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Humerus Distal Fractures: Treatment and Complications

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Original Research Article

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Abstract: ***Purposes:*** Surgical treatment of distal humerus fractures is difficult because of the complex anatomy, often short distal segment or comminution. This study aimed to compare the plate fixation types and evaluate the effects of concomitant injuries on the results. ***Methods:*** Between January 2003-December 2010, 34 patients who underwent open reduction and internal fixation (ORIF) using distal humerus locking compression plate (LCP), were investigated retrospectively. All patients were above 16 years old, and minimum follow-up was 24 months. Exclusion criteria were; revisions, refractures, an insufficient follow-up to document results, mental disorders that may impair adaptation to the whole treatment. Functional results were evaluated with using MEPI (Mayo elbow scoring index) and VAS (Visual analog scale) score. Radiologic results were evaluated by the presence of avascular necrosis, nonunion, stepping on the joint, implant insufficiency, arthrosis, and heterotopic ossification. Arthrosis grade was defined by Broberg-Morrey scale and heterotopic ossification grade was defined by Brooker scale. ***Results:*** Mean follow-up was 63 (IQR: 50-76) months. The mean interval between trauma and surgery was 9 (IQR: 5-13) days. Eleven (32%) patients had a concomitant injury. Functional and radiological results were worse in concomitant injury (+) patients. Implant insufficiency and instability rates were lower in single plate group than double plate group. ***Conclusions:*** Patients with accompanying injuries should be informed about possible poor functional and radiological outcomes. If double plate fixation is not applied by the technical details, instability and insufficiency rates will increase.

Keywords: Humerus, distal, fracture, parallel, plate.

INTRODUCTION

Surgical treatment of distal humerus fractures is difficult because of the complex anatomy of the region's, often short distal segment and comminution with osteoporosis [1]. Literature mostly recommends transolecranon approach and double plate fixation for AO (Arbeitsgemeinschaft für Osteosynthesefragen) Type C fractures with some debates about the settlement. Namely, some advocates rectangular plating, by some suggests parallel plating [2-5]. By the evidence-based view; anatomical reduction, stable fixation, and early rehabilitation reduce the complication rates [6-8]. This study aimed to compare the rectangular and parallel plate fixation for possible reasons, evaluate the effects of the concomitant injuries on the results and preventions of complications with mid-term results.

MATERIAL AND METHODS

Between January 2003-December 2010, 47 surgically treated humerus distal end fractures were investigated, retrospectively. All patients underwent open reduction and internal fixation using a distal humerus locking compression plate. Minimum follow-up was 24 months. Patients younger than 16 years old, were excluded. According to AO classification; 17(%) were type B3. These type of fractures needs special consideration and treatment modalities, so they also excluded from this study. Eight patients had died, and five were lost to follow-up leaving 34 cases were taken into consideration. All patients had pre-operative elbow anterior-posterior and lateral x-rays also 3D CT (3-Dimension Computerised Tomography). Post-operative follow-up was made on 15. day, 1-3-6 and moreover, 12. months with elbow anterior-posterior and lateral x-rays. Functional results were evaluated with MEPI and VAS score. Radiologic results were evaluated by the presence of avascular necrosis, nonunion, stepping on the joint, implant insufficiency, degeneration, and heterotopic ossification. Degeneration grade was

defined by Broberg-Morrey scale; heterotopic ossification grade was made by Brooker scale. Consolidation considered as; if the fracture line has disappeared on x-ray and no sensitivity on the lateral colon by palpation. Stepping in the joint was classified as above and below 1mm. All patients were operated under general anesthesia. Antibiotic prophylaxis was made with sephazoline sodium 1 gr intravenously. The tourniquet was not used because of the proximity to the incision. A lateral approach was used only for one AO type A2 fracture; a posterior approach was used for other types. Elbow splint was used for all patients postoperatively to reduce pain and was removed with the drains in the second day. Passive exercises immediately, active and against resistance exercises at sixth week, were started. Sports activities were not allowed until the radiological consolidation was seen. Indometasine 75 mg/day for three weeks was given for prophylaxis of heterotopic ossification.

Statistical methods

NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA) software package was used. In the evaluation of the data, Dunn's multiple comparison test was used in the Kruskal Wallis test subgroup comparisons, Mann-Whitney-U test in the comparison of the binary groups, and chi-square test in the qualitative data comparisons were used in the intergroup comparisons as well as the descriptive statistical methods (mean, standard deviation, median, interquartile range). The results were evaluated at a significance level of $p < 0.05$.

Table-1: MEPI comparisons between AO type C fractures

Dunn's Multiple Comparison Test	MEPI
C1 / C2	0,046
C1 / C3	0,999
C2 / C3	0,046

Table-2: Relation between plate number and functional results

		Single plate(n=11)	Double Plate(n=21)	MW	p
MEPI	Mean±SD	96±8,94	94,72±9,15	40	0,647
	Median (IQR)	100 (90-100)	100 (90-100)		
ROM	Mean±SD	113±19,88	90,79±22,5	19,5	0,042
	Median (IQR)	110 (95-132,5)	90 (80-100)		
VAS	Mean±SD	1,75±0,96	1,56±0,92	30,5	0,585
	Median (IQR)	1,5 (1-2,75)	1 (1-2)		

RESULTS AND DISCUSSION

Twenty-four (71%) male, 10 (29%) female, mean age was 44 (IQR: 28-64) of total 34 cases. Fourteen (41%) right, 20 (59%) left side was broken. Etiology was; falling on the ground for 17 (49%), traffic accidents for 10 (30%), falling from high for 5 (15%) and direct trauma for 2 (6%) patients. Eight (24%) fractures were open. According to Gustillo-Anderson classification, 1 (3%) of them was grade 1, 4 (12%) were grade 2, and 3 (9%) were grade 3. According to the AO classification; 4 (12%) type A, 3 (9%) type B and 27 (79%) type C were identified. C subtypes were; 5(15%) C1, 16 (47%) C2 and 6 (18%) C3. Thirty-three (97%) posterior and 1 (3%) lateral approach were used. Twenty-five (76%) olecranon osteotomy, 7 (21%) triceps sparing and 1 (3%) triceps-splitting were used. Rectangular plating for 9 (26%), parallel plating for 13 (38%) and single plate for 12(35%) were used. Ulnar nerve transposition was made for 5 (15%) cases due to disturbance of the implant. Mean discharge time was 13 (IQR: 8-14) days. Mean follow-up was 63 (IQR: 50-76) months. Mean elbow Rom was 97 (IQR: 84-121) degrees. According to MEPI; 28(82%) excellent, 4(12%) good and 2 (6%) moderate results were obtained. Mean MEPI was 95 (IQR: 91-100). The mean interval between trauma and surgery was 9 (IQR: 5-13) days. Eleven (32%) patients had a concomitant injury. Functional and radiological evaluation criteria were better in the concomitant injury (-) patients (p=0,02; p=0.06, respectively). Also, MEPI was lower for C2 fractures, according to C1 and C3 fractures (p=0.04). No functional or radiological differences were found between the C1 and C3 fractures according to MEPI (p=0.65) (Table 1). Also, no difference was found between C1, C2 and C3 fractures according to final ROM (p= 0.234) (Table 2). Final ROM was found decreased in double plate fixation compared to a single plate (p=0.036) (Table 2). There was no difference between single and double plate fixation according to MEPI and VAS score (p=0.647, p=0.585; respectively). Implant insufficiency and instability rates were lower with single plate fixation (p=0.046, p=0.015; respectively). AVN, arthrosis and total complication rates were lower with single plate fixation (p=0.666, p=0.289, p=0.197; respectively). Moreover, no differences were found between rectangular and parallel plate fixation according to functional and radiological criteria (p=0.15, p=0.078; respectively). Patients with concomitant injury, elbow rom was decreased, arthrosis and heterotopic ossification rates were doubled. Accompanying head or spinal cord injury comes with a significantly lower range of motion, functional outcomes and higher heterotopic ossification rates. These cases must be notified about possible worse functional outcome and complications before the

surgery. surgery should be done without delay to be protected from the malpractice cases. Rom exercises and heterotopic ossification prophylaxis should be started. C3 fractures' patient satisfaction and final rom were reported as lower than C1 and C2 fractures' [3,9]. In contrast; mean MEPI score in C2 fractures was lower in this study. This may be due to the higher number of C2 fractures than C1 and C3 fractures in our series. There was no difference between osteotomy (+) and (-) approaches according to functional results. However; in osteotomy(-) group; heterotopic ossification rate was 11% and 32% for opposing. Behind this rise; there may be different preparatory factors for heterotopic ossification, accompany to complex fractures. There is a consensus about the anatomic reduction of joint and stable fixation of both colons, but a debate is ongoing about the type and place of the plates [4,10]. O 'Driscoll concluded that parallel plating is better than rectangular plating only in osteoporosis and also suggested to use distally 2.7 mm screws, passing far cortex [11]. In this study, there was no difference between parallel and rectangular functional and radiological results. According to our clinical experience; distally 2,7 mm screws should be used, especially if the fracture line is below the fossa olecranon. Moreover, also, to decrease the cortex vulnerability due to the screw holes; proximal locked screws must pass only near cortex. A most common complication of surgical treatment was reported as skin irritation depending on the implants, especially in the ulnar side [9]. Preference to use anatomic plates and low profile cortical screws instead of cannulated big head ones may have reduced this rate in our series. Ulnar nerve neurapraxia range was slightly elevated in our series. Two-thirds was improved within six months, but the remaining became persistent. This persistence may be related to residual valgus deformity. Preventions are; avoidance of prolonged immobilization, manipulations during surgery, extreme nerve dissection causes insufficient feeding and insufficient release of m. flexor carpi radialis fascia [6]. Jupiter *et al*. classified the arthrosis according to their classification system and reported as 56% mild to moderate and 12% severe [13]. In our series, according to Broberg classification, 26% was stage 1 and 2, 9% was stage 3 arthrosis. However, radiological staging depends on the observer and could be subjective. Nonunion rate was comparable with the literature. In the etiology; insufficient fixation reported for 75% and infection reported for 20% [14,15]. In our series; etiology was an insufficient fixation for one and infection for another patient. Treatment modality is autogenous grafting, stable fixation and releasing the contractures [15]. Allende *et al*. concluded that; painless instability is not an indication for difficult revisions [16]. The same way we decided not to touch one of them, due to painless instability, despite poorly functional and radiological results.

In conclusion; even if surgical treatment is not possible in the first 48h, good functional and radiological results could be obtained with anatomical reduction, stable fixation, and early rehabilitation. Valgus deformity due to malunion may lead to the persistence of ulnar nerve neuropathy, and the subsequent releases w/o anterior translation would make a positive effect. Patients with accompanying injuries should be informed about possible poor functional and radiological outcomes. If double plate fixation is not applied by the technical details, instability and insufficiency rates will increase.

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