Original Article

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Functional Outcomes after Triceps Sparing Surgery for Distal Humerus Fractures

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Abstract

Introduction: Surgeon's primary goal in distal humerus fracture is to obtain fixation with sufficient stability so that the elbow can be mobilized as early as possible. The present study aimed at assessing the functional outcomes in distal humeus fracture patients managed with open reduction internal fixation with triceps sparing approach. *Methodology:* The present study included adults presenting with distal humeral fractures and managed with open reduction and internal fixation with triceps sparing approach at the Department of Orthopedics, AJ Institute of Medical Sciences, Mangalore from August 2015 to April 2017. The Mayo Elbow Performance Score (MEPS) was used as an objective measure of overall outcome. Grades of MEPS were compared between different age groups and different fracture types. *Results:* There was only one case of extra-articular type fracture. In the fractured elbow, the mean range of motion increased significantly from 63.4±14.2 at 6th week to 120±6 at 24th week. In our study population, the mean MEPS was 81.7±10.7. The MEPS was found to be excellent in 40% of the patients, fair in 20%, good in 36.7% and poor in only one patients. The MEPS was found to be similar among different age groups (p value = 0.92). Similarly, MEPS did not vary with the fracture type (p value = 0.21). *Conclusions:* Excellent grade of MEPS was observed in majority of the patients and only one case yielded poor grade. Age and fracture type were not found to be associated with the grade of MEPS.

Keywords: humerus; open reduction and internal fixation; triceps-sparing

Introduction

Fractures of distal humerusare becoming increasingly commondue to increased physical activity and increasing number of road traffic accidents. Fractures of the distal humerus remain a challenging problem despite advances in our knowledge about the biomechanics and implants. Non-operative treatment can be performed in some cases like advanced osteoporosis or fractures with extensive bone loss, however, the functional outcomes are typically less than optimal [1]. Surgeon's primary goal is to obtain fixation with sufficient stability so that the elbow can be mobilized as early as possible. Olecranon osteotomy is considered the gold standard for treating distal humerus fractures. This technique provides excellent articular exposure, but has been associated with complications like delayed union, non-union and prominent hard-ware [2]. One alternative technique to approaching through the posterior elbow is the triceps-sparing approach described by Bryan and Morrey [3]. In this technique, the triceps mechanism is spared and reflected from the medial to the lateral direction without being detached. Few single centre studies have demonstrated satisfactory functional outcomes using this technique [4]. The present study aimed at assessing the functional outcomes in distal humeus fracture

patients managed with open reduction internal fixation with triceps sparing approach.

Methodology

Study Design and Sampling

The present study included adults presenting with distal humeral fractures at the Department of Orthopedics, AJ Institute of Medical Sciences, Mangalore from August 2015 to April 2017. All skeletally mature patients with distal humerus fractures and operated at our center with open reduction and internal fixation with triceps sparing approach were included in the study. Patients with open injuries, associated with neurovascular injury, skeletally immature patients and pathological fractures. During the study period 30 cases underwent surgery and were included in the final analysis. The study was approved by the institutional ethics committee. All patients were explained the purpose of the study and an informed written consent was obtained from them.

Surgical technique

On admission of the patient a careful history was elicited from the patients and or attendants of injury and the severity of trauma. Radiograph of distal humerus i.e. antero-posterior view and lateral view were taken and fractures were classified according to AO/OTA classification. Patients were placed in the lateral position under suitable anaesthesia with the involved elbow at 90^0 placed over an elbow support. Under asepticmeasures, open reduction and internal fixation of the fracture was done with plates of adequate size. The fascia overlying the triceps was then divided and two fasciocutaneous flaps were raised. The lateral and medial borders of the triceps were then readily visualized, as was the tricipital aponeurosis. The radial window was developed by initially lifting the lateral triceps from the lateral intermuscular septum and then the posterior surface of humerus. The ulna window was developed by lifting the medial triceps from the intermuscular septum and the dorsal surface of the humerus. In extra-articular distal humerus fractures, the two windows gave good enough access for fracture reduction, temporary fixation and application of 90/90 or parallel plates. In simple intra-articular fractures, where no joint comminution was encountered, a combination of anatomical reduction of the condyles and intra-operative imaging of the joint surface was all that was needed for an accurate reduction and fixation. When the articular surface was comminuted, then the whole distal articular surface needed to be accessed. Connection of the medial and lateral dissections by mobilisation and elevation of the triceps muscle from the fracture and posterior humeral periosteum allowed visualisation of the entire posterior distal humerus. After that, the fracture was reduced and fixed provisionally with 1.5 or 2.0 mm K wires under fluoroscopic control in two planes. The intercondylar fracture was fixed with a 3.5-mm lag cortical screw in the coronal plane across the trochlea, thus converting the fracture into a supracondylar type. The articular fragment was then secured to the humeral shaft with two 3.5 reconstruction plates or condylar plates contoured to fit along the involved columns. An intraoperative radiograph was made to check reduction and fixation. The elbow was moved through a range of motion to test the stability of the fixation. The reconstructed distal articular block was then approximated to the humeral diaphysis. Kirschner-wire fixation was converted to definitive fixation with the application of either parallel or orthogonal plate constructs, depending on the surgeon's choice. All patients were admitted as inpatients and mobilization of the elbow was encouraged immediate postop. Post operative physiotherapy was followed according to the protocol, and functional outcome was assessed at 6 weeks, 12 weeks and at 6 months. All patients were encouraged to start range of motion exercises on the first day following surgery depending on the patient compliance and surgeon's discretion regarding a stable fixation.

Data Collection and Data Analysis

Patients' baseline demographic and clinical information was noted from the hospital records. Routine clinical and radiological evaluations were done for all patients. Fractures were classified according to the AO/OTA classification of fractures and dislocations. Anteroposterior and lateral elbow radiographs were obtained at the time of examination and assessed for reduction, alignment, fracture union, posttraumatic arthrosis, and heterotopic ossification. All data were analysed in SPSS version 21 (IBM Corp, NY). Quantitative and qualitative variables were described as mean (standard deviation) and frequency (percentage) respectively. The Mayo Elbow Performance Score (MEPS) was used as an objective measure of overall outcome [5]. This score is based on a 100-point scale, with maximum scores of 45 points for pain relief, 25 points for function, 20 points for motion

and 10 points for stability. There are four grades of MEPS: ≥90 is Excellent; 75–89 is Good; 60–74 is Fair; and <60 is Poor. Using Fisher's exact test, grades of MEPS were compared between different age groups and different fracture types. The significance level of this study was set at two-sided $\alpha = 0.05$.

Results

During the study period 30 patients were included in the study, of which 70% were below the age of 40 years. The mean age of the total population was 37.7±13.8 years. There were 57% males and 43% females and left side was more commonly affected (60%). Patients were classified according to AO classification. There was only one case of extra-articular (A2- moderate) type fracture (Table 1). Partial articular fracture was seen in eight patients, of which one was simple, three were moderate and four were severe type. Intra-articular fracture was seen in 21 patients, of which eight patients had simple type, seven had moderate types and six patients were severe type. Post-operatively, only one patient reported complication of ulnar neuritis. The range of motion in the normal elbow ranged between 0 to 140 degrees in majority of the patients (46.7%). Furthermore, in the fractured elbow, the mean range of motion increased significantly from 63.4±14.2 at 6th week to 120±6 at 24th week. In our study population, the mean MEPS was 81.7±10.7. The MEPS was found to be excellent in 40% of the patients, fair in 20%, good in 36.7% and poor in only one patients (Table 2). Table 3 describes the association of MEPS with age and fracture type of the patients. The MEPS was found to be similar among different age groups (p value = 0.92). Similarly, MEPS did not vary with the fracture type (p value = 0.21).

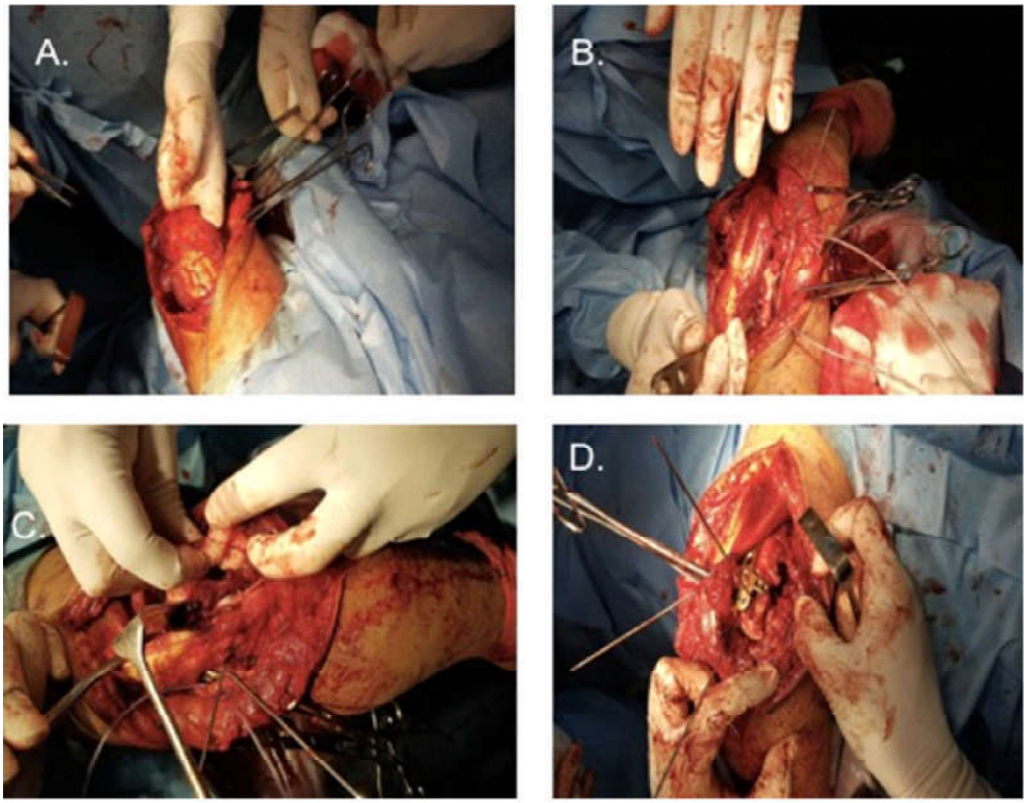

Fig. 1: Operative steps for open reduction internal reduction with triceps sparing approach

A. Triceps is freed from its attachment on the posterior humerus and elevated
B. Ulnar nerve retracted, fracture fragments stabalized with K-wire
C. Reconstructed intra-articular distal humerus
D. Medial columnar plating

Table 1: Distribution of patients according to their baseline demographic and clinical characteristics

Variables	n (%)
Age distribution	
21 to 30 years	12 (40)
31 to 40 years	09 (30)
41 to 50 years	02 (07%)
51 to 60 years	05 (17%)
More than 60 years	02 (06%)
Gender distribution	
Females	13 (43%)
Males	17 (57%)
Affected side	
Left	18 (60%)
Right	12 (40%)
Type of fracture	
Extra articular (A2-moderate)	01 (03%)
Partial articular	
Simple (B1)	01 (03%)
Moderate (B2)	03 (10%)
Severe (B3)	04 (13%)
Intra-articular	
Simple (C1)	08 (27%)
Moderate (C2)	07 (23%)
Severe (C3)	06 (20%)

Table 2: Post-operative outcomes in the patients

Variables	N (%)
Complications	
Yes	01 (03%)
No	29 (97%)
Mayo Elbow Performance Score	
Excellent	12 (40%)
Fair	06 (20%)
Good	11 (36.7%)
Poor	01 (3.3%)

Table 3: Association of Mayo Elbow Performance Score with age and fracture type

	Mayo Elbow Performance Score				p value*
	Excellent (n=12)	Fair (n=6)	Good (n=11)	Poor (n=1)	
Age distribution (in years)					0.92
21 to 30	3	3	5	1	
31 to 40	3	2	4	0	
41 to 50	1	0	1	0	
51 to 60	3	1	1	0	
More than 60	2	0	0	0	
Fracture type					0.21
Moderate extra-articular	1	0	0	0	
Simple Partial articular	1	0	0	0	
Moderate Partial articular	0	1	2	0	
Severe Partial articular	0	3	1	0	
Simple Intra-articular	3	1	4	0	
Moderate Intra-articular	5	0	1	1	
Severe Intra-articular	2	1	3	0	

*compared using Fischer's exact test

Discussion

The present study describes our experience of managing patients of fractures distal humerus managed with open reduction internal fixation with triceps-sparing approach. As the age of the patient may significantly affect the functional outcomes of surgically managed intra-articular distal humerus fractures and is especially true for patients above 60 years of age [6], we asssessed functional outcomes categories with age. Although in our study we did not find any association between age and functional outcome, different observations have been suggested by previous authors. Chen et alreported that as compared to triceps-sparing, open reduction internal fixation with olecranon osteotomy resulted in better function outcomes in patients aged more than 60 years [7]. The authors reported that the rate of excellent/good MEPS was more than 80% for all ages in the group of patients treated with olecranon osteotomy. In contrast, only 37.5% patients in the triceps-sparing group >60 years of age obtained excellent/good MEPS and these patients tended to have more extension loss. However, the rate of excellent/good MEPS was 100% in patients aged less than 40 years of age treated with triceps-sparing.

In our patient population, one patient (3.3%) had ulnar neuritis post-operatively, which is one of the most common complications following distal humerus fracture. Reported incidence of ulnar neuropathy following open reduction internal fixationis between 7% and 15% [8]. Unfortunately, the management of the ulnar nerve damage during distal humerusfixation remains controversial. Few authors have recommended ulnar nerve transposition has been recommended by some [9]. Gofton et al. did not observe any objective ulnar nerve findings in their series of distal humerus fracture fixation after ulnar nerve transposition [10].

There are a few limitations of the study. First, definition of excellent/good joint function varies across different scales. MEPS uses an objective measure of functional outcome. Some authors haveused the Aitkens and Rorabeck, in which an excellent result had an arc of flexion of 110^0 or more, full use of the armincluding heavy labor, and no pain [11]. Pajarinen et al. used the Orthapedic Trauma Association (OTA) method for evaluating elbow function [12]. Different scales have different definitions for excellent range of joint motion, which eventually makes the comparison difficult. Second, there were only two patients above the age of 60 in our study population. So the results of our study may not be applicable to older patients.

Conclusion

Patients of distal humerus fracture managed with triceps sparing approach in our department had a significantly improved range of motion at 24th week follow up. Excellent grade of MEPS was observed in 40% of the patients with only one case yielded poor grade. Age and fracture type were not found to be associated with the grade of MEPS. Results of our study need to be supported by large multicentric randomized controlled studies.

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