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SYMPOSIUM: ARTHROSCOPY

Arthroscopic Scapholunate Joint Reduction. Is an Effective Treatment for Irreparable Scapholunate Ligament Tears?

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Abstract

Background Irreparable tears to the scapholunate (SL) interosseous ligament area are common causes of mechanical wrist pain and yet treatment of this condition remains challenging. The reduction association of the SL joint (RASL) technique alleviates pain while preserving wrist function by creating a fibrous pseudarthrosis stabilized by a cannulated screw placed through the SL joint. Although arthroscopic RASL (ARASL) is a minimally invasive alternative to the open procedure, its effectiveness in controlling pain and preserving wrist function has not been established.

Questions/purposes To determinate whether ARASL was obtained relieve pain and restore function to the wrist.

Patients and Methods We reviewed eight patients (nine wrists) who had ARASL for SL instability with a reducible SL ligament tear (chronic lesion) from 2005 to 2009. Seven of eight were males and mean age was 44.5 years (range, 38–56 years). We recorded pain using a scale, the Disabilities of the Arm, Shoulder and Hand (DASH) score, grip strength, and range of motion (ROM). Minimum followup was 12 months (mean, 34.6 months; range, 12–43 months).

Results The visual analog pain score was rated 5.4 (range, 0–10) preoperatively and 1.5 (1–3) after ARASL. Postoperative grip strength of the wrist was 78% of the contralateral, unaffected wrist. The average postoperative wrist ROM was to 107°, 20% less than the preoperative ROM. The SL angle decreased from 70.5° to 59.3°. In three cases, screws were removed owing to loosening or symptoms.

Conclusions Our preliminary observations suggest ARASL for treating irreparable SL ligament tear is feasible, controls pain, and improves wrist function while preserving ROM. Larger series with longer followup are required to confirm our observations.

Level of Evidence Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Introduction

Irreparable damage of the scapholunate (SL) interosseous ligament is a relatively injury that leads to joint instability [7], potentially causing painful arthritis [17]. The best surgical approach for this challenging lesion is unclear [15, 23]. Over the last several decades, an improved understanding of SL joint anatomy and biomechanics [19, 21, 30] has allowed for the introduction of several surgical techniques (ie, partial carpal fusions [19, 21, 24, 26, 27, 30, 31], capsulodesis [6, 16], tenodesis [7, 10, 12], bone-tendon-bone reconstructions [13, 29], and dynamic tendon transfers [13, 29]). Most reflect an aggressive approach and do not lead to an ideal or sustained SL joint alignment [1, 26–30]. Although most of these techniques have been associated major improvement in pain and grip strength [6, 16] none has restored or preserved SL joint alignment [13, 23]. Moreover, these procedures result in substantial deterioration of wrist motion (10%–40%) and grip strength (13%–35%).

The reduction association of the SL joint (RASL) for SL interosseous ligament tears is an open operation that improves pain and grip strength while maintaining/restoring SL joint alignment [20]. In RASL, the surgeon creates a "stable fibrous pseudo-arthrosis" by stabilizing the SL joint with a cannulated Herbert's screw [20]. Recently, the adjunctive use of arthroscopy during hand/wrist interventions had gained popularity worldwide, minimizing soft tissue trauma and improving visualization of the surgical field. Although the arthroscopic RASL has been described, it is unclear whether it achieves its goals of relieving pain and restoring function while maintaining motion [4].

We therefore determined whether ARASL relieved pain and restored wrist function.

Patients and Methods

From January 2005 to December 2009, we evaluated 34 patients with SL instability for possible arthroscopic RASL (ARASL) in two high-volume academic institutions. Patients with a reducible SL ligament tear (subacute or chronic) confirmed by static arthroscopy with early or no scapholunate advance collapse (SLAC) were deemed to be appropriate candidates for ARASL [25]. The following were considered contraindications to ARASL: prior wrist operation, prior wrist infection, severe degenerative changes, Stage II or III SLAC and lunotriquetral, or midcarpal instability. A total of nine ARASL procedures were performed in eight patients, one patient undergoing bilateral ARASL. All the operations were performed by two surgeons (MC, EP).

Seven of the eight patients were male; mean age was 44.5 years (range, 38–56 years). The dominant hand was affected in all cases but one. In four cases, SL interosseous ligament injury was related to recreational sport, whereas daily working was responsible for the other four cases. In one case, hand injury followed a vicious consolidation of a previous (3 years old) distal radius fracture. SL joint instability was subacute in two of nine cases and chronic in the other seven cases, respectively; one patient had a Grade I SLAC wrist [28]. Mean time from diagnosis to surgical correction was 16 months (range, 6–34 months). No patients were lost to followup. The minimum followup was 12 months (mean, 34.6 months; range, 12–43 months). No patients were recalled specifically for this study; all data were obtained from medical records and radiographs.

Preoperatively, we evaluated all patients for ROM by goniometry, whereas wrist pain was rated using the visual analog scale (VAS). Wrist instability was assessed using the Watson test. Routine radiographic examination included posteroanterior, lateral (Fig. 1), and AP (palm up) views with a clenched fist. We measured SL angle and the SL gap (in millimeters). In cases in which an irreducible dissociation of the SL joint was suspected, we also performed radiographic dynamic views (Fig. 2).

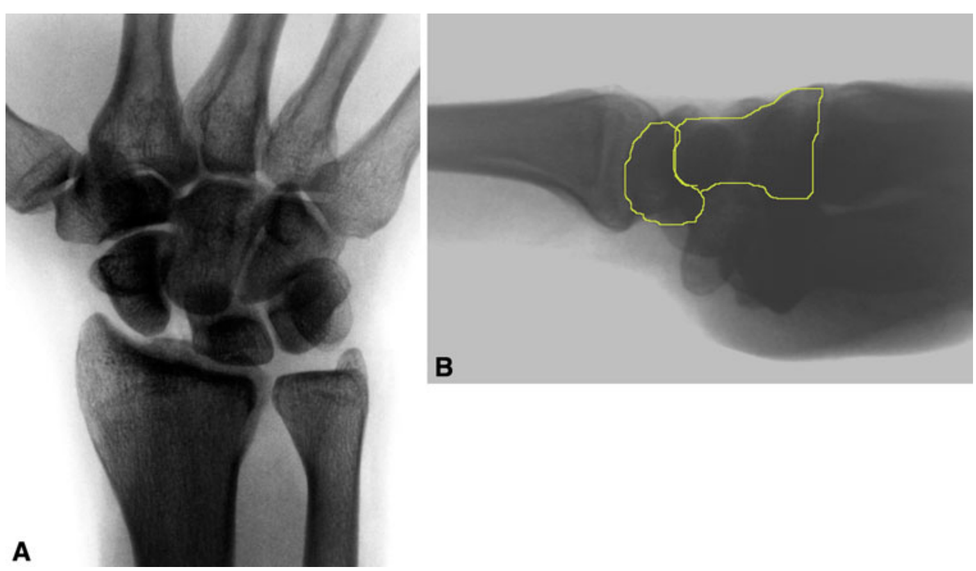

Fig. 1A–B (**A**) AP radiograph of the wrist illustrating scapholunate (SL) diastasis (Terri-Thomas sign) with shortening and pronation of scaphoid distal pole, characteristic of SL ligament tear. (**B**) Lateral radiograph of the wrist demonstrating dorsal intercalated segment instability deformity with alteration of SL and radiolunate angles.

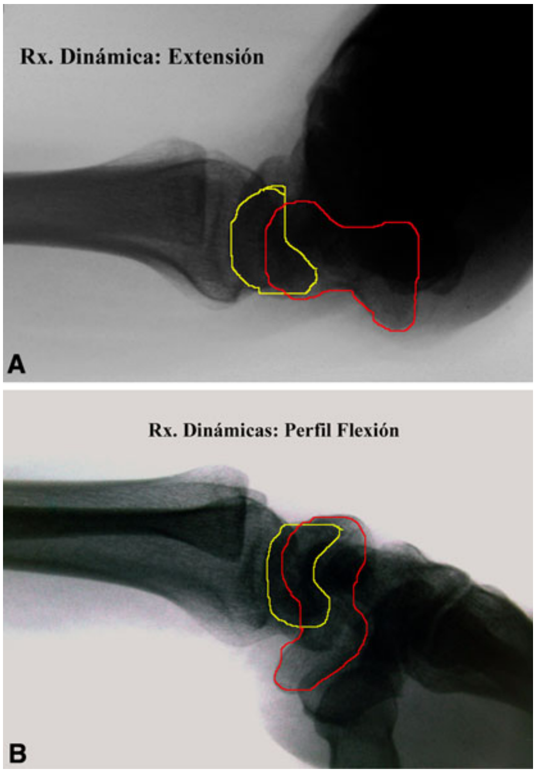

Fig. 2A–B Dynamic lateral radiographs of the wrist. The wrist is shown in (**A**) extension and (**B**) flexion. These images provide relevant information regarding scapholunate joint reducibility.

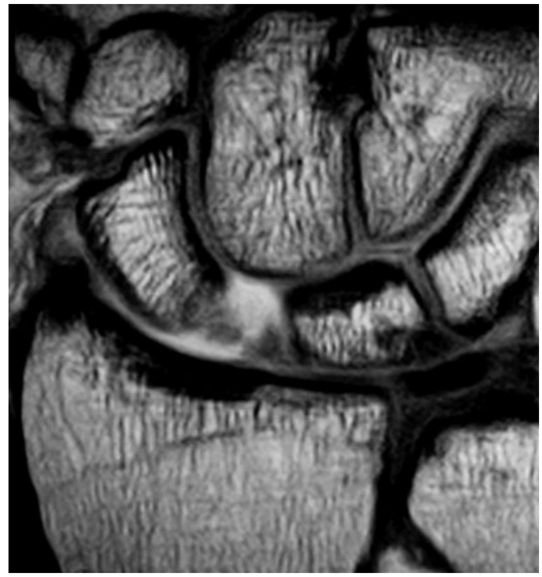

Fig. 3 Arthro-MR, coronal view. This view is particularly important for confirmation of scapholunate ligament tear, assessment of cartilage integrity, and identification of additional wrist lesions.

Table 1. Intraoperative scapholunate inspection according to the classification of Geissler et al.

Classification of Geissler et al. of cartilage lesions	Total (N = 9)
Stage I (attenuation/hemorrhage SL in RCJ; no incongruence in MCJ)	0
Stage II (attenuation/perforation of SL in RCJ; small incongruence in MCJ)	0
Stage III (perforation of SL in RCJ/incongruence and stepoff in MCJ [< probe])	2
Stage IV (incongruence and stepoff RCJ and MCJ: gross instability with manipulation)	7

SL = scapholunate; RCJ = radiocarpal joint; MCJ = midcarpal joint.

We performed MR arthrography in all cases to evaluate radiocarpal, midcarpal, and distal radioulnar joint spaces (Fig. 3). Arthro-MRI allowed confirmation of clinical and radiologic suspicion, demonstrating SL ligament tear. Furthermore, MRI revealed additional dorsal radiocarpal ligament tear in two cases (one of them associated with bone avulsion) and transverse intercarpal ligament injury in three additional cases.

All procedures were done under regional anesthesia on an outpatient basis by two surgeons (MC, EP). Patients were placed in a supine position. We used an arthroscopic traction tower. A 3–4 portal was created for inspection of the SL interval, whereas an additional radial portal was inserted near the midcarpal to confirm the presence of the drive-through sign [11]. If SLAC was present, we determined the degree of chondrolysis based on the Outerbridge classification [18]. The reducibility pattern was determined arthroscopically based on the four stages of scapholunate lesions described by Geissler et al. [11] (Table 1). Furthermore, scapholunate dissociations were staged according to the system described by Garcia-Elias et al. [10] that is based on bone alignment, reparability of the SL ligament, and cartilage integrity. The SL ligament is irreparably damaged in Stage 3, 4, and 5 lesions and thus was treated with the ARASL technique (Table 2). We then placed the scope through the radial midcarpal portal and a 2.5-mm shaver was introduced through the 3–4 portal to eliminate ligament remnants and to denudate the cartilage surface of the SL joint until punctuate bleeding was visualized, carefully avoiding bone decortication. First, we placed a 1.5-mm Kirschner wire as a "joystick" at the distal pole of the scaphoid and another wire at the distal part of the lunate (Fig. 4) so as not to interfere with the screw placement. Next, a radial incision was made for the screw placement distal to the radial styloid and dorsal to the first extensor compartment, corresponding to the 1–2 portal. In two cases with prominent styloid process, a 3- to 4-mm radial styloidectomy was performed to facilitate screw placement. We introduced the guidewire through the scaphoid waist in the midportion on the lateral view controlling the positioning of the guidewire fluoroscopically

Table 2. Intraoperative scapholunate inspection according to staging of Garcia-Elias et al.

Stages	I	II	III (N = 1)	IV (N = 7)	V (N = 1)	VI
Dorsal SL ligament intact?	Yes	No	No	No	No	No
Repairable SL ligament?	Yes	Yes	No	No	No	No
Scaphoid alignment normal?	Yes	Yes	Yes	No	No	No
Carpal malalignment reducible?	Yes	Yes	Yes	Yes	No	No
Cartilages in RCJ and MCJ normal?	Yes	Yes	Yes	Yes	Yes	No

SL = scapholunate; RCJ = radiocarpal joint; MCJ = midcarpal joint.

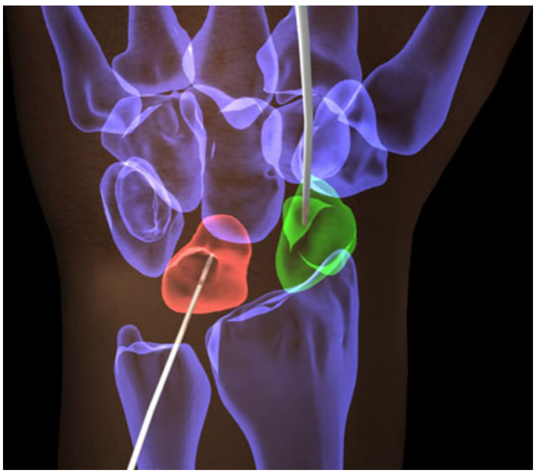

Fig. 4 The figure illustrations the reduction of the scapholunate joint using Kirschner wires as joysticks.

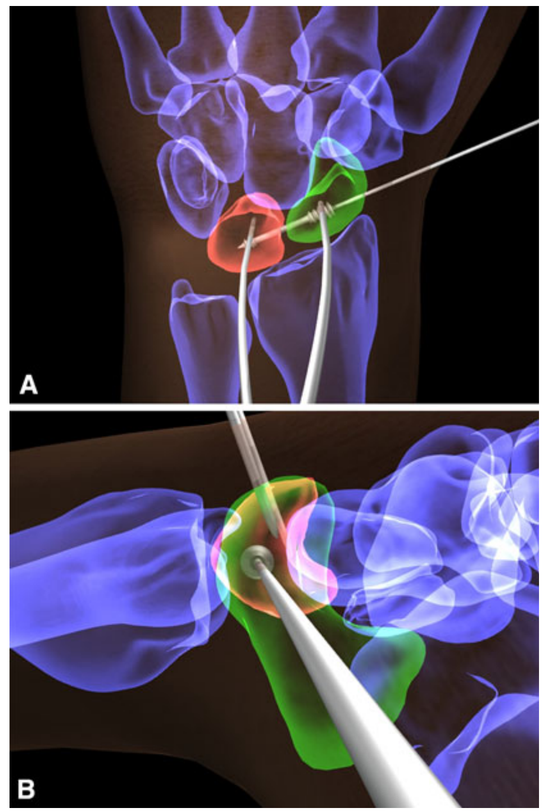

Fig. 5A–B (**A**) Reduction association of the scapholunate joint. Note the optimal placement of the screw at the ulnar angle of the lunate. (**B**) Lateral view depicting optimal positioning of the screw at the central axis of the joint.

and arthroscopically through the 3–4 portal. The guidewire should exit the medial facet of the scaphoid just proximal to the articular surface of the scaphoid to the capitate. Before traversing the lunate with the guidewire, we performed reduction with the "joystick" wires with extension and supination of the scaphoid and flexion of the lunate (Fig. 5A–B). Then, the SL interval was traversed toward the medial pole of the lunate, and reduction was controlled fluoroscopically and arthroscopically and maintained using a radiolunate wire and scaphocapitate wire. After measuring the screw length, we advanced the guidewire across the lunate to avoid unnoticed withdrawal with the drill. To determine the proper length of the screw, a second Kirschner wire was placed against the scaphoid from the 1–2 portal. Next, the pin was advanced to the surface of the scaphoid. The difference in length between the two wires was taken to represent the length inside the bones. The final screw length was 4 to 5 mm shorter than the inside bone length.

Another wire was placed parallel to the guidewire for additional stabilization. At this point, we used the drill for the Herbert screw through the guidewire without pressure to avoid distraction of the SL joint. After drilling, a Herbert-Whipple screw 5 mm shorter than previously measured was inserted (Fig. 6). All wires were withdrawn, and reduction was controlled under fluoroscopy and arthroscopy. Portals were then closed and patients were casted. There was one case of wrist SLAC I associated with distal radius fracture. In that case, arthroscopic styloidectomy and capsulotomy enabled staging as Garcia-Elias Stage IV, achieving reducibility of the SL joint.

The first 2 weeks postoperatively, the patients used a long-arm (sugar-tong) splint and performed shoulder and digit active motion. During Weeks 3 and 4, patients used a long-arm thumb spica splint and performed digit, elbow, and shoulder ROM. During Weeks 5 to 8, patients used a short-arm thumb spica cast and continued with digit, elbow, and shoulder ROM. During Weeks 9 to 12, patients

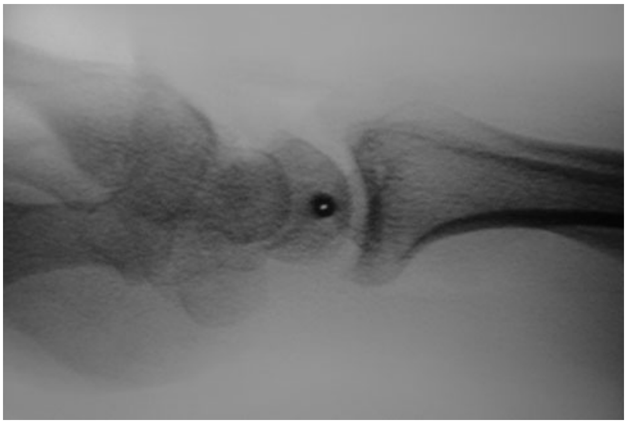

Fig. 6 Lateral radiograph of the wrist. Immediate postoperative image shows reduction in scapholunate and radiolunate angles.

Fig. 7 Additional stability may be added by a scaphocapitate Kirchner wire.

used a wrist splint, began active gentle active wrist ROM, proprioception re-education of flexor carpi radialis, and scar mobilization while joint mobilization techniques were still contraindicated. During Weeks 13 to 16, patients were weaned from the wrist splint, continued with wrist ROM, and started with gentle passive wrist flexion. From Week 16, patients began grip strengthening and continued wrist ROM. In cases in which we observed difficulty in SL joint reduction (as a result of fibrosis of distal secondary stabilizers), we added transfixing the scaphocapitate Kirschner wire for 4 weeks (Fig. 7). The latter may augment SL stabilization during the healing period of the SL fibrosis.

Patients were seen every week for the first month and then every month for the first year. Then, clinical visits were scheduled twice per year. Followup data were collected from the latest clinical visit. All patients underwent postoperative radiographic examination for the measurement of SL angle and gap (in millimeters). In addition, we assessed wrist pain (VAS scale) and grip strength (Jamar Hand Dynamometer; Preston Corporation, Jackson, MO). We obtained a Disabilities of the Arm, Shoulder and Hand (DASH) score [14] on all patients at each followup.

Results

Serial radiographic examination revealed a noticeable reduction in SL angle (70.5° before and 59.3° after surgery) and joint diastasis (SL gap 3.8 mm before and 2.5 mm after surgery). Preoperatively, all cases presented dorsal intercalated segment instability (DISI) with scaphoid verticalization and pronation. DISI was successfully corrected in all but one instance. The case of persistent DISI deformity was the result of incomplete reduction that was a result of lunate facet malunion from a prior radial fracture. However, the patient was asymptomatic at followup.

According to the VAS, pain was rated 5.4 (range, 0–10) preoperatively and 1.5 (range, 1–3) after surgery. Two patients reported moderate pain with strenuous activities. Regarding the case with baseline SLAC, pain only persisted during seasonal changes but the patient was able to return to his regular recreational and labor activities. After surgery, grip strength of the wrist was 78% compared with the contralateral wrist. In the patient with bilateral lesions, grip was 40.1 and 37.8 kg for the right and left, respectively. Overall, mean DASH score was 22 points. At followup (mean, 34.6 months), mean ROM (flexion-extension mobility by goniometry) was 107°, which constituted a 20% reduction from baseline. There were no severe complications (severe bleeding, infection, nerve impingement). In two patients we removed the Herbert-Whipple screw (mean, 9.3 months; range, 7–13). One patient was a recreational rugby player in whom the screw loosened without signs of diastasis. The other patient (bilateral ARASL) had bilateral screw removal owing to pain with strenuous activities in both wrists and evidence of radiographic radiolucencies close to the screws at the scaphoid level. At last followup at 18 months the patient's pain had been relieved.

Discussion

SL instability is the most frequent instability pattern at the carpal level. Despite its frequency, early detection and correction of mild or repairable forms of the disease are unusual. Thus, SL instability may invariable progress to irreparable forms of SL instability. The SL interosseous ligament constitutes the intrinsic stabilizer of the SL joint and its injury is classified as dynamic or static according to the integrity of the extrinsic restraints of the SL joint. During dynamic SL ligament injuries, extrinsic restraints are still preserved, usually with a lack of radiographic findings. On the other hand, static SL ligament injuries required involvement of both intrinsic and extrinsic restraints; its symptoms are frequently more severe and associated with frank SL dissociation [1–3, 5, 8, 9]. The best surgical treatment for patients with SL instability resulting from an irreparable SL interosseous ligament has been unclear and controversial. Some authors advocated the open RASL procedure for the treatment of irreparable SL ligament injuries, because it restores SL alignment, relieves pain, and improves function. In 2007, in an effort to reduce soft-tissue trauma and enhance visibility, Aviles et al. developed an arthroscopic approach to RASL. Despite the theoretical benefits of ARASL, its role in the treatment of irreparable SL ligament injuries has not been established. We therefore determined whether ARASL relieved pain and restored wrist function.

We acknowledge limitations of our study. First, the small number of cases provides preliminary data and does not allow us to identify factors that predict outcome. Nonetheless, this study is the only series of patients treated with ARASL and given the positive preliminary results serves as an impetus for further study. Second, because of the relatively short followup, we cannot evaluate the durability of ARASL nor determine its long-term impact on the development of arthritis.

Minimally invasive orthopaedic surgery with adjunctive use of arthroscopy reduces the amount of trauma to the adjacent soft tissues compared with open surgery and has recently been advocated during hand/wrist interventions. Arthroscopic assistance of RASL allows for optimal joint alignment [19]. The adjunctive use of arthroscopy conveys relevant information regarding the integrity of the entire wrist, identifying additional unexpected lesions. Moreover, arthroscopy guides SL reduction. Unlike other techniques, ARASL improves symptoms while preserving ROM. ARASL is associated with a 20% loss ROM, whereas other techniques result in a loss of ROM ranging from 10% to 45% (capsulodesis 10%–45% [6, 16], tenodesis 31% [7, 10, 12], bone-tendon-bone reconstruction 40% [13, 29], dynamic tendon transfer 46% [22]). In addition, grip strength was adequate after surgery (78% of the contralateral wrist). ARASL is an ambulatory procedure that requires regional anesthesia, generating little tissue trauma and durable medium-term followup results, representing an attractive treatment for irreparable SL ligament tear.

Our preliminary observations suggest ARASL for the treatment of irreparable SL ligament tear is feasible, relieves pain relief, and improves function while preserving ROM. Furthermore, ARASL has a low rate of complications. A larger series of patients with long-term followup are needed to confirm our findings and prove the durability of the technique.

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