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Short-term results of arthroscopic dorsal capsulodesis in scapholunate instability

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ABSTRACT

Objective: Although many techniques have been described in the literature for the treatment of scapholunate (SL) instability, there is no standard treatment for this most common form of carpal instability. However, arthroscopic ligamento capsulodesis offers some advantages over open techniques.

Methods: Fourteen patients (eight male, six female) who underwent dorsal arthroscopic capsulodesis between 2016 and 2018 were retrospectively evaluated. The mean age of the patients was 34 years (range, 20–42). Preoperative and postoperative grip strength, range of motion, MAYO wrists scores, and pain visual analog scale (VAS) scores were compared.

Results: There was a statistically significant difference in mean flexion and extension range of motion before and after surgery ($p = 0.004$). There was also a statistically significant difference between pre- and postoperative mean VAS values ($p = 0.001$). Excellent results were obtained in ten patients, and good results were obtained in four patients. There was a statistically significant difference in grip strength before and after surgery ($p < 0.001$). There were no complications related to the procedure.

Conclusion: Arthroscopic capsulodesis can be considered in Geissler stage 2 and 3 SL instability, since the treatment is minimally invasive, and does not damage the extrinsic wrist ligament complex.

Key words: *Arthroscopic capsulodesis, carpal instability, scapholunate instability, wrist arthroscopy*

Introduction

Scapholunate (SL) instability is the most common form of carpal instability [1]. Patients usually suffer from dorsal wrist pain, decreased grip strength, and impaired wrist function. Untreated SL instability can result in a sequence of degenerative changes in the wrist. Normally, wrist stability is provided by the anatomical articulation of the carpal bones and the ligaments between these bones. The SL interosseous ligament (SLIL) is the primary stabilizer of the SL joint; when injured, abnormal scaphoid and lunate movement, dorsiflexion intercalary segment instability (DISI) and proximal migration of the capitate may occur. Dissociation between the scaphoid and lunate bones seen in neutral posteroanterior (PA) radiography without provocative tests is static instability; dissociation occurring

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only with provocative tests is dynamic instability [2].

The goal of SL ligament injury treatment is to relieve pain, restore wrist function, and prevent the development of arthritis. Although many methods have been described in the literature for SL instability treatment, there is no standard treatment [3,4]. Although pain reduction and increase in grip strength can be achieved with open surgical repair and reconstruction techniques, joint stiffness often occurs [5]. During open surgical procedures, extensive dissection of the wrist capsule can cause stiffness of the joint; however, with arthroscopic techniques, interventive procedures such as SL ligament debridement and dorsal and volar capsulodesis can be applied. The arthroscopic dorsal capsulodesis method was developed by Mathoulin to avoid the complications of open surgery [3]. The advantages of wrist arthroscopy are that it is less damaging to the wrist capsule, causes less stiffness, and requires a shorter recovery time compared to open methods. In addition, triangular fibrocartilage complex (TFCC) tears and other ligament injuries accompanying SL instability can be treated in the same session.

Geissler's arthroscopic classification and Garcia-Elias classification are used for staging SL ligament injury and instability [5,6]. The arthroscopic dorsal capsulodesis technique can be applied in Garcia-Elias stage 2, 3 and 4 instabilities in which there is a complete or partial rupture of the SL ligament and the scaphoid is aligned or subluxated but reducible [2]. In this study, we evaluate the short-term clinical results of the arthroscopic dorsal capsulodesis method applied to Garcia-Elias stage 2, 3 and 4 patients with a diagnosis of dynamic SL instability.

Patients and Methods

Patients who underwent wrist arthroscopy between 2016 and 2018 in our clinic with the diagnosis of chronic SL instability were evaluated retrospectively. The study was approved by the institutional review board of our institution. The inclusion criteria were the presence of reducible scapholunate instability (Garcia-Elias stages 2,3 and 4), age older than 18 years, and a minimum 12-month follow-up. Patients with irreducible scapholunate instability, accompanying triangular fibrocartilage complex tear, radiocarpal and midcarpal arthritis, a history of a distal radius fracture, and a history of a carpal bone fracture were excluded from the study. Fourteen patients (eight male, six female) met the inclusion criteria. The mean age of the patients was 34 years (range 20–42). Three patients had a history



Figure 1. A widening of the scapholunate interval and a ring sign of the scaphoid seen in a clenched fist back-front x-ray.

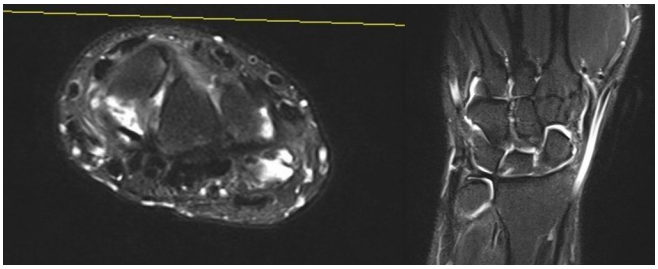


Figure 2. Signal increase in the T2 sequence over the dorsal SL ligament and the dorsal capsule in the axial section in MRI.

of falling on an outstretched hand, and the remaining eleven patients had no specific trauma history. The time between the injury and the surgery for these three patients were 6,7, and 9 months, respectively. All patients had wrist pain affecting daily living activities.

Each patient's preoperative and postoperative grip strength and range of motion were evaluated in comparison with the contralateral side. A Jamar hand dynamometer was used to evaluate the grip strength, and a goniometer was used to measure the range of motion. The measurements were performed by an orthopedic surgeon with two years of experience in hand surgery (SSU). While the functional evaluation of the patients before and after the operation was made with the Mayo wrist score, the assessment of pain status was made with a visual analog scale (VAS). MRI and direct radiography were used for radiological evaluations of the patients' wrists.

Preoperative Evaluation

During physical examinations, patients were evaluated in terms of pain using Watson's test and palpation just distal to Lister's tubercle and on the dorsal SL ligament. The feeling of a "clunk" while moving the wrist from the extension-ulnar deviation position to the flexion-radial deviation position was considered positive for the Watson test [7]. In addition, bilateral wrist range of motion and grip strength were evaluated before the surgery.

A widening of the SL interval of more than 4 mm while the hand was in fist position (as seen in a posterior anterior (PA) x-ray) and a ring sign of the scaphoid due to excessive flexion were interpreted in favor of SL instability (Figure 1). In some patients, a signal increase in the T2 sequence over the dorsal SL ligament and the dorsal capsule in the axial section was observed via magnetic resonance imaging (MRI) (Figure 2).

Surgical Technique

After applying regional anesthesia, a 5 kg distraction was applied to the patient's hand under a pneumatic tourniquet. First, the SL ligament was evaluated with the help of a probe advanced from the 6R portal using imaging from 3–4 portals. Later, the midcarpal ulnar (MKU) portal was opened and the midcarpal joint was visualized. After the midcarpal radial (MKR) portal was opened in the appropriate location, the probe was advanced through it and the SL ligament and joint surfaces were evaluated (Figure 3). At this stage, intraoperative staging was performed. Arthroscopic dorsal capsulodesis was performed in cases with Geissler

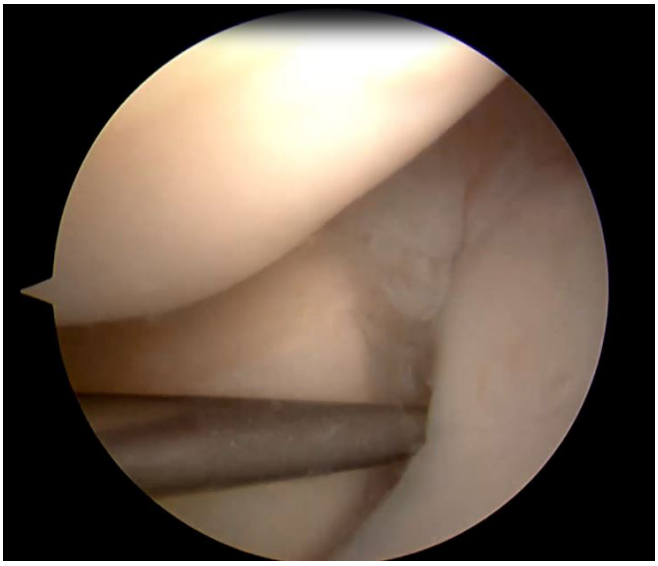


Figure 3. SL widening is assesed by a probe which is advanced through MCR portal.

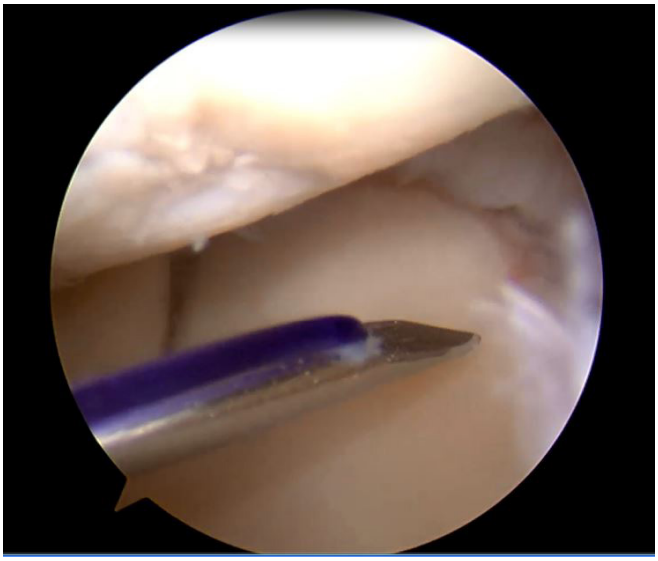


Figure 4. 18G needles loaded with a 3/0 PDS suture were advanced through the 3–4 portals into SL remnants.

stage 2.3 or modified Garcia-Elias stage 2.3 and 4 SL ligament injuries.

While the scope displayed the radiocarpal joint from the 6R portal, 18G needles loaded with a 3/0 PDS suture were advanced through the 3–4 portals (Figure 4). Instead of penetrating the radiocarpal joint (RCJ), the needles were inserted through the dorsal capsule and remnants of the SL ligament and directed towards the midcarpal joint (MKJ). The scope was then changed to the MCU portal. Suture threads were passed through the needle and pulled out through the MCR portal with a hemostat, and a knot was tied between the two sutures (Figure 5). Both proximal ends of the suture were pulled to place the knot on the MCJ. A second knot was tied between the two proximal ends and placed on the dorsal capsule of the RCJ. In stage 4 cases, the SL joint was reduced and stabilized percutaneously with a K-wire, and dorsal capsulodesis was then performed.

A long arm splint was applied at 30–40 degrees of wrist extension and 90 degrees of elbow flexion. Later, the short arm splint was used for three weeks. At the end of this period, the physical therapy program was started.

Statistical Analysis

The normality of distribution of data was tested by Shapiro-Wilk test. Mean±Standard deviation, median (minimum, maximum) values were used to show descriptive statistics. Categorical variables were summarized with frequency and percentage. Pre and post comparisons were performed using Paired Sample T-test for normally distributed variables, whereas Wilcoxon signed-rank test was used for non-normally distributed variables. Statistical analyzes were carried out with IBM SPSS 23 software and statistical significance level was accepted as $p<0.05$.

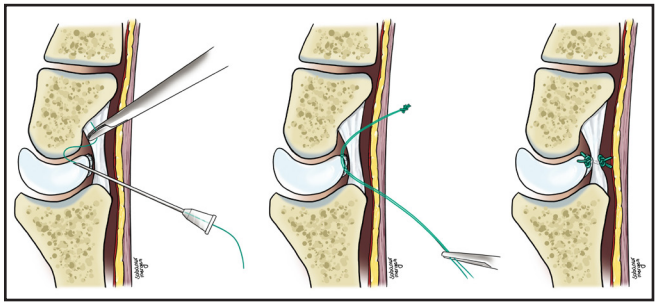


Figure 5. Suture threads were passed through the needle and pulled out through the MCR portal with a hemostat, and a knot was tied between the two sutures.

Results

In the mean follow-up period of the patients of 14 months (12–26), none of the patients experienced complications. The results are summarized in Table 1 and 2. Compared to the healthy wrist, the mean preoperative flexion difference was 3.29^0 ±1.14^0, while the extension difference was 4.43 ±3.06. The postoperative flexion difference was 1.36 ±.84, and the extension difference was 1.64 ±.34. There was a statistically significant difference in the mean flexion and extension ranges of motion before and after surgery ($p < 0.05$). None of the patients had a positive Watson test in the final follow-up.

The preoperative VAS value was 6.43±1.22 (min=4, max=8) while the postoperative mean value was 2.36±1.50 (min=1, max=5). There was a statistically significant difference between the pre- and postoperative mean VAS values ($p < 0.05$). While the preoperative average Mayo wrist score was 61.43±9.69 (min=50, max=80), the postoperative mean Mayo score was 88.93±5.61 (min=80, max=95). Excellent results were obtained in ten patients, and good results were obtained in four patients.

While the preoperative grip strength was 34.86 kg/m^2 (±8.98), postoperative grip strength was 46.43 kg/m^2 (±10.11). There was a statistically significant difference in grip strength before and after surgery ($p < 0.05$). No complications were observed in any patient.

Discussion

SL instability is the most common cause of chronic carpal instability and is primarily the result of a fall over an outstretched hand. Although it is frequently encountered, early diagnosis of acute repairable forms is difficult in the majority of cases. If not treated appropriately, instability may progress to irreparable static forms

Table 1. Demographic characteristics and relevant variable values in pre-operative and post-operative period of the patients.

Patient number	Age/gender	Preoperative Grip Strength (kg/m²)	Postoperative Grip Strength (kg/m²)	Preoperative Mayo Wrist Score	Postoperative Mayo Wrist Score	Preoperative VAS Score	Postoperative VAS score	Preoperative flexion difference (degrees)	Postoperative flexion difference (degrees)	Preoperative extension difference (degrees)	Postoperative extension difference (degrees)
1	27/f	22	38	50	90	8	2	4	1	2	2
2	31/m	44	60	70	95	6	1	5	0	8	2
3	20/f	24	36	65	95	6	1	3	0	5	2
4	38/f	28	40	80	90	4	1	5	2	9	2
5	35/m	36	48	60	80	7	5	4	1	6	3
6	36/m	42	44	70	90	6	2	2	2	0	0
7	42/m	52	68	55	90	6	2	3	3	5	0
8	38/m	36	50	50	80	8	5	5	2	10	4
9	27/f	30	38	70	85	5	2	2	2	0	0
10	30/f	27	36	70	80	5	5	3	1	2	1
11	33/m	30	48	50	90	7	2	3	1	3	1
12	40/m	42	50	60	90	7	2	2	2	4	1
13	28/f	30	36	50	95	8	2	2	1	4	4
14	34/m	45	58	60	95	7	1	3	1	4	1

Table 2. Comparison of relevant variable values in pre-operative and post-operative period.

	Pre-operative		Post-operative	
Variables	**Mean±SD**	**Median (min; max)**	**Mean±SD**	**Median (min; max)**
Flexion difference (degrees)	3.29±1.14	3.00 (2; 5)	1.36±.84	1.00 (0; 3)
Extension difference (degrees)	4.43±3.06	4.00 (0; 10)	1.64±1.34	1.50 (0; 4)
Mayo Wrist Score	61.43±9.69	60.00 (50; 80)	88.93±5.61	90.00 (80; 95)
VAS	6.43±1.22	6.50 (4; 8)	2.36±1.50	2.00 (1; 5)
Grip strength kg/m²	34.86±8.98	33.00 (22; 52)	46.43±10.11	46.00 (36; 68)

Mean±SD: Mean±Standard deviation / (min; max): (minimum; maximum)

or even scapholunate advanced collapse (SLAC) wrist arthrosis. The best results in treating SL instability are obtained with partial ligament tears that are treated in the first two months [2]. SL ligament repair with dorsal augmentation is the most commonly used method in acute lesions; however, the treatment of chronic lesions that have not developed carpal arthritis is controversial. Several open techniques have been described, such as ligament reconstruction with tendon grafts, dorsal capsulodesis, and inter-carpal fusion [8]. These techniques are effective in reducing pain, but they may cause significant limitations to wrist motion. In addition, none of these methods prevent the development of SLAC wrist [9].

Wrist arthroscopy has become part of the armamentarium of hand surgeons, from performing a diagnostic procedure to ligament reconstruction surgery. The presence of instability can be assessed in terms of

dynamic instability and degree of injury, which is described by Geissler et al. [6]. Arthroscopy reduces the amount of trauma to the adjacent soft tissues compared with open procedures without causing stiffness in the wrist joint. Mathoulin et al. reported that arthroscopic SL dorsal ligamento capsulodesis gave promising results in the short term with regards to improving pain, wrist motion, and strength [3]. We think that this technique should be primarily considered in Geissler stage 2 and 3 instability since it is minimally invasive, and does not damage the extrinsic wrist ligament complex.

Gajendran et al. reported that in patients treated with open dorsal intercarpal ligament capsulodesis wrist flexion decreased from 66 degrees to 50 degrees, extension from 62 degrees to 55 degrees, radial deviation from 24 degrees to 17 degrees, and ulnar deviation from 45 degrees to 36 degrees [10]. Moreover, in 50% of the same patients, SLAC of the wrist developed within their five-year follow-up time. Deshmukh et al. reported that 44 patients with SL instability treated with the Blatt capsulodesis method had a 36.7% reduction in wrist extension, 43.7% in flexion, 76.5% in radial deviation, and 50% in ulnar deviation compared to the contralateral side [11]. However, the preoperative VAS pain value of the patients was 7.9 on average, but decreased to 4.1 postoperatively. The postoperative grip strength of the patients could only reach 75.1% of the strength of the contralateral side. Moran et al. compared the modified Brunelli technique with the Berger capsulodesis method, a statistically significant reduction in the flexion-extension range of motion was observed in both groups [12].

In our study, all patients had good or excellent results. The mean reduction in range of motion was only 3 degrees compared with the contralateral wrist, which was lower than that published in the above-mentioned studies. This could be attributed to lower soft tissue dissection and less scar tissue formation than open capsulodesis techniques. In addition, arthroscopy avoids injury to the posterior interosseous nerve, secondary dynamic stabilizers, and vascular blood supply. We observed better grip strength in our cases, and none of our patients required a second surgery due to persistent symptomatic instability. However, steep learning curve and requirement of specific instruments are major drawbacks of this technique. Despite these disadvantages, we believe that arthroscopic dorsal capsulodesis is a safe and reliable method to stabilize SL dissociation.

We recognize several limitations in our study. The major limitations were its small sample size, retrospective design, and short-term follow-up period. A larger cohort of patients and a more extended follow-up period are needed to observe the effect on SLAC wrist deterioration. Another limitation was the lack of a control group. There is a need for randomized controlled prospective studies comparing open techniques and arthroscopic methods.

As a conclusion, we observed that our patients had increased ranges of motion, decreased pain scores, and improved functional Mayo wrist scores. In patients with chronic midcarpal pain that is unresponsive to conservative treatment, SL instability should be suspected. Since SL instability can be recognized early with diagnostic wrist arthroscopy, SLAC of the wrist can be prevented.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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