Anterior Release of the Elbow for Extension Loss

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Background: There are many causes of elbow contracture. When nonoperative techniques fail to increase the arc of motion of the elbow, surgical intervention may be indicated. The purpose of this study was to report the outcomes of surgical correction, predominantly with an anterior release, of elbow flexion contractures. In addition, we evaluated the efficacy of continuous passive motion in the immediate postoperative period.

Methods: We retrospectively reviewed the outcomes of 106 consecutive patients who had undergone anterior elbow release for the treatment of a flexion contracture between July 1975 and June 2001. Twenty-nine patients were excluded because they had been followed for less than twelve months, leaving a study group of seventy-seven patients. Postoperatively, fifty-four of the seventy-seven patients were treated with continuous passive motion and the other twenty-three patients were treated with extension splinting. The average duration of follow-up was thirty-three months. The average patient age was thirty-four years. The results were evaluated on the basis of both preoperative and postoperative radiographs as well as clinical measurements of elbow motion, all performed by the same examiner using the same large (47-cm-long) goniometer.

Results: The mean preoperative extension in the seventy-seven patients was 52°, which decreased to 20° postoperatively. The mean flexion increased from 111° preoperatively to 117° postoperatively, and the mean total arc of motion increased from 59° to 97°. The total arc of motion in the patients treated with continuous passive motion increased 45°, compared with an increase of 26° in those treated with extension splinting. There were eleven complications in ten patients. The majority were traction neuropathies. There were two infections (one superficial and one deep), both of which resolved following treatment.

Conclusions: Release of a pathologically thickened anterior elbow capsule through a predominantly anterior approach to correct diminished elbow extension is a safe and effective technique. Furthermore, compared with splinting in extension alone, the utilization of continuous passive motion during the postoperative period increases the total arc of motion.

Level of Evidence: Therapeutic study, Level III-2 (retrospective cohort study). See Instructions to Authors for a complete description of levels of evidence.

There are many causes of limited elbow motion, including local trauma, burns, osteoarthritis, inflammatory arthritis, hemophilia, and infection. These causes have been classified as intrinsic or extrinsic factors. Nonoperative techniques such as active and passive range-of-motion exercises with static and dynamic splinting can improve motion. When these modalities fail, operative intervention may be indicated. Several operative approaches for the release of flexion contractures have been reported. The purpose of this study was to determine which factors influenced the outcomes in a series of seventy-seven patients treated predominantly with an anterior elbow release to correct a flexion contracture.

Materials and Methods

We retrospectively reviewed the outcomes of all patients who had undergone surgical release of the elbow for the treatment of diminished elbow motion during the period from July 1975 to June 2001 at our institution. The senior author (J.R.U.) performed all of the surgical procedures. Nonoperative treatment (physical therapy and static and dynamic splinting) had been attempted and had failed to regain elbow motion in all patients. Patients with congenital elbow contracture or elbow spasticity were not included in the study. Of the 106 patients who underwent surgical release of the elbow, twenty-nine were excluded because they had not been followed for twelve months, leaving seventy-seven patients who had been followed clinically for a minimum of twelve months. Fifty-two patients had been followed for two years or more postoperatively, and the remaining twenty-five had been followed for between one and two years postoperatively. The mean duration of follow-up was thirty-three months (range, twelve to 120 months). Follow-up range-of-motion data were included only when the
measurements had been done at our institution with use of a large goniometer (47 cm in length, with 5.5 cm from the center axis to the increment markings) by the same surgeon (J.R.U.). Preoperatively, all patients were concerned primarily about the loss of elbow extension. Few patients also desired increased elbow flexion. Follow-up radiographs were not routinely made; they were obtained only for the patients who were experiencing pain or other symptoms, with a deviation from the standard postoperative course.

Our primary indication for surgery was a flexion contracture exceeding 20° that the patient believed affected elbow function or was related to pain. After attainment of a thorough history, performance of a physical examination and recording of the findings, and discussion of the needs and desires of the patient, the final decision to perform an elbow release through an anterior approach was based on the imaging studies of the elbow, if the plain radiographs, tomograms, or computed tomography scan revealed a relatively well-preserved ulno-
Fig. 1-C
The medial aspect of the capsule is released sharply. An approximately 8-mm-long strip of capsule is excised.

humeral joint and minimal or no osteophytes in the olecranon fossa, the patient was considered a good candidate for this procedure. Twenty-four elbows (31%) showed only mild irregularities of the ulnohumeral articulation, and the remainder were free of ulnohumeral irregularities.

The mean age was thirty-four years (range, thirteen to sixty-six years). There were fifty-four male patients and twenty-three female patients. The etiologies of the elbow contractures included fifty-one isolated fractures (seven intra-articular and forty-four extra-articular), one pure dislocation, eight ulno-

humeral and/or radiocapitellar dislocations with associated fractures, one case of primary osteoarthrosis, one case of inflammatory arthritis, one closed head injury, one brachial plexopathy, eight other cases of local trauma (two gunshot wounds and six soft-tissue injuries), one infection, and one case of osteochondrosis; the injury or disease was not specified for three patients. No patient was excluded from the final cohort because of the etiology of the contracture or because of ulnohumeral incongruity. Fifty-eight of the seventy-seven patients had undergone a total of ninety prior procedures.

Fig. 1-D
The lateral capsule is released in a similar fashion, with care taken to protect the radial nerve.
which we believed to be indicated when radiographs demonstrated a posterior bone block (i.e., an olecranon osteophyte) causing impingement, a loose body, or retained posterior hardware. All elbows with an additional posterior release were approached through a direct posterior incision with a triceps-splitting technique, with care taken to minimize local dissection. Ten patients with preoperative evidence of ulnar neuropathy underwent ulnar nerve decompression (four patients) or transposition (six patients) at the time of the index procedure. Twenty-three patients had excision of osteophytes from the coronoid (ten patients), coronoid fossa (three), olecranon tip (nine), or radial head (one). The majority (sixty-one) of the seventy-seven patients had the surgery with regional anesthesia. An indwelling catheter placed adjacent to the brachial plexus was used in twelve patients for forty-eight hours of postoperative pain management. This treatment was initiated late in the series. Although we prefer to use it, it is not always feasible as some patients refuse a block and, occasionally, the anesthesia staff cannot obtain an effective block.

Following surgical release, the upper extremity was either placed in an anterior splint (twenty-three patients) in maximum extension or treated immediately in a continuous passive motion machine (Kinetic, Charlevoix-Mezieres, France) (fifty-four patients). The typical postoperative course consisted of inpatient hospitalization for two to three days for instruction regarding use of the continuous passive motion machine and adjustment of the machine. We recommend that patients use the continuous passive motion machine for one to four weeks, depending on the severity of the preoperative contracture and our presumption of patient compliance. The patients who had the most severe contracture and who seemed most likely to neglect self-driven postoperative physical therapy were told to use the continuous passive motion machine for four weeks or more, whereas highly motivated patients with a less severe contracture utilized the continuous passive motion machine for only one or two weeks. At the time of discharge, supervised physical therapy, which was to last three to six weeks, was arranged for all patients regardless of whether they were to use the continuous passive motion machine.

A Student t test, performed with Microsoft Excel X statistical software (Redmond, Washington), was utilized to compare data between two groups (those treated with and those not treated with the continuous passive motion machine, those with and those without ulnohumeral arthritis, and different age groups). Results were considered significant when the p value was ≤0.05.

Results

The mean flexion contracture of 52° preoperatively decreased to 20° postoperatively. The mean flexion increased from 111° preoperatively to 117° postoperatively, and the mean total arc of motion increased from 59° preoperatively to 97° postoperatively, an improvement of 38°. Range-of-motion data are summarized in Figure 2.

The mean preoperative arc of motion (and standard deviation) had been 52° ± 28° (range, 0° to 100°) in the fifty-
four patients treated with continuous passive motion during the early postoperative period and 73° ± 29° (range, 20° to 150°) in the twenty-three treated with extension splitting. Postoperatively, these values improved to 96° ± 25° (mean increase, 45° ± 3°) and 99° ± 25° (mean increase, 26° ± 5°), respectively (p = 0.0076).

We found no significant difference, with the numbers available, between age groups with regard to the corrected arc of elbow motion or the amount of correction of the flexion contracture. The mean gain in the arc of elbow motion was 38.8° ± 34.1° for patients between the ages of thirteen and nineteen years, 34.2° ± 24.9° for those between the ages of twenty and thirty-nine years, and 46.1° ± 22.1° for those forty years of age or older (p = 0.6). The mean amount of correction of the flexion contracture was 35.7° ± 22.6°, 28.3° ± 13.9°, and 33.7° ± 20.6°, respectively (p = 0.27).

The mean improvement in the range of motion was 37.5° ± 3.5° in the twenty-four patients with radiographic evidence of ulnohumeral osteoarthritis and 36.9° ± 4.1° in the fifty-three without evidence of osteoarthrosis (p = 0.8).

There were eleven complications in ten patients. New symptoms of ulnar neuropathy and/or neuritis developed during the postoperative course of four patients. Three of these patients were treated with ulnar nerve transposition. The other two patients had improvement with nonoperative treatment (vitamin B12 [50 mg three times a day], elbow pads, and nonsteroidal anti-inflammatory medications). Transient radial nerve palsy developed in two patients. One of them had had an external rotation humeral osteotomy at the time of the index procedure. Paresthesias in the distribution of the superficial radial nerve developed in one patient. One patient had a posterior interosseous nerve palsy. Three months after the elbow release, this patient had a surgical exploration that revealed a neuroma in continuity with the posterior interosseous nerve. Nerve grafting was performed, but there was an incomplete return of digital extension. One patient had an avulsion of the lateral antebrachial cutaneous nerve. This patient had had a flexion contracture of 80° for seventeen years.

A deep infection developed in one patient; it resolved with administration of intravenous antibiotics and surgical irrigation and débridement. A superficial wound infection developed in another patient, and it responded to oral antibiotics. This patient had persistent pain and limitation of motion after the anterior release and later underwent interposition arthroplasty.

Thirteen patients had inferior results. Eleven of them had 0° to 10° of improvement in elbow motion, and the other two had a decrease in the overall arc of motion. No pattern with regard to age, gender, medical comorbidities, or degree or duration of contracture could be identified among these sixteen patients to predict who is at risk for inferior results.

Discussion

Prior to the 1985 report by one of us (J.R.U.) and colleagues, there were few reports in the literature on operative release of elbow contracture. In 1944, Wilson described his results following complete anterior capsulectomy and lengthening of the biceps tendon. Willner described a modified technique that included osteotomy of the medial epicondyle and reflection of the common flexor origin to allow a complete anterior capsulectomy. More recently, there have been several reports on operative release through a lateral approach, a medial approach, or a posterior approach and on arthroscopic release.

In an earlier report on anterior elbow release, fifteen patients who had been treated without a continuous passive motion machine postoperatively had an increase in the mean arc of motion from 69° (range, 48° to 117°) preoperatively to 94° (range, 19° to 114°) at the time of follow-up. In another study, eighteen patients treated with anterior release and postoperative continuous passive motion had an increase in the mean arc from 48° (range, 55° to 103°) to 96° (range, 23° to 119°). This represented a larger overall improvement in flexion and the total arc of motion with the use of a continuous passive motion machine. Breen et al. reported on the use of anterior release and continuous passive motion in three patients. The mean preoperative flexion contracture of 41° decreased to 5°. Richards et al. also reported on anterior release followed by use of a continuous passive motion machine, in a group of twenty-two patients. There was a mean increase in extension of 36°. Our experience with the adjunctive use of a continuous passive motion machine in the immediate postoperative period parallels that in those reports. The improvement in the total arc of motion was 45° ± 3° in our patients treated with a continuous passive motion machine, whereas it was 26° ± 5° in those not treated with a continuous passive motion machine; this was a significant difference of 19° (p = 0.0076).

Mansat and Morrey reported on the use of a lateral approach, between the extensor carpi radialis longus and the brachioradialis, in thirty-eight patients with a contracture secondary to extrinsic causes. This so-called column procedure involved anterior capsulectomy and capsulotomy, with posterior capsulectomy as necessary. The mean arc of elbow motion increased from 49° preoperatively to 92° postoperatively.

Husband and Hastings described their lateral approach, and Cohen and Hastings later modified it to a lateral collateral ligament-sparing technique. They performed an anterior and posterior capsulectomy through a lateral approach in twenty-two patients. The mean arc of motion of the elbow increased from 74° to 129°.

Arthroscopic elbow release was reported in 1992. Propo

nents of this technique consider it to be safe and associated with less morbidity when compared with an open release. In 1994, Timmerman and Andrews reported on nineteen patients with posttraumatic arthrofibrosis who underwent arthroscopic treatment. Mean extension improved from 29° to 11°, and mean flexion improved from 123° to 134°. Phillips and Strasburger reported on twenty-five patients with arthrofibrosis treated with arthroscopic release. The average improvement in the total arc of motion was 41°. In three elbows that were approached through an anterior incision, we found the median nerve to be imbedded in the anterior capsule as a result of severe trauma.
dislocation) and subsequent scarring. In these patients, the median nerve would be at risk during arthroscopic capsular release. Furthermore, it should be noted that the patients in the arthroscopic studies had less severe elbow contractures.

One weakness of our study is the lack of a two-year follow-up for twenty-five patients. Fearing that the presence of ulnohumeral arthritis was a risk factor for a late decline in the results, we were initially concerned about this lack of a two-year follow-up. To address this concern, we compared the results between patients examined at a minimum of twelve months but less than two years and patients examined at a minimum of two years. We found no difference between the two groups with respect to the postoperative total arc of motion of the elbow. The mean improvement in the arc of motion was $42^\circ \pm 26^\circ$ in the one-year follow up group and $38^\circ \pm 24^\circ$ in the two-year follow-up group ($p = 0.25$).

Another concern with this study is the degree of heterogeneity of our cohort. Patients with congenital elbow contracture and spasticity were excluded from the study, but fractures, dislocations, osteoarthritis, inflammatory arthropathies, closed head injury, brachial plexopathy, and other local trauma were all etiologies in our patient population. However, we believe that this degree of variability is representative of most orthopaedic practices that treat elbow disorders and thus these conclusions are generally applicable.

We believe that release of an elbow flexion contracture through an anterior incision is a safe and effective technique and that the use of continuous passive motion during the postoperative period significantly increases the total arc of motion compared with that associated with splinting alone.

**Appendix**

A table showing patient demographics and elbow range-of-motion data for each of the patients is available with the electronic versions of this article, on our web site at jbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM).

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