Arthroscopic débridement for primary osteoarthritis of the elbow: analysis of preoperative factors affecting outcome

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Background: The purposes of this study were to evaluate the clinical results of arthroscopic débridement and to identify preoperative factors that influence the outcome.

Methods: Forty-three elbows with primary osteoarthritis in 43 patients treated with arthroscopic débridement were retrospectively evaluated. At a mean follow-up of 38 months (range, 18-77 months), the visual analog scale (VAS) score for pain, the arc of elbow motion, and the Mayo Elbow Performance Index (MEPI) score were assessed. The relationships between postoperative MEPI score and postoperative motion arc and preoperative factors including age, sex, involvement of the dominant arm, duration of symptoms, demand of elbow activity, VAS score, previous history of failed surgery, and arc of elbow motion were statistically evaluated.

Results: The mean VAS score for pain, the mean arc of flexion-extension, and the mean MEPI score significantly improved after the operation (all P values < .001). Multivariate regression analysis revealed that among preoperative variables, arc of motion was found to be the only independent prognostic factor that affected both postoperative elbow function (P = .024) and final arc of motion (P < .001). The cutoff value of preoperative arc of motion for the final arc of motion was determined to be 80° (P < .001). Involvement of the dominant arm was found to be another independent factor that affected postoperative MEPI scores (P = .016).

Conclusions: Arthroscopic débridement for elbow osteoarthritis provides satisfactory pain relief, improvement of elbow motion, and good functional outcome. Based on the fact that preoperative motion arc is the independent factor that can predict clinical outcome, arthroscopic treatment is highly recommended for patients who have a motion arc of 80° or more as it yields reliable results.

This study was approved by the Institutional Review Board (IRB No. 2010-12-074-001) of the Samsung Medical Center, Seoul, South Korea.

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The optimal treatment of symptomatic primary elbow osteoarthritis remains controversial. Open procedures including ulnohumeral arthroplasty and débridement arthroplasty have been reported to produce satisfactory pain relief and motion gain with lower complication rates. Arthroscopic technique has gained popularity as a viable alternative option. Compared with open procedures, the minimally invasive approach of arthroscopy allows more rapid rehabilitation and has a low risk of capsular contracture by reducing the morbidity associated with a large incision and exposure of the joint. Savoie et al suggested that an open procedure can be fully accomplished by arthroscopy, which can provide outcome similar to that of open surgery. However, the surgical technique of arthroscopic débridement of the elbow is highly demanding, particularly in that the surgeon’s experience and familiarity with the technique are essential to avoid neurovascular injury. Moreover, the improvement of the range of motion after surgery has been varied in the literature, ranging from 8° to 81°.

Evaluation of preoperative predictors is of great value to provide useful insight into decision-making about the appropriate surgical approach. To our knowledge, no authors have investigated the prognostic factors affecting outcome after arthroscopic débridement of elbow osteoarthritis. The purposes of this study were to evaluate the clinical outcome of arthroscopic débridement for the treatment of elbow osteoarthritis and to identify preoperative factors that may affect clinical outcome in terms of elbow motion and overall function.

Materials and methods

Between June 2001 and May 2010, a single surgeon performed 55 arthroscopic débridement procedures for primary osteoarthritis of the elbow in 55 patients, and they were included in this retrospective study. All patients had typical elbow symptoms including terminal pain at flexion and extension with limitation of motion. Standard radiographs and/or computed tomography scans of the elbow joint confirmed osteophytes and loose bodies around the ulnohumeral joint and/or radiocapitellar joint in all patients. Arthroscopic débridement was indicated for patients with persistent symptoms that had not responded to nonoperative management, including nonsteroidal anti-inflammatory drugs, activity modification, and physiotherapy, for at least 6 months. Of them, we excluded 12 patients for the following reasons: 4 patients were lost to follow-up, 1 patient refused return for final evaluations, and 1 patient was excluded because of death; 4 patients who had preoperative symptoms of ulnar neuropathy and underwent concomitant anterior transposition were excluded from the investigation to eliminate a confounding factor; and 2 patients who had only radiocapitellar arthritis without ulnohumeral joint involvement were also excluded. Finally, we evaluated the remaining 43 patients in the current study.

There were 37 men and 6 women with a mean age of 51.4 years (range, 33-69 years). The dominant arm was involved in 35 patients. Ten patients reported minor previous trauma on the affected arm, but none of the patients had evidence of post-traumatic arthritis after single inciting injuries involving the elbow joint on the basis of radiographic studies including computed tomography. Three patients had undergone previous arthroscopic loose body removal on the involved elbow at other institutes and were not excluded. In terms of the level of elbow activity, 25 patients were heavy manual laborers and 11 were active participants in sports involving repetitive use of the arm. These 36 patients (84%) were considered patients requiring high demand of elbow activity. The median duration of elbow symptoms was 76 months (range, 10-360 months). Radiographic severity of osteoarthritis was graded class I in 9 elbows and class II in 34 elbows according to the Rettig classification.

Surgical technique

Under general anesthesia or brachial plexus block combined with intravenous sedation, the patient was placed in the lateral decubitus position with the arm over a bolster and a tourniquet applied. We mainly used a 2.9-mm 30° arthroscope, a 4.5-mm full radius resector, and a 4.0-mm motorized burr. Through a proximal anteromedial portal and proximal anterolateral portal, we removed loose bodies and impinging osteophytes from the coronoid process and fossa and radial head and fossa. A motorized hooded burr with carefully controlled suction device allowed removal of a sufficient amount of osteophytes while reducing the risk of inadvertent neurovascular injury. Resection of the coronoid process with its osteophytes was performed down to the level of the radial head (Fig. 1). The coronoid fossa and radial fossa were re-created by removal of osteophytes, including those formed on the rim of the fossa. However, it was frequently not possible to access osteophytes inside the coronoid fossa with the anterior portals. They were removed later, if required, by fenestrating the olecranon fossa from the posterior portal, or they were left if they did not impinge on the coronoid process at full flexion. We thoroughly resected marginal spurs from the radial head; we did not attempt to remove the radial head.

After completion of the procedure on the anterior compartment, we addressed the posterior compartment using the posterolateral portal and the posterior central portal. Excision of capsule and synovium was performed with a full radius shaver in the central and lateral parts only and not in the medial one, where the ulnar nerve is at risk. Use of a small osteotome through the posterior central portal facilitated removal of osteophytes from the tip of the olecranon (Fig. 2). The remaining osteophytes on the side of the olecranon were removed with a motorized burr. The
hypertrophied olecranon fossa was deepened to the extent that the olecranon tip did not impinge on the fossa at full extension. The fenestration was performed in 16 patients (37%) who needed coronoid fossa debridement to eliminate anterior impingement. A 4.0-mm-diameter drill bit through the posterior central portal was used to make the pilot hole, which was circumferentially enlarged with the burr. The remaining osteophytes on the coronoid fossa were removed from the anterior portals. Then, we examined the posterior space of the radiocapitellar and proximal radioulnar joint through the soft spot portal and removed posterior osteophytes from the radial head and fossa. Although focal loss of cartilage on the contact area of the radial head and capitellum was observed in 25 patients, no attempt was made to resect the radial head because there was no remnant impingement or painful and limited forearm prosupination preoperatively. Once all the osteophytes were excised from the anterior and posterior compartments, the anterior capsule was excised with a shaver and reverse basket punch in 22 patients (51%), in whom ≥20° of residual extension was still observed on passive manipulation.

Finally, we checked the passive motion arc and confirmed no remnant mechanical impingement. A suction drain was inserted, and a long arm splint with compression dressing was applied. At 2 to 4 days after the operation, patients were instructed to start active-assisted motion exercises. Neither bracing nor continuous passive motion (CPM) was employed. As the pain subsided, we emphasized gentle passive stretching exercise. Formal physiotherapy was given to the patients who showed resistance to motion increase during the first 4 weeks after the operation until motion arc improved, which often took 3 to 6 months after surgery.

At the final follow-up visit, pain was evaluated with a visual analog scale (VAS) for pain (10 points indicated intolerable pain). Flexion and extension arcs were measured by use of a hand-held goniometer. The Mayo Elbow Performance Index (MEPI) was used to assess total elbow function before surgery and at final follow-up. The final results were rated excellent, good, fair, or poor according to the MEPI. An independent observer blinded to patient information performed all the clinical evaluations.

Statistical analysis

For analysis of clinical improvements, the differences between preoperative and postoperative pain VAS scores, MEPI scores, and ranges of motion were determined by paired t test or the Wilcoxon signed rank test. Univariate analysis was performed to correlate both postoperative MEPI scores and arc of motion with preoperative factors. Categorical variables (sex, arm dominance, demand of elbow activity, and previous history of failed surgery) were analyzed with the 2-sample t test or Mann-Whitney test, and continuous variables (age, preoperative VAS score, and arc of motion) were analyzed with Spearman correlation analysis. Subsequently, multiple linear regression analysis was used to assess the association between either postoperative MEPI score or arc of motion and the studied preoperative factors. If any preoperative variable was found to be significantly correlated with postoperative MEPI score or arc of motion, the cutoff value of the variable was determined and statistically tested by the minimum P value approach in conjunction with correction of P value by the method of Lausen and Schumacher. Statistical significance was set at P < .05.

Results

Complications and revision surgeries

The mean duration of postoperative follow-up was 38.4 months (range, 18-77 months). No complication related to surgery, such as neurovascular injury or wound infection, developed during the follow-up period. Five patients underwent revision surgeries. Persistent pain and limitation of motion existed in 4 patients, in 3 of whom ulnar neuropathy developed. Open débridement and transposition of the ulnar nerve were performed in 3 patients, and arthroscopic removal of loose body with transposition
of the ulnar nerve was performed in another patient. The remaining patient underwent an additional open procedure for persistent pain 3 years after the index surgery at another institution.

**Clinical results**

The mean VAS score for pain decreased from 4.5 points (range, 0-9 points) preoperatively to 2.2 points (range, 0-8 points) at the final follow-up ($P < .001$). The mean flexion increased from 103° degrees (range, 70°-130°) preoperatively to 116° (range, 90°-130°) at the final follow-up, and the mean flexion contracture decreased from 19° (range, 5°-35°) preoperatively to 12° (range, 0°-30°) after the operation ($P < .001$ in both). A total arc of ≥100° was obtained in 30 patients (70%). The mean MEPI score improved from 57.4 points (range, 34-95 points) preoperatively to 81.3 points (range, 55-100 points) at the final follow-up ($P < .001$). Postoperative elbow functions were rated excellent in 13 patients, good in 21, fair in 5, and poor in 4. Poor results were related to failure of motion improvement and associated functional limitations in 3 patients and to persistent pain in spite of 20° of motion improvement (from 85° preoperatively to 105° postoperatively) in 1 patient.

**Preoperative predictive factors of outcome**

Univariate analysis showed that involvement of the dominant arm and greater preoperative arc of motion were correlated with better MEPI scores. High demands of elbow activity, longer duration of symptoms, and decreased preoperative arc of motion were correlated with decreased final arc of motion (Table I). Other factors did not correlate with postoperative MEPI score or final arc of motion.

However, multivariate analysis showed preoperative arc of motion to be the only prognostic factor that affected both postoperative MEPI score and arc of motion. After adjustment of other variables, preoperative arc of motion showed significant correlations with both postoperative MEPI score ($P = .024$) and postoperative arc of motion ($P < .001$); an increment of 0.32 in postoperative MEPI score and an increment of 0.79 in postoperative arc of motion could be expected according to each additional level (1°) of the preoperative arc of motion. Our analysis also showed involvement of the dominant arm to be another independent factor that affected results of the postoperative MEPI score only ($P = .016$); a higher postoperative MEPI score by 12.5 points could be expected in patients who had involvement of the dominant elbow compared with those who did not.

The cutoff value of preoperative arc of motion that could predict results of postoperative arc of motion was found to be 80° ($P = .000009$ after correction for multiple comparisons). However, the cutoff value for the postoperative MEPI score could not be determined because there was no significant $P$ value (all of the corrected $P$ values > .05). When patients were dichotomized by preoperative arc of motion (arc <80° or ≥80°), for the 14 elbows with preoperative arc <80°, the mean MEPI score improved from 54 points preoperatively to 76 points postoperatively, and the arc of motion improved from 64° preoperatively to 89° postoperatively. Although 5 (36%) of those 14 patients achieved final functional motion arc (>100°) with motion improvement by 34° (range, 25°-45°), the remaining 9 patients did not reach functional motion arc and gained motion improvement of only 21° (range, 15°-30°). On the other hand, for the 29 elbows with preoperative arc ≥80°, the mean MEPI score improved from 59 points preoperatively to 84 points postoperatively, and the arc of motion improved from 94° preoperatively to 111° postoperatively; 27 (93%) of them achieved functional motion arc.

**Discussion**

The goal of this study was to identify clinical features that could affect the outcome of arthroscopic débridement for primary elbow osteoarthritis. High demand of elbow activity and longer duration of elbow symptoms were found to be significant factors that can adversely affect postoperative elbow motion. However, these significant relationships were observed only in the univariate analysis, indicating that these variables were the confounding factors. On the other hand, multivariate analysis of the data showed involvement of the dominant arm to be an independent prognostic factor that may predict better outcome in terms of postoperative elbow function. Whereas positive correlation of development of elbow osteoarthritis with hand dominance has been established,9,22 the relationship of involvement of the dominant arm with better clinical outcome has not yet been reported in the literature.

Our most notable finding was the predictive role of preoperative arc of motion on both postoperative motion and function. The cutting edge was 80°. Although patients with preoperative motion <80° gained motion improvement by 25°, the mean value of the final motion arc is only 89°. Given that functional motion arc of >100° is required for performance of daily living activities,2 this result appears still unsatisfactory despite motion improvement and pain relief. Furthermore, only 5 of 14 patients with preoperative motion <80° gained functional motion arc after surgery in our series. These results may indicate that the restoration of functional motion after arthroscopic treatment is unpredictable in this group.

Review of the literature also reveals an improvement of mobility after arthroscopic débridement for elbow osteoarthritis ranging from 8° to 81°,1,7,14,17,18,31 whereas the improvement in pain or the patient’s satisfaction after surgery tended to be consistent.1,7,14,17,18,25,31 Explanations about the role of the techniques on the gain of motion are not supported by references. The authors present different procedures without their influences. Removal of loose
bodies and osteophytes was the essential procedure in all the previous reports.1,14,18,25,31 However, an additional procedure varied: release of the anterior capsule,1,14,18 release of the posterior capsule including posteromedial capsule,1,14,18 fenestration of the olecranon fossa,1,18,25,31 and radial head resection.18 In this study, we routinely performed removal of loose bodies and osteophytes, whereas release of the anterior capsule and fenestration of the olecranon fossa were performed in selected patients, depending on the intraoperative findings. We did not perform release of the posteromedial capsule because of concerns about ulnar nerve injury or excise the radial head because we believed that radial head excision was not indicated. Before finishing the procedure, we always confirmed the restoration of passive motion arc with the absence of bone impingement. By this technique, we achieved mean motion arc improvement of 20°.

We provided satisfactory pain relief and recovery of elbow function without neuromuscular complication. However, in terms of final motion arc, our technique yielded less satisfactory results in patients with preoperative arc <80°. This result may suggest that a more vigorous surgical approach is needed to regain greater motion arc. It is well known that contracture of the posterior bundle of the medial collateral ligament prevents flexion in patients with a long-standing lack of flexion,29 indicating that aggressive release of the posteromedial capsule may be helpful in gaining more flexion. Whereas most authors did not routinely perform posteromedial release during arthroscopic débridement because of the proximity of the ulnar nerve, it can be performed all-arthroscopically or with concomitant release of the ulnar nerve, depending on the surgeon’s technique.1,18 Given the technical limitations of the arthroscopic procedure for complete capsular release and extensive osteophyte removal, better results can be expected with open débridement in patients with <80° of motion arc. Cohen et al7 compared outcomes after arthroscopic débridement with those of open ulnohumeral arthroplasty and reported greater improvement in flexion with the open procedure. Open débridement can employ medial and lateral approaches, depending on the pathologic and clinical features, such as the presence of ulnar neuropathy, and allows removal of a sufficient amount of osteophytes and complete release of capsular contracture.10,26,32,34,35

The postoperative regimen is also an important issue. However, the efficacy of each postoperative regimen in increasing the motion arc has not been verified. In the series of Cohen et al,7 it involved a dynamic bracing program or use of a CPM device, which was individualized according to the surgeon’s discretion. They compared the efficacy of CPM vs bracing, but no conclusion was drawn. Krishnan et al18 used CPM with the axillary nerve block immediately after surgery. This protocol has been recommended after surgical release of posttraumatic intrinsic or extrinsic stiff elbow with the expectation of preventing early adhesion or capsular contracture.1,20 However, whether it is beneficial in patients with an osteoarthritic elbow remains controversial because the main cause of motion loss is mechanical impingement by osteophytes rather than soft tissue contracture. Kim and Shin17 reported their experience with arthroscopic surgery in 30 patients with degenerative arthritis and observed that the gains in motion that had been achieved intraoperatively were lost during the first and second postoperative weeks and slowly regained until 1 year. We believe that to achieve maximum motion arc,

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Results by univariate analysis for the factors affecting postoperative MEPI score and motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>No. or mean ± SD</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
<tr>
<td>Involvement of dominant arm</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Demand of elbow activity</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Previous surgical history</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Age, years</td>
<td>51.4 ± 8.1</td>
</tr>
<tr>
<td>Duration of symptoms, months</td>
<td>76.2 ± 83.4</td>
</tr>
<tr>
<td>Preoperative VAS score</td>
<td>4.5 ± 2.7</td>
</tr>
<tr>
<td>Preoperative arc of motion</td>
<td>84.3 ± 16.9</td>
</tr>
</tbody>
</table>

MEPI, Mayo Elbow Performance Index; SD, standard deviation; VAS, visual analog scale.
continuous effort to stretch the joint until the motion reaches the plateau is more important than an immediate temporary trial of CPM.

A limitation of this study is the lack of standardization regarding the technical experience and follow-up period, which might affect the outcomes. A high level of arthroscopic experience and training is required to perform the procedure safely and effectively. We excluded an initial 20 cases of arthroscopic elbow surgery, including 5 débridement procedures for osteoarthritis, to lessen the effects of the learning curve. Recently, Kim et al16 reported that improvement in motion or clinical score after arthroscopic release of elbow stiffness was not related to the surgeon’s experience. Although recurrence of osteophytes, pain, and motion loss are concerns with longer follow-up, several studies with long-term follow-up of open débridement or ulnohumeral arthroplasty reported relatively good durability of symptom relief and motion gain even with radiographic deterioration.1,2,7,12,13,16 Wada et al21 observed 19 patients for more than 10 years after débridement arthroplasty and found a loss of extension by 7° while the flexion remained consistent. Compared with other studies, our analysis was based on the relatively short-term outcomes, which ranged from 18 to 77 months, indicating that the influence of the follow-up period on the results might be low.

Conclusion

Arthroscopic débridement for elbow osteoarthritis provides satisfactory pain relief, improvement of elbow motion, and good functional outcome. Based on the fact that preoperative motion arc is the independent factor that can predict clinical outcome, arthroscopic treatment is highly recommended for patients who have a motion arc of 80° or more as it yields reliable results.

Acknowledgment

The authors thank Seon Woo Kim, PhD, for statistical consultation.

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The authors, their immediate families, and any research foundations with which they are affiliated did not receive any financial payments or other benefits from any commercial entity related to the subject of this article.

References