Patel V et al. GAIMS J Med Sci 2023;3(2) (Jul-Dec):49-54
Online ISSN: 2583-1763

Original Research Article

Functional Outcomes of Distal Humerus Fractures in Adults Treated with Precontoured Anatomical Locking Plates in Parallel Fashion: A Study from a Tertiary Centre in India

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ABSTRACT

Introduction: Distal humerus fractures accounts for 2-6% of all fractures and 1/3 of all humerus fractures. Intra-articular fractures of distal humerus are very rare accounting for 0.5% of all fractures. In the modern society having growing elderly population and an extremely active young population, the incidence of distal humeral fractures is rising and having a bimodal distribution. In young adults, most fractures occur from high-energy trauma like sideswipe injuries, motor vehicle accidents (MVA). In elderly persons with more osteoporotic bone, these injuries occur from simple falls. For fracture fixation two modalities are commonly used they are orthogonal (perpendicular) plate fixation and parallel plate fixation many researchers have reported poor outcomes with perpendicular plate fixation, thus this study aims at analysing the functional outcomes of parallel plates in fixation of distal humerus fracture.

Material and Methods: A prospective study was carried out at GAIMS, Bhuj during the period of October 2021 to December 2022. Patients satisfying the inclusion criteria like Age group from 18 years to 65 years and closed distal humerus fractures were included in the study. While open fracture patients, polytrauma patients, patients having neurovascular deficit, patients having pathological fractures and patients unwilling, and medically not fit for surgery were excluded from the study.

Results: Out of total 32 patients majority of patients had intra-articular High T type fracture. Male to female ratio was 4:1. Most common age group was 31-40 yrs. Most common mode of injury was road traffic accident. Complications included stiffness, superficial infection, plate impingement, myositis, pain, nerve injury and nonunion at osteotomy site. Mayo Elbow Performance Score (out of 100) in our study was 72 minimum and 94 maximum. The average score was 83. We had excellent results in 10 (32%) patients, 19(58%) had good results, 2(6%) patients had fair results and 1(4%) of the case had poor result.

Conclusion: Fixation of distal humerus with dual platting in parallel fashion provides good to excellent results with minimum post-operative complications and good range of motion.

Key-words: Distal humerus, Functional outcomes, Locking plates, Parallel

INTRODUCTION

The distal humerus fractures accounts for 2-6% of all fractures and 1/3 of all humerus fractures. Intra-articular fractures of distal humerus are very rare accounting for 0.5% of total fractures[1]. In this modern society having growing elderly population and with a extremely active young population, the incidence of distal humeral fractures is increasing and having a bimodal distribution. In young adults, most fractures occur from high-energy trauma like sideswipe injuries, motor vehicle accidents (MVA).

In elderly persons with more osteoporotic bone, these injuries occur from simple falls[2].

In this era of modern orthopaedics, despite of various advances, distal humeral fractures is one of the most challenging injuries to treat. Composite problems in fracture management include frequent articular involvement, metaphyseal communition, bone loss and osteopenia. The mentioned issues along with the complex three dimensional geometry provide great difficulties in fixation of fracture. Poor outcomes like contracture, stiffness secondary to prolonged immobilization are thought to be necessary to protect the fixation, nonunion and high failure rate is noted with old internal fixation techniques. The treatment of these fractures is still debated, and an ongoing quest for the ideal solution still remains. The chances of impairment of function and deformity are very high following conservative treatment of distal fractures of the humerus.[3,4,5] Attempt to achieve painless and mobile elbow requires a systematic approach for open reduction and internal fixation.[6,7,8,9,10,11]

The guidelines proposed by the AO/ASIF group for fixation of fractures of distal humerus has been a gold standard up till now with 2 locking plates placed at a 90° angle to one another (orthogonal / perpendicular / 90° / 90° plating). Using these fixation techniques, different authors have reported unsatisfactory results in 20% to 25% of patients due to implant failure occurring, if mobilized early.[6,7,8,12,13,14]

As a result for the ongoing search for a more better and secure technique, developed the concept of parallel plating (180°), which includes placing one plate along the medial aspect of the distal humerus and the other plate along the lateral aspect, with the screws in the distal fragment interdigitating with each other forming the *'tie-beam arch'* of the distal humerus. Several biomechanical studies have shown that parallel plating is superior to traditional method but still there are only few clinical studies to determine the functional outcome of parallel plates in fractures of distal humerus fixation.

MATERIAL AND METHODS

A prospective study was carried out at GAIMS & G K General Hospital, Bhuj during the period of October 2021 to December 2022. Permission from Human Research Ethics Committee was taken before starting the study. Patients satisfying the inclusion criteria like Age group from 18 years to 65 years and closed distal humerus fractures were included in the study. While open fractures patients, polytrauma patients, patients having neurovascular deficit, patients having pathological fractures and patients unwilling and medically unfit for surgery were excluded from the study. All patients selected for the study were inquired and examined according to protocol and associated injuries, if any, were noted and investigations carried out in order to evaluate fitness for anesthesia.

Regular follow up of all cases was done at 1st week, 4th week, 3rd month and 6th month. At each follow-up, patients were evaluated clinically using the Mayo Elbow Performance Score (MEPS)[15] and radiologically with appropriate X-rays.

Mayo Elbow Performance Score consist of 100 points divided in 4 parts and as follows: Part 1: Pain, Part 2: Range of motion, Part 3: Stability, Part 4: ADL (activity of daily living)

RESULTS

This study was carried out in department of orthopaedics, GAIMS, Bhuj with inclusion criteria of age group from 18 years to 65 years and closed distal humerus fractures and exclusion of open fractures, polytrauma patients, patients having neurovascular deficit, patients having pathological fractures and patients unwilling for surgery and medically unfit for surgery. The results for Mayo Elbow Performance Score are rated as: <60 - poor 60-74 – fair, 75-89 - good, 90-100 - excellent.

Table 1 shows 7 patients (21.9%) in 18-30 years age, 10 patients (31.3%) in 31 to 40 years, 9 patients (28.2%) in 41-50 years age, 3 patients (9.3%) in 51-60 years age and 3 patients in 61-65 years age group. The ratio of Male to Female (M:F) is 4:1.

TABLE 1: AGE AND SEX DISTRIBUTION

Age (in years)	No. of Patients	Male	Female	Percentage
18-30	7	6	1	21.9
31-40	10	10	0	31.3
41-50	9	7	2	28.2
51-60	3	2	1	9.3
61-65	3	1	2	9.3
Total	**32**	**26**	**6**	**100**

Table 2 shows the most common mode of injury observed in our series was road traffic accident. It accounted for 15 patients (46.9%). The next common cause was history of self-fall accounting for 8 patients (25%). The other causes were fall from height accounting for 5 patients (15.6%) and animal attack accounting for 4 patients (12.5%).

TABLE 2: MODE OF INJURY

Mode of Injury	No. of patients	Percentage
Simple Fall Injury	8	25
RTA	15	46.9
Fall from Height	5	15.6
Animal Attack	4	12.5
Total	**32**	**100**

Table 3 shows the most common fracture type observed was Intra-articular High T type fracture accounting for 8 of 32 patients (25%). The next common being Intra-articular Low T type fracture accounting for 6 of 32 patients (18.7%). In 3 patients it was Intra-articular Y type fracture (9.4%). In 3 patients it was Intra-articular H type fracture (9.4%). In 5 patients it was Intra-articular medial Lambda type fracture (15.6%). In 4 patients it was Intra-articular Lateral Lambda type fracture (12.5%) and In 3 patients it is Extra-articular type fracture (9.4%).

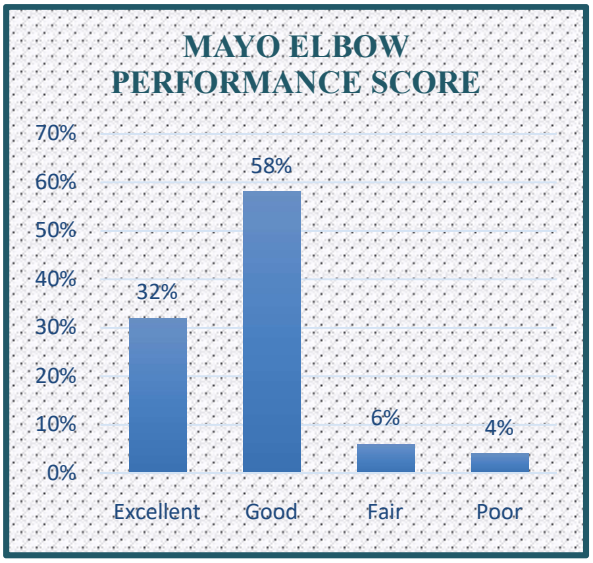
TABLE 3: MOST COMMON TYPE OF FRACTURE

Type of Fracture (MEHNE & MATTA Classification)[16]	No. of patients	Percentage
Intra-articular High T type	8	25
Intra-articular Low T type	6	18.7
Intra-articular Y type	3	9.4
Intra-articular H type	3	9.4
Intra-articular medial Lambda type	5	15.6
Intra-articular Lateral Lambda type	4	12.5
Extra-articular type	3	9.4
Total	**32**	**100**

Graph 1 shows the final results evaluated by using MAYO ELBOW PERFORMANCE SCORE out of 100. In our study the minimum score was 72 and maximum of 94. The average score was 83. We had excellent results in 10(32%) patients, 19(58%) had good results, 2(6%) patients had fair results and 1(4%) of the case had poor result in our study.

Graph 2 shows complications during the follow up period in which out of all the patients, 3 patients had complaint of stiffness, 2 patients had complaint of

superficial infection, 1 patient had complaint of plate impingement, 1 patient had complaint of myositis, 2 patients had complaint of pain, 1 patient had complaint of nerve injury and 1 patient had complaint of nonunion at osteotomy site. Our average time of union was 14 weeks. In our study the shortest time for union was 12 weeks and longest time for union was 17 weeks.



GRAPH 1: MAYO ELBOW PERFORMANCE SCORE

DISCUSSION

Functional elbow is requirement of an individual for social and economic thriving. Distal humerus fractures usually affect the functional movement of elbow especially intercondylar (intra-articular) fracture. The relationship of the radiohumeral joint and ulnohumeral joints must be perfect for a good functional outcome. The majority of fractures of distal humerus presenting to our centre were resulting from road traffic accidents (46.9%) compared to study by Sanchez-Sotelo et al[17] where the major mechanism of injury was accidental fall from standing height (56%). This is probably reflective of the fact that several trauma cases are being referred to our centre which is the tertiary referral centre for trauma care of this region.

The high male : female ratio seen in our centre (4:1) as compared to 1:1 recorded by Sanchez-Sotelo et al[17] is the resultant of the high number of trauma cases treated in our centre and the fact that males are more prone for road traffic accidents compared to females because in our society females travel less.

Thirty two cases in our study were operated with parallel plating which provided absolute stability for early mobilization. The lateral plate placement directly on the lateral column allows for lengthy screw placement which is limited in traditional orthogonal plating due to the fear of anterior capitellar breach in the same. Since we used the 3.5mm anatomical locking plates, it allowed for easy contourability for both column fixations.

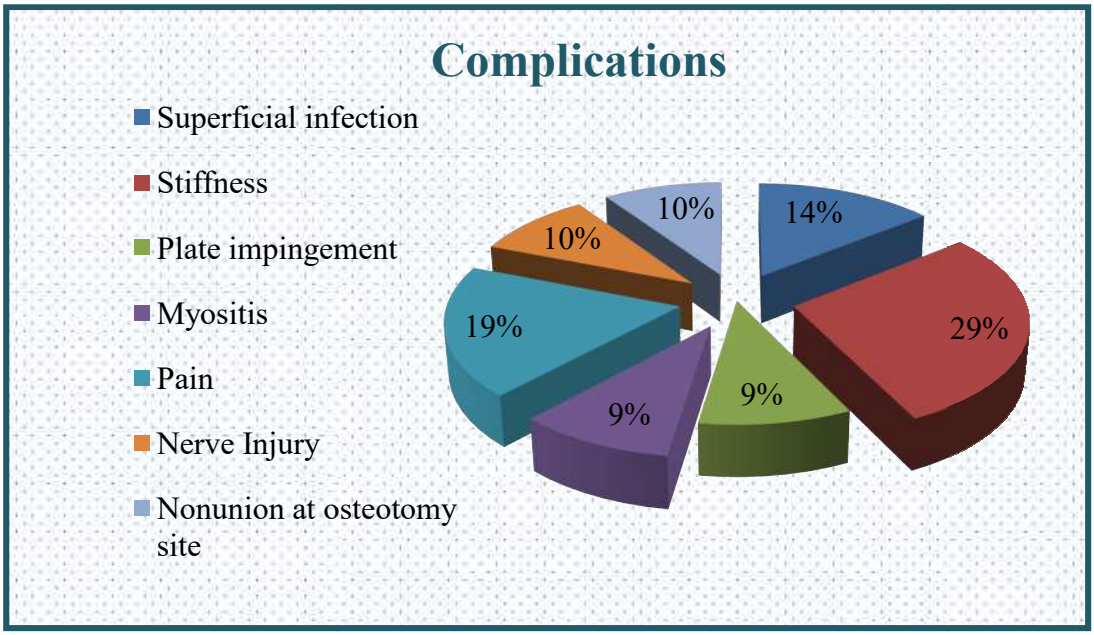
In our study we have not met any implant failures or non-union at the fracture site which is on par with the fact that parallel plating offers an inherently stable construct in a given clinical situation and in concurrence with studies done on parallel plating by Sanchez-Sotelo et al[17] and Atalar et al.[18]

Our study showed a similar complication rate of 42% which is concurrent with the international literature which included superficial infection (14.28% of all complications), stiffness at elbow joint (28.56% of all complications), non-union at osteotomy site (9.53% of all complications), ulnar nerve injury (9.53% of all complications), plate impingement (9.53%), pain (19.53% of all complications) and myositis (9.53%) of all complications.

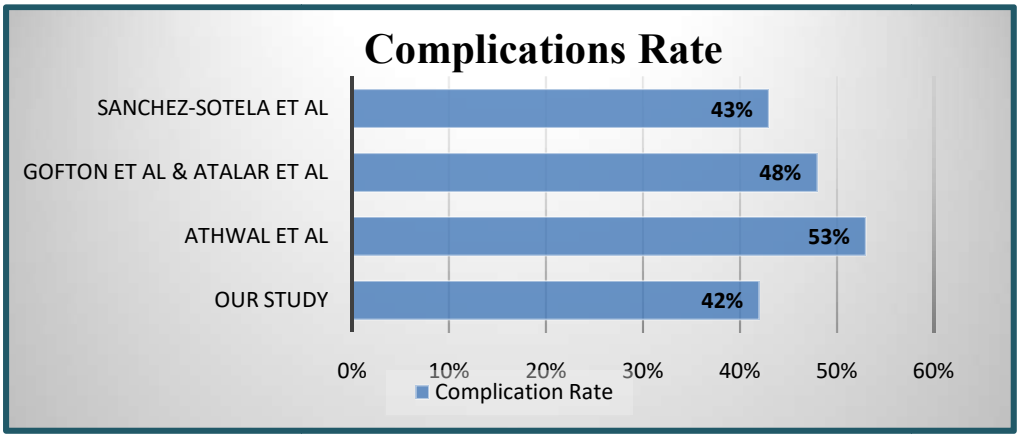
Bony union took an average of 14 weeks in our study which is comparable to 12 weeks obtained by Sanchez-Sotelo et al[17] and 14 weeks in Athwal et al.[19] All patients had bony union at end of the study period.

CONCLUSION

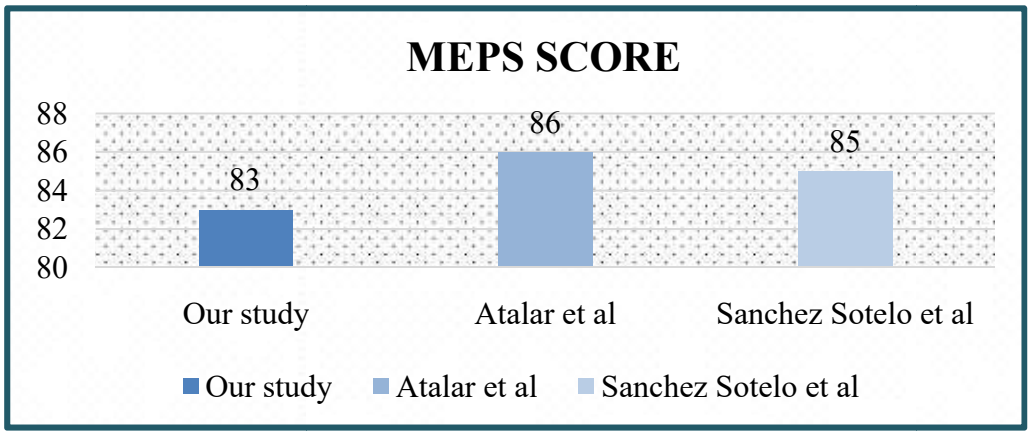
Incidence of complex distal humerus fractures among younger population is on the rise due to increasing motor vehicle accidents. The advantages of locking plates in parallel fashion are: stable internal fixation, early remobilization, functional restoration of articular anatomy, and secondary loss of reduction uncommon. An adequate surgical technique will minimize complications and aggressive rehabilitation regime will ensure the best possible result.



GRAPH 2: COMPLICATIONS DURING FOLLOW UP PERIOD



GRAPH 3: COMPLICATIONS RATE



GRAPH 4: MAYO ELBOW PERFORMANCE SCORE

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Source of support: Nil

Conflict of interest: None declared

How to cite: Patel V, Bhatt P, Pushkarna V, Rudani T, Mendiratta S, Patel D. Functional Outcomes of Distal Humerus Fractures in Adults Treated with Precontoured Anatomical Locking Plates in Parallel Fashion: A Study from a Tertiary Centre in India. GAIMS J Med Sci 2023;3(2):49-54.

https://doi.org/10.5281/zenodo.8112293