Radiological Classification and Clinical Results of Arthroscopic and Open Surgical Release for Elbow Osteoarthritis: A Two-Center Comparative Case Series

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Research article

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Abstract

Background

This study aimed to compare the image classification and clinical results in cases of debridement arthroplasty for elbow osteoarthritis and to compare between open and arthroscopic surgery performed at two independent facilities.

Methods

Of the 51 patients who underwent surgery for elbow osteoarthritis performed by two doctors, 36 patients whom we were able to observe for more than 6 months were included. One doctor performed open surgery at one hospital, while another doctor performed arthroscopic surgery at the other hospital. There were 15 cases of open surgery (group O) and 21 cases of arthroscopic surgery (group A). All patients were examined for the range of motion, Hand20 score, and pain. The degree of osteoarthritis was examined using the Broberg and Morrey classification and Hastings and Rettig classification. The intra- and interobserver degree of agreement of the two classifications were analyzed using intraclass correlation coefficients.

Results

The range of motion improved in both groups. There were no significant differences between the two groups with respect to incidence of ulnar symptoms, operation time, postoperative Hand20 score, postoperative pain, and degree of radiological osteoarthritis. The intra- and interobserver degree of agreement for radiological classifications were moderate to substantial and moderate, respectively. There was no correlation between the clinical results and radiological classifications. One patient in group A showed ectopic ossification but no serious complications or adverse events, such as nerve damage, were observed in either group.

Conclusions

At the time of the final follow-up, nearly the same results were observed in both groups. No relationship was found between symptoms and radiological osteoarthritis classification scores.

Level of Evidence

Treatment study Level III

Background

The incidence of elbow osteoarthritis (OA), which develops in 2% of the population, peaks in the 50s. The condition is four times more prevalent among men and tends to affect the dominant hand; however, the exact epidemiology is unknown. Patients with elbow OA present with decreased elbow range of motion,

pain at the extremes of motion, and painful locking or catching. Ulnar nerve symptoms present in 26–55% of the patients (1–3). Moreover, OA restricts daily activities, including work; therefore, a treatment method that maximizes improvements in daily activities is preferred.

Both open and arthroscopic surgical releases have been reported for elbow OA, and a comparative study including a systematic review has been reported (4–6). Generally, the diagnosis of elbow OA is made radiographically; however, reports have also described a computed tomography (CT)- and a plain radiograph-based classification (7,8). Although some image evaluation classifications have been reported, there is not yet a definitive classification that defines a suitable treatment strategy. While many evaluation systems have been proposed, a gold standard evaluation that is practical, efficient, and accurate enough to detect clinically relevant worsening or improvement does not yet exist (9).

Therefore, we compared image classification and clinical results in patients undergoing debridement arthroplasty for elbow OA via open and arthroscopic surgery performed at two independent facilities. We hypothesized that arthroscopic surgery has comparable clinical results to open surgery, and that radiological classifications reflect the degree of clinical symptoms.

Methods

We retrospectively evaluated the results of open and arthroscopic surgical release for symptomatic elbow OA in a comparative case series of patients who were managed at two institutions. In this study, the surgical procedures were performed by two doctors at two institutions; one doctor performed open surgery at one institution while another doctor performed arthroscopic surgery at the other institution. Of the 51 patients who underwent surgery for OA between 2007 and 2017, 36 patients who were observed for more than 6 months were included in the study.

Operative procedures

Under general anesthesia or brachial plexus block combined with intravenous sedation, the patients were positioned in the spine and lateral decubitus position for open and arthroscopic surgery, respectively. Additionally, a tourniquet was applied during surgery.

Open surgery was performed from the medial side and ulnar nerve release was performed regardless of the symptoms. Growing osteophytes and synovia in the anterior and posterior capsules were excised. The range of motion of the joint was confirmed intraoperatively; in four cases, the surgery was performed inside the joint using the lateral approach.

Arthroscopic surgery was performed by first creating a proximal anteromedial portal and then a mid-anterolateral portal using the inside-out technique. The assistant supported the joint capsule with a blunt tip. We mainly used a 2.9-mm 30° arthroscope, a 3.5-mm full radius resector, and a 4.0-mm motorized burr to perform arthroscopic debridement of the anterior side of the elbow joint and excision of the growing synovium and osteophyte. Following debridement of the anterior side, we added a posterolateral

portal to begin debridement of the posterior side; the direct posterior portal and direct lateral portal (soft spot) were used to perform arthroscopic debridement on the posterior side of the elbow. For concomitant cubital tunnel syndrome, nerve release and anterior subcutaneous transfer with internal synovial and osteophyte resection on the medial side were performed in 11 patients.

Postoperative protocols

Following surgery, we checked the passive motion arc and confirmed that there was no remnant mechanical impingement. Soft compressive dressings were applied in both groups, and a suction drain was inserted in patients in the open surgery group for 1–2 days. At 2–4 days after surgery, patients were instructed to start active-assisted motion exercises. Neither braces nor continuous passive motion were employed and assisted mobilization by a physiotherapist twice per week was recommended.

Evaluations

The primary outcome was the range of motion, while the secondary outcome was the Hand20 score (10). We examined and compared the ulnar nerve symptoms, operation time, range of motion, postoperative pain, Hand20 score, and OA levels using both the Broberg and Morrey (BM) and the Hastings and Rettig classifications for OA levels (11,12).

The BM classification of elbow OA (11) was used to stage the severity of OA using the following criteria: Grade 1 – slight joint space narrowing with minimal osteophyte formation; Grade 2 – moderate joint space narrowing with moderate osteophyte formation; and Grade 3 – severe degenerative change with gross destruction of the joint.

Furthermore, the Hasting and Rettig classification (HR) of elbow OA (12) was used to stage the severity of OA using the following criteria: Class I – degeneration in the margins of the ulnotrochlear joint with the presence of coronoid and olecranon spurring and absence of degenerative changes within the radiocapitellar joint; Class II – class I with mild joint space narrowing within the radiocapitellar joint, without subluxation of the radial head; and Class III – class II with radiocapitellar subluxation.

Two independent observers were asked to evaluate both classifications from plain films without instruction using the standard computerized measurement caliper with references (11,12). After 2 weeks, the same observers repeated evaluation of the films.

Statistical analysis

All data analyses were performed using SPSS software version 26 (IBM, Chicago, IL). We used the chi-square test to compare categorical variables and analyzed differences in two independent samples of pre- and postoperative measurements using the Mann-Whitney U-test. Values of $p < 0.05$ were considered statistically significant. Intra- and interobserver reliability was calculated using the intraclass correlation coefficient (ICC) (13). The degree of agreement of the two evaluations made by the observers was interpreted as follows: poor ICC, < 0.20; fair ICC, 0.21–0.40; moderate ICC, 0.41–0.60; good ICC, 0.61–0.80; and very good ICC, > 0.80 (14).

Results

Of the 51 patients who underwent elbow OA surgery performed by the two doctors between 2007 and 2017, 36 patients were enrolled in the study. There were 15 cases of open surgery (group O) and 21 cases of arthroscopic surgery (group A). The average age and the follow-up period were 58 years and 16 months in Group O, and 55 years and 24 months in Group A, respectively (Table 1).

Table 1
Patients' summary

	Group O	**Group A**
Number	15	21
Male: female *p = 1.000*	15: 0	20: 1
Average age (years) *p = 0.778*	58 [9.9]	55 [9.7]
Average follow-up periods (months) *p = 0.910*	16 [13]	24 [27.3]
	All cases with ulnar nerve release 4 cases with lateral/medial approaches	11 cases with ulnar nerve release using a medial approach
[standard deviation]		

The symptoms improved in both groups postoperatively. The results are summarized in Table 2. There were no significant differences between the groups in terms of the incidence of ulnar nerve symptoms (67% in group O and 48% in group A), operation time (136 min in group O and 153 min in group A), range of motion before and after surgery (87–112° in group O and 92–111° in group A), Hand20 score (11 points in group O and 17 points in group A), postoperative pain, or degree of OA. Furthermore, there were no significant differences in the degree of OA or clinical outcomes between the groups (Tables 3 and 4). There was one case of ectopic ossification in group A but no restriction of range of motion. Further, there were no complications, such as neuropathy, in either group. The intra- and interobserver degree of agreement were moderate to substantial (observer 1: BM 0.52/HR 0.59; observer 2: BM 0.74/HR 0.55) and moderate (inter-observer: BM 0.46/HR 0.45), respectively.

Table 2
Summary of clinical results

	Group O	Group A	*P* value
Pre-op extension (deg)	−20 [10.1]	−22 [16.2]	0.720
Pre-op flexion (deg)	107 [8.4]	114 [12.0]	0.106
Pre-op flexion-extension (deg.)	87 [12.9]	92 [18.6]	0.282
Ulnar nerve symptoms	67%	48%	0.320
Broberg & Morrey classification	I:5, II:8, III: 2	I:12, II:8, III: 1	0.320
Hastings & Rettig classification	I:5, II:8, III: 2	I:12, II:6, III: 3	0.296
Post-op extension (deg)	−13 [9.0]	−14 [13.0]	0.519
Post-op flexion (deg)	125 [7.1]	124 [6.1]	0.720
Post-op flexion-extension arc (deg)	112 [13.3]	111 [13.0]	0.693
Operation time(min)	136 [36]	153 [54.0]	0.499
Hand20 score	11 [13.2]	17 [16.0]	1.000
deg, degrees; min, minutes, [standard deviation]			

Table 3
Broberg and Morrey classification

	Grade 1 17 cases	Grade 2 16 cases	Grade 3 3cases	*P* value
Age (years)	52.7 [8.9]	58.3 [9.7]	66.3 [5.5]	0.069
Pre-op extension (deg)	−19 [10.7]	-23 [17.5]	−18 [7.6]	0.777
Pre-op flexion (deg)	114 [11.0]	110 [9.5]	100 [15.0]	0.160
Pre-op flexion-extension (deg)	96 [17.8]	87 [14.7]	81 [14.4]	0.314
Ulnar nerve symptoms	41%	63%	100%	0.126
Post-op extension (deg)	−14 [11.3]	-12 [12.7]	-13 [2.9]	0.784
Post-op flexion (deg)	124 [6.8]	126 [6.1]	120 [5.0]	0.318
Post-op flexion-extension arc (deg)	110 [16.0]	114 [14.5]	107 [7.6]	0.560
Operation time (min)	146 [52]	138 [30]	191 [83]	0.594
Hand20 score	14 [15.6]	14 [15.4]	16 [15.5]	0.981
deg, degrees; min, minutes, [standard deviation]				

Table 4
Hastings and Rettig classification

	Class 1 17 cases	Class 2 13 cases	Class 3 6 cases	*P* value
Age	53 [8.9]	58 [9.8]	64 [8.1]	0.086
Pre-op extension (deg)	−19 [10.7]	-25 [18.6]	-17 [7.5]	0.153
Pre-op flexion (deg)	114 [11.0]	110 [10.5]	104 [10.7]	0.248
Pre-op flexion-extension (deg)	95 [17.8]	85 [15.4]	88 [12.9]	0.131
Ulnar nerve symptoms	41%	64%	80%	0.216
Post-op extension (deg)	−14 [11.3]	-14 [13.1]	-10 [7.9]	0.691
Post-op flexion (deg)	124 [6.8]	127 [6.3]	121 [3.7]	0.937
Post-op flexion-extension arc (deg)	110 [16.9]	113 [15.5]	111 [10.3]	0.723
Operation time (min)	146 [52.6]	134 [31.0]	173 [58.3]	0.934
Hand20 score	14 [15.6]	11 [13.5]	21 [17.0]	0.850
deg, degrees; min, minutes, [standard deviation]				

Discussion

Although many treatment options exist for elbow OA, controversy remains about the best treatment for symptomatic elbow OA (15). Our study revealed that the clinical results of the two surgical methods were nearly equivalent in two experienced surgeons. These findings are similar to results from previous reports (4–6). A comparison of the Outerbridge-Kashiwagi procedure and arthroscopic surgery showed that both surgical methods were effective in improving the range of motion in without serious complications (4). Although endoscopic surgery may allow patients to undergo early rehabilitation, it is technically demanding and poses risks of transient/permanent nerve injury (radial, ulnar, and median nerves) and compartment syndrome (16). When comparing the two methods described herein, the risk of surgical complications and the results obtained should be evaluated. In our study, neither group had any serious complications, such as neurologic complications. Although both surgical methods yielded satisfactory results, the patients continued experiencing a limited range of motion. Currently, total elbow arthroplasty has many post-operative limitations and is not indicated for most elbow OA patients, especially young people (17,18). Development of new treatment strategies for elbow OA, such as tissue engineering, is needed.

Although we encountered no problems in reproducing the radiological classification, we could not determine a relationship between the clinical results and radiological classification scores. It may therefore be necessary to conduct evaluations, such as CT and MRI, as emphasized in the past; however,

such evaluations would be quite complex and costly. Hence, a new classification system should be created and evaluated to facilitate making decisions related to elbow OA treatment (19). Although both surgical methods evaluated herein are useful, we believe that a new classification is necessary to apply these methods. Cartilage degeneration is a feature of elbow OA and may affect the degree of symptoms that present in OA patients. Arthroscopic examination may help detect the degree of degenerative changes; therefore, arthroscopic classification will be needed in the future.

This study has some limitations. One limitation is the relatively small number of cases that were evaluated in this study. So there is the lack of power analysis because of the results of two experienced surgeons. Second, the follow-up period was short. Third, patient progress was not evaluated starting immediately following surgery until rehabilitation. Prospective research in this area is necessary. The duration of postoperative functional improvement and incidence of complications by multicenter registration should be further evaluated.

Conclusions

In conclusion, at the time of the final follow-up, similar results were observed in both groups. Open and arthroscopic surgical release for elbow OA were associated with significant improvement in terms of pain and function, as measured by the Hand20 score. Moreover, there were no significant differences in the clinical outcomes between the two groups during the follow-up period. We did not find concordance amongst degree of OA and classification.

Appebdix

Abbreviations

OA: osteoarthritis, CT: computed tomography, BR: Broberg and Morrey classification, HR: Hastings and Rettig classifications, ICC: intraclass correlation coefficient

Declarations

Ethics approval and consent to participate: This study was approved by our institutional ethics committees (*Nagoya University Hospital Institutional review board* No. 2018-0007-11984). Personal data: Not applicable
Consent for publication: Not applicable
Availability of data and material: The data that support the findings of this study are available upon request from the corresponding author [MT]. The data are not publicly available to protect the privacy of the research participants.
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Authors' contributions: Masahiro Tatebe designed and directed the project, Toshikazu Kurahashi and

Akimasa Morita performed the experiments, Masahiro Tatebe wrote manuscript, Hitoshi Hirata supervised the project.

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