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ORIGINAL ARTICLE / ARAŞTIRMA YAZISI

Orthopedics and Traumatology / Ortopedi ve Travmatoloji

Long-Term Results of Open Arthrolysis for Elbow Stiffness

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ABSTRACT

Purpose: Stiff elbow is a common upper extremity problem which can limit patients' daily life activities. The purpose of this study was to evaluate the long-term outcomes of open arthrolysis for stiff elbow. Our hypothesis was that open arthrolysis would yield good functional results and patient satisfaction.

Methods: This retrospective study assessed 110 patients who underwent surgery for stiff elbow in a single institute between 2003-2012. Twenty-four of the patients who underwent open arthrolysis without heterotopic ossification excision and minimum followed up for 24 months were included in this study. All patient's surgical procedure, ulnar nerve and radial head management, preoperative and postoperative ranges of elbow motion and complications were noted. Functional outcomes were evaluated with Quick-DASH and Mayo Elbow Performance score (MEPS).

Results: The mean age of the patients was 36.1 years at the time of open arthrolysis and mean follow-up period was 50.6 months. The mean preoperative flexion–extension arc increased form 52.4° to 96.5° and preoperative supination–pronation arc increased form 103.3° to 137.8°($p<0.05$). The mean MEPS score was 81.6 and the Q-DASH score was 6.3. Complication occurred in 9 patients (37.5%) and 4 patients required additional surgery.

Conclusion: Open arthrolysis is an effective treatment method for stiff elbows, with reliable long-term functional outcomes. The complication rates are high; however, they are generally minor and temporary.

Keywords: Stiff elbow, open arthrolysis, ulnar nerve

Dirsek Sertliğinde Açık Kapsüler Gevşetmenin Uzun Dönem Sonuçları

ÖZET

Amaç: Sert dirsek hastaların günlük yaşam aktivitelerini kısıtlayabilen ve sık karşılaşılan bir üst ekstremite patolojisidir. Çalışmamızın amacı sert dirsek hastalarında uygulanan açık kapsüler gevşetme yönteminin uzun dönem sonuçlarını değerlendirmekti. Hipotezimiz, açık kapsüler gevşetme ile başarılı fonksiyonel sonuçlar ve hasta memnuniyeti elde edebileceğimizdi.

Yöntem: Bu retrospektif çalışmada, 2003-2012 yılları arasında tek bir merkezde sert dirsek tanısı ile ameliyat edilen 110 hasta incelendi. Heterotopik ossifikasyon eksizyonu yapılmadan yalnızca açık kapsüler gevşetme uygulanan ve minimum 24 ay süre ile takip edilen 24 hasta çalışmaya dahil edildi. Bütün hastalara uygulanan cerrahi prosedür, ulnar sinir ve radius başı yönetimi, preop ve postop dirsek hareket açıklıkları not edildi. Fonksiyonel sonuçlar Mayo Dirsek Performans Skoru (MEPS) ve hızlı DASH (Q-DASH) skorları ile değerlendirildi.

Bulgular: Hastaların açık kapsüler gevşetme yapıldığı sıradaki yaş ortalaması 36.1 yıldı. Ortalama takip süresi 50.6 aydı. Hasaların ortalama preop fleksiyon-ekstansiyon hareket arkı 52.4°'den 96.5°'ye yükselirken, ortalama preop supinasyon-pronasyon hareket arkı 103.3°'den 137.8°'ye yükseldi ($p<0.005$). Ortalama MEPS skoru 81.6 ve Q-DASH skoru 6.3 bulundu. Hastaların dokuzunda (%37.5) komplikasyon gelişti ve bu hastaların dördünde ek cerrahi girişim uygulandı.

Sonuç: Açık kapsüler gevşetme sert dirsek hastalarında uygulanan, güvenilir uzun dönem sonuçları olan etkili bir tedavi yöntemidir. Komplikasyon oranı yüksek olmakla beraber bu komplikasyonlar genellikle geçici ve yönetilebilirdir.

Anahtar Kelimeler: Sert dirsek, açık kapsüler gevşetme, ulnar sinir

Elbow function is crucial for activities of daily living. Flexion is more important than extension for activities such as eating, washing hair, and using cell phones. Morrey et al. (1) defined a functional elbow arc between 30° and 130° of flexion-extension which is sufficient for most daily activities. A reduced of range of motion of the elbow joint under 30°–130° in the flexion-extension arc, and 50°–50° in the supination-pronation arc is defined as stiff elbow.

The elbow joint is particularly prone to stiffness owing to its complex anatomy (2). The presence of three articulations, congruent skeletal anatomy, collateral ligaments stability, and a close relationship of the muscles with the capsule makes the elbow prone to stiffness (3). Morrey (4) classified the causes of elbow stiffness as intrinsic, extrinsic or mixed. Intrinsic factors are intra-articular fracture, malunion, and adhesions, as well as cartilage damage. Extraarticular malunion, heterotopic ossification (HO), joint capsule contracture, and soft tissue contractures are the main extrinsic factors. Generally, elbow stiffness occurs as because of both intrinsic and extrinsic factors.

Treatment for stiff elbow should be decided after careful evaluation of the patient's elbow function and expectations. All causes of elbow contracture should be addressed before treatment. Conservative treatment such as early rehabilitation and progressive splinting should be considered, especially in elbow stiffness due to extrinsic factors (5, 6). If nonoperative treatment fails after 3-6 months or if the patient has heterotopic ossification or malunion, surgical treatment should be considered. Several surgical methods have been described in the literature, including open arthrolysis (7), arthroscopic capsular resection (8), heterotopic ossification excision (9, 10), distraction interposition arthroplasty (11) and total elbow arthroplasty (12).

Although there is a tendency towards arthroscopic surgery in orthopedics, open arthrolysis is still the initial treatment choice for stiff elbow, especially in patients who had previous elbow surgery, need for hardware removal, ulnar nerve problems, osteoarthritis, or heterotopic ossification. The purpose of this study was to evaluate the long-term outcomes of open arthrolysis for stiff elbow. We hypothesized that open arthrolysis would yield good functional results and patient satisfaction.

Materials and Methods

The medical records of patients who underwent surgery for stiff elbow at a single institute during 2003-2012 years were retrospectively reviewed. A total of 110 patients were identified, who underwent arthroscopic release, open arthrolysis or heterotopic ossification excision procedures. Patients who had undergone open arthrolysis without HO excision, were older than 18 years, and had a minimum of 24 months of follow-up were included in the study. Patients with elbow instability, severe arthrosis, heterotopic ossification, or severe deformities were excluded. We identified 24 patients eligible for the study. The patients' demographic data, initial injury, initial treatment method, surgical procedure, ulnar nerve and radial head management, and complications were noted. All patients' preoperative and postoperative ranges of elbow motion were measured using a goniometer. To evaluate functional outcomes the Quick-DASH and Mayo Elbow Performance Score (MEPS) were used at the last visit.

Surgical Technique

All patients underwent surgery under general anesthesia, and a supraclavicular catheter was applied for postoperative analgesia and physiotherapy. The patients were placed in the supine position, and a sterile tourniquet was placed. To determine the surgical approach prior surgeries and main pathology of the stiffness were considered. A lateral approach or a combination of medial and lateral approaches was used. First, the radiocapitellar joint was exposed using a lateral Kocher approach. The lateral ulnar collateral ligament was preserved. The brachialis was released from the anterior capsule. An anterior capsulectomy was performed. Loose bodies or osteophytes of the coronoid were excised and the coronoid fossa was debrided. Radiocapitellar joint debridement or radial head excision was performed if rotational movements were also restricted. Posterior capsulectomy was performed. The tip of the olecranon and olecranon fossa were debrided and osteophytes were excised.

If an adequate range of motion was regained (Fig. 1) and the patient did not have any symptoms of preoperative ulnar neuropathy, the operation was finalized. Otherwise, a medial release was performed. First, the ulnar nerve was released and posteromedial capsulectomy was performed. The posterior bundle of the medial collateral ligament was then released. After all releases were completed, hardware removal was performed if necessary. The elbow was tested for instability. Then the tourniquet was deflated, and an intra-articular drain was placed after hemostasis.

After wound closure, the patients' elbow was held in extension with an anterior long-arm splint. All operations were performed by two experienced shoulder and elbow surgeons at a single institution.

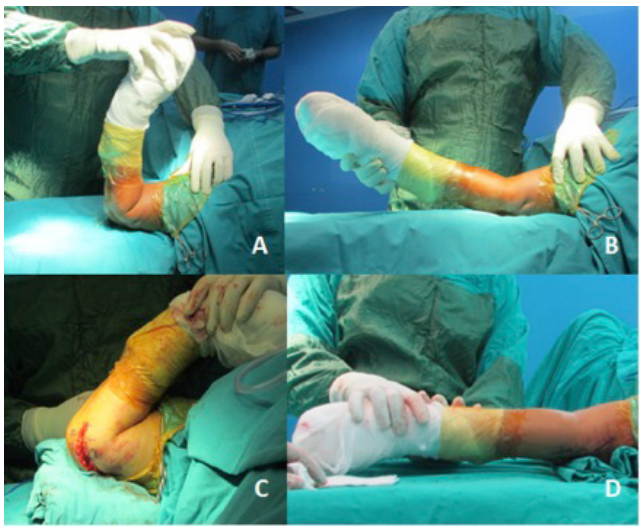

Figure. 1 A-B *Preoperative flexion-extension arc of the patient* ***C-D*** *Peroperative flexion-extension arc of the patient after open arthrolysis*

Postoperative Care

Passive and active assisted range of motion exercises were started on the first postoperative day. A supraclavicular catheter was used for analgesia for three days. The patients were discharged on the 3rd or 4th postoperative day. Outpatient physiotherapy was continued until the desired range of motion was achieved. A night splinting or external hinged brace could be used for flexion or extension to protect the gained range of motion. All patients received 75 mg/day indomethacin for 6 weeks for HO prophylaxis.

Statistical Analysis

The distribution of variables was analyzed using the Kolmogorov–Smirnov and Shapiro-Wilk tests. Statistical analyses were performed using the Student's t-test for parametric data, the Mann Whitney U test (Wilcoxon rank test), and the Kruskal-Wallis test for non-parametric data. SPSS Version 20.0 (SPSS Inc, Chicago, IL, USA) was used, and statistical significance was defined as p value <0.05.

Results

Open capsular release was performed for 42 patients. Twenty-four patients who had closed physis, and were followed-up for at least 24 months, and did not have severe arthrosis or HO were included in this study. The mean age of the patients was 36.1 (range 17–73) years at the time of surgery. One-third of the patients were female and 16 were male. The etiology of elbow stiffness was post-traumatic in 16 patients, early arthrosis in 4, secondary to coagulopathy in 3, and inflammatory arthritis in 1.

The lateral approach was performed in seven patients and the combined mediolateral approach was performed in 17 patients. The mean follow-up time was 50.6 (range 24–130) months. The mean preoperative flexion–extension arc was 52.4°(range 20°–75°), and the mean preoperative supination–pronation arc was 103.3°(range 0°–160°). The postoperative mean flexion–extension increased to 96.5° (range 60°–135°) ($p<0.05$), and the mean supination–pronation arc increased to 137.8° (range 90°–170°) at the last visit ($p<0.05$). The mean postoperative MEPS score was 81.6 (range 70–100) and the Q-DASH score was 6.3 (range 0–20.4). Fifteen patients reported being very satisfied, seven were satisfied, and two were dissatisfied at their last follow-up.

In addition to capsular release, implant removal was performed in five patients who had previously undergone surgery for distal humerus fracture. Radial head resection was needed in 8 patients who had severe supination–pronation restriction. Ulnar nerve neurolysis or subcutaneous ulnar nerve transposition was performed in 17 patients who had preoperative ulnar nerve neuropathy or elbow flexion <90° preoperatively.

Complications occurred in 9 patients (37.5%). A perioperative supracondylar humerus fracture developed in one patient and was fixed with a plate. Hematoma occurred in two patients, and surgical drainage was performed in the first postoperative week. Ulnar neuropathy developed in two patients and resolved spontaneously within 6 months. One patient had superficial infection and was treated with a debridement and antibiotic therapy. HO occurred in five patients. Two of them did not have any functional limitations and were classified as Hastings Class I. Three patients who had functional limitations were defined as Hastings Class IIA. None of the patients who developed HO needed any further surgery.

Discussion

Elbow stiffness remains a challenging problem. The etiology of elbow stiffness is multifactorial, and although new surgical techniques have been developed, the treatment of all of these factors is still demanding. In this study, 24 patients underwent open arthrolysis for elbow stiffness. Significant improvements in the flexion–extension arc and supination–pronation arc were maintained, and 91.6% of the patients were satisfied or very satisfied with their final result at a mean of 50.6 months postoperatively. In this study, the mean motion gain was 44.1° in flexion–extension and 34.5° in the rotational arc. In the literature, the reported improvements with open arthrolysis in the flexion–extension arc were ranged from 40° to 64°(13), which was similar to our results. The results of open capsular release reported in the literature are summarized in Table 1 (3, 7, 9, 14-20).

Table 1. Results of Open Capsular Release for Stiff Elbow

Study	Number of Patients	Mean Follow up (months)	Preop Flex-Ext. Arc	Postop Flex-ext. Arc	Mean Motion Gain
Mansat, 1998	38	43	49°	94°	45°
Wada, 2000	14	57	46°	110°	64°
Marti, 2002	47	120	44°	99°	55°
Park, 2004	27	23	46°	102°	56°
Tan, 2006	52	18	57°	116°	59°
Ring, 2006	46	48	48°	99°	51°
Gundlach, 2008	21	24	69°	113°	44°
Higgs, 2012	81	15	69°	109°	40°
Pettersen, 2016	43	41	50°	106°	56°
Haglin, 2017	103	14.7	60°	112°	52°
Our Study	24	50.6	52.4°	96.5°	44.1°

Compared with other studies in the literature, our study had a smaller population. The main reason for this situation was that patients with HO were not included, and we maintained a minimum follow-up period of 24 months. Therefore, our study had a longer follow-up period in a more homogenous group. Furthermore, excluding patients with HO could diminish the degree of improvement in the flexion–extension arc in our study. Haglin et al.(3) showed that patients who underwent HO excision with capsular release experienced significantly greater increases in their flexion–extension arc than patients with only capsular release (53.3° vs 44.2°). The mean motion gain in our study was similar to that in patients who underwent capsular release only (44.1° vs 44.2°).

Functional range of motion (>100° of flexion–extension) was achieved in 75% (18/24) of the patients in this study. Six patients who had a range of motion arc less than 100° did not undergo any further surgeries. In the literature, complication rates after open capsular release have been reported to vary from 10% to 47% (20, 21). The complication rate in our study was 37.5%; however, only 4 patients required reoperation (16%). Most of the complications were minor and transient, and were treated conservatively.

Some authors suggested routine ulnar nerve decompression or transposition in all stiff elbow procedures to prevent postoperative ulnar neuropathy symptoms (22, 23). However, some authors advised ulnar nerve decompression only when the patient had preoperative ulnar nerve symptoms or less than preoperative 100° of elbow flexion (20, 24). In our study, ulnar nerve decompression or transposition was performed in 17 patients with preoperative neuropathy symptoms or preoperative elbow flexion <90°.

Routine HO prophylaxis after capsular release procedure remains controversial. Some studies support the use of HO prophylaxis after elbow surgery, whereas others do not support it (3). We preferred 75 mg indomethacin per day for HO prophylaxis in all cases. Although we did not include the patients who had HO and underwent routine prophylaxis, HO occurred in 5 patients. However, none of the patients required HO excision.

This study had several limitations. First, it was a retrospective study. Second, the number of study cohort was small. We could explain this with the exclusion of patients who had HO and had a follow-up period of less than 24 months. Using these criteria, we were able to evaluate the long-term results in a more homogenous cohort. Third, the study did not include a comparison group. Arthroscopic capsular release is another treatment method that is mostly used for stiff elbow. However, it is difficult to compare these methods because their indications are not the same.

Arthroscopic release is generally performed for patients with isolated capsular contractures and mild stiffness. Patients who had hardware, a history of ulnar transposition, heterotopic ossification or severe stiffness open arthrolysis were preferred.

Conclusion

Open arthrolysis is an effective treatment method for stiff elbows, with reliable long-term functional outcomes. Ulnar nerve decompression should be performed in patients with preoperative ulnar neuropathy or elbow flexion <90°. The risk of contracture recurrence should be considered, and the patients must be informed about the possibility of further operations.

Declarations

Conflicts of Interest

All of the authors declare that they have no conflict of interest.

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None of the authors did not receive any grant or outside funding for this study.

Ethics Approval

This retrospective study was approved by the Institutional Review Board of İstanbul University İstanbul Medical Faculty Orthopaedics and Traumatology Department in 2013. This study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Availability of Data and Material

Available upon request.

Authors' Contributions

OT: conceived and designed the analysis, contributed data and analysis tools, wrote the paper.

MK: conceived and designed the analysis, collected the data (patient evaluation), performed statistical analysis.

AE: participated in the design of the study and made revisions of the manuscript.

ACA: conceived and designed the analysis, one of the surgeons who made open arthrolysis.

MD: conceived and designed the analysis, one of the surgeons who made open arthrolysis.

HD: conceived and designed the analysis.

All authors read and approved the final manuscript.

REFERENCES

1 Morrey BF, Askew LJ and Chao EY. A biomechanical study of normal functional elbow motion. J Bone Joint Surg Am. 1981;63:872-7.

2 Adolfsson L. Post-traumatic stiff elbow. EFORT Open Rev. 2018;3:210-6. DOI:10.1302/2058-5241.3.170062

3 Haglin JM, Kugelman DN, Christiano A, et al. Open surgical elbow contracture release after trauma: results and recommendations. J Shoulder Elbow Surg. 2018;27:418-26. DOI:10.1016/j.jse.2017.10.023

4 Morrey BF. Post-traumatic contracture of the elbow. Operative treatment, including distraction arthroplasty. J Bone Joint Surg Am. 1990;72:601-18.

5 Doornberg JN, Ring D and Jupiter JB. Static progressive splinting for posttraumatic elbow stiffness. J Orthop Trauma. 2006;20:400-4. DOI:10.1097/00005131-200607000-00006

6 Muller AM, Sadoghi P, Lucas R, et al. Effectiveness of bracing in the treatment of nonosseous restriction of elbow mobility: a systematic review and meta-analysis of 13 studies. J Shoulder Elbow Surg. 2013;22:1146-52. DOI:10.1016/j.jse.2013.04.003

7 Mansat P and Morrey BF. The column procedure: a limited lateral approach for extrinsic contracture of the elbow. J Bone Joint Surg Am. 1998;80:1603-15.

8 Tucker SA, Savoie FH, 3rd and O'brien MJ. Arthroscopic management of the post-traumatic stiff elbow. J Shoulder Elbow Surg. 2011;20:S83-9. DOI:10.1016/j.jse.2010.11.029

9 Marti RK, Kerkhoffs GM, Maas M, et al. Progressive surgical release of a posttraumatic stiff elbow. Technique and outcome after 2-18 years in 46 patients. Acta Orthop Scand. 2002;73:144-50. DOI:10.1080/000164702753671713

10 Kapıcıoğlu M SY, Erşen a, Atalar a, Demirhan M,Durmaz H. Does Resection of Heterotopic Ossification of the Elbow Result in Satisfactory Functional Outcomes? Bezmiâlem Science. 2019;7:124-31. DOI:10.14235/bas.galenos.2018.2467

11 Larson AN and Morrey BF. Interposition arthroplasty with an Achilles tendon allograft as a salvage procedure for the elbow. J Bone Joint Surg Am. 2008;90:2714-23. DOI:10.2106/JBJS.G.00768

12 Mansat P and Morrey BF. Semiconstrained total elbow arthroplasty for ankylosed and stiff elbows. J Bone Joint Surg Am. 2000;82:1260-8. DOI:10.2106/00004623-200009000-00006

13 Streubel PN and Cohen MS. Open surgical release for contractures of the elbow. J Am Acad Orthop Surg. 2015;23:328-38. DOI:10.5435/JAAOS-D-14-00051

14 Wada T, Ishii S, Usui M, et al. The medial approach for operative release of post-traumatic contracture of the elbow. J Bone Joint Surg Br. 2000;82:68-73. DOI:10.1302/0301-620x.82b1.9782

15 Park MJ, Kim HG and Lee JY. Surgical treatment of post-traumatic stiffness of the elbow. J Bone Joint Surg Br. 2004;86:1158-62. DOI:10.1302/0301-620x.86b8.14962

16 Tan V, Daluiski A, Simic P, et al. Outcome of open release for post-traumatic elbow stiffness. J Trauma. 2006;61:673-8. DOI:10.1097/01.ta.0000196000.96056.51

17 Ring D, Adey L, Zurakowski D, et al. Elbow capsulectomy for posttraumatic elbow stiffness. J Hand Surg Am. 2006;31:1264-71. DOI:10.1016/j.jhsa.2006.06.009

18 Gundlach U and Eygendaal D. Surgical treatment of posttraumatic stiffness of the elbow: 2-year outcome in 21 patients after a column procedure. Acta Orthop. 2008;79:74-7. DOI:10.1080/17453670710014798

19 Higgs ZC, Danks BA, Sibinski M, et al. Outcomes of open arthrolysis of the elbow without post-operative passive stretching. J Bone Joint Surg Br. 2012;94:348-52. DOI:10.1302/0301-620X.94B3.27278

20 Pettersen PM, Eriksson J, Bratberg H, et al. Increased ROM and high patient satisfaction after open arthrolysis: a follow-up-study of 43 patients with posttraumatic stiff elbows. BMC Musculoskelet Disord. 2016;17:74. DOI:10.1186/s12891-016-0928-8

21 Zhang D, Nazarian A and Rodriguez EK. Post-traumatic elbow stiffness: Pathogenesis and current treatments. Shoulder Elbow. 2020;12:38-45. DOI:10.1177/1758573218793903

22 Blonna D and O'driscoll SW. Delayed-onset ulnar neuritis after release of elbow contracture: preventive strategies derived from a study of 563 cases. Arthroscopy. 2014;30:947-56. DOI:10.1016/j.arthro.2014.03.022

23 Shuai C, Hede Y, Shen L, et al. Is routine ulnar nerve transposition necessary in open release of stiff elbows? Our experience and a literature review. Int Orthop. 2014;38:2289-94. DOI:10.1007/s00264-014-2465-0

24 Williams BG, Sotereanos DG, Baratz ME, et al. The contracted elbow: is ulnar nerve release necessary? J Shoulder Elbow Surg. 2012;21:1632-6. DOI:10.1016/j.jse.2012.04.007