SCIENTIFIC ARTICLE

Effectiveness of an Arthroscopic Technique to Correct Supination Losses of 90° or More

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Purpose To present a new arthroscopic method for treating supination losses.

Methods Six patients (15−71 y) were eligible for this study. All had a history of trauma to the wrist more than 6 months previously. Five of them had sustained a distal radius fracture: 3 had been treated with a volar plate (1 of them for an extra-articular malunion), 1 with an external fixator and K-wires, and 1 had been treated in a cast. One of these patients underwent a further operation for correcting an intra-articular malunion. The last patient underwent an open reduction of a transscaphoid perilunate dislocation. During a standard radiocarpal arthroscopy, a curved periosteal elevator was inserted through the 6R portal into the volar-radial corner of the triangular fibrocartilage complex and advanced proximally gliding on the anterior ulnar head surface. The volar capsule was then distended with the periosteal elevator and by means of gentle sweeping motion adherences between them, the volar capsule and the ulnar head were freed. Finally, the arthroscopic release was combined with a gentle passive supination force applied by the surgeon. Full supination was maintained in an orthosis for 2 to 3 days. Afterward, regular physical therapy was instituted. Concomitant surgery, arthroscopic or open, was performed in all to treat associated conditions.

Results Full supination (90°) was achieved in all intraoperatively. At a mean follow-up of 3.3 years, mean supination was 76° in the latest follow-up (range, 50° to 90°). Mean improvement in supination was 80° (range, 50° to 100°). No distal radioulnar instability or other complications were noted.

Conclusions The method presented proved effective in severe forms of supination deficits.

Type of study/level of evidence Therapeutic V.

Key words Supination loss, pronosupination stiffness, wrist arthroscopy, distal radius fractures.

Online Exclusive

Loss of supination is frequently seen after a distal radius fracture. Although often painless, lack of supination leaves patients unable to place their hand in space effectively. Adherence and retraction of the volar distal radioulnar joint capsule,[1] due to immobilization in pronation, and retraction of the pronator quadratus by compartment syndrome[2] have been proposed to be responsible for

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the condition. If, after extensive physical therapy, lack of supination persists, open excision of the volar capsule is recommended. For cases where this is insufficient, Garcia-Elias[3] recommends excising the distal edge of the pronator quadratus. In both instances, an open approach, ulnar or radial, to the flexor carpi ulnaris is recommended to progressively excise the volar distal radioulnar capsule and release the pronator quadratus from the ulna.

Arthroscopic arthrolysis of the distal radioulnar joint (DRUJ) has also been proposed for cases of rotational stiffness.[4–6] The procedure is performed from the DRUJ portals.[4–6]

The purpose of this study was to present a new method for arthroscopic release, through the radiocarpal joint, of adherences and contractures in the volar radioulnar capsule that may cause supination losses. To evaluate the true value of the method, its effectiveness was assessed in a selected group of patients with a severe lack of supination (90° minimum).

METHODS

Six patients lacking at least 90° supination were included in this series. All had sustained trauma to their wrist and had been initially treated at other centers. Five had a distal radius fracture and 1 an ununited scaphoid fracture with midcarpal degeneration, in the setting of a transscaphoid perilunate dislocation that was kept immobilized in a cast for 3 months after open reduction.

There were 4 females and 2 males with ages ranging from 15 to 71 years. Several patients had pain (Table 1). Four patients also had losses of pronation of 30°, 10°, 50°, 50° (cases 2, 3, 4, and 6, respectively). All patients had undergone extensive physical therapy before the procedure.

For the purpose of this study, they were recalled and the range of motion was recorded with a handheld goniometer by the surgeon. To avoid any contribution by the shoulder, the arm was adducted to the side and the elbow flexed. All patients were aware of the treatment aims and understood the risks and benefits of the procedure.

Informed consent was obtained for each patient for the arthroscopic as well as the possible conversion to open procedure if the need arose.

Surgical technique

Arthroscopy was performed in all cases as the first part of the procedure to assess the joint and identify possibilities for reconstruction. The hand was set in traction to an overhead bow. Even traction of 12 to 15 kg was distributed to all fingers. Typically, only 3-4 and 6R portals were needed—no DRUJ portals were used. Arthroscopy was performed dry in all cases, flushing the joint with saline as needed to remove debris, as recommended by del Piñal et al.[7,8] The midcarpal joint was not entered as the scarred tissue rarely involves this joint. The exception was one case in which an arthroscopic 4-corner arthrodesis was carried out.[9]

In most cases, there was abundant scar tissue and time was required to triangulate in the radiocarpal space. First, a working space was created, and this was done by recreating the dorsal sulcus by releasing adhesions between the carpal bones and the dorsal capsule with a 2.9-mm shaver. Then, if any pathology was treatable under arthroscopy (ulnar styloid impingement: cases 1 and 6), it was carried out.[10] At this point, correction of the supination deficit was undertaken. While the scope was in the 3-4 portal, a slightly curved rib periosteal elevator (Fig. 1) was introduced through the 6R portal. The tip of the instrument perforated the volar radial corner of the triangular fibrocartilage (TFC) (if the TFC was intact) and gently twisted until the capsule yielded. Then, the instrument was swept ulnarly, gliding over the head of the ulna and pushed volarly to distract the capsule and free the ulnar head from adhesions. At the same time, the surgeon brought the hand into supination to permit release of the volar adhesions. At this point, full, or nearly full, supination had been achieved. Gentle passive forearm supination and volar pressure on the ulna completed the correction (Figs. 2, 3; Videos 1, 2, available on the *Journal's* Web site at www.jhandsurg.org).

Any required concomitant procedure was carried out after this release. No open surgery was performed in case 1 or 2. In case 2, an arthroscopic 4- corner arthrodesis was performed in the same operation.[9] As regards the rest, in 2, a volar plate was removed, whereas in another 2, a volar plate was installed for fixation after an arthroscopic guided intra-articular osteotomy.[11] Finally, 1 patient who also had stiffness of the fingers had intrinsic muscle releases and a carpal tunnel release. Details are presented in Table 2.

Patients were immobilized with an above-elbow orthosis in full supination for the first 2 to 3 days. Self-directed exercises, which consisted of assisted supination (and pronation) to the point of slight pain and maintaining that position for 5 seconds, were instituted afterward. This exercise was repeated 10 times every hour during daytime. After the fourth to sixth week, this was implemented by the therapist in every case. The passive force exerted was commensurate with the concomitant surgery. Unrestricted active and passive

TABLE 1. Demographics

Case	Age	Sex	Hand	Original Injury	Previous Treatment	Time Since Injury (mo)	Ext./Flex/Pro/Sup	Associated Pathology	Worker's Compensation
1	71	F	ND	EADRF	Cast 6 wk	15	30/40/90/0	Ulnar pain	No
2	48	M	ND	TSPLD	Dorsal ORIF-K-wires Scaphoid screw	13	20/5/60/−10	Scaphoid nonunion "RSD"	Yes
3	38	F	D	IADRF	External fixator for 4 mo	14	25/25/80/−5	Fixed ulnar deviation stance (+20°)	No
4	16	M	D	Salter-Harris II	Volar mini-plate	10	40/65/40/0	Plate encroaching growth plate	No
5	49	F	D	IADRF	1st: VLP 2nd: open osteotomy for IAMU, fixation with K-wires	8	20/5/80/0	Persistent IAMU	Yes
6	60	F	D	EADRF	1st: cast 6 wk 2nd:osteotomy+VLP	13	20/20/40/−10	"RSD" Intrinsic contracture fingers	Yes

D, dominant; EADRF, extra-articular distal radius fracture; IADRF, intra-articular distal radius fracture; IAMU, intra-articular malunion; ND, nondominant; RSD, reflex sympathetic dystrophy; TSPLD, transscapho-perilunate dislocation; VLP, volar locking plate.

exercises began at 6 to 8 weeks. Patient 2 was kept in an orthosis and then in a cast for 5 weeks. At that time, exercises were commenced from nearly no rotation as he found it impossible to perform pronosupination while in the cast, despite this being a below-the-elbow cast.

After the operation, they were followed a minimum of 1 year (1−6.4 y, average: 3.3 y).

RESULTS

Full effortless passive pronosupination was achieved in all at surgery. Except in one who maintained the range of motion from the immediate postoperative period, all patients lost some of the arc gained at surgery in the ensuing days and only after starting supervised physical therapy was this regained. The mean supination was 76° at the latest follow-up (range, 50° to 90°). Net improvement in supination was 80° (range, 50° to 100°). Pronation also improved by a mean of 17°. The total arc of improvement in pronosupination was 97° (range, 70° to 120°). There were no cases of DRUJ instability, ulnar wrist pain, or other complications (Table 2).

DISCUSSION

Posttraumatic contractures of the DRUJ capsule are common, especially loss of supination after a distal radius fracture.[1] Despite being a common complication, there is a paucity of literature on how to deal with the problem. This may be due to the fact that many patients with lesser degrees of limitation accept the deformity and compensate by humerus rotation with the elbow semiextended or with shoulder abduction and adduction.

Severe loss of pronation and/or supination may be limiting for many daily activities. Kleinman and Graham[2] described the so-called silhouette capsulectomy of the volar capsule of the DRUJ for the loss of supination and of the dorsal DRUJ capsule for the loss of pronation. Technically, it consists of excising the involved capsule from its insertions into the radius, TFC, and ulna. The operation is only indicated when the bone anatomy is reasonably preserved, as otherwise another type of surgery (ie, osteotomy of the sigmoid notch[12]) is recommended. In a report on a series of patients who had open capsulectomy, improvement in forearm motion was universal, with an average increase in supination of 51° and in pronation of 28°.[2] There were no complications, including no iatrogenic cases of DRUJ instability. Garcia-Elias[3] pointed to the pronator quadratus as being partially responsible for supination restriction. He advised not only silhouette capsulectomy, but also release of the

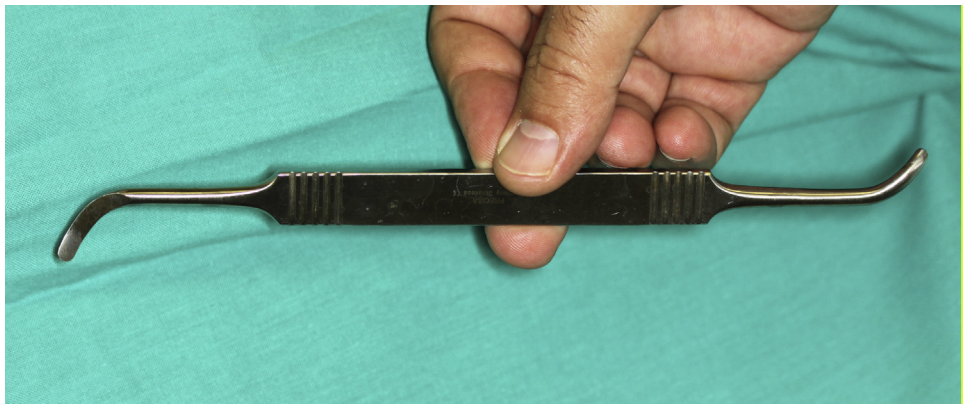

FIGURE 1: Instrument used for releasing the adherences between the volar capsule and the head of the ulna. It is slightly curved with an ideal shape to work around the anterior aspect of the ulnar head.

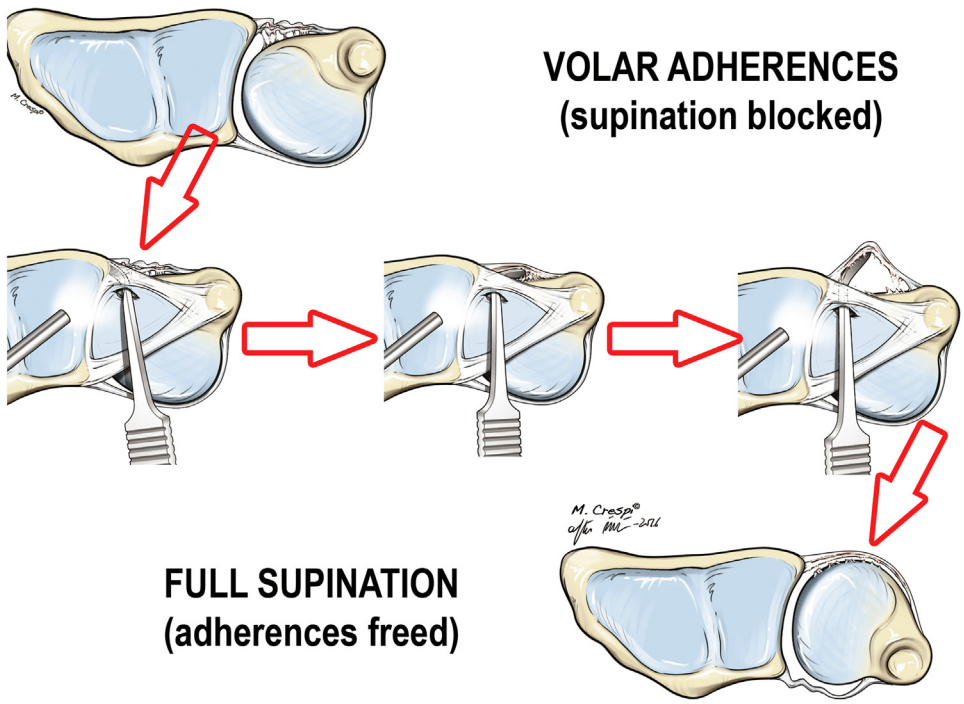

FIGURE 2: Artistic rendering summarizing the procedure (see the text for details).

neighboring distal edge of the pronator quadratus. In a group of 6 patients with supination contracture, he reported an improvement of 53° of supination at an average follow-up of 15 months.

Luchetti et al[4–6] published a method to carry out arthroscopic release of DRUJ contractures by using DRUJ portals. They warned that the procedure was fraught with difficulties and consisted of removing the scar around the head of the ulna and the TFC. A shaver was used to release adherences at the sigmoid notch and release the capsule from the proximal DRUJ portal. No results were presented relating to the DRUJ in their most recent papers; however, in their initial work, Luchetti et al[4] reported an improvement in pronosupination of 15° in 2 patients whose DRUJ was treated arthroscopically. Osterman et al[13] presented their long-term results of wrist arthrolysis including 19 patients with DRUJ contracture (50 mo average). They reported an improvement of 34° in supination (from 31° to 65°) and 28° in pronation (from 42° to 70°). The technique is not specified in the abstract but it is carried out through DRUJ dorsal portals and consists of removal of a scar and at times using a Freer elevator to separate the adherences from the TFC and the ulnar head.

The technique we present, although relatively easy and straightforward, requires considerable

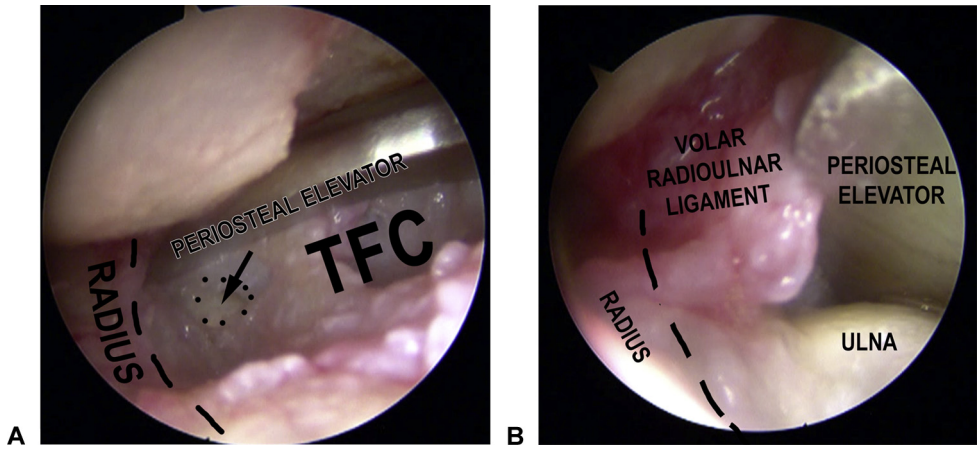

FIGURE 3: A A rent has been created in the volar radial corner of the TFC (arrow points to the ulnar head) and **B** through it the maneuvers presented with the periosteum elevator were done (Video 1).

TABLE 2. Surgical Details and Results

Case	Concomitant Procedures	Follow-up (y)	ROM Ext/Flex/Pron/Sup	Supination Preoperative/Postoperative	Δ in Pronosupination arc
1	Arthroscopic ulnar styloid resection	6.4	65/50/90/90	0/90	90
2	Arthroscopic 4-corner arthrodesis	4.9	40/5/70/80	−10/80	100
3	Arthroscopic intra-articular osteotomy Volar plate+bone graft	3.4	65/65/85/85	−5/85	105
4	Plate removal	3.0	50/65/60/50	0/50	70
5	Arthroscopic intra-articular osteotomy+plate	1.5	30/50/90/80	0/80	90
6	Arthroscopic ulnar styloid resection Plate removal CTR Intrinsic release	1.0	50/55/80/70	−10/70	120

CTR, carpal tunnel release; ROM, range of motion.

arthroscopic expertise, not for correcting the supination itself, but because these joints are scarred and experience is needed to create a working space. However, our method is much easier than other arthroscopic alternatives as the operation is carried out from the radiocarpal joint. The DRUJ is difficult to scope even under ideal circumstances and scarring makes it even more difficult to enter the joint. Under the scarred conditions, the scope is at risk of breakage, while the cartilage of the sigmoid notch and the ulnar head are also at risk of iatrogenic injury.

The manipulation that helps release secondary and minor adherences should be done gently and at the end of the arthroscopic capsular release. The osteoporotic ulna may not be strong enough to resist any force without fracturing. We combine this torque force with palmar translation of the ulna when in nearly full supination to mimic the physiological movement of the ulna, and in the opposite direction in pronation.[1,2] At arthroscopy, distension of the anterior capsule should be done gently, because the idea is to make it yield. We have no data to know if the distal edge of the pronator quadratus was also released or not, nor can we comment whether the volar capsule is simply stretched or is actually torn, but it appears to be stretched (Fig. 4).

Despite the fact that our results have been very encouraging, this study has limitations. First of all, it

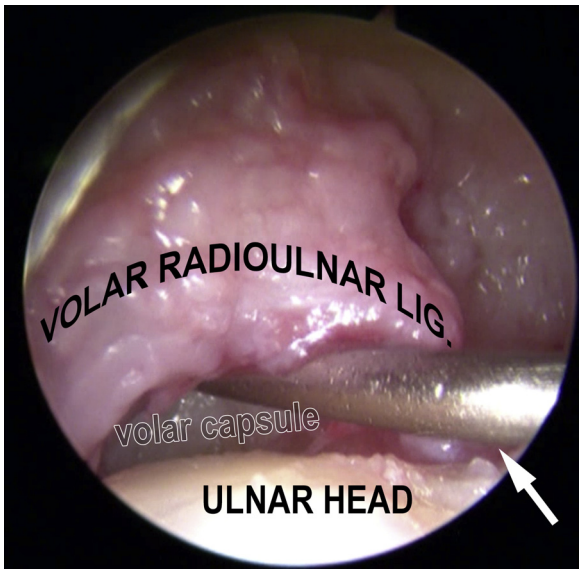

FIGURE 4: Volar capsule distended and intact volar radioulnar ligament. Arrow points to the fovea. Notice that this right joint is in pronation.

is a small series. Secondly, many other procedures were performed concomitantly with the index procedure and these may have had an impact on the improvement of supination. However, the index operation was performed as part of the initial arthroscopy. Arthrolysis of the radiocarpal joint had no effect on pronosupination, and only after the release of the volar DRUJ capsule was the rotation restored. Furthermore, to test the real value of the operation, only patients with severe loss of supination were selected for this study. A final limitation of the study is that all patients belong to the same surgeon's practice and we were not blinded at the time of gathering the data.

We emphasize that the procedure is relatively simple in expert hands, and can be performed in a matter of seconds (Video 2, available on the *Journal's* Web site at www.jhandsurg.org). Most importantly, we have demonstrated that supination contracture can be corrected efficiently using an arthroscopic technique.

REFERENCES

1. Kleinman WB. Distal radius instability and stiffness: common complications of distal radius fractures. *Hand Clin*. 2010;26(2):245–264.
2. Kleinman WB, Graham TJ. The distal radioulnar joint capsule: clinical anatomy and role in posttraumatic limitation of forearm rotation. *J Hand Surg Am*. 1998;23(4):588–599.
3. Garcia-Elias M. Management of lost pronosupination. In: Slutsky DJ, ed. *Principles and Practice of Wrist Surgery*. Philadelphia: WB Saunders; 2010:507–514.
4. Luchetti R, Atzei A, Fairplay T. Arthroscopic wrist arthrolysis after wrist fracture. *Arthroscopy*. 2007;23(3):255–260.
5. McGuire DT, Luchetti R, Atzei A, Bain GI. Arthroscopic arthrolysis. In: Geissler WB, ed. *Wrist and Elbow Arthroscopy*. New York: Springer Science+Business Media; 2015:165–175.
6. Luchetti R, Bain G, Morse L, McGuire D. Arthroscopic arthrolysis. In: Randelli et al, eds. *Arthroscopy*. Berlin, Heidelberg: Springer-Verlag; 2016:935–951.
7. del Piñal F, García-Bernal FJ, Pisani D, Regalado J, Ayala H, Studer A. Dry arthroscopy of the wrist: surgical technique. *J Hand Surg Am*. 2007;32(1):119–123.
8. del Piñal F. Dry arthroscopy and its applications. *Hand Clin*. 2011;27(3):335–345.
9. del Piñal F, Klausmeyer M, Thams C, Moraleda E, Galindo C. Early experience with (dry) arthroscopic 4-corner arthrodesis: from a 4-hour operation to a tourniquet time. *J Hand Surg Am*. 2012;37(11):2389–2399.
10. Bain GI, Bidwell TA. Arthroscopic excision of ulnar styloid in styloarpal impaction. *Arthroscopy*. 2006;22(6):677.e1–677.e3.
11. del Piñal F, Cagigal L, García-Bernal FJ, Studer A, Regalado J, Thams C. Arthroscopically guided osteotomy for management of intra-articular distal radius malunions. *J Hand Surg Am*. 2010;35(3):392–397.
12. del Piñal F, Studer A, Thams C, Moraleda E. Sigmoid notch reconstruction and limited carpal arthrodesis for a severely comminuted distal radius malunion: case report. *J Hand Surg Am*. 2012;37(3):481–485.
13. Osterman AL, Culp R, Abzug J. Long term outcome of arthroscopic release of wrist contractures. Presented at the American Academy of Orthopaedic Surgeons meeting. New Orleans, March 10–13, 2010.