

# A Prospective Study on the Functional and Radiological Outcomes of AO Type C Distal Humerus Fractures in Adults Treated Surgically with Bicolumn AR Fixation

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## ABSTRACT

Distal humeral fractures (DHF) embody a group of complex articular fractures that occur due to severe trauma to elbow. If fractured, the complex three-dimensional structure of the distal humerus poses a challenging task for reconstruction. The study group comprises of 30 patients with DHFs who presented to the casualty & OPD of the Department of Orthopaedics, Sree Balaji Medical College and Hospital, Chromepet, Chennai between the period of September 2018 to December 2020. Majority of the cases of DHFs belonged to the 21-30 years age group. The age of the oldest patient was 73 years, & the youngest patient was 25 years old, with 44 years being the mean age in our study group. Females had a higher mean age (49 years) as compared to males (41 years). Closed intra-articular, intercondylar fractures of the distal humerus classified as AO type C fractures should be treated only by surgical management, unless strongly contraindicated in elderly patients.

**Key words:** Distal humeral fractures, Bicolumnar Fixation, Plate fixation

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## INTRODUCTION

Distal humerus fractures (DHF) in adults comprise 2% of all fractures & roughly 1/3rd of all humeral fractures, with an incidence of 5.7/100000 per year [1]. Fractures of the distal humerus mainly have a bimodal distribution of occurrence [2,3]. Most DHFs in young adults are a result of high-energy trauma sustained during road traffic accidents (RTAs), sports injuries, sideswipe injuries, gunshot wounds & falls from height, while elderly persons usually have a history of low-energy trauma sustained via simple falls with direct impact on the elbow [4,5] or indirect impact because of a fall on the outstretched hand.

Hence, a global awareness in the more precise treatment of this diverse group of injuries has been generated due to improved knowledge about the complex biomechanics of unstable DHFs in adults. Various challenges like articular surface fragmentation in multiple planes, separation of articular fragments from distal humeral columns and deficient bone quality are faced by surgeons intra-operatively. DHFs commonly display varying patterns in adults. Complications like malunion and non-union are common, with even slight irregularities of articular surfaces of the elbow causing loss of function and secondary arthritis.

There has been a significant advancement in the surgical treatment of these fractures over the past few decades. Most surgeons in the 1960s&70s condemned treating these fractures surgically, mainly due to high rates of failure associated with loss of internal fixation, non-union & stiffness of the elbow [6]. Through this study, we will try to evaluate the functional and radiological outcomes of intra-articular, intercondylar DHFs (AO type C fractures) treated surgically with open reduction & stable internal fixation using bi-columnar plating. The aim of this prospective study is to analyze the functional and radiological outcomes of AO type C distal humeral fractures in adults treated surgically with bi-columnar fixation.

## MATERIALS AND METHODS

### Study design

A prospective study was done to evaluate the functional & radiological outcomes of AO type C distal humeral fractures (DHF) in adults treated surgically with open reduction & bicolumnar internal fixation, and the results were analyzed upon regular follow-up.

### Study group

The study group comprises of 30 patients with DHFs who presented to the casualty & OPD of the Department of Orthopaedics, Sree Balaji Medical College, and Hospital, Chromepet, Chennai between the periods of September 2018 to December 2020. The study was spread over a

period of 30 months, but recruitment of new patients was stopped by December 2019, so that the minimum follow-up period was 12 months. The study was conducted after getting clearance from the Hospital ethical committee. Those patients who fulfilled the inclusion criteria mentioned below were invited to participate in the study. Informed consent was obtained from all the patients willing to take part in the study.

**Inclusion criteria**

- Male & female adult patients older than 18 years of age.
- Intra-articular DHFs falling under AO type C classification.
- Closed injuries.
- Consenting to the study.
- Acute fractures < 2-weeks-old.

**Exclusion criteria**

- Patients younger than 18 years of age.
- Pathological fractures due to tumours or any other diseases are excluded.
- Previously operated elbow joint pathologies for either cold or traumatic conditions are excluded.
- Traumatic cases presenting after >2 weeks.
- Those who have had any kind of operative intervention

previously that involved the elbow joint, at any age, are excluded. Cases of open fractures of the distal humerus are excluded.

**Implant selection**

The 3.5 mm pre-contoured LCP plate was used. Based on the fracture type assessed radiographically, 5-14 holed plates were kept available during surgery.

Additionally, cancellous screws, Stainless Steel wires, and Kirschner -wires were also kept ready.

**RESULTS**

**Age & sex distribution**

Majority of the cases of DHFs belonged to the 21-30 years age group. The age of the oldest patient was 73 years, & the youngest patient was 25 years old, with 44 years being the mean age in our study group.

Females had a higher mean age (49 years) as compared to males (41 years).

**Side affected**

Out of 30 patients with DHFs, 17 patients were affected on the right side, whereas 13 patients were affected on the left side (Table 1).

**Table 1: Side effects.**

Side affected	No. of cases	% of cases
Right	17	57
Left	13	43
Total	30	100

**Mode of injury**

Out of 30 patients who participated in our study, majority of them (14 cases) sustained DHF because of Motor Vehicle Accidents (MVA). Of those 14 patients, majority were young males. Another chief cause of elbow injury resulting in DHFs was a simple fall (10 cases), with

patients landing directly on the elbow, or reporting a history off all on an outstretched hand – of this group, elderly females comprised a major part (Table 2). 3 cases had a history off all from height (FFH) whereas the remaining 3 patients sustained a direct trauma (DT) to the elbow.

**Table 2: Mode of Injury.**

Mode of Injury	No. of cases		Total	% of cases
	Male	Female		
MVA	10	4	14	47
FALL	3	7	10	33
FFH	3	—	3	10
DT	2	1	3	10
Total	18	12	30	100

**Type of fracture**

Out of 30 cases which were classified under the AO type C DHFs, 16 cases were assigned to be AO type C2

fractures, 9 cases were classified under AO type C1 & the remaining 5 cases fell under AO typeC3 classification (Table 3).

**Table 3: Type of fracture.**

AO type C	No. of cases	% of cases
TypeC1	9	30
TypeC2	16	53
TypeC3	5	17
Total	30	100

**Type of plate fixation at fracture site**

Out of 30 cases operated by ORIF with bicolunar plate osteo synthesis using precontoured distal humeral LCPs,

19 cases were fixed using the orthogonal (perpendicular) plating configuration, whereas for the remaining11cases, parallel plate fixation was done (Table4).

**Table 4: Type of plate fixation.**

Type of fixation	No. of cases	% of cases
Orthogonal plating	19	63
Parallel plating	11	37
Total	30	100

**Post-operative complications**

We encountered post-operative complications in 4 out of 30 cases. Ulnar nerve neuro praxia was seen in 2 patients. One patient reported wound gaping at the

region of the Cannulated cancellous screw head (fixed at osteotomy site along with TBW). Post-operative infection at fracture site was seen in one patient after 2 weeks–the same patient also showed stiffness of the elbow at the latest follow-up (Table 5).

**Table 5: Post-operative complications.**

Post-operative Complications	No. of cases	% of cases
Ulnar Nerve Neuropraxia	2	7
Infection+Stiffness at the Elbow	1	3.3
Wound Gaping at Cancellous Screw Head Region	1	3.3
Total	4	13.6

**Time required for radiological union**

Most of the cases (22 patients) of distal humerus AO type C fractures treated by ORIF with bi-columnar plating showed signs of radiological union between 12-16weeks.

8 patients showed signs of union between 17-21 weeks. All the olecranon osteotomies performed for the surgical approach united uneventfully (Table 6).

**Table 6: Time required for radiological union.**

Radiological Union	No. of cases	% of cases
12-16 weeks	22	73
17-21 weeks	8	27
Total	30	100

**Functional results based on MEPS (Mayo Elbow Performance Score)**

After functionally assessing the patients based on the MEPS on last follow-up, the following results were

obtained: 25 patients showed excellent results, good & fair results were attained in 2 patients each, whereas a poor outcome was seen in 1 patient (Table 7).

**Table7: Functional results based on MEPS.**

Functional results based on MEPS	No. of cases	% of cases
Excellent	25	83
Good	2	7
Fair	2	7
Poor	1	3
Total	30	100

### DISCUSSION

In our study, we treated 30 adults with AO type C DHFs by Open reduction and internal fixation (ORIF) with bicolunar fixation. In our study, the mean age of patients was 44 years, which is comparable to the study led by Shin SJ et al. [7], in which the average age of subjects was 42 years. The mean age for females was higher (49 years) as compared to that of males (41 years), although majority of patients (9 patients; 30% cases) in our study belonged to the 21-30 years age group, of which, most were males. This indicates a bimodal pattern of age distribution in DHFs [2,3].

Palvanen et al. [8] established that DHFs after simple falls from standing height were commoner in osteoporotic females older than 60 years of age. In another study, Palvanen et al [2] they also found that specific injury mechanisms are likely to cause most typical osteoporotic elbow fractures of older adults, like fall causing direct impact at the fracture site. Robinson CM et al. [5] also showed similar results in their study spanning over 10 years which included 320 patients.

In our study, out of the 30 cases classified under AO type C DHFs, maximum cases were assigned to type C2 fractures (16 cases; 53%). We had 9 (30%) cases of type C1, whereas 5 (17%) cases of fractures belonging to type C3. Holdsworth BJ et al. [9] in their study had a comparable distribution of fracture patterns falling under AO type C.

As indicated by Kinik H et al. [10] surgical management of DHFs is not contraindicated in old age, & outcome is dependent more on the bone quality than the patient's age. We agree with Sodergard J et al. [11] that the results are less likely to be gratifying, if only elderly patients who have poor bone quality are considered.

The findings of our study have been consistent with previous research that has been carried out over the past few decades regarding bicolunar plate fixation of DHFs. Though it is still a debatable topic, like many other studies, our study found no discernible difference between the outcomes obtained by using either orthogonal, or parallel plate constructs for treating these fractures. Our functional outcomes evaluated using the MEPS system were comparable to the study led by Muzaffar NA et al. [12] who recommended using the anatomically pre-contoured dual plate system for treating these fractures. Similar results were also obtained by Sarkhel et al. [13] using pre-contoured plating technique, with a mean MEPS of 95 – they also concluded that condylar orientation is very important with perfect articular congruity in elbow motion.

The findings of our study are also supported by the studies conducted by Patel et al. [14] who achieved similar outcomes. Though the functional outcomes of surgical management of fractures of the distal humerus were consistent from the 1980s to early 2000s, post-operative complications were greatly reduced because of later studies advocating the use of olecranon osteotomy approach, routine anterior ulnar nerve transposition, double-plate configurations, pre-contoured anatomical LCPs, and early post-operative mobilization of the elbow.

### CONCLUSION

From this prospective study concluded closed intra-articular, intercondylar fractures of the distal humerus classified as AO type C fractures should be treated only by surgical management, unless strongly contraindicated in elderly patients. Open reduction with bicolunar internal fixation by using either orthogonal, or parallel plate configuration should be the preferred choice of treatment in acute type C fractures. Routine anterior ulnar nerve transposition helps in reducing post-operative complications related to neuropraxia significantly. Early post-operative rehabilitation, & mobilization of the elbow with active physiotherapy started as early as 3 weeks, helps considerably in regaining a good arc of elbow motion.

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