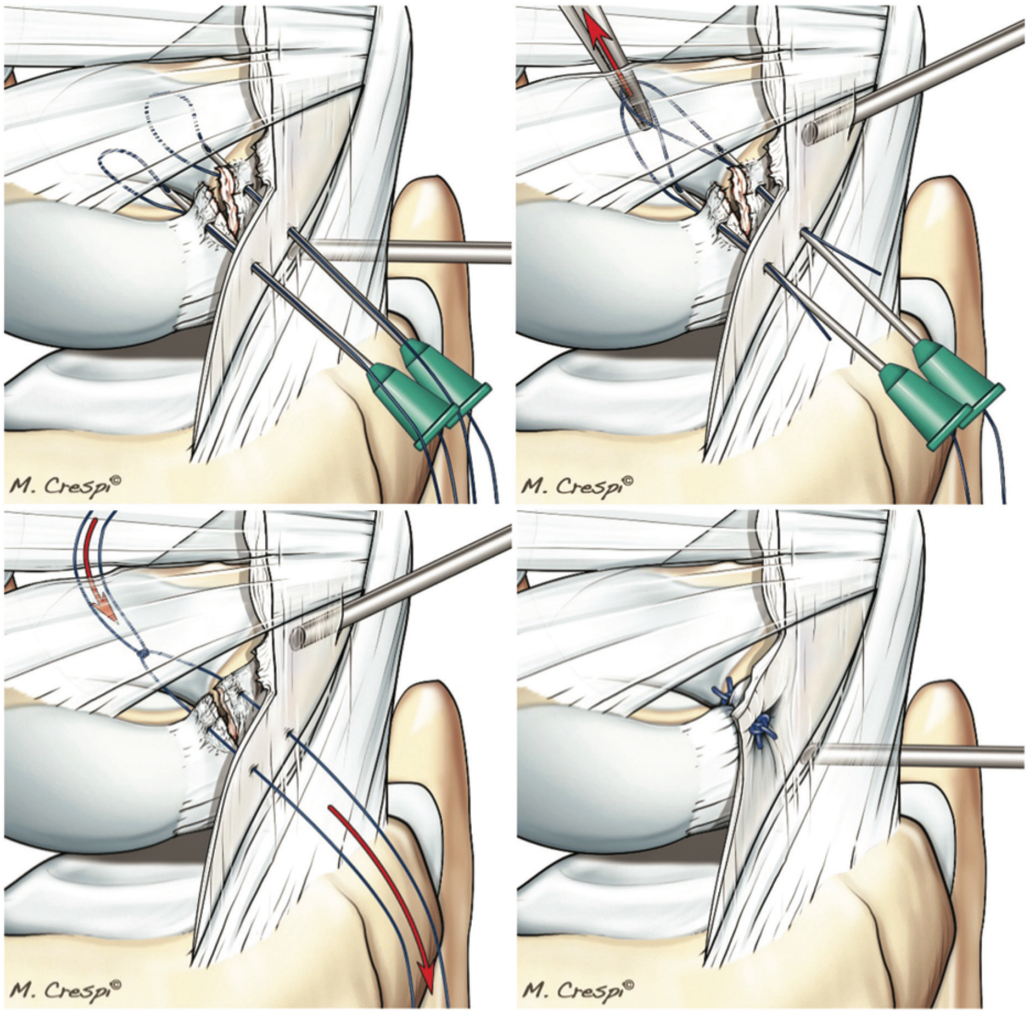

Fig. 2 Surgical technique.

appropriate traction system. We use a standard 30-degree arthroscope, through the radiocarpal 3–4 and 6R and the radial and ulnar midcarpal portals. We begin with a synovectomy and a complete exploration of the wrist. The SLIL usually presents with a scaphoid avulsion and an intact lunate insertion. We then evaluate the rest of the wrist, especially the TFCC and the LTL.

The surgical method is shown in ►**Fig. 2**: using needles, PDS 3–0 sutures are passed via the 3–4 portal, through the dorsal capsule and the intrinsic ligaments if they are still present. The sutures are then retrieved through the radial midcarpal portal where they are tied outside of the joint and then reinserted inside the joint by pulling through the 3–4 radiocarpal portal. The knot passes inside the SL joint. Reduction of the scapholunate joint was visually tested by pulling on the proximal sutures to close the gap and by trying to push the probe through the scapholunate joint.

The scope is placed in the radiocarpal joint to assess the stability of the joint. If the joint is stable, the traction is removed, and the proximal knot is tied in maximal wrist extension. If the remaining SLIL is insufficient or in cases of important SL dissociation, the same technique can be performed with a distal capsulodesis instead of the SLIL suture. The strains are retrieved through two different transcapsular areas at the midcarpal joint before tying the distal knot. If the stability is insufficient, SL and scaphocapitate pinning using K-wires is performed. Postoperatively, an anterior splint is worn for 6 weeks. If present, K-wires are removed at 6 weeks postoperatively.

The RL and SL angles were then again measured on the immediate postoperative X-ray and then again at 3, 6, and 12 months postoperatively. We also included patients with associated lesions of the TFCC or the LTL.

The statistical analysis was done using a paired Student's *t*-test with 145 degrees of freedom and $\alpha = 0.05$. The results are shown in ►**Tables 1** and **2** and ►**Figs. 3** and **4**.

The exclusion criteria were the presence of arthritis on preoperative X-rays, normal preoperative SL or RL angles, and an intraoperative persistent SL instability after the dorsal capsulodesis, requiring an additional pinning or an advanced ligamentoplasties.

We also accounted for the standard error involved in measuring angles on radiographs, which can be as high as 5 degrees.

Table 1 Radiolunate angle over time

Time of measurement	Average RL angle (degrees)	Difference with healthy side (degrees)	CI 95%	*p*-Value
Healthy side	5.158	0		
Pre-op	−7.233	12.390	11.953–12.828	<0.0001
Post-op	−3.870	9.027	8.573–9.482	<0.0001
3 mo	−1.760	6.918	6.496–7.340	<0.0001
6 mo	2.808	2.349	1.932–2.767	<0.0001
12 mo	4.370	0.788	0.353–1.222	<0.001

Abbreviations: RL, radiolunate; CI, confidence interval

Table 2 Scapholunate angle over time

Time of measurement	Average SL angle (degrees)	Difference with healthy side (degrees)	CI 95%	*p*-Value
Healthy side	48.160	0		
Pre-op	74.550	26.397	24.984–27.810	<0.0001
Post-op	68.810	19.651	18.387–20.915	<0.0001
3 mo	59.200	11.041	9.653–12.429	<0.0001
6 mo	58.580	10.418	9.139–11.697	<0.0001
12 mo	54.950	6.788	5.548–8.027	<0.0001

Abbreviations: SL, scapholunate; CI, confidence interval.

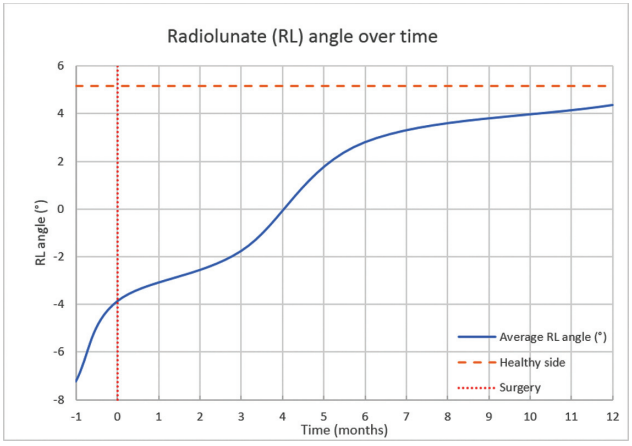

Fig. 3 Radiolunate angle over time.

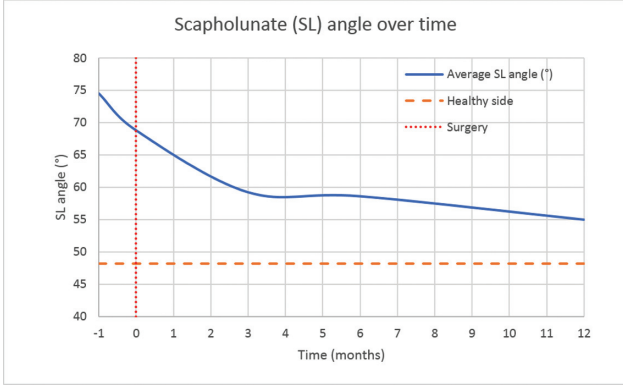

Fig. 4 Scapholunate angle over time.

Results

We included a total of 146 patients with a 1-year follow-up. The sex ratio was around 2:1 (97 male for 49 female patients). The average age was 31.86 years (range: 15–55). The delay from injury was 5.35 months (range: 0–11). EWAS classification distribution was the following: 16 stage 2, 61 stage 3, and 69 stage 4. Thirty-four patients (23.39%) had an associated reparation: 28 patients (19.18%) had a TFCC, 4 patients (2.74%) had an LTL, and 2 patients (1.37%) had a TFCC and an LTL reparation. We did not need to exclude any patient for persistent SL instability requiring an additional pinning.

The RL angle evolution is shown in ►**Table 1** and ►**Fig. 3**, and the SL angle evolution is shown in ►**Table 2** and ►**Fig. 4**.

We can see that both the RL and SL angles approach the healthy side at 12 months postoperatively. The RL angle has increased from −7.23 to 4.37 degrees; the difference is still statistically significative (0.788 degrees) ($p < 0.001$), but it is almost equal to the healthy side (5.16 degrees) and is not radiologically significative (<1 degree). Furthermore, the average preoperative angle was negative (a.k.a. DISI) and the average 1-year postoperative angle is positive (no DISI). The SL angle has lowered from 74.55 to 54.95 degrees; the

difference is still statistically significative (6.788 degrees) ($p < 0.0001$) and radiologically significative (6.788 degrees) but has been lowered by 74.3%. We also need to account for the standard error involved in measuring angles on radiographs, which can be as high as 5 degrees.

Sixty-nine patients presented with an EWAS stage 4 injury. The average time from injury was 5.72 months. The mean SL angle went from −7.34 degrees (preoperative) to 4.45 degrees (at 1-year follow-up), with a healthy side at 4.93 degrees. The mean RL angle went from 74.49 degrees (preoperative) to 55.07 degrees (at 1-year follow-up), with a healthy side at 48.09 degrees.

Seventy-seven patients presented with an EWAS stage 2 or 3 injury. The average time from injury was 5.01 months. The mean SL angle went from −7.25 degrees (preoperative) to 4.30 degrees (at 1-year follow-up), with a healthy side at 5.36 degrees. The mean RL angle went from 74.61 degrees (preoperative) to 54.83 degrees (at 1-year follow-up), with a healthy side at 48.22 degrees.

Seventy patients presented with a time from injury greater than 6 months (average 7.04 months, and up to 11 months). The mean SL angle went from −7.22 degrees (preoperative) to 4.27 degrees (at 1-year follow-up), with a healthy side at 5.21 degrees. The mean RL angle went from 74.92 degrees (preoperative) to 55.37 degrees (at 1-year follow-up), with a healthy side at 49.51 degrees.

Thirty-four patients needed an associated TFCC and/or LTL reparation. The average time from injury was 5.65 months. The mean SL angle went from −6.69 degrees (preoperative) to 4.44 degrees (at 1-year follow-up), with a healthy side at 5.24 degrees. The mean RL angle went from 73.26 degrees (preoperative) to 55.88 degrees (at 1-year follow-up), with a healthy side at 46.94 degrees.

Discussion

The understanding of the SL joint has been evolving in the previous years. The SLIL was believed to have a major role in the SL stability, especially its dorsal portion.[9,10] A chronic tear of the SLIL has been shown to lead to a rotatory subluxation (DISI), followed by an SL gap and ending in arthritis with an SLAC wrist.[11] Recent findings have lessened the role of the SLIL and shown that the dorsal capsuloscapholunate septum might play a very important role in SL stability as well as a proprioceptive role over the proximal row stability.[12–16]

There is still no consensus over how to manage scapholunate instability, regardless of whether the lesion is acute or chronic. It has been shown that arthroscopy is very sensitive to detect and treat ligamentous lesions.[1,4,9,11,16,17] Open ligamentous repairs or reconstructions have been described,[9,11,18,19] but these techniques result in considerable soft-tissue damage to secondary stabilizers and vascular supply[20] and lead to clinical stiffness.[21,22] Arthroscopic techniques have been described to treat SLIL lesions, for example, a simple debridement and thermal shrinkage in acute cases,[9] but they have not shown good results in chronic cases.[23]

Several complex arthroscopic transosseous ligamentoplasties have been published to treat chronic cases,[19,21,24–27] but these techniques are complex, difficult, and at risk of peri- and postoperative complications.[22,26–28]

We have used a simple arthroscopic dorsal capsulodesis in almost every case for several years, with several hundred patients treated. The clinical results are very encouraging even for advanced stages according to the EWAS classification (stages 2–4).[5] We now have radiologic evidence that this technique seems to be sufficient to reduce the DISI overtime and seems to also normalize the SL angle without the need for any pinning or invasive ligament reconstructive surgery.

►**Figs. 3** and **4** show that the difference between the pathologic and healthy side lowers continuously overtime. The RL angle (a.k.a. the DISI) is almost normalized at 1-year postoperatively. The remaining difference (0.788 degrees) ($p < 0.001$) is still statistically significative because of the large number of patients and the standard error involved in measuring angles in radiographs. We believe that a longer follow-up would show that the correction maintains over time.

The SL angle follows the same pattern, but it seems to take a longer time to normalize. At 1-year postoperation, the difference (6.788 degrees) ($p < 0.0001$) is still statistically significative and is still radiologically relevant (since the margin of error is up to 5 degrees) but it has been lowered by 74.3% (from 26.397 to 6.788 degrees) and is much closer to the healthy side. We hope that a longer follow-up will show that it keeps on lowering and normalizes after a longer period. We also found out that a time from injury greater than 6 months did not see to change the clinical or radiological results at 1-year postoperation. In this study, patients were treated the same whether the SLIL tear was acute or chronic (up to 11 months) without any failure for chronic cases. There was no radiological or statistical difference between patients who presented with an EWAS stage 2, 3, or 4, or patients with an associated TFCC or LTL lesion.

We now have evidence to support that this simple technique can normalize the DISI.

This study leads us to believe that indications of dorsal capsulodesis should be broadened to all nonarthritic reducible scapholunate injuries (EWAS stages 2–4) whether they are acute or chronic, even if DISI is present. Ligament reconstruction should almost only be used when the capsulodesis has failed or in nonreducible cases.

Conflict of Interest
None declared.

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