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Open Elbow Arthrolysis for Post-traumatic Elbow Contracture

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Abstract

Background: Post-traumatic contracture is a common complication after elbow trauma. If conservative therapy fails to restore adequate elbow motion, arthrolysis is indicated. The purposes of this study were to evaluate the clinical outcome of open arthrolysis for post-traumatic elbow contracture and to determine factors influencing the outcome.

Methods: Twenty-seven patients with post-traumatic elbow contracture were followed-up after open arthrolysis for at least 12 months. Before surgery, the mean limitation in extension was 30° and the mean maximum flexion was 83°. A posterior surgical approach was used in 18 patients, and a lateral approach was employed in nine patients. Using the posterior approach, the fibrotic posterior capsule was excised and the ulnar collateral ligament was split. Both the anterior and posterior capsules were released with a lateral approach.

Results: The mean flexion increased from 83° to 121°, but the mean extension improved little from -30° to -26°. The mean flexion-extension arc increased from 53° to 95°. According to the elbow evaluation score by the Japanese Orthopaedic Association, both pain and function scales improved significantly. By Hertel's subjective evaluation, the results were good in 13 patients, fair in ten patients, and poor in four patients. Twenty-three patients (85 percent) were satisfied with the results, but four were not satisfied because of residual contracture. These poor results were related to severe soft tissue trauma, residual displacement of intra-articular fragments, and recurrence of heterotopic bone formation.

Conclusions: Tendon lengthening of stiff triceps, accurate reduction of intra-articular fragmens, and sharp epiperiosteal resection around the heterotopic bones are essential procedures of open arthrolysis to restore adequate motion in post-traumatic elbow contracture.

Introduction

Post-traumatic contracture is a common complication after elbow trauma. It may result from a variety of causes, including contractures of the capsule or ligaments, heterotopic bone formation, intra-articular adhesions, incongruity of the articular surface, and loss of articular cartilage (1, 2). Many contractures can be treated initially with physical therapy and static or dynamic splinting. When conservative management fails, arthrolysis is indicated (1, 5). In this study, we reviewed 27 patients with post-traumatic elbow contracture treated by open arthrolysis and investigated the factors influencing the clinical outcome.

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Patients and methods

Between 1994 and 2005, 27 patients with post-traumatic elbow contracture underwent open arthrolysis in our institute, and were followed-up for 12 to 37 months (mean, 18 months). Eighteen patients were men and nine were women. The mean age was 42 years (11 to 80). An operation was indicated if there was flexion contracture of at least 40° or the active flexion was less than 110° (1) after conservative treatment. The time from injury to operation was varying from four to 144 months (mean, 14 months). Nineteen patients had been initially treated elsewhere and eight patients at our institute.

The primary injury to the elbow was an intra-articular fracture of the distal humerus in nine patients, an olecranon fracture in six, a fracture-dislocation in five, a supracondylar fracture in three, a radial head fracture in two, an ulnar collateral ligament injury in one, and an open fracture of the olecranon and the radial head in one. Previous treatments had included open reduction and internal fixation of the fracture in 21 patients, casting in three, closed reduction in one, traction in one, and radial head excision in one. In six patients, preoperative radiographs showed heterotopic bone formation around the elbow. Radiographs showed a malunion of the distal humerus in two patients, a nonunion in four, a delayed union in two, and traumatic arthritis of the elbow in one.

Extension, flexion, pronation, and supination were measured by a goniometer. The mean limitation in extension was 30° (zero to 50), the mean maximum flexion was 83° (30 to 120), the mean pronation was 62° (20 to 100), and the mean supination was 74° (zero to 100) before surgery. Eight patients had no elbow pain, whereas eight had motion pain, and eleven had continuous pain before surgery.

Operations were performed under brachial plexus block or general anesthesia with an air tourniquet applied. The operations were aimed to restore motion during an arc of 20° to 120° of flexion. A posterior surgical approach was used in 18

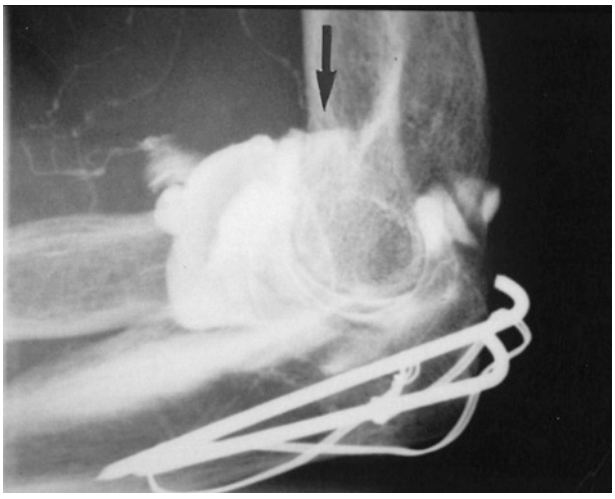

Figure 1 A Elbow without adhesion of the anterior capsule. Arthrogram of the elbow showed infiltration of contrast medium to the coronoid fossa (arrow), which means no adhesion of the anterior capsule.

patients in which preoperative arthrogram of the elbow showed no adhesion of the anterior capsule (6) (Fig. 1A). The ulnar nerve was exposed and protected, and medial and lateral margins of the triceps tendon were split. The fibrotic posterior joint capsule and periarticular adhesions were released, and the olecranon and its fossa were cleaned. The fibrotic ulnar collateral ligament was split except for the anterior cord portion (5). If adequate motion of at least 20° to 120° of flexion could not be achieved and the anterior capsule looked fibrotic, it was exposed and released by splitting the anterior margin of the lateral collateral ligament with an additional lateral approach. Other procedures included lengthening of the triceps tendon in five patients, excision of the heterotopic bones in five, open reduction and internal fixation of the humeral condylar fragment with bone grafting in four, metal removal in three, and nerve suture for the torn ulnar nerve in one. A lateral approach was employed in nine patients whose arthrograms of the elbow showed an adhesion of the anterior capsule (Fig. 1B). The tissue between the anconeus and extensor carpi ulnaris, and the lateral collateral ligament were split, and the anconeus and triceps were reflected posteriorly to release the triceps tendon and debride the olecranon and its fossa. The brachioradialis and extensor carpi radialis were released from the humerus exposing the anterior capsule. The fibrotic anterior capsule was released and the coronoid and radial fossae were debrided. In one patient, both the lateral and medial approaches were used and open reduction and internal fixation of the humeral condylar fragment with bone grafting was performed. Other procedures included metal removal in two, excision of the heterotopic bones in one, excision of the radial head in one, and osteotomy of humeral lateral condyle in one. A drain tube was inserted and a plaster splint was applied to the elbow in a 90° flexed position after operation.

In all patients, isometric flexion-extension exercise was started on the day after surgery, and active and passive motion with slow stretching of the elbow were be-

Figure 1 B Elbow with adhesion of the anterior capsule. Arthrogram revealed no infiltration of contrast medium to the cornoid fossa (arrow), which means an adhesion of the anterior capsule.

gun on the fourth postoperative day. Aggressive manipulation was not undertaken, and a continuous passive motion device or dynamic brace was not used. A splint was worn for three weeks after operation and out-patient physical therapy was continued two to three times per week for four weeks.

We assessed the elbow condition with an elbow evaluation score by the Japanese Orthopaedic Association (7) before and after operation. This method evaluated pain (30 points), function (20 points), and motion (30 points). Total score was 80 points. Pain was scored as 30 points (none) to zero (severe). The function scale included activity of daily living (12 points) and muscle power (8 points). The motion scale involved flexion and extension (22 points) and forearm rotation (8 points). The post-operative elbow condition was evaluated using a subjective method by Hertel et al. (8) and characterized as satisfactory (good), acceptable for daily use including work (fair), or unsatisfactory (poor). The differences between the pre- and post-operative outcome for the range of motion and evaluation scale were analyzed with a Student's t-test for paired samples. A P-value less than 0.05 was considered statistically significant.

Results

The mean flexion showed a significant increase from 83° (SD 24°) to 121° (SD 11°) ($p<0.001$), and the mean intra-operative range of flexion was maintained at the time of the follow up (Fig. 2). However, the mean extension improved little from –30° (SD 14°) to –26° (SD 15°), and the mean intra-operative range of extension showed a decrease at the time of the follow up (Fig. 3). The mean flexion-extension arc increased significantly from 53° (SD 17°) to 95° (SD 21°) ($p<0.001$). The mean pronation increased from 62° (SD 25°) to 73° (SD 17°) and the mean supination also improved from 74° (SD 27°) to 80° (SD 23°). There were no significant differences between the pre- and post-operative range of pronation and range of supination. In nineteen patients with preoperative elbow pain, there was no pain in ten patients and it decreased in nine after surgery. The mean pain scale increased significantly from 24.1 points to 28.3 points ($p<0.001$) and the mean function scale improved from 14.1 points to 18.9 points ($p<0.001$). The mean motion scale increased from 12.6 points to 19.8 points, and the mean postoperative total score was 67.1 points, an improvement of 16.2 points compared with the preoperative score ($p<0.001$). According to the subjective evaluation by Hertel et al. (8), the results were good in 13 patients, fair in ten patients, and poor in four patients. Twenty-three patients (85 percent) were satisfied with the results, but four were not satisfied because of residual contracture. In these dissatisfied four patients, post-operative mean extension was –37° and the mean flexion was 102°, and the mean flexion-extension arc was 65°. Flexion-dependant sensory dysfunction of the ulnar nerve was observed in four patients, and it was resolved after neurolysis surgery in all four patients. No infections or vascular complications occurred.

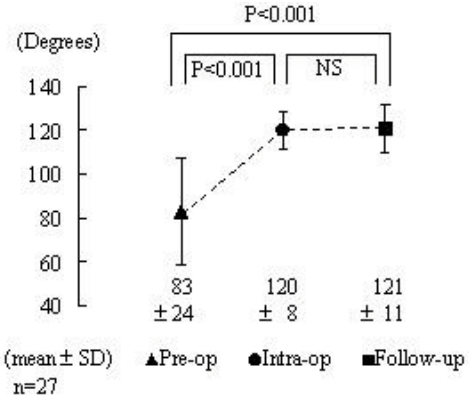

Figure 2. Change in flexion. The mean flexion had increased significantly from 83° to 121°, and mean intra-operative range of flexion was maintained at the time of follow up.

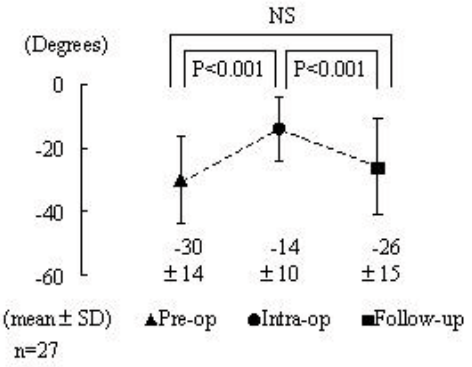

Figure 3. Change in extension. The mean extension improved little from –30° to –26° and mean intra-operative range of extension had decreased at the time of follow up.
(pre-op=pre-operative range of motion; Intra-op=intra-operative range of motion; Follow-up=range of motion at follow up; NS=not significant)

Discussion

Arthrolysis for post-traumatic elbow contracture is indicated when function is severely impaired due to limited motion and conservative management has failed. An arc of motion from 30° short of full extension to 120° of flexion (90° of motion) is considered essential for activities of daily living (2). Therefore we operated on our 27 patients to restore motion of at least 20° to 120° of flexion. With regards to the timing of surgery, the effect of conservative therapy is not expected after five months or more since the initial injury (6). The operation should wait until the radiological margin of heterotopic bone formation is clearly defined and signs of inflammation have been resolved (9, 10). Therefore, we considered the timing of surgery as four months or more after initial injury (6).

The surgical approach is based on many factors including the location of heterotopic bone formation, severity of contracture, and the location of a capsulo-ligamentous stiffness (1, 10). We determined the surgical approach and procedure by checking the severity of adhesions of the anterior capsule on the elbow arthrogram (6). As the cause of the contracture was located posteriorly in most patients (1), a posterior approach was usually employed. Using the posterior approach, we were able to excise the fibrotic posterior joint capsule, split the fibrotic ulnar collateral ligament, and lengthen the triceps tendon. If adequate motion could not be gained, the anterior capsule was released by splitting the anterior margin of the lateral collateral ligament with an additional lateral approach. We used a lateral approach for patients who showed adhesions of the anterior capsule by preoperative arthrogram. One of the advantages of the lateral approach is the ability to manage both the anterior and posterior joint surfaces through one incision (3, 4).

The mean improvement in flexion-extension arc was 42° in our series, which was almost similar to that of previous reports (3, 8, 9). The mean flexion had increased significantly, and the mean intra-operative range of flexion was maintained at the time of the follow up. However, the mean intra-operative range of extension had decreased at the time of the follow up. An arc of motion from 30° short of full extension is regarded as essential for activities of daily living (2), consequently the postoperative mean extension was thought to improve little (9). In our series, the mean flexion increased greatly from 67° to 124° in five patients by lengthening the triceps tendon, which indicated that lengthening was an essential procedure to restore adequate flexion in patients with stiff triceps (1). Concerning the elbow pain associated with the contracture, ten patients showed no pain and nine patients showed decreased pain after surgery. However, residual mild pain did not influence the subjective evaluation. The relief of pain was probably attributable to the removal of bony and soft tissue impingement within the joint. Excision of the fibrotic capsule may also lead to a partial denervation of the elbow (3).

We had four patients who were dissatisfied with the results because of residual loss of elbow motion. These poor results were thought to be caused by severe soft tissue trauma associated with a delayed union of the distal humerus, failed congruency of the ulno-humeral joint due to residual displacement of the intra-articular fragments, and recurrence of heterotopic bone formation. Failed congruency of the ulno-humeral joint results in recurrence of joint adhesion and loss of elbow motion (5), and accurate restoration of the shape of the ulno-humeral and radio-humeral joints gives resistance to biomechanical stresses (11). Park et al. (10) reported that the mean final arc of movement was slightly greater in patients without than in those with intra-articular injury. Similarly, our patients with accurate restoration of the ulno-humeral joint with reduction of the intra-articular fragment restored sufficient motion. Therefore, accurate reduction of intra-articular fragments is thought to be necessary to restore adequate elbow motion. In five of six patients with preoperative heterotopic bone formation, no recurrence of heterotopic bone formation occurred because of epiperiosteal resection of bones. To prevent recurrence of heterotopic bone formation, sharp epiperiosteal resection should be done around the clear margin of the heterotopic bones (1, 8). The use of indomethacin may also have contributed to the low recurrence rate (3, 8), but its effect is still undetermined (8). We believe that accurate reduction of intra-articular fragments, sharp epiperiosteal resection around the heterotopic bone, and lengthening of the triceps tendon are essential procedures to restore adequate motion of the elbow.

Postoperative physical therapy is very important to minimize the loss of movement acquired at operation. Previous studies reported the usefulness of the continuous passive motion device (5, 8), intermittent dynamic elbow bracing (3, 5), and night splinting (10). However, the device, bracing, or splinting is thought to be troublesome for some patients. Thus, we consider that isometric flexion-extension exercise and active and passive motion with slow stretching of the elbow in an early postoperative stage are most important in postoperative physical therapy (1, 6).

In our series, initial articular injury seemed to have healed and no more marked

loss of articular cartilage was observed at operation. If more than half of the articular surface of the elbow is damaged and is not covered by hyaline cartilage, or if intra-articular adhesions avulse portions of the articular cartilage as the elbow is moved, distraction arthroplasty combined with fascial interposition (2) is thought to be indicated.

In recent years, arthroscopy has been proposed as treatment for post-traumatic elbow stiffness (12, 13). However, arthroscopic treatment is not recommended in cases of severe fibrosis or contracture (13) because a stiff elbow capsule has considerably less capacity and compliance than a capsule in a normal elbow, thus increasing the potential for neurovascular injury in elbow arthroscopy (14).

Acknowledgments

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