Arthroscopic treatment of post-traumatic elbow contracture

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The purpose of this study was to evaluate range of motion and patient-reported outcome after complete arthroscopic release of post-traumatic elbow contracture. Fourteen consecutive patients who underwent elbow arthroscopy and capsular release were reviewed retrospectively at a minimum follow-up of 1 year. Pain and range of motion were measured. Patient outcome was assessed with the American Shoulder and Elbow Surgeons Elbow Assessment Form. Mean self-reported satisfaction on a visual analog scale was 8.4 out of 10. Only 6 patients continued to have pain, with a mean maximum pain score of 4.6 out of 10. Flexion increased from a mean of 117.5° to 133°, and extension improved from a mean of 35.4° to 9.3°. In those patients with a preoperative arc of motion less than 100° (10 patients), the mean arc of motion improved from 69° to 119°. All patients had improved function after the procedure, with a mean self-reported functional ability score of 28.3 out of 30. There were no neurovascular complications. The improvement in range of motion and functional outcome compares favorably with open-release procedures. Combined with the potential benefits of improved joint visualization and low surgical morbidity, arthroscopic release of post-traumatic elbow contracture appears to be a reasonable alternative to open techniques. (J Shoulder Elbow Surg 2002;11:624-9.)

Loss of motion after elbow trauma is a common complication that can significantly interfere with the ability to perform activities of daily living.[14] Many different surgical procedures have been used to treat the stiff elbow, with most having used an open approach.[3,4,7,12,13,19,20] However, open-contracture release can result in additional soft-tissue trauma to the elbow, which may increase the risk of recurrence and restrict early physical therapy because of pain. Open techniques also may not allow complete assessment and treatment of associated intraarticular pathology.

Arthroscopic release of post-traumatic elbow contracture is an alternative strategy with the potential benefits of improved joint visualization, decreased postoperative morbidity, and a more rapid functional recovery. Previous studies have reported on the use of arthroscopic debridement.[1,8,17,18] Results have been encouraging, but injuries to the neurovascular structures have occurred.[6,8,10] The purpose of this study was to evaluate patient-reported outcome and postoperative range of motion after complete arthroscopic treatment of post-traumatic elbow contracture with a technique of capsulotomy by sharp anterior capsular releases.

MATERIALS AND METHODS

Between May 1998 and October 1999, 14 elbows in 14 consecutive patients were treated with an arthroscopic procedure for post-traumatic elbow contracture. No open releases were performed during this particular collection period, as no patient met the criteria for exclusion. All patients were available for review at a minimum follow-up of 1 year (range, 12-29 months). There were 8 men and 6 women. The mean age at the time of surgery was 36.9 years (range, 18-57 years). The dominant elbow was involved in 6 patients and the nondominant elbow in 8. The interval from the onset of symptoms to arthroscopic treatment ranged from 3 months to 3 years (mean, 14 months).

All patients had trauma as the cause for their elbow stiffness. Previous injuries included elbow fracture-dislocation (2), fracture of the radial head (3), fracture of the olecranon (1), and previous pediatric elbow fracture (2). The remaining patients all had specific injuries to the involved elbow without a fracture or dislocation occurring (6). Of the 14 patients, 4 had undergone prior open reduction/internal fixation of a fracture around the elbow.

Inclusion criteria

Arthroscopic treatment was indicated when restricted elbow motion interfered with activities of daily living and did not improve despite nonoperative treatment. Of the 14 patients, 11 received nonoperative treatment including physical therapy for a minimum of 6 months. There were 3 patients who underwent early arthroscopic release, all of whom had sustained radial head fractures. One of these patients had mechanical symptoms from a loose body. The

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other two had significant pain and a progressing contracture despite physical therapy.

Exclusion criteria

Patients with significant intrinsic disease of the joint or disruption of the normal ulnohumeral architecture were excluded. Those patients with a previous fracture who were included in the study had all undergone healing in a nondisplaced fashion. Patients with primary degenerative or inflammatory arthritis were also excluded from the study, as were those with post-traumatic heterotopic ossification diagnosed on radiographs. No patients during this collection period met the criteria for exclusion.

Clinical assessment

The Elbow Assessment Form, as developed by the Research Committee of the American Shoulder and Elbow Surgeons,[11] was completed for all patients to evaluate the results of treatment at final follow-up. Elbows were assessed before and after surgery for range of motion, pain, stability, and strength. Range of motion was evaluated by a handheld goniometer with standard anatomic landmarks.[5] Pain was assessed with a 10-point visual analogue scale. Varus and valgus stability was assessed by a standardized examination protocol. Postoperative strength was recorded according to Medical Research Council grade.

To assess functional status, all patients completed the Functional Self Evaluation Form. Their ability to perform 10 activities of daily living was rated on a 4-point ordinal scale from 0 to 3. In addition, all patients were asked to rate the success of their surgery on a scale from 1 to 10 and were questioned on whether they would undertake the same procedure again.

Surgical technique

Surgery was performed with the patient under general endotracheal anesthesia in the lateral decubitus position. A padded tourniquet was used and the arm supported in an arm-holder allowing free access to either side of the elbow. Bony landmarks and the course of the ulnar nerve were outlined with a sterile marking pen after skin preparation. Care was taken to ensure that the nerve was not subluxable or located in an anteriorly transposed position. The joint was predistended with up to 20 mL of saline solution. Not all elbows accommodated 20 mL of saline solution.

A 4.5-mm, 30° arthroscope was introduced through a proximal-medial portal located 2 cm proximal to the medial epicondyle and just anterior to the medial intermuscular septum. A proximal-lateral working portal was established under direct arthroscopic vision through use of spinal needle localization. This portal was located 2 cm proximal to the lateral epicondyle and just anterior to the lateral supracondylar ridge. Through this portal, a blunt trochar was used to break down intraarticular adhesions and elevate the capsule from the anterior aspect of the distal humerus, allowing an initial working space to be established (Figure 1).

Synovectomy and debridement of adhesions were undertaken with a 4.5-mm oscillating shaver (Figure 2). The oscillating shaver was directed only at material in the working space and not at the capsule itself. Osteophytes were debrided from the anterior joint, and any loose bodies were removed. A capsulotomy of the anterior capsule was performed under direct arthroscopic vision with a 15° upcutting basket resector. Initially, the plane between the brachialis and the anterior capsule was identified and developed from the lateral working portal. Then, progressing from lateral to medial, the capsule was incised directly (Figure 3). Visualization within the joint space was maintained by avoiding the use of a suction device. In addition, blunt trochars were placed through accessory lateral portals to be used as retractors (Figure 4). [9] A switching stick was used to transfer the arthroscope laterally in order to complete the release from the medial side. No dissection was taken superficially past the undersurface of the brachialis muscle belly (Figure 5).

A posterior-central portal 4 cm proximal to the olecranon tip through the triceps tendon and a posterior-lateral portal

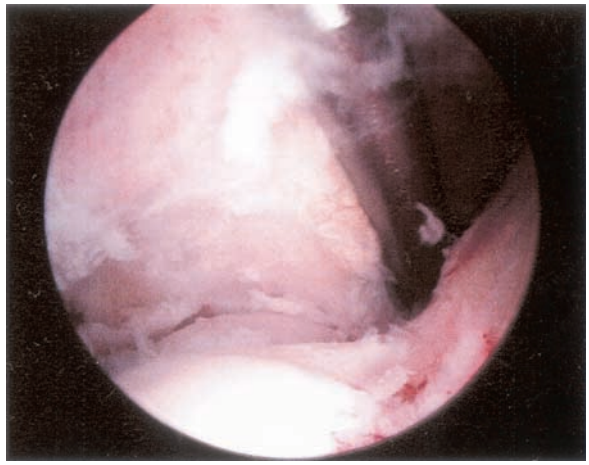

Figure 1 A blunt trochar through the lateral portal is used to elevate the capsule off the distal humerus *(right)* to create an initial working space.

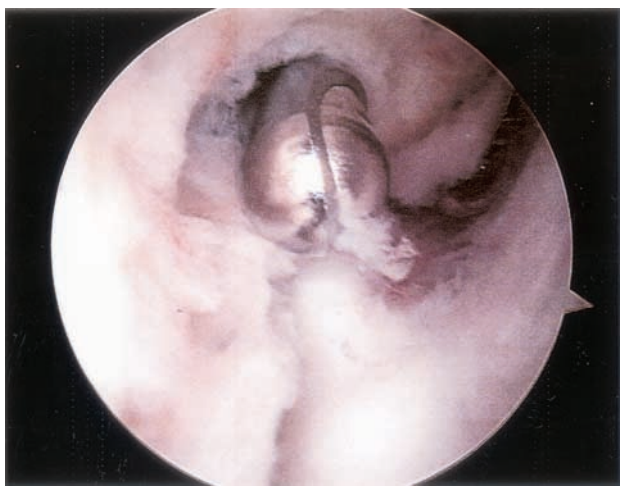

Figure 2 The oscillating shaver is used to perform an initial joint debridement. The shaver is not directed toward the capsule.

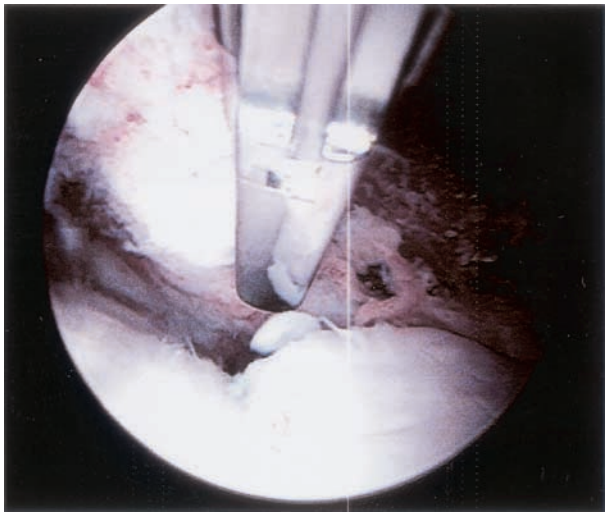

Figure 3 Starting laterally, the anterior capsular release is performed under direct vision with a 15° up-cutting resector.

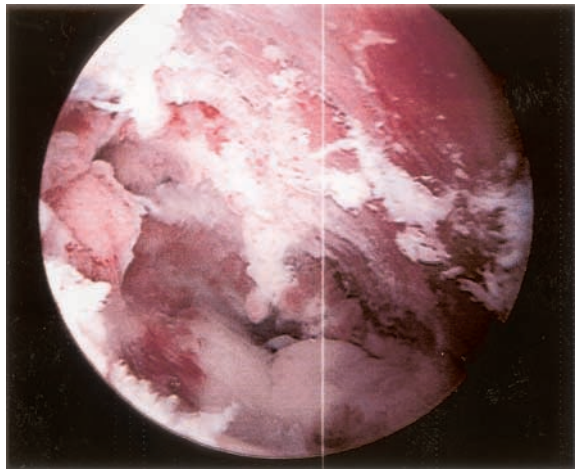

Figure 5 Dissection is not continued past the fibers of the brachialis muscle, which form the endpoint of the release. A complete capsulotomy leaves only brachialis muscle visible anteriorly.

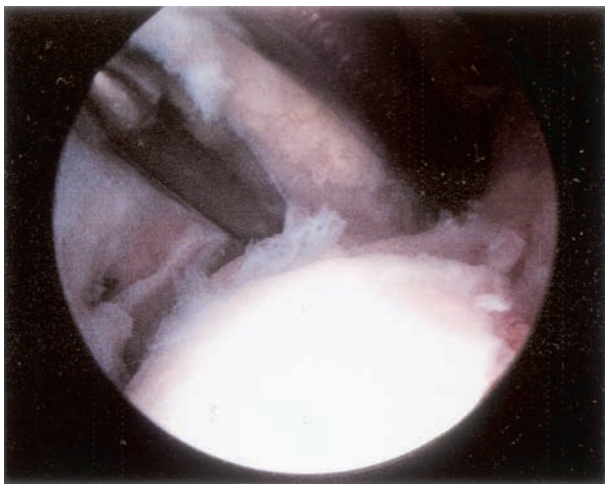

Figure 4 A blunt trochar inserted through an accessory lateral portal can be used as a retractor to maintain visualization.

2 cm proximal to the olecranon tip and lateral to the triceps tendon were used to perform the posterior joint debridement, with the arthroscope inserted in the posterolateral portal. The shaver was used initially to debride the space, and osteophytes and loose bodies were removed. Once adequate visualization was obtained, the posterior capsule was released with the use of an elevator, both medially and laterally. To avoid injury to the ulnar nerve, the release was not taken past the medial aspect of the olecranon fossa. A sharp release of the posterior bundle of the medial collateral ligament was not performed.

Range of motion of the elbow was assessed, and gentle manipulation was performed if necessary to release any remaining capsular contracture. Gentle traction was applied at maximal flexion and maximal extension in order to maximize gains in range of motion. Postoperatively, active and active-assisted range-of-motion exercises were begun with a physician-supervised home exercise program without the need for a physical therapist. Continuous passive motion and static or dynamic splinting were not used postoperatively.

RESULTS

Pain relief

In addition to loss of motion, 11 of the 14 patients also reported pain as a primary complaint. At the latest follow-up, 6 continued to report some pain. In 4, the pain was minimal and occurred only with activity (mean maximum pain score, 3.25/10). The remaining 2 patients complained of some pain at rest. No patient had worse pain, and none had new pain develop as a result of the procedure. All elbows were stable both preoperatively and at the latest follow-up examination, and all had normal strength. Any weakness that had been detected preoperatively was thought to be because of pain.

Range of motion

Before the procedure, the mean arc of flexion-extension was from 35.4° of extension (range, 20°-45°) to 117.5° of flexion (range, 65°-145°), with a mean total arc of 82° (range, 45°-120°). At the latest follow-up examination, the mean arc of flexion-extension was from 9.3° of extension (range, –5° to 20°) to 133° of flexion (range, 95°-145°), with a mean total arc of 123.6° (range, 95°-145°). The mean gain in extension was 26.1° ($P < .0001$), and the mean gain in flexion was 15.4° ($P < .05$). The mean gain in motion overall was 41.5° ($P < .0001$).

Of the 14 patients, 10 had an arc of motion less than 100° before surgery. A functional arc of motion

of 100° or more between 30° to 130° was obtained in 13 of the 14 patients postoperatively. The greatest improvement in motion was found in those elbows that had a preoperative flexion-extension arc of less than 80° (6 patients), which a mean gain of 47.5°. A gain in extension was obtained more readily and was usually greater (mean, 26.1°) than the gain in flexion (mean, 15.4°). All patients gained extension after surgery (range, 10°-40°). No patient lost flexion, although the flexion arc did not improve in 3 patients (range, 0°-45°). One patient lost motion between the time of the operation and latest follow-up. However, the final arc of motion was still improved.

A history of previous elbow surgery did not appear to affect the final gain in range of motion. In addition, there was no correlation between the duration of symptoms and improvement in postoperative range of motion. Sex and age of the patient and arm dominance also had no effect on motion gains. Eleven associated procedures were performed on 10 patients at the time of the capsular release (71.4%). These included removal of loose bodies (4), removal of retained metalware (3), arthroscopic ulnohumeral arthroplasty, a modified technique originally described by Kawasaki-Outerbridge for early osteoarthritis (3), and subcutaneous transposition of the ulna nerve done after release was performed (1). There was no correlation between having an associated procedure and the range-of-motion findings at latest follow-up.

Patient satisfaction

All patients stated that they would undergo the procedure again. The mean self-reported satisfaction score on a visual analog scale was 8.4 out of 10 (range, 3-10), with 7 of the 14 patients reporting complete satisfaction. One patient reported a postoperative satisfaction of only 3 out of 10, despite high functional scores and minimal pain.

Functional outcome

All patients had improved function after the procedure. On self-evaluation, patients reported no difficulties in a mean of 8.6 of the 10 assessed activities (range, 6-10), which was a marked improvement from that recorded preoperatively. The mean self-reported functional ability score was 28.3 out of 30, ranging from 25 to 30. All patients were able to return to their previous employment, although there were 2 patients who reported some restriction in their ability to perform their usual work. One of these was the only patient in the series with a pending workers' compensation claim.

Complications

One patient had a superficial portal site infection develop, which required drainage and antibiotic therapy but resolved completely. There were no other complications.

DISCUSSION

Early reports on open surgical release procedures for the post-traumatic stiff elbow generally had satisfactory results.[4,20,21] Urbaniak et al[19] reported a mean improvement in extension from 48° to 19° in 15 patients. In a series of 7 patients, Husband and Hastings[7] reported a mean improvement in extension from 45° to 12°, with flexion improving from 116° to 129°. More recently, Mansat and Morrey[12] reported improved range of motion in 89% of 38 elbows, with a mean total gain in the flexion-extension arc of 45°. Eighty-two percent of patients had a satisfactory result.

For patients with extrinsic contractures limited to the capsule, arthroscopic treatment provides an alternative strategy, with the potential benefits of improved joint visualization, decreased postoperative morbidity, and a more rapid functional recovery. Clinical reports on the use of arthroscopy did not appear until quite recently,[15] and most have focused on debridement rather than directed capsular release.[1,8,18] This study addressed not only range of motion as a measure of outcome but also functional outcome as assessed by a functional outcome scoring system, as well as patient satisfaction.

Jones and Savoie[8] reported improved motion and decreased pain in 12 patients with flexion contractures of the elbow treated by arthroscopic debridement. One patient in their series sustained a permanent posterior interosseous nerve palsy after a sharp capsular release was performed with a motorized shaver. Timmerman and Andrews[18] reported good to excellent results in 79% of 19 patients with post-traumatic stiffness treated with arthroscopic debridement and manipulation. Extension improved from a mean of 29° to 11°; flexion improved from a mean of 123° to 134°.

In this series we looked specifically at range of motion and functional outcome after directed sharp arthroscopic release of the capsule for post-traumatic elbow contractures. Before surgery, only 4 of 14 patients had a functional range of motion. After arthroscopic release, 13 of 14 patients had an arc of greater than 100°. This improvement in motion was highly significant ($P < .001$). The mean gain in the flexion-extension arc was 41.5°. All patients were satisfied, although 6 still reported some pain. On self-evaluation, all patients had improved function,

with a mean American Shoulder and Elbow Surgeons Functional Ability Score of 28.3 out of 30.

The major limitations of this study were its retrospective design and the relatively low patient numbers. However, in all cases the primary indication for surgery was post-traumatic arthrofibrosis, and all patients had a capsular contracture as their predominant pathology.

Our results compare favorably with a recent analysis of the results of open operative release.[12] This revealed a mean gain in the flexion-extension arc of 30° to 60°, with most of the authors reporting an 80% to 90% rate of satisfactory results. Although an improvement in motion was observed in more than 90% of patients, a functional arc of motion was obtained in only about 50%. This contrasts with our series in which all but 1 patient regained a functional arc of motion.

The fact that the predominant loss of motion in our patients was in extension rather than flexion (mean, 35.4° and 117.5°, respectively) likely had a positive influence on our results. Anterior capsular contractures are much more amenable to arthroscopic release than contractures involving the posterior structures. This is because the posterior bundle of the medial collateral ligament becomes involved in extension contractures. An arthroscopic release in this area is more difficult because of the proximity of the ulnar nerve. Improvement in flexion was thus less reliably obtained than improvement in extension, most likely because the posterior bundle of the medial collateral ligament was not addressed. In our series the mean gain in extension was 26.1° compared with 15.4° of flexion, and the flexion arc did not improve in 3 patients. Therefore, patients with significant flexion loss may be better suited to an open procedure that allows the posteromedial structures to be addressed.

Arthroscopic treatment of the post-traumatic stiff elbow is a technically demanding procedure, and significant complications have been reported with the use of shavers to release the capsule.[6,8,10] Neural and vascular structures appear to be most at risk,[16] and the reduced capsular compliance of the stiff elbow increases the potential for injury.[2] In one of the earliest reports, a permanent posterior interosseous nerve palsy occurred.[8] Complete transection of the median and radial nerves has also been described.[6]

Complications were few in our series, with no neurovascular injuries. There were a number of factors that probably helped to avoid this complication: (1) Arthroscopy was initiated from a proximal-medial portal to avoid the anatomically vulnerable radial and ulnar nerves. (2) The proximal-lateral portal was established under direct vision. (3) A blunt trochar was used to elevate the anterior capsule off of the humerus before the insertion of instruments, opening up an initial working space. (4) A capsulotomy was performed only after initial debridement had improved visualization. (5) Sharp releases were performed under direct vision, with the working space maintained because a suction device was not used. (6) Surgery was performed by a surgeon experienced in elbow arthroscopy.

Conclusion

Sharp arthroscopic release of a post-traumatic elbow contracture can reliably improve range of motion and provides a high degree of patient satisfaction. Improvement in extension is easier to obtain than is improvement in flexion, and our results do not support the use of this procedure for a deficit primarily in flexion. Pain relief is also less predictable than the expected gains in range of motion and function. Careful patient selection and meticulous surgical technique may help to minimize complications.

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