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Long-term results of open extensive débridement arthroplasty for primary osteoarthritis of the elbow: what direct examination and computed tomography images revealed

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Background: Although open and arthroscopic débridement arthroplasties are major surgical strategies in patients with primary osteoarthritis of the elbow, the long-term results remain inadequately studied. Therefore, this study aimed to evaluate long-term clinical and radiographic results after extensive débridement arthroplasty (EDA) for primary osteoarthritis of the elbow.

Methods: Eleven patients with primary osteoarthritis treated with EDA were able to be retrospectively evaluated by direct examination. The mean age of the seven male and four female patients was 56 years (range, 47-74 years). The surgical procedure involved the removal of all osteophytes and free bodies, release of anterior and posterior capsules, fenestration of the olecranon fossa, and excision of the posterior bundle of the ulnar collateral ligament. At a mean follow-up of 15 years, clinical and radiographic outcomes were assessed.

Results: The mean flexion increased significantly from 110.5° to 129.6° postoperatively in the short term and was generally maintained at the final follow-up. Conversely, the mean extension improved significantly from −26.4° to −11.4° postoperatively in the short term; however, at the final examination, it had decreased to −25.5°. According to the Mayo Elbow Performance score, results were excellent for five elbows, good for five, and fair for one. In all cases, postoperative pain was “none” or “mild,” and no postoperative complications were observed. In all cases, recurrence of osteophytes was seen, and the fenestration hole of the olecranon fossa remained open in three elbows, was partially refilled in four elbows and was completely refilled in four elbows at the time of the final follow-up. Univariate analysis revealed that among preoperative variables, age, arc of motion, and extension were prognostic factors that significantly affected postoperative extension in the long term.

Conclusions: The present findings indicate that EDA provides marked long-term relief of pain and improved flexion despite the recurrence of restricted extension. Patients with extremely restricted extension preoperatively are at the risk of deteriorated extension over the long term.

Primary osteoarthritis is relatively rare in the elbow compared to other joints.[4] Many surgeons consider strenuous physical exertion to be a significant predisposing factor for the development of this degenerative change in the elbow. [9,11,13,18] Range of motion becomes increasingly limited as elbow osteoarthritis progresses, with severe pain appearing at the final limits of elbow range of motion dramatically interfering with daily life and work. Surgical intervention may become necessary if conservative treatment proves ineffective. The difference from osteoarthritis of other joints is that the deformation of the joint surface is relatively mild, and the main pathology is osteophyte formation and sclerosis of the joint capsule and ligament.[4] The main surgical treatment for primary elbow osteoarthritis is thus open or arthroscopic débridement arthroplasty, for which many studies have demonstrated favorable short- and medium-term results.[2,3,5-9,11,13,16,19] However, relatively few reports have described long-term results.[1,12,15,20] We have performed extensive débridement arthroplasty (EDA) for primary elbow osteoarthritis. This surgical

The Hokushin Hospital Ethics Review Board approved the study (approval no. 2003).

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procedure involves fenestration of the olecranon fossa in addition to conventional open elbow débridement, and the osteophytes, joint capsule, and ligaments that limit the range of motion and cause pain are thoroughly excised. The present study aimed to evaluate the long-term functional and radiographic results of EDA for primary osteoarthritis of the elbow.

Materials and methods

Study design

This study was conducted as a multicenter, retrospective, observational trial. The study protocol was reviewed and approved by the institutional review board at Orthopedic Hokushin Orthopaedic Hospital (approval no. 2003). The participating institutions included two private orthopedic hospitals.

Study patients

Between February 1999 and January 2008, a total of 59 elbows with primary osteoarthritis of the elbow were treated using EDA. As many patients had been lost to follow-up, letters inviting patients to undergo an additional examination were sent to all 58 patients in October 2018. Subsequently, 11 elbows of 11 patients (7 men, 4 women) who responded to the letter were directly examined and 10 of them underwent computed tomography.

The mean age at surgery was 56 years (range, 47-74 years). Clinical and radiographic outcomes were assessed at a mean follow-up of 15 years (range, 10-20 years). Patient demographic data are presented in Table I. With regard to occupational backgrounds, 9 patients were heavy manual laborers, one was a housekeeper, and one was a high school teacher.

EDA was performed by one of the two coauthors (N.S. and N.O.). EDA was indicated for primary osteoarthritis of the elbow in cases where the patient showed difficulty in activities of daily living due to pain or limitation of range of motion at the elbow, along with radiographic evidence of a preserved joint space. We excluded patients who had undergone revision for previous surgery.

Table I
Demographic characteristics of patients.

Characteristics	Value
Age at time of operation, y	55.7 (47-74)
Sex (male/female)	7/4
Dominant arm involved (yes/no)	8/3

Surgical technique

Under general anesthesia, the patient was placed in the supine position with a tourniquet applied to the upper limb. If the patient had no ulnar nerve palsy and the limitation to range of motion was moderate, the operation could be performed using a lateral approach. However, in most cases, the patient showed ulnar nerve palsy and needed excision of the posterior bundle of the ulnar collateral ligament to gain good flexion, so we started the operation with a medial approach. Initially, a skin incision 8-10 cm in length was executed medially along the course of the ulnar nerve. The ulnar nerve was fully released and protected during the procedure, and the posterior to the medial joint capsule and the posterior bundle of the ulnar collateral ligament were excised. Subsequently, osteophytes around the olecranon fossa, olecranon tip, and medial side of the ulnohumeral joint were removed while preserving the anterior bundle of the ulnar collateral ligament. Next, between the pronator teres muscle and biceps brachii muscle, an approach into the anterior compartment was made, and the anterior capsule was detached from the humerus. Osteophytes in front of the humerus, around the coronoid fossa, and at the coronoid process were removed. A fenestration hole was made from the anterior to the posterior to connect the coronoid fossa and olecranon fossa with a diameter of about 1.5-2 cm using a high-speed burr (Fig. 1). A lateral approach was added in many cases when the extension remained limited after the procedure from the medial approach. An oblique skin incision was made from 3 cm proximal to the lateral epicondyle to 5 cm distal to the radial head. The radial joint space was approached through the anterior and posterior edges of the lateral ligament. The anterior and posterior capsule and osteophytes around the radial fossa, capitellum, and radial side of the ulnohumeral joint were resected. After confirming sufficient improvement of range of motion, the tourniquet was deflated and hemostasis was achieved. Subcutaneous anterior transposition of the ulnar nerve was performed. A suction drainage tube was placed in the joint, and skin closure was performed.

Postoperative rehabilitation program

The elbow was immobilized in a splint for 2 days after the operation. The drainage tube was removed two days postoperatively, and active and passive movement of the elbow was started.

Clinical evaluation

Preoperatively and at final follow-up, we evaluated the active range of motion of the elbow, Mayo Elbow Performance score (MEPS), and pain. Active range of motion was also evaluated at short-term follow-up (mean 15.1 months; range 1-37 months) and compared with that at the final follow-up. The MEPS provides a functional evaluation of the elbow joint, including an assessment of elbow pain (45 points), joint movement (20 points), stability (10 points), and function (25 points).[10] Pain was quantified using the pain intensity subscale of the MEPS and was classified as “none,” “mild,” “moderate,” or “severe.”

Radiographic evaluation

At the final follow-up, the results of X-rays and computed tomography for the recurrence of osteophytes and the state of the fenestration hole were evaluated. The degree of regrowth of fenestration was assessed using the method described by Phillips.[15] Radiographs that showed more than 75% of the fenestration hole as still visible were graded as “open,” between 25% and 75% as “partially open,” and less than 25% as “closed.”

Statistical analysis

All statistical analyses were performed using EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). More precisely, EZR is a modified version of R Commander designed to add statistical functions frequently used in biostatistics. The Wilcoxon rank-sum test was used to compare pre and postoperative values for range of motion of the elbow. Univariate analysis was used to correlate both postoperative range of motion (flexion, extension, and arc of motion) and MEPS with preoperative factors. Continuous variables (age, flexion, extension, and arc of motion) were analyzed using Spearman’s correlation analysis. The level of significance was set at $P < .05$.

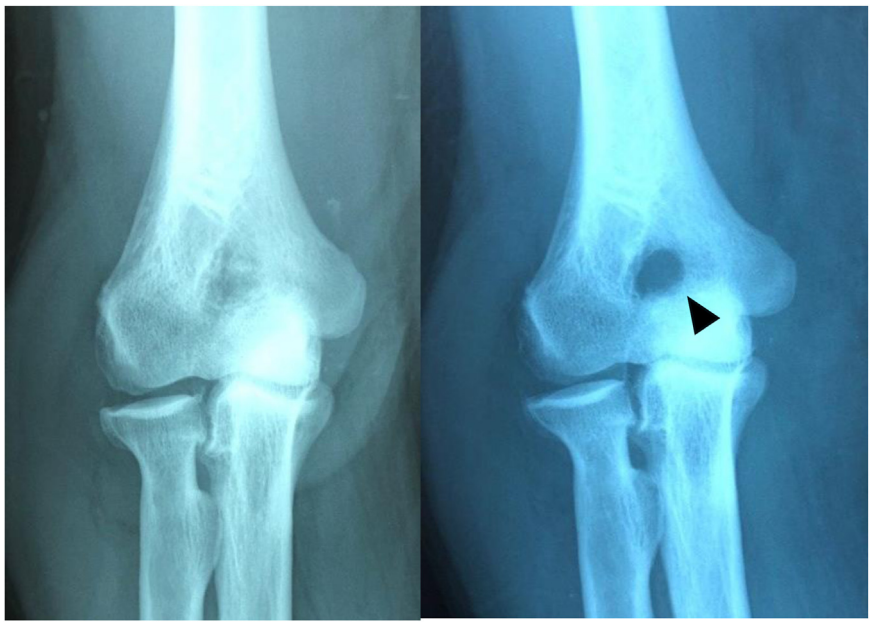

Figure 1 Pre and postoperative plain radiographs. A fenestration hole was made connecting the coronoid fossa and olecranon fossa (*arrowhead*).

Table II
Pre and postoperative parameters.

Parameter	Preoperative	Short-term follow-up	*P* value (vs. preop.)	Long-term follow-up	*P* value (vs. preop.)
Mo		15.1 (1-53) mo		180 (120-240) mo	
Flexion	110.5 (range, 90-120°)	129.6 (range, 120-135°)	0.005	122.3 (range, 110-140°)	0.02
Extension	−26.4 (range, −60 to 5°)	−11.4 (range, −35 to 0°)	0.005	−25.5 (range, −35 to 0°)	0.88

Results

The mean flexion increased significantly ($P = .005$) from 110.5° (range, 90-120°) preoperatively to 129.6° (range, 120-135°) postoperatively at short-term follow-up and was generally maintained at final follow-up (122.3°; range, 110-140°; $P = .02$ vs. preoperatively). On the other hand, although extension improved significantly ($P = .005$) from −26.4° (range, −60° to −5°) to −11.4° (range, −35 to 0°) postoperatively in the short term, then decreased to −25.5° (range, −35 to 0°) at the final examination (not significant vs. preoperatively) (Table II).

According to the MEPS, the result at the final follow-up was excellent for five elbows, good for five, and fair for one. Pain intensity according to the MEPS was “none” for seven elbows and “mild” for four elbows.

At the final follow-up, we were able to evaluate radiographs for the fenestration hole in all cases and computed tomography images for recurrent osteophytes in 10 of the 11 cases. In all cases, recurrent osteophytes were seen. Recurrence at the coronoid fossa was seen in four of those 10 cases with recurrence, coronoid in eight, olecranon fossa in two, and olecranon in nine. The fenestration hole of the olecranon fossa remained open in three elbows, partially open in four elbows, and closed in four elbows at the time of the final follow-up. Table III shows the range of motion, site of osteophyte recurrence at the olecranon, and refill of the fenestration hole for each case.

No revision surgeries, infections, or other complications were encountered during the study period.

Univariate analysis revealed that among the preoperative variables, age, preoperative extension, and preoperative arc were prognostic factors associated with postoperative extension in the long term ($P < .05$). No other factors were seen to correlate with postoperative outcomes (Table IV).

Discussion

Although elbow débridement arthroplasty for osteoarthritis of the elbow is a major surgical treatment for primary osteoarthritis of the elbow and many studies have demonstrated favorable short- and medium-term results,[2,3,5-9,11,13,16,19] few reports have provided long-term results.[1,12,15,20] The present study investigated the results of EDA for primary osteoarthritis of the elbow over the long term (mean follow-up, 15 years).

In the short term, this study showed excellent range of motion, with a mean flexion of 129.6° and extension of −11.4°. Compared to the Outerbridge-Kashiwagi method and arthroscopic ulnohumeral arthroplasty, better postoperative range of motion can be expected. This is because the current procedure removes osteophytes and soft tissue contractures, including anterior and posterior joint capsule and the posterior bundle of the ulnar collateral ligament that cause range-of-motion restrictions. The effectiveness of anterior and posterior capsulectomy and resection of the posterior bundle of the ulnar collateral ligament has been demonstrated in other reports,[1,5,14,17] and performing all necessary procedures to improve the range of motion is important. Further, compared to normal débridement arthroplasty, good results were expected to be maintained in the long term because restricted range of motion was considered less likely to recur after fenestration on the humeral side, even if osteophytes recur on the ulnar side.

Table III
Overall patient data (NA: not available).

Case	Age	Sex	Preoperative		Postoperative (short term)		Postoperative (long term)		Site of osteophyte recurrence at olecranon			Fenestration hole
			Flexion	Extension	Flexion	Extension	Flexion	Extension	Medial	Middle	Lateral	
1	53	M	120	−30	120	−10	125	−15	+	−	−	Open
2	47	M	100	−20	125	0	125	0	−	−	−	Partially open
3	62	M	100	−30	135	−10	125	−35	+	−	−	Open
4	47	M	110	−20	135	−5	120	−25	+	+	+	Partially open
5	53	F	120	−20	130	−10	120	−20	+	+	−	Partially open
6	58	M	110	−30	135	−15	140	−35	−	+	−	Closed
7	74	F	120	−5	130	−5	120	−25	+	+	+	Closed
8	58	F	90	−60	125	−35	120	−35	+	+	+	Closed
9	52	M	115	−15	135	0	120	−20	+	−	−	Open
10	55	M	110	−30	125	−15	110	−35	+	+	+	Partially open
11	54	M	120	−30	130	−20	120	−35	NA	NA	NA	Closed

Table IV
Results by univariate analysis for factors affecting postoperative outcomes.

Postoperative outcome	Preoperative factor	*P* value	ρ
Flexion	Age	.912	0.0378
	Preoperative flexion	.566	−0.195
	Preoperative extension	.64	−0.159
	Preoperative arc of motion	.523	−0.216
Extension	Age	.0239	−0.671
	Preoperative flexion	.374	0.298
	Preoperative extension	.049	0.604
	Preoperative arc of motion	.0328	0.643
Arc of motion	Age	.156	−0.459
	Preoperative flexion	.651	0.154
	Preoperative extension	.238	0.388
	Preoperative arc of motion	.241	0.386
MEPS	Age	.13	−0.486
	Preoperative flexion	.153	0.462
	Preoperative extension	.615	0.171
	Preoperative arc of motion	.333	0.323

MEPS, Mayo Elbow Performance score.

Although few reports have provided long-term results for débridement arthroplasty performed to treat osteoarthritis of the elbow, we were able to review four such reports.[1,12,15,20] Among them, Nobuta et al, Phillips et al, and Antuna et al reported good long-term results in terms of range motion; however, the range of motion in the short and mid-term was not mentioned, so postoperative transitions in range of motion over time remained unclear.[1,12,15] On the other hand, Wada et al examined the results of open débridement arthroplasty and found promising results for both flexion and extension at 1 year postoperatively. However, they reported that at a mean follow-up of 121 months, flexion was preserved, but extension was worsened.[20] Our results were similar to those results, suggesting that débridement arthroplasty for osteoarthritis of the elbow can still result in the reappearance of restricted extension over the long term. Nevertheless, in terms of the MEPS over the long term, our result was better than in other reports.[1,12,15] This may have been due to the absence of recurrent pain. In EDA, the anterior and posterior capsules were removed if these structures were contributing to the limited range of motion. Another report suggested that capsulectomy may have an effect of pain release due to denervation.[9] Similarly in this study, one possibility is that capsulectomy may have reduced pain recurrence. In addition, by making the fenestration hole, the anterior and posterior space of the joint are connected, which can be expected to reduce pain caused by intra-articular pressure on the anterior side during elbow flexion and on the posterior side during elbow extension.

Regarding predictors of postoperative outcome, Galle et al reported that young patients, sharp capsule release, and better preoperative motion were associated with better improvements in the postoperative range of motion.[3] Lim et al reported that the preoperative motion arc was an independent factor that can predict clinical outcomes.[8] In this study, over the long term, older age, decreased preoperative extension, and arc of motion correlated with decreases in postoperative extension. Preoperative range of motion thus dramatically affects postoperative range of motion, and even if patients with poor preoperative extension obtained good extension in the short term, extension may decline in the long term. In these cases, the possible prognosis must be explained to the patient in advance, thorough osteophyte resection should be applied as in this surgical method, and careful follow-up should be continued after the operation.

In this study, although the degree and location differed depending on the case, osteophyte recurrence was observed in all cases. Some studies have contended that the recurrence of osteophytes and closure of fenestration were not associated with postoperative symptom recurrence,[1,12,15] while Wada et al reported that the loss of extension could be explained by the recurrence of osteophytes at the olecranon process and olecranon fossa.[20] In this study, as shown in Table III and Fig. 2, osteophytes recurred at the olecranon in nine of the 10 cases, and large osteophytes often occurred on the medial side of the olecranon. Given the above, our assumption is that the recurrence of large osteophytes on the medial side of the olecranon or recurrence of osteophytes in the middle of the olecranon and closure of the fenestration hole were factors contributing to the deterioration of extension over the long term. The mechanisms underlying such osteophyte recurrence are still unclear and require elucidation in future studies.

The major strengths of this study were the long-term clinical and radiographic assessments and longitudinal radiographic evaluation of EDA for primary osteoarthritis of the elbow, which have rarely been reported. However, some limitations must be acknowledged in our study. First, this was a retrospective study with loss of follow-up in many cases and a small sample size, which may have contributed to selection bias. Second, we could not account for confounding variables due to the infeasibility of conducting multivariate analysis with a small number of subjects. Third, we did not evaluate preoperative or short-term pain scores.

Conclusions

The present findings indicate that EDA provides significant pain relief and improvement in flexion over the long term, despite the recurrence of limits to extension. Patients with preoperative

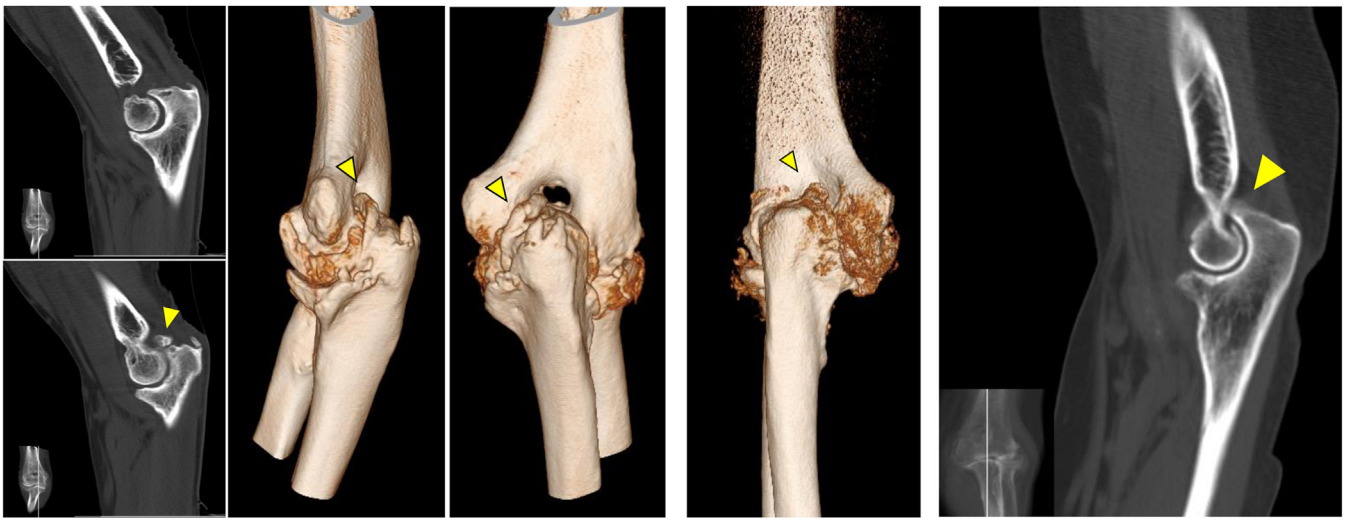

Figure 2 2-1 A case with recurrent osteophyte at the medial side of the olecranon (*arrowhead*). Fig. 2-2 A case with recurrent osteophyte at the middle of the olecranon and closure of the fenestration hole (*arrowhead*).

significant limitations to elbow extension are at risk of showing deterioration to extension in the long term.

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References

1. Antuna SA, Morrey BF, Adams RA, O'Driscoll SW. Ulnohumeral arthroplasty for primary degenerative arthritis of the elbow: long-term outcome and complications. J Bone Joint Surg Am 2002;84:2168-73. https://doi.org/10.2106/00004623-200212000-00007.
2. Cohen AP, Redden JF, Stanley D. Treatment of osteoarthritis of the elbow: a comparison of open and arthroscopic debridement. Arthroscopy 2000;16:701-6.
3. Galle SE, Beck JD, Burchette RJ, Harness NG. Outcomes of elbow arthroscopic osteocapsular arthroplasty. J Hand Surg Am 2016;41:184-91. https://doi.org/10.1016/j.jhsa.2015.11.018.
4. Gramstad GD, Galatz LM. Management of elbow osteoarthritis. J Bone Joint Surg Am 2006;88:421-30. https://doi.org/10.2106/JBJS.E.00568.
5. Hattori Y, Doi K, Sakamoto S, Hoshino S, Dodakundi C. Capsulectomy and debridement for primary osteoarthritis of the elbow through a medial transflexor approach. J Hand Surg Am 2011;36:1652-8. https://doi.org/10.1016/j.jhsa.2011.07.018.
6. Kelly EW, Bryce R, Coghlan J, Bell S. Arthroscopic debridement without radial head excision of the osteoarthritic elbow. Arthroscopy 2007;23:151-6. https://doi.org/10.1016/j.arthro.2006.10.008.
7. Krishnan SG, Harkins DC, Pennington SD, Harrison DK, Burkhead WZ. Arthroscopic ulnohumeral arthroplasty for degenerative arthritis of the elbow in patients under fifty years of age. J Shoulder Elbow Surg 2007;16:443-8. https://doi.org/10.1016/j.jse.2006.09.001.
8. Lim TK, Koh KH, Lee HI, Shim JW, Park MJ. Arthroscopic débridement for primary osteoarthritis of the elbow: analysis of preoperative factors affecting outcome. J Shoulder Elbow Surg 2014;23:1381-7. https://doi.org/10.1016/j.jse.2014.01.009.
9. MacLean SB, Oni T, Crawford LA, Deshmukh SC. Medium-term results of arthroscopic debridement and capsulectomy for the treatment of elbow osteoarthritis. J Shoulder Elbow Surg 2013;22:653-7. https://doi.org/10.1016/j.jse.2013.01.030.
10. Morrey BF, An K-N. Functional evaluation of the elbow. In: Morrey BF, editor. The elbow and its disorders. 3rd ed. Philadelphia: WB Saunders; 2000. p. 74-83. ISBN: 9780721677521.
11. Morrey BF. Primary degenerative arthritis of the elbow: treatment by ulnohumeral arthroplasty. J Bone Joint Surg Br 1992;74:409-13.
12. Nobuta S, Sato K, Itoi E. Long-term results of ulnohumeral arthroplasty for symptomatic elbow osteosrthritis. J Arthritis 2016;5:196. https://doi.org/10.4172/2167-7921.1000196.
13. Oka Y. Debridement arthroplasty for osteoarthrosis of the elbow: 50 patients followed mean 5 years. Acta Orthop Scand 2000;71:185-90.
14. Park MJ, Chang MJ, Lee YB, Kang HJ. Surgical release for posttraumatic loss of elbow flexion. JBJS Essent Surg Tech 2011;1:e16. https://doi.org/10.2106/JBJS.I.01367.
15. Phillips NJ, Ali A, Stanley D. Treatment of primary degenerative arthritis of the elbow by ulnohumeral arthroplasty. A long-term follow-up. J Bone Joint Surg Br 2003;85:347-50. https://doi.org/10.1302/0301-620x.85b3.13201.
16. Rettig LA, Hastings H 2nd, Feinberg JR. Primary osteoarthritis of the elbow: lack of radiographic evidence for morphologic predisposition, results of operative debridement at intermediate follow-up, and basis for a new radiographic classification system. J Shoulder Elbow Surg 2008;17:97-105. https://doi.org/10.1016/j.jse.2007.03.014.
17. Ruch DS, Shen J, Chloros GD, Krings E, Papadonikolakis A. Release of the medial collateral ligament to improve flexion in post-traumatic stiffness. J Bone Joint Surg Br 2008;90:614-8. https://doi.org/10.1302/0301-620X.90B5.19999.
18. Stanley D. Prevalence and etiology of symptomatic elbow osteoarthritis. J Shoulder Elbow Surg 1994;3:386-9.
19. Tsuge K, Mizuseki T. Debridement arthroplasty for advanced primary osteoarthritis of the elbow: results of a new technique used for 29 elbows. J Bone Joint Surg Br 1994;76:641-6.
20. Wada T, Isogai S, Ishii S, Yamashita T. Debridement arthroplasty for primary osteoarthritis of the elbow. J Bone Joint Surg Am 2004;86:233-41. https://doi.org/10.2106/00004623-200402000-00004.