

A retrospective comparison of olecranon osteotomy and paratricipital approach in treatment of distal humerus intra-articular fractures

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Abstract

Aim: Paratricipital approach and Olecranon osteotomy are most commonly used to treat intra-articular distal humerus fractures in adults. In this study we have analysed the patients in whom we performed open reduction and internal fixation with and without olecranon osteotomy and evaluated the advantages and disadvantages of both methods.

Materials and Methods: Between 2014 and 2018, 36 adult patients with intra-articular distal humerus fracture were retrospectively analysed. According to AO classification system 9, patient has Type B2, 1 Type B3, 7 Type C1, 10 Type C2 and 9 Type C3 fractures. Mayo Elbow Performance Score for evaluation of the elbow joint stability and Disabilities of Arm, Shoulder and Hand score to evaluate the functionality of shoulder, arm and hand was used.

Results: Paratricipital approach was used in 12 patients (8 male, 4 female) and olecranon osteotomy in 24 patients. Mayo Elbow Performance Score and Disabilities of Arm, Shoulder and Hand scores were found respectively 15.808 and 81.25 in the Paratricipital group whereas those values were determined as 17.37 and 79.17, respectively. No statistically significant difference was found between two groups in terms of these two scorings ($p=0.147$ and $p=0.244$, respectively). A statistically significant difference was detected between the groups in terms of heterotopic ossification ($p=0.008$). In the paratricipital group; no heterotopic ossification was found in 7 (58.3%) patients whereas Type 1 heterotopic ossification was detected in 5 (41.7%) patients. In the olecranon osteotomy group; no heterotopic ossification was found in 4 (16.7%) patients whereas Type 1 and Type 2 heterotopic ossification were detected in 16 (66.7%) and 4 (17.7%) patients, respectively ($p=0.008$). A statistically significantly higher rate of elbow degeneration and heterotopic ossification was observed in the patients who underwent osteotomy compared with those who were not performed osteotomy ($p=0.008$).

Conclusions: Paratricipital approach can be performed as an alternative treatment option in the distal humerus fractures to reduce the postoperative complications even though it does not allow to perform a comprehensive preoperative evaluation of the joint as well as olecranon osteotomy approach.

Keywords: Heterotopic ossification; intraarticular fracture; olecranon osteotomy; paratricipital approach

INTRODUCTION

Distal humerus fractures make 2% of all adult elbow fractures (1). Intraarticular fractures are caused by the impaction of proximal ulna onto the articular surface of the distal humerus (capitellum, trochlea) during elbow flexion or elbow extension. These fractures are rarely seen, however, development of a specific treatment algorithm is still difficult (1). The risk for functional loss and residual pain is high in the intraarticular humerus fractures (2,3). Hence, there is a consensus on surgical treatment in these type fractures (4). The main purpose of surgical treatment is to achieve early postoperative mobilization by detecting the fracture and obtaining adequate stabilization (1,5).

The gold standard of the surgical technique is olecranon osteotomy combined with plate osteosynthesis(1,6). Beside this, triceps-sparing and triceps-reflecting (Bryan and Morrey's) approaches have been defined including their advantages and disadvantages (7,8). Although, olecranon osteotomy provides excellent exposure for surgery, several complications such as nonunion, delayed union (malunion), avascular necrosis and heterotopic ossification may be seen (9-11). On the other hand, triceps-sparing or triceps-reflecting approaches represent some disadvantages such as difficulty in obtaining articular exposure, longer duration of surgery and triceps weakness (12,13). In the present study, we have analyzed

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the patients in whom we performed open reduction and internal fixation with and without olecranon osteotomy and evaluated the advantages and disadvantages of both methods.

MATERIALS and METHODS

This study was conducted with totally 36 patients distal humeral fragment fractures consisting of 26 males and 10 females aged between 18-65 years. The study protocol was approved by the Local Ethics Committee (B.30.2.ATA.0.01.00/453). The patients with a follow-up period shorter than 12 months, the functional loss of the limb before fracture, pathological fractures, simultaneous ipsilateral forearm fractures and metabolic bone diseases were excluded from the study. The fractures were classified according to the AO Classification System of the fractures. Our study involved 9 Type B2, 1 Type B3, 7 tipType C1, 10 Type C2 and 9 Type C3 fractures. Preoperative and postoperative standard A-P and lateral radiographies were used for radiological evaluation. The degenerative changes and heterotopic ossifications (HO) on the articular surface were evaluated according to these radiographies. We did not use prophylactic agent for HO in none of the two groups. BROBERG Classification was used for elbow joint degeneration while heterotopic ossification was assessed using HASTING Classification System (14). A standard physical examination was performed. This physical examination involved MEPS (Mayo Elbow Performance Score) for evaluation of the elbow joint stability (90< = excellent, 75-89 = good, 60-74 = acceptable and 60> = poor) and DASH (Disabilities of Arm, Shoulder and Hand) to evaluate the functionality of shoulder, arm and hand).

Surgical Technique

We operated our patients in the lateral decubitus position and did not use tourniquet. All the patients were operated by an identical surgical team. Distal humerus fixation was performed combined with olecranon osteotomy using transolecranon approach in 24 patients whereas distal humerus fixation was performed with paratricipital approach without olecranon osteotomy in 12 patients. Posterior midline incision was used in both techniques. First, ulnar nerve was found and preserved by detaching from the surrounding tissues. Ulnar nerve was applied anterior transposition. Medial and lateral humerus was reached by dissection performed from the medial and lateral intermuscular septum in the paratricipital approach. All the patients were applied bicolumnar plating in accordance with the principles of AO. On the other hand, in our patients with olecranon osteotomy, we sent a 6.5 mm screw from the tip of the olecranon to ulnar medulla to facilitate fixation and made chevron osteotomy 2-3 cm distal to the tip of the olecranon after removing this screw. We cut osteotomy using a chainsaw until 0.5 mm from the articular surface and continued using an osteotome. That helps formation of the fracture tips on the articular surface and thereby facilitates achieving reduction. Also these patients were applied bicolumnar plating in accordance to

AO principles. Then, we inserted 6.5 mm intramedullary screw with washer into the hole previously prepared for olecranon fixation and used the tension band wire fixation. One negative pressure drain was placed in all patients. A splint was postoperatively applied at 90 degrees of flexion in all patients. The postoperative control examinations of the patients were regularly performed at 2nd, 4th, 6th and 12th weeks.

Postoperative Protocol

Negative pressure drain was removed within the first 24-48 hours. Active supported flexion and extension exercises were initiated in the first week. Splints were removed in all patients at the end of the 2nd week. ROM exercises were gradually increased until the sixth week to achieve whole range. Full active motion of the elbow was allowed after radiographic confirmation of the union.

Statistical analysis

Statistical data of the study were analyzed using Statistical Package for Social Sciences (SPSS) Version 20 (IBM CORP; ARMONK, NY, USA). Data were presented as mean, standard deviation, minimum, maximum and percentile values. The groups were compared in terms of age, MEPS, DASH and operation duration were tested using Mann-Whitney U Test. The groups were compared regarding Broberg, HO, gender and diagnosis using Fisher's Exact test. The statistical significance level was accepted as $p < 0.05$ value.

RESULTS

Thirty-six patients were analyzed retrospectively (Table 1). Mean age in the PT (Paratricipital) group was 38.25 years whereas that was 47.42 years in the OO (Olecranon Osteotomy) group. PT group included 8 (66.7%) male and 4 (33.3%) female patients while OO group was composed of 18 (75%) males and 6 (25%) female patients (Figure 1-2). MEPS and DASH scores were found respectively 15.808 and 81.25 in the PT group whereas those values were determined as 17.37 and 79.17, respectively. No statistically significant difference was found between two groups in terms of these two scorings ($p=0.147$ and $p=0.244$, respectively). Mean operation duration was 2.162 hours in the PT group where as a mean operation duration of 2.558 hours was determined in the OO group. A statistically significant difference was detected between the groups in terms of HO ($p=0.008$). In the PT group; no heterotopic ossification (HO) was found in 7 (58.3%) patients whereas Type 1 HO was detected in 5 (41.7%) patients. In the OO group; no heterotopic ossification (HO) was found in 4 (16.7%) patients whereas Type 1 and Type 2 HO were detected in 16 (66.7%) and 4 (17.7%) patients, respectively ($p=0.008$). In the PT group, Broberg-Morrey radiological imaging scale was determined Type 1 and Type 2 in respectively 10 (83.3%) and 2 (16.7%) patients whereas this scale was encountered Type 1 and Type 2 in 10 (41.7%) and 14 (58.3%) patients in the OO group, respectively. According to these results, no statistically significant difference was found between the patients who underwent open reduction and internal fixation with and without osteotomy in terms of age, MEPS and DASH

scorings whereas a statistically significant difference was detected. Mean operation duration was 2.558 hours in the patients who underwent osteotomy whereas mean operation duration was 2.162 hours in the patients without osteotomy (p=0.011). No statistically significant difference was encountered between the patients who were performed and not performed osteotomy in terms of gender and diagnosis whereas significant difference was determined between these two groups regarding elbow degeneration and heterotopic ossification. A statistically significantly higher rate of elbow degeneration and heterotopic ossification was observed in the patients who underwent osteotomy compared with those who were not performed osteotomy (p=0.008).

Table 1. Comparison of the olecranon osteotomy (OO) approach group and paratricipital approach group in terms of age, gender, MEPS ,DASH, Operation time, HO ,BROBERG and fracture type

Parameter	PT approach group (n=12)	OO approach group (n=24)	Remark P
Age	38.25 (18-73)	47.42 (18-94)	0.261
MEPS	15.808 (12.5-20.00)	17.37 (15.00-25.00)	0.147
DASH	81.25 (75-85)	79.17 (65-85)	0.244
Surgery time(h)	2.162 (1.45-3.00)	2.558 (2.00-3.00)	0.011
Fracture type			
TYPE B	3 (%25)	7 (%29.2)	0.406
TYPE C	9 (%75)	17 (%70.8)	
Gender			
Male	8 (%66.7)	18 (%75)	0.70
Female	4 (%33.3)	6 (%25)	
HO			
None	7 (%58.3)	4 (%16.7)	0.008
TYPE 1	5 (%41.7)	16 (%66.7)	
TYPE 2	0 (%0)	4 (%16.7)	
Broberg			
TYPE 1	10 (%83.3)	10 (%41.7)	0.032
TYPE 2	2 (%16.7)	14 (%58.3)	



Figure 1. Preoperative X-rays (anteroposterior and lateral views) of the elbow shows intra-articular fracture of distal humerus (A,B), after parallel plate fixation using olecranon osteotomy approach (C,D)



Figure 2. Preoperative X-rays (anteroposterior and lateral views) of the elbow shows intra-articular fracture of distal humerus (A,B), after parallel plate fixation using paratricipital approach (C,D)

DISCUSSION

The essential goal of the treatment approach in the distal humerus intraarticular fractures should provide restoration of the articular surface, full fixation and early active rehabilitation (15-17). O'Driscoll et al. have identified an ideal treatment approach that "provides adequate exposure, allows to elongate the incision when needed and also to perform soft tissue dissection without osteotomy, dissection through intraneural dissection, all surgical procedures including with a single incision and to achieve early active rehabilitation" in their study (18).

Wilkinson et al. have compared triceps sparing, triceps reflecting and osteotomy as the surgical techniques and found their rates as 35%, 46% and 57%, respectively (12). OO approach allows to evaluate the joint comprehensively and is accepted as the gold standard treatment technique at the present time. On the other hand, osteotomy presents some complications such as nonunion, delayed union (malunion) and implant failure(19). Implant removal or failure requires an additional surgery in these patients. Implant failure after OO has been reported ranging between 13% and 30% (20,21). The debates on the most ideal approach are still current at the present time. The most critical parameter in the intraarticular distal humerus fractures is achievement of the elbow range of motion. No statistically significant difference was determined between the patients who were performed and not performed osteotomy in terms of articular range of motion (22). In also our study, we detected no significant difference between the patients who were performed and not performed osteotomy regarding DASH scale score as a subjective, functional and physical evaluation based on the personal statement of the patient (p=0.244). In the same manner, we determined no significant difference between the two groups in terms of MEPS score which is based on the patient's ability to do daily activities (p;0.147).

Helfet and Hotchkiss have shown that fixation with double-plates applied in both columns of distal humerus is biomechanically stronger compared with single-plate fixation (23). Hence, we have concluded that treatment approaches such as open reduction without osteotomy in which double-plates could be contoured are effective. Heterotopic ossification is the most important complication which decreases the articular range of motion after elbow traumas. In our study, the rates of elbow joint degeneration and heterotopic ossification were found significantly higher in the patients treated with OO approach. In addition, a longer operation duration was encountered in the patients who underwent osteotomy than those who were not treated with osteotomy. The patients may become more sensitive to complications due to prolonged duration of anaesthesia. Hang et al. have proven in their study that delayed surgery and prolonged surgery duration increase the incidence of heterotopic ossification in the fractures around elbow (24). The retrospective design of the study, inability to perform an evaluation based on the subtypes of fractures, the small number of the patient groups and unstated criteria for the postoperative early mobilization may be considered as the limitations of our study.

CONCLUSION

As a consequence, paratricipital approach can be performed as an alternative treatment option in the distal humerus fractures to reduce the postoperative complications even though it does not allow to perform a comprehensive preoperative evaluation of the joint as well as OO approach.

Competing Interests: The authors declare that they have no competing interest.

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