Revision Wrist Arthroscopy after Failed Primary Arthroscopic Treatment

Eugene Jang, MS¹ Jonathan R. Danoff, MD¹ Rebecca A. Rajfer, MD¹ Melvin P. Rosenwasser, MD¹

¹Department of Orthopaedic Surgery, Columbia University Medical Center, New York, New York

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Address for correspondence Melvin P. Rosenwasser, MD, Robert E. Carroll Professor of Hand Surgery, Department of Orthopaedic Surgery, Columbia University College of Physicians and Surgeons, 622 West 168th Street, PH11-1164, New York, NY 10032 (e-mail: ttc@columbia.edu).

Abstract

Background The etiologies and outcomes of cases of failed therapeutic wrist arthroscopy have not been well-described to date.

Purpose The purposes of this study were to identify common preventable patterns of failure in wrist arthroscopy and to report outcomes of a series of revision arthroscopy cases.

Patients and Methods Retrospective review of 237 wrist arthroscopies revealed 21 patients with a prior arthroscopy for the same symptoms, of which 16 were assessed by questionnaires and physical exam for this study.

Results Six of sixteen patients (38%) had unrecognized dynamic ulnar impaction after débridement of triangular fibrocartilage complex (TFCC) tears, which resolved with arthroscopic wafer resection. Five (31%) had persistent distal radioulnar joint (DRUJ) instability after initial treatment of TFCC tears, requiring arthroscopic repair at revision. Four (25%) experienced diffuse dorsal wrist pain initially diagnosed as TFCC tears, but dynamic scapholunate ligament injuries were found and addressed with radiofrequency (RF) shrinkage at reoperation. Two (13%) required further resection of the radial styloid, after initial débridement was insufficient to correct radioscapoid impingement. At a mean of 4.8 years after repeat arthroscopy (range, 1.5–13.4 years), this cohort had significant improvements in pain and satisfaction with outcomes after revision arthroscopy.

Keywords

- arthroscopy
- failed arthroscopy
- outcomes research
- revision arthroscopy
- wrist arthroscopy

Conclusions The most common indications for repeat wrist arthroscopy were ligamentous instability (of the DRUJ or scapholunate ligament) and osteoarthritis (from dynamic ulnar impaction or radioscapoid impingement). Although revision wrist arthroscopy may yield acceptable outcomes, careful assessment of stability and cartilage wear at index procedure is crucial.

Level of Evidence: Level IV Therapeutic.

Historically, the small number of procedures performed arthroscopically in the wrist as compared with those in other joints has made it difficult to assess the risk factors for complications. An overall complication rate of 0.56% in arthroscopy of all joints was found in a survey of 395,566 arthroscopic procedures by the Arthroscopy Association of North America in 1986, but only 121 of all procedures

surveyed were performed on the wrist.¹ However, as the number and complexity of arthroscopic procedures of the wrist continue to grow, more data are becoming available on the incidence of complications.

Aside from unintended complications and side effects in wrist arthroscopy, little is reported on cases in which therapeutic arthroscopy of the wrist fails to improve symptoms. An

understanding of the common reasons why arthroscopy fails to achieve expected results will alert the treating surgeon to assess carefully certain patterns of injury seen via the arthroscope, so that corrective action may be taken at the index procedure. To date, the only systematic study of “causes of failure” in wrist arthroscopy was published by Luchetti et al in 2006, in which 8 of 350 cases of wrist arthroscopy were deemed to have failed to relieve symptoms.² However, patient outcomes and subsequent procedures were not reported in that study.

The true incidence of diagnostic and therapeutic failures of wrist arthroscopy may be obscured by the fact that many failed arthroscopies are converted to, or revised by, open procedures.^{3–6} Evaluating cases in which patients undergo multiple arthroscopic procedures for the same complaint may better serve to elucidate the reasons for subsequent procedures, to demonstrate what should have been done at the index procedure, and to predict outcomes for similar patients. The surgeon performing arthroscopy in larger joints enjoys the advantage provided by numerous published reports of the incidence and causes of revision arthroscopy.^{7–14} However, no studies have been published to date that specifically examine the indications for revision wrist arthroscopy or its outcomes.

The primary purpose of this study was to identify common, preventable patterns of failure in wrist arthroscopy. Our hypothesis was that failure to stage and treat dynamic instability and cartilage wear appropriately would represent the most common failure patterns. A secondary question addressed by this study is whether there is a pattern to outcomes after revision arthroscopy that may suggest that certain patients may benefit more from revision wrist arthroscopy.

Patients and Methods

Study Design

Institutional review board approval was obtained before 237 consecutive wrist arthroscopy procedures by the senior author between 1997 and 2010 were retrospectively reviewed. The sole inclusion criterion was prior arthroscopy for the same chief complaint and clinical presentation. Patients were excluded if there was an intervening change in the clinical presentation of the patient (e.g., traumatic injury) after primary arthroscopy. Clinical course between primary and secondary arthroscopy, indications for the revision procedure, and detailed descriptions of operative interventions were documented. Records associated with prior procedures performed elsewhere were obtained with patients' consent.

Subjects

Twenty-one of the 237 patients (8.9%) met the inclusion criteria. Of these, 16 patients agreed to participate in the present study. The remaining five patients could not be located despite an exhaustive search. The 16 patients evaluated for the present study included nine men and seven women, with a mean age of 28 years (range, 12–65 years) at primary arthroscopy and 30 years (range, 15–75 years) at

revision arthroscopy. Of the 16 subjects in the study, nine were available for both voluntary follow-up physical examination and questionnaires, while the remaining seven patients only completed questionnaires.

All but three subjects had their primary arthroscopy performed elsewhere and were subsequently referred to the senior author. The main indication for repeat arthroscopy in all 16 cases was persistent wrist pain despite sufficient convalescence and rehabilitation following the prior arthroscopy. There was a mean interval of 26.3 months (range, 3.9–120.0 months) between the primary and secondary procedures. All patients underwent reoperation at minimum 1 year from index procedure, with the exception of a professional athlete treated 4 months after initial surgery and a collegiate athlete who underwent reoperation at 6 months, as persistent dynamic impaction and/or distal radioulnar joint (DRUJ) instability was preventing return to play. Patient follow-up after revision arthroscopy averaged 4.8 years (range, 1.5–13.4 years).

Outcome Measures

All patients completed comprehensive questionnaires that included items regarding current pain level, functional level, employment, and recreational activities. Patients rated their pain before and after both arthroscopic procedures using a visual analog scale (VAS, 0–10), which was the primary outcome of this study, as well as satisfaction with surgical outcomes. All subjects completed the Disabilities of the Arm, Shoulder, and Hand (DASH) validated outcome measure,¹⁵ and those patients available for follow-up visits underwent range of motion and grip strength measurements. The Modified Mayo Wrist Score (MMWS)¹⁶ was tabulated for each subject available for follow-up physical examination.

Statistical Methods

A normality test of each variable, with use of the Kolmogorov-Smirnov test with $\alpha = 0.05$, demonstrated that all outcomes with continuous variables had normal distributions. Thus, all comparisons of these variables were assessed using standard statistical measures: paired Student *t*-test or independent two-sample *t*-test. Data are graphically represented as the mean $\pm$ standard error of the mean. Results with $p < 0.05$ were considered statistically significant.

Results

All patients had either ligamentous instability or a bony impaction that was appropriately diagnosed and treated at second-look arthroscopy, but not at primary arthroscopy. Each of these two classes of pathology could be further subdivided by their localization to ulnar or radial structures of the wrist. As such, all cases were divided into four categories according to the type and location of the relevant pathoanatomy (**Fig. 1**). Patients within the same class tended to have similar courses of management (**Table 1**). Long-term follow-up also revealed similar postarthroscopy outcomes within groups (**Table 2**).

Table 1 Clinical course of patients, grouped by reason for revision

n	Reason for revision arthroscopy	Main diagnosis before first procedure	First arthroscopic procedure	Main diagnosis before second procedure	Second arthroscopic procedure
6	Dynamic ulnar impaction syndrome	Type 1A (n = 3) or 1C (n = 3) TFCC tear	TFCC débridement (n = 3) or TFCC repair (n = 3)	Type 2B (n = 1), 2C (n = 3), or 2D (n = 4) TFCC tear + ulnar impaction syndrome	Ulnar shortening using arthroscopic wafer procedure
5	DRUJ instability	Type 1A (n = 4) or Type 1B (n = 1) TFCC tear	TFCC débridement (n = 4) or TFCC repair (n = 1)	Type 1B (n = 4) or 2B (n = 1) TFCC tear + DRUJ instability	TFCC repair (n = 4) or revision of repair (n = 1) followed by Shuck test
4	SLIL instability	Diffuse wrist pain + synovitis with Type 1A TFCC tear	TFCC débridement	Same + Geissler grade I (n = 1) or II (n = 3) scapholunate instability	Midcarpal inspection, radiofrequency shrinkage
2	Advanced radioscapoid impingement	Scapholunate dissociation	Radial styloid débridement	SLAC Stage 1	Radial styloidectomy

Abbreviations: DRUJ, distal radioulnar joint; SLAC, scapholunate advanced collapse; SLIL, scapholunate interosseous ligament; TFCC, triangular fibrocartilage complex. Type of TFCC repair refers to the Palmer classification.

Table 2 Outcomes at latest follow-up, grouped by reason for revision

	Dynamic ulnar impaction	DRUJ instability	Dynamic SLIL instability	Radioscapoid impingement	All groups
Outcome measure	(n = 6)	(n = 5)	(n = 4)	(n = 2)	(n = 16)
Months follow-up after revision	43.7 ± 5.7	58.1 ± 16.8	75.1 ± 29.4	58.6 ± 26.9	57.7 ± 9.3
DASH	17.6 ± 5.0	8.8 ± 4.5	46.3 ± 9.2	13.8 ± 12.1	21.0 ± 5.0
Pain VAS	1.0 ± 0.6	0.2 ± 0.2	3.1 ± 1.3	0.4 ± 0.2	1.2 ± 0.5
MMWS	Good	Fair	Poor	Excellent	Fair
Subsequent procedures	Ulnar shortening osteotomy (n = 1)		RASL (n = 2)		
			PRC (n = 1)		
			Arthrodesis (n = 1)		

Abbreviations: DASH, Disabilities of the Arm, Shoulder, and Hand score; PRC, proximal row carpectomy; RASL, reduction and association of the scaphoid and lunate; VAS, visual analog scale. Data are presented as mean ± standard error of the mean.

Location of Wrist Pain at Presentation			
		Radial	Ulnar
Type of Pathology	Ligamentous Instability	Dynamic SLIL Instability (n=4)	DRUJ Instability (n=5)
	Impaction/Osteoarthritis	Radiocarpal Impingement (n=2)	Dynamic Ulnar Impaction (n=6)

Fig. 1 Classification of pathology warranting revision. The primary diagnosis necessitating revision arthroscopy may be classified by type of pathology (bony impaction versus ligamentous instability) as well as by location (radial-sided versus ulnar-sided wrist pain). DRUJ, distal radioulnar joint; SLIL, scapholunate interosseous ligament.

Dynamic Ulnar Impaction Syndrome

Six patients required repeat arthroscopy for unrecognized or undertreated dynamic ulnar impaction. All originally presented with Palmer type 1A ($n = 3$) or 1C ($n = 3$) triangular fibrocartilage complex (TFCC) tears, initially treated with débridement alone ($n = 3$) or débridement and repair ($n = 3$), respectively.¹⁷ Radiographs and magnetic resonance imaging (MRI) obtained with the wrist in neutral position prior to the first surgical intervention suggested ulnar-neutral wrists. All patients experienced incomplete relief of symptoms, and the pain returned to a subjective level of intolerance necessitating intervention at a mean of 20.7 months after the first arthroscopy (range, 3.9–38.6 months).

At revision, dynamic ulnar variance was assessed via radiographic studies including pronated grip views, and patients in this category exhibited a mean of 2 mm positive ulnar variance with grip. In all 6 patients, the ulnar impaction suggested by grip views was confirmed via arthroscopic visualization of bruising or eburnation of the surfaces of the lunate and/or distal ulna. The diagnoses were revised as a result of this evidence to include Palmer type 2B ($n = 1$), 2C ($n = 3$), and 2D ($n = 2$) tears of the TFCC. A Feldon arthroscopic wafer resection was performed in each case in order to unload the distal ulna.¹⁸ Postoperative management of this subgroup included a minimum of 4 weeks of splinting and 4 weeks of hand therapy. Pain was reduced from a mean VAS of 7.5 ± 0.8 preoperatively to 1.0 ± 0.6 at latest follow-up (out of 10).

DRUJ Instability

Five patients required repeat arthroscopy to address DRUJ instability after initial arthroscopic treatment of traumatic

TFCC tears. One of the five was also included in the dynamic ulnar impaction cohort previously described, having had both conditions at repeat arthroscopy. All 5 originally presented with ulnar-sided wrist pain after an identifiable trauma, and were arthroscopically staged as Palmer type 1A ($n = 4$) or 1B ($n = 1$) TFCC tears. There was no documentation of intra-operative DRUJ stability assessment before or after initial treatment.

All patients subsequently presented to the senior author with persistent wrist pain, and clinical evaluation suggested DRUJ instability as a contributing factor. Repeat arthroscopy was performed at a mean of 18.8 months (range, 6.6–38.6 months) after primary arthroscopy. Second-look arthroscopy revealed attenuation or disruption of the peripheral attachment of the TFCC ($n = 4$) or a failed prior primary repair ($n = 1$). Diagnoses at second arthroscopy included Palmer type 1B ($n = 4$) and 2B ($n = 1$) tears. Provocative Shuck testing under arthroscopic visualization of the DRUJ was performed without traction and with the examiner firmly immobilizing the radius while translating the ulna in a palmar-dorsal direction in neutral, full pronation, and full supination. Revisions consisted of an outside-in repair of the TFCC peripheral attachment, with retensioning and stability confirmed using a trampoline test. Post-repair Shuck tests with arthroscopic visualization confirmed that DRUJ stability was improved. Postoperative management of this subgroup included 4–8 weeks of splinting and 8 weeks of hand therapy, and pain was reduced from a mean VAS of 6.8 ± 0.9 to 0.2 ± 0.2 (out of 10.0) as a result of revision arthroscopy.

Scapholunate Instability

Four patients presented after wrist trauma with diffuse pain and synovitis, which were initially diagnosed and treated as Palmer type 1A TFCC tears. Initial arthroscopic management consisted of débridement of the TFCC along with synovectomy of the ulnocarpal joint. Operative notes from the initial procedures stated that carpal ligaments were visualized to be intact via midcarpal portals, but there was no indication that the scapholunate joint was stressed with probes. Pain did not change significantly after initial surgery in all cases, and persistent dorsal wrist pain led to repeat arthroscopy at a mean of 28.4 months (range, 6.0 to 74.9 months).

At revision, examination through multiple portals led to the discovery of dynamic scapholunate instability and signs of radioscapoid impingement not evident on static preoperative radiographs, along with recurrent synovitis in the ulnocarpal and dorsal capsular regions. Midcarpal arthroscopic assessment was supplemented by a probe inserted between the scaphoid and lunate and manipulated in a rotational fashion to push them apart and evaluate for evidence of scapholunate interosseous ligament (SLIL) tear under dynamic stress (–Fig. 2). This assessment yielded a diagnosis of Geissler grade I ($n = 1$) or II ($n = 3$) instability of the SLIL that was missed at first arthroscopy.¹⁹ Most elements of prior procedures were repeated in the second arthroscopy, with the addition of (RF) thermal shrinkage of the SLIL to address scapholunate instability (supplemented with Kirschner wire [K-wire] fixation in one case due to a greater degree of

Fig. 2 Dynamic assessment of scapholunate ligament attenuation with probe. Illustration of technique used to assess for dynamic scapholunate instability intraoperatively. (a) As a component of mid-carpal arthroscopic examination of the carpal bones, a right-angle probe is placed between the scaphoid and lunate and rotated (see arrow) to stress the scapholunate interosseous ligament in tension. (b) Degenerative wear of the ligament will be evident as a noticeable lack of force maintaining the scapholunate joint, resulting in a widening (see arrows) of the interval upon rotation of the probe.

instability). Postoperative management of this subgroup included a minimum of 3–4 weeks of splinting, and pain was reduced from a mean VAS of 8.1 ± 0.6 to 3.1 ± 1.3 (out of 10).

Radial Stylo-Scaphoid Impingement

Two patients required radial styloidectomy at reoperation, after the initial radial styloid débridement failed to resolve their pain from radioscapoid impingement secondary to scapholunate instability. Both patients initially presented with pain localized to the radial stylo-scaphoid joint but not the scapholunate interval. Both were treated with débridement of the radial styloid and synovectomy at first, but their pain did not improve, and repeat arthroscopy was required at a mean of 64.2 months after primary (range, 8.4 to 120.0 months).

In both instances, radioscapoid impingement secondary to scapholunate instability and resultant scapholunate advanced collapse was evident upon repeat arthroscopy, manifested by cartilage degeneration on the scaphoid and radial styloid. An arthroscopic débridement with radial styloid resection of 2–3 mm of the styloid tip and débridement of the scapholunate interval was performed to decompress the radioscapoid joint. At the end of the procedure, adequate resection was confirmed arthroscopically. Postoperative management of this subgroup included a minimum of 2 weeks of splinting, and pain was reduced from a mean

VAS of 7.2 ± 0.6 to 0.4 ± 0.2 (out of 10) as a result of the second arthroscopy.

Overall Outcomes

Follow-up for patients was obtained at a mean of 4.8 years (range, 1.5–13.4 years) after revision arthroscopy (►Table 3). The average age of patients at latest follow-up was 35 years (range, 18–77 years). At most recent follow-up, patients had a mean DASH score of 21.0 ± 5.0 and significant improvements in reported pain ($p < 0.001$) and satisfaction with the post-surgical outcome ($p < 0.001$) (►Fig. 3). Prior to the second operation, five patients were unable to work, as their occupation required manual labor (two mechanics, one police officer, one poultry breeder, and one professional athlete), and 11 worked in a reduced capacity despite continued symptoms. After reoperation, 15 of 16 returned to their preinjury occupation, and only two of 16 required medications for pain at latest follow-up. Eleven patients reported being able to return to participation in their primary sports or performing arts activities, and eight of 16 were able to return to (or surpass) preinjury levels of athletic competition.

The nine patients who were available for physical examination regained a mean of 89.5% of the contralateral wrist flexion-extension arc (range, 40.0–116.7%) and 91.9% of grip strength (range, 23.2–120.0%). The mean MMWS was 71.7, corresponding to a “fair” outcome (range, 25–100, “poor” to “excellent”). Translational Shuck tests revealed DRUJ stability equal to or greater than that of the contralateral wrist in all relevant patients. Scapholunate stability, as evaluated using Watson’s scaphoid shift maneuver, was shown to be equivalent to that of the contralateral side in all patients whose main reason for revision involved radial-sided wrist pain.

Discussion

The rationale of this study was twofold: to assess for common patterns of failure in therapeutic wrist arthroscopy and to

Table 3 Demographic data of 16 revision wrist arthroscopy patients

Demographic	Data
Age at time of revision arthroscopy	30.6 (15.2–75.1)
Gender	
Male patients	9 (56.2%)
Female patients	7 (43.8%)
Affected side	
Left	10 (62.5%)
Right	6 (37.5%)
Dominant hand	8 (50.0%)
Etiology of pathology	
Traumatic	13 (81.3%)
Chronic	3 (18.7%)

Age is presented as mean age in years (range). All other data are presented as number (%).

Fig. 3 Patient-rated pain and satisfaction with surgery. (a) Patients experienced a significant decrease in pain after repeat arthroscopy, as measured on a 10-cm VAS. (b) Patients reported significant increases in satisfaction with the outcomes of the second surgery as compared with the first. * $p < 0.001$.

report outcomes of a series of patients who were not improved by the initial wrist arthroscopic procedure and treated with a second arthroscopic procedure.

A limitation of this study was the number of patients, restricted to only those who had index and revision procedures that were entirely arthroscopic. This distinction was made to prevent the open component of any procedure from confounding the results. A second limitation of our research was the number of patients lost to follow-up (5 of 21 eligible subjects). The length of follow-up in these patients—upwards of 10 years after repeat arthroscopy—likely accounts for the difficulties in contacting these patients. Finally, the outcome measures of pain VAS before and after the initial surgery, and satisfaction with both the initial and revision surgeries, were collected in a retrospective manner. Because there was no reliable way to compare assessments of pain by the different surgeons performing the primary operation, these data were gathered from patients in a uniform manner by having them assign these values retrospectively. This introduces a risk of recall bias. The lack of a preoperative DASH score and the lack of a preoperative MMWS also limited the conclusions of this study, since the only preoperative outcome used was a VAS score.

Some clear patterns of failure were observed in this series. Six of the 16 repeat arthroscopies addressed a dynamic positive ulnar variance causing ulnar impaction, when the operating surgeon either missed this finding during the first procedure or did not treat it. The majority of these wrists appeared to have an ulnar neutral variance on plain films and MRI. This stresses the importance of performed pronated grip anteroposterior (AP) X-ray views and arthroscopic visualization of chondral surfaces in assessing for ulnar impaction syndrome,²⁰ especially since evidence suggests that ulnar variance increases by a mean of 1.95mm with maximal grip effort.²¹ In these cases, an arthroscopic wafer distal ulna resection is an appropriate

alternative to open ulnar-shortening osteotomy, with evidence of good outcomes and the added benefit of being able to treat the pathoanatomy immediately after visualization by arthroscopy.^{3,22–24} Five revision arthroscopies resulted in symptomatic relief because DRUJ instability was noted before repair of the TFCC peripheral attachment at revision. Review of the operative notes for prior arthroscopic cases revealed either no evidence of translational stress testing of the DRUJ after treatment of the TFCC tear, or instability noted and left untreated. Since DRUJ instability may either signal an underlying TFCC tear or exacerbate the symptoms associated with one, it is especially important in these scenarios to assess for tears and treat them properly. It is likely that simply performing (or revising) the TFCC repair at repeat arthroscopy accounts for the improved outcomes after revision. Four cases yielded better outcomes than the primary arthroscopic procedure because previously unrecognized scapholunate instabilities were found and addressed using RF shrinkage. Because radiography and MRI may not always reveal subtle instabilities on the radial side of the wrist, a chief complaint of ulnar-sided wrist pain should not preclude a thorough radiocarpal and midcarpal evaluation. Two cases represented a more aggressive treatment for radioscapoid impingement secondary to scapholunate instability. In these cases, careful attention to the proper staging of radiocarpal impingement, as well as appropriate management of the underlying instability of the scapholunate ligament, is recommended.

As for outcomes after revision wrist arthroscopy, patients tended to do well, especially after the operating surgeon was able to address the underlying pathology that was missed by the operating surgeon at the first procedure. Significant improvements in pain and satisfaction with outcomes were demonstrated in this series of patients after revision wrist arthroscopy. While the failure of primary wrist arthroscopy did not preclude the potential for satisfactory outcomes after

revision wrist arthroscopy, it is notable that this cohort of patients averaged a “fair” outcome on the MMWS in the long term, in large part because of the progression of instability in those patients with residual DRUJ and SLIL instability. This result highlights the importance of careful staging of wrist pathology, and wrist instability in particular.

This retrospective study highlighted a special group of patients who were not improved with primary wrist arthroscopy, and common patterns of failure were observed. Radiographic and MRI findings should not serve as a substitute for the proper assessment of dynamic pathoanatomy using both provocative stress testing and wrist arthroscopy. Arthroscopy is a visual tool with high sensitivity and specificity, but it must be coupled with examination via probes and provocative testing for instability. Wrist arthroscopy has become the gold standard for diagnosing many wrist injuries, and identifying instances of failure is a key component to its continued improvement as both a diagnostic and therapeutic technique.

Conflict of Interest

None

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