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Clinical Outcomes After Posterior Open Elbow Arthrolysis for Posttraumatic Elbow Stiffness

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Background: Loss of motion is a well-known complication after elbow trauma and in severe cases, arthrolysis of elbow is the procedure of choice. The posterior approach might have some advantages especially in post-traumatic patients who have undergone the same surgical approach in the past.

Objectives: The aim of this study was to evaluate the short-term outcomes of elbow arthrolysis through posterior approach. Moreover, we assessed the effect of operation on the patients' quality of life.

Patients and Methods: During a retrospective-cohort study, the medical records of 14 patients (12 men, two women) whose range of movement had been limited post-traumatically and had undergone elbow arthrolysis with posterior approach were reviewed. Before intervention, the patients had a flexion less than 100 degrees or an extension lag of 30 degrees or more. For evaluation of the final outcomes, they were invited to participate in our study and the final range of motion, visual analogue score (VAS), disability of arm, shoulder and hand (DASH), Mayo elbow score (MES) and short form health survey (SF-36) scores were measured in the patients.

Results: Mean age of the participants was 28.7 years. The interval from initial injury and arthrolysis was 16 months and the patients were followed for 14 months. The mean range of motion in patients before surgery was 35.8 degrees, which was increased to a mean of 108.9 after the surgery, indicating a 73.1 degrees improvement. The means of VAS, DASH, Mayo elbow and SF-36 scores in the patients were 1.6, 34, 68 and 43, respectively. A significant inverse correlation was found between the preoperative range of motion and final range of motion.

Conclusions: According to our results, elbow arthrolysis through posterior approach could be an effective technique with low complications. Since the final range of motion improved significantly, it might be a valuable method in promoting the patients' quality of life.

Keywords: Elbow; Stiffness; Release; DASH

1. Background

Loss of motion is a well-known complication after elbow trauma (1-4). After internal fixation of the intercondylar distal humerus fractures, one-third of the patients fail to regain the functional range of motion (1-3, 5, 6). After atraumatic event, changes in intra-articular parts of the elbow joint as well as intra or extra adhesions may lead to post-traumatic stiffness (7-10). A mild elbow flexion contracture is not always problematic, but contractures of more than 30 degrees, not only are aesthetically unacceptable but also affect the elbow's function as well (4, 10-13). Different approaches are used for open arthrolysis of stiff elbow (6, 7, 14-18). Among them, the posterior approach might have some advantages especially in post-traumatic patients, who have undergone the same surgical approach in the past. Using the posterior approach, triceps muscle, which is considered the most important cause in post-opera-

tional adhesion formation, could bead-dressed easily (4, 7, 10). In the posterior approach, the manipulation of the anterior elements is minimal, so neurovascular complications will be reduced (6, 7, 14). It also provides a better accessibility to the medial and lateral posterior elements and makes it easier to remove the previous devices. The superior radio-ulnar joint is accessible in this approach and it makes it possible to release the intra-articular adhesions that limit the elbow range of motion (7, 19).

2. Objectives

In the current study, we evaluated the short-term outcomes of elbow arthrolysis through posterior approach. Moreover, we assessed the effect of operation on the patients' quality of life.

3. Patients and Methods

3.1. Population

In a retrospective-cohort study, the medical records of 14 patients (12 men and two women) with traumatic elbow stiffness were reviewed. After that, they were invited to participate in our study to evaluate the final outcome. Prior to undergoing arthrolysis via posterior approach, all patients had elbow joint stiffness secondary to previous surgical intervention via posterior approach, or posterior heterotopic ossification (Table 1). Inclusion criteria for the study included the flexion-extension range of motion less than 100 degrees or an extension lag of more than 30 degrees. The patients with active infection, severe joint arthritis, or heterotopic ossification in anterior elbow were excluded from the study. This study was approved by the Research Committee at Mashhad University of Medical Sciences, and all patients signed a consent form for the surgery and follow-up study (MUMS Project 89264).

3.2. Clinical Parameters

We followed up all the patients up to a year after the index surgery. All data from the examinations and interviewing of the patients were recorded in a data bank. Each patient's range of motion was recorded before and after surgery in the final follow-up visit. For final assess-

ment we used the visual analogue score (VAS), disability of arm, shoulder and hand (DASH) score, Mayo elbow score and short-form health survey (SF-36).

3.3. Surgical Technique

All the patients underwent surgery in the lateral decubitus position through posterior approach. Skin incision was started postero-medially, from distal one-third of the humerus to 5 cm distal to the olecranon tuberosity. After opening the fascia, we exposed the triceps muscle completely and decompressed the ulnar nerve. If there was any concern about subluxation, or excessive tension on the ulnar nerve, we transposed the nerve anteriorly. We released the triceps muscle adhesions from medial and lateral and also from the distal end of the arm. Subsequently, we separated the articular capsule from the olecranon tuberosity to release intra-articular arthrofibrosis. If there was any implant in situ from the primary surgery, we removed it at the time of arthrolysis. In the patients with myositis ossificans, we removed the mass as much as it does not interfere with the range of motion. If the appropriate range of motion was not achieved, the articular capsule was opened and the adhesions of the collateral ligaments were released and the range of motion was also revised again. To achieve the complete extension, we evacuated the olecranon fossa and removed the tip of the olecranon. After placing a suction drain,

Table 1. Results of 14 Patients with Elbow Stiffness Treated With Arthrolysis (Fx = Fracture)

Case	Age	Gender	First Pathology	Interval Between Primary Injury-ARTHROLYSIS (Mon)	Pain	Pre-OPERATION ROM	Post-Operation ROM	STABILITY	VAS Score	Mayo Score	DASH Score	SF-36 Score
1	31	male	intercondylar fx	17	moderate	50	110	stable	5	60	64	35
2	47	female	intercondylar fx	20	moderate	60	100	stable	5	60	48	45
3	33	male	proximal ulna + radial head fx	8	severe	10	120	stable	7	45	12	43
4	44	male	intercondylar fx	14	mild	10	140	stable	3	60	74	39
5	32	male	intercondylar fx	12	mild	40	110	stable	1	60	16	53
6	15	female	supracondylar fx	3	no pain	50	105	stable	0	75	10	45
7	25	male	proximal ulna + radial head fx	18	no pain	30	60	stable	0	65	74	36
8	25	male	myositis ossificant	40	no pain	0	120	stable	1	65	43	40
9	26	male	intercondylar fx	18	moderate	40	120	stable	0	55	40	30
10	24	male	supracondylar fx	17	no pain	50	140	stable	0	85	6	50
11	25	male	proximal ulna + radial head fx + infection	14	no pain	20	40	stable	0	70	36	43
12	35	male	intercondylar fx	12	no pain	65	110	stable	0	75	39	40
13	24	male	intercondylar fx	18	no pain	50	110	stable	0	80	10	57
14	26	male	myositis ossificant	27	no pain	30	140	stable	0	100	0	53

Table 2. Pre and Post Operation Range of Motion in Patients with Elbow Stiffness Undergone Arthrolysis^a

	Extension Lag	Maximal Flexion	Total Range of Motion
Before operation	53 ± 59	88 ± 60	36 ± 41
After operation	21 ± 39	129 ± 46	109 ± 59
Pair t-test	P < 0.001	P = 0.001	P < 0.001

^a Data are presented as Mean ± SD.

Table 3. Different Scores of SF-36 Domains in Normal Population Compared with Patients Underwent Elbow Arthrolysis^a

	Physical Function	Physical Role	Body Pain	General Health	Vital	Social Function	Emotional Role	Mental Health
Patients	48 ± 8	38 ± 13	47 ± 10	46 ± 8	54 ± 8	42 ± 10	39 ± 15	38 ± 13
Normal population	55	50	48	55	63	66	63	67
P value	0.007	0.004	0.785	0.002	0.001	> 0.000	> 0.000	> 0.000

^a Data are presented as Mean ± SD.

we repaired the incision in routine fashion. At the end of the surgery, the resulted degree of extension and flexion were documented. The drain was removed after 24 hours and postoperative range of motion exercises were started under the supervision of physiotherapist on the second postoperative day.

3.4. Statistical Analysis

SPSS 16 was applied for statistical analysis. Descriptive analysis of the demographics was performed. Relation between variables was tested using two-sided student's t-test with statistical significance set at 0.05 (α = 0.05). To find a correlation between the continuous variables, we used Pearson correlation test. Since the number of our patients was limited, we did not use multivariable analysis.

4. Results

A total of 14 patients (10 men and 4 women) underwent posterior arthrolysis of the elbow and none of them were excluded from the study. The average age of the patients was 28.7 years old (range 15 to 47 years old). The interval between initial injury and arthrolysis was 16 months (range 3 to 40 months). The patients were followed for 14 months (range, 12 to 17 months) after surgery. Among the patients, seven had a history of intercondylar fractures of distal humerus, which had been managed with open reduction and internal fixation. Three patients had undergone surgery because of the olecranon and radius neck fractures. Two patients had posterior heterotopic ossification as the consequence of blunt head trauma. The other two patients had a supracondylar fracture of the humerus. All patients had stable elbows after operation. On the last visit, one patient expressed severe pain during elbow range of motion, three expressed moderate pain, two had mild pain, and eight had no pain during daily activities. The average VAS score was 1.6 (range, 0 to 7) during the last visit (Table 1) the mean flexion-extension arc

improved to 73.5 degrees. More dilatations are demonstrated in (Table 2). After operation the mean of DASH and Mayo elbow scores were measured 33.7 and 68, respectively. According to the Mayo elbow score, seven patients were rated as excellent (50%), two as good (14.3%), three as fair (21.4%), and 2 as poor (14.3 %). Among those with excellent outcomes, two patients underwent distal humerus osteotomy in addition to arthrolysis. One of the patients suffered from chronic proximal ulnar osteomyelitis that completely resolved after one session of debridement and antibiotic therapy. No refractures were noted in our series. Based on SF-36 questionnaire, the different domain scores were as follow: physical functioning was 48, physical role functioning 38, bodily pain 47, general health 46, vitality 54, social role functioning 42, emotional role functioning 39, and of mental health was 38. Total score for SF-36 was 43. All the scores except body pain domain were less than those of normal population (Table 3). No significant correlation was found between the changes in the range of motion and age or other scores (VAS, DASH, Mayo and SF-36 scores). We only found a significant inverse correlation between the preoperative arc of motion and final one (P = 0.037, r = -0.58). Moreover, there was a significant correlation between VAS score and age as well (P = 0.011, r = 0.66).

5. Discussion

Posttraumatic stiffness and range of motion loss is common and troublesome for both patients and surgeons. Intra- and extra-articular malunion and nonunion may cause pain, instability, and limitation of the elbow function. Post-traumatic and post-operative immobilization of the elbow for long periods could lead to adhesions and contractures of intra- and peri-articular elements (9, 14). In our study, after posterior elbow arthrolysis, the range of motion increased significantly. No instability was noted and most of our patients were pain free during daily

activities. Hand and upper extremity functions improved as well as the overall quality of life. In our study, we used posterior approach for all the patients. There are several surgical techniques for arthrolysis of a stiff elbow, among which lateral and posterior approaches are more common (4, 7, 13, 17). Breborowicz et al. (14) compared four different approaches of lateral, medial, posterior and lateral-medial with each other. After following up of 100 patients for 60 months, they could not find a significant difference between the four groups and concluded that the decision should be made by a surgeon according to his/her experience. The range of motion gained in this study was 38 degrees that was inferior than our results. Our results were shown more improvement in the range of motion compared with that of Sharma and Rymaszewski study as well (20). We chose the posterior approach since the medial lateral, and posterior elements of elbow are easily accessible with this approach, and the articular capsule can easily be opened in this way. This approach also reduces the damage to the surrounding neurovascular elements (4, 7, 13). Elbow stiffness can limit patients' daily functions despite having normal functions of the shoulder, arm and hand. Seventy-nine percent of our patients achieved a range of motion of more than 100 degrees. Similarly, Koh et al. reported the same improvement in range of motion in 72% of their patients after arthrolysis of intercondylar fractures using posterior approach (3). Weizenbluth et al. gained the range of motion of more than 100 degrees in 11 out of 13 patients (85%) via extended lateral approach and this rate was 72% in Swaroop et al. series via posterior approach (21, 22). Bhattacharya in a 15-year follow-up study reported 65% of the patients gained more than 100 degrees of flexion-extension range of motion via combine medial and lateral release (23). It seems that it is possible to achieve considerable range of motion following different approaches. However, Breborowicz et al. (14) could not achieve a 100 degree range of motion in any of their eight patients who underwent arthrolysis via posterior approach. The most important factor that predicts final range of motion is the maximum arc of motion achieved at the time of operation (2). Severity of primary stiffness is another factor affecting the outcome. Patients with more severe motion restriction benefit more from this operation (14, 15, 24). Our study supports these results as well. Age and sex do not affect arc of motion (14, 18, 20, 25). There are some concerns about the loss of the gained motion with time. In the study by Breborowicz et al. (14) the arc of motion measured at the final follow-up was 86% of what was obtained intraoperatively. The extension was affected more than the flexion with time (14, 16). The means of DASH and Mayo scores were 33.7 and 68, respectively and the range of motion increased 73.5 degrees. The average Mayo score in Swaroop et al. study was reported 95, which shows more functional elbow motion in their series (22). In a recent systematic review of 21 studies with a total of 637 patients, open arthrolysis increased the final range of motion as high as 51 degrees (26). Koh et al. used

posterior approach for stiffness after an intercondylar fracture fixation and achieved the final range of motion of 45 degrees and Mayo elbow score of 87 (6). Heirweg et al. (13) reviewed the results of surgical arthrolysis of elbow in 16 patients with the mean follow-up of 47 months. Their study showed that total arc of motion improved from 47 degree to 87 degrees, and the DASH score increased significantly (13). Gosling et al. evaluated the range of motion of 59 patients who underwent arthrolysis of the elbow 53 months after surgery (12). Before surgery the mean flexion-extension arc was 46 degrees. These patients underwent posterior capsule release, in addition to anterior release. The mean improvement of flexion-extension was 59 degrees and the final mean range of motion was 105 degrees (12). In a study by Cikes et al. (4) patients were evaluated at an average of 16 months after open elbow arthrolysis for posttraumatic stiffness (11). The mean total increase in the range of motion was 40 degrees (13 to 112 degrees), with a mean gain in flexion of 14 degrees (0 to 45 degrees) and 26 degrees in extension (5 to 67 degrees) (11). Other studies released the elbow stiffness via different approaches reported the excessive flexion-extension gain of 50 to 68 degrees 24-26. Complication rate has been reported to be as high as 23% in open arthrolysis (26). Refracture is an important complication after post-traumatic release with hardware removal. While we did not have any refractures in our series, it has been reported to occur in up to 25% in some studies (6). Elbow instability followed by arthrolysis is not common, but it can affect the final outcome seriously. Swaroop et al. using posterior approach for arthrolysis and only reported one patient with elbow instability out of 25 patients. We had not elbow instability in our series. There were some limitations to our study. First, our study was retrospective. Our population was limited to 14 patients and one center. We did not have access to pre-operative data such as pain, VAS score, DASH score and SF-36. We only expressed the posterior arthrolysis results and we did not use control groups for other surgical approaches. Our follow-up period was limited to 14 months. Our study showed that arthrolysis improves the flexion-extension arc twice as much as the preoperative range. Considering the limitations of this study, we concluded that arthrolysis via posterior approach is a helpful technique to remove the contracture of elbow. Due to the minimal complications of this technique, it could be recommended as a standard technique for elbow arthrolysis. According to our results, elbow arthrolysis through posterior approach could be an effective technique with low complications. Since the final range of motion improved significantly, it might be a valuable method in promoting the patients' quality of life.

Authors' Contributions

Ali Birjandi nejad, Mohamad Hosein Ebrahimzadeh and Ali Moradi all were involved in the study design, selection of the patients for surgery, doing the procedure, follow-

up of the patients, data analysis, drafting of the paper and final approval.

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