

# Functional Outcome of Distal Humerus Fractures Treated with Open Reduction and Internal Fixation through Bi-Columnar Plating

Outcome of  
Distal Humerus  
Fractures  
Treated with  
ORIF

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## ABSTRACT

**Objective:** Study was purposed for assessment of functional outcomes of distal humerus fractures treated with ORIF using bi-columnar plating.

**Study Design:** Cross-sectional retrospective study.

**Place and Duration of Study:** This study was conducted at the Mufti Mehmood Memorial and Teaching Hospital, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan from March 2020 to March 2022.

**Materials and Methods:** We conducted a cross-sectional study of 62 patients who underwent ORIF through bi-columnar plating for distal humerus fractures. Using Mayo Elbow Performance Score (MEPS) questionnaire, functional outcomes of humerus fracture were assessed.

**Results:** It was found that 82.25% of the patients were male and 17.74% were females ( $p < 0.05$ ). 53.22% patients had a fracture of left humerus and 46.77% had a fracture of the right humerus ( $p < 0.05$ ). 91.93 percent of patients had closed fractures, while 8.07 percent had open fractures ( $p < 0.05$ ). We discovered that 51.61% of patients received an outstanding score on MEPS standard scoring scale, whereby 33.87% were ranked Good, 11.29 percent were fair and only 3.22% of them were ranked as poor. This suggested that majority of patients with distal humerus fractures had favorable outcomes on MEPS standard scoring system.

**Conclusion:** In the majority of patients, functional outcomes following ORIF through bi-columnar plating are good to outstanding. To confirm our findings, however, additional research with larger sample size and unmitigated follow-up periods is required.

**Key Words:** Arm disability; Columnar plating; Humerus fracture; Laxation injury; Orthopaedics; Surgery.

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## INTRODUCTION

Fractures of distal humerus are complicated injuries that can cause significant functional impairment and disability<sup>1-2</sup>. These fractures typically results owing to high-energy trauma from falls, vehicle accidents, or sports-related hurts.<sup>3</sup>

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Distal humerus fractures are uncommon, accounting for 2% of entire fractures, and can be difficult to treat.<sup>4-5</sup> Approximately 30% of such fractures and 2% of all adult fractures are distal humerus fractures, which pose significant management challenges for complex morphology of elbow joint, presence of neurovascular system in the area, and limited soft tissue. Primary treatment goal for these fractures is to maintain elbow stability and guarantee adequate functional range of motion (ROM); therefore, evaluation of ability of fracture repair is essential to generate a stable joint with adequate mobility.<sup>5</sup>

Several systems are used to classify distal humerus fractures, including the extensively used AO/OTA classification system. One the basis of fracture line location, this system classifies distal humerus fractures as type A, B, C. Type A fracture engross supracondylar region, type B has condylar region, and C fractures involve both regions.<sup>6</sup>

These fractures are treated based on various variables, including fracture type, patient's age and his health, and presence of associated injuries.<sup>7</sup> For certain stable

fractures, nonsurgical treatment, such as immobilization with a cast or splint, may be appropriate. However, most often the distal humerus fractures necessitate surgical intervention for optimal outcomes.<sup>8-9</sup> ORIF is most frequently used surgical procedure for treating distal humerus fractures.<sup>10</sup> ORIF entails creating an incision at fracture site, reducing fracture fragments, and stabilizing them with plates, screws, or other fixation devices. Bi-columnar plating entails the placement of two plates on either side of medial or lateral columns of humerus. This technique provides stability and permits early mobilization, which may result in enhanced functional outcomes.<sup>11</sup>

These fractures can result in impediments such as malunion, nonunion, rigidity, nerve injury, infection, and implant failure. Appropriate surgical technique, meticulous patient selection, and postoperative rehabilitation can reduce the risk of complications.<sup>12-13</sup>

The functional prognosis of distal humerus fractures depends on several factors, including fracture's severity, patient's age and his health status, and timing and quality of surgical intervention.<sup>14</sup> Early surgical intervention and anatomic reduction of fracture fragments are typically associated with improved functional outcomes. ORIF through bi-columnar plating is a common surgical technique employed for treating distal humerus fractures.<sup>5,15</sup> Bi-columnar plating technique provides stability and permits early mobilization, which may result in enhanced functional outcomes.<sup>16-17</sup>

Several researchers reported that bi-columnar plating had good to outstanding outcome for managing distal humerus fractures. However, majority of these studies have inadequate sample sizes and brief durations of follow-up. This investigation was conducted for evaluation of functional outcomes of distal humerus fractures treated with ORIF through bicolumnar plating.

## MATERIALS AND METHODS

We conducted cross-sectional study of 62 patients who underwent ORIF with bi-columnar plating for distal humerus fractures at Mufti Mehmood Memorial and Teaching Hospital, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Age, gender, injury mechanism, fracture classification according to AO/ISSF criteria and according to AO/ISSF criteria for each patient was recorded.

**The following were the inclusion criteria:** (1) From 18-65 years, (2) closed or open distal humerus fractures, (3) bicolumnar plating treatment, and (4) a minimum 12-month follow-up period (5) all genders. The following were the exclusion criteria: (1) age < 18 years; (2) pathologic fractures; (3) periprosthetic fractures; (4) comminuted fractures necessitating alternative fixation methods; and (5) inadequate follow-up; and (6) patients with additional fractures on the

same limb. (7) Type II/III Gustilo-Anderson fractures (8) preexisting deformities (9).

The clinical evaluation consisted of measuring ROM of elbow utilizing goniometer, with first post-operative assessment occurring at 6 weeks and subsequent appointments occurring every 4-8 weeks until fracture consolidation was achieved. To make sure the patients were healthy enough for anesthesia and surgery, preparatory exams were performed before to the procedure. Prior to surgery, intravenous injections of cephalosporin antibiotics were given to all patients. The posterior Campbell's method was used to locate and protect the ulnar nerve when the patients were lying on their right or left side. The fracture was exposed using a triceps muscular tongue, and it was subsequently reduced and treated using parallel plates that had already been moulded to it. A drain was used to help close the wound. Postoperative antibiotics (cephalosporin) and drains were removed post 48 hours. One to two days after surgery, patients were urged to start moving about. After three to four days, passive range of motion with support was advised, and after three weeks, active mobility.<sup>18</sup>

Two weeks after surgery, patients were requested to come in to the OPD for wound inspection and stitch removal. Four weeks, three months, and six months later, there were three more follow-up sessions planned. During the six-month follow-up visit, the Mayo elbow performance score variables were noted, and the overall score was computed and graded in accordance with the operational definitions.

A standardized grading system called MEPS was employed to appraise the functional results of elbow surgery. Higher results on the MEPS, which is graded out of 100, indicate stronger elbow function.<sup>19</sup> The MEPS's components are:

1. Pain (45 points)
2. Performance (20 points)
3. Motion range (10 pts)
4. Consistency (10 points)
5. Moving the elbow (5 points)
6. Patient satisfaction (10 points)

Their sums constitute MEPS score for a patient. It can be divided into the following four groups:

In order to evaluate the results of different elbow procedures, such as fracture fixation, arthroplasty, and ligament repair, the MEPS is frequently employed in clinical practice and research.

All patients provided informed written consent prior to surgery, including for research inclusion and institutional ethical approval was collected.

Qualitative data were described in terms of frequency and percentages, and categorical data were analyzed using One-way ANOVA analysis using IBM SPSS version 21.0 software.

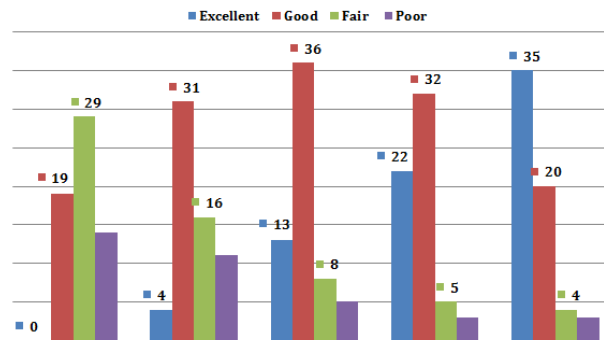
**RESULTS**

We conducted study on 62 patients affected with distal humerus fracture. Demographic variables and their frequency distributions for a cohort of patients with a humerus fracture were noted and statistically analyzed. Age of patients showed that 51.61% patients had ages of 18 and 30, 27.41% had 31 and 50, and 20.96% 51 and 65 years. F-value is 66.888 and p-value is 0.00001, which indicating a significant difference in age ( $p < 0.05$ ) between the categories. 82.25% of the patients were male and 17.74% were females ( $p < 0.05$ ). 12.90% patients were underweight, 24.19% were of normal weight, and 62.90% were overweight ( $p < 0.05$ ). 53.22 percent of the patients had a fracture of the left humerus and 46.77 percent had a fracture of the right humerus ( $p < 0.05$ ). 91.93 percent of patients had closed fractures, while 8.07 percent had open fractures ( $p < 0.05$ ). This table summarized the demographic characteristics of patients with humerus fractures and suggested that there was significant difference between the groups being compared for each variable (Table 1).

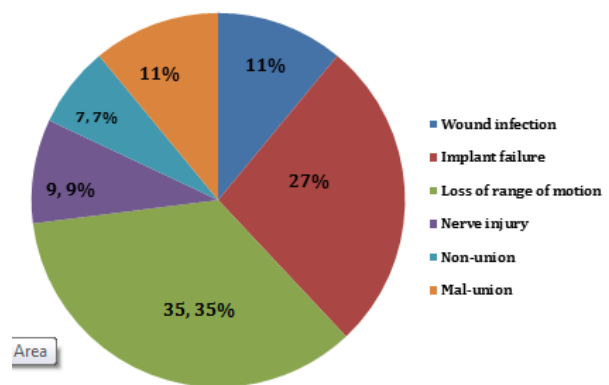
Table 2 depicted the nature of these fractures in patients. Number of patients (n) and frequency (%) for each mode of injury, as well as the F-value and p-value, were reported. It indicated that falls were the leading cause such fractures, accounting for 59.67% of cases ( $p < 0.05$ ). Direct trauma caused 17.74% incidences in the general population, making it the second most prevalent cause of injury. 14.51 % of patients sustained distal humerus fractures as a result of road incidents. Sport-related injuries accounted for only 3.22 percent of distal humerus fractures. The remaining 3.22 percent of patients had distal humerus fractures due to unspecified causes ( $p < 0.05$ ).

Functional outcome of patients were assessed through MEPS system, whereby 51.61% of patients received an outstanding score on MEPS standard scoring scale, which ranged from 90 to 100. The F-value of 135.03 and p-value of 0.000 These fractures are typically caused by high-energy trauma, such as falls from great heights, car accidents, or sports-related injuries 0001. 33.87% of patients received Good score, 11.29 percent patients received fair score ranging from 60 to 74, and only 3.22% of them received a score below 60, ranked as poor (Table 3). The F- and p-values for table indicated that frequency of excellent scores was substantially higher than other scoring categories. This suggested that majority of patients with distal humerus fractures had favorable outcomes on MEPS standard scoring system. At the second, third, and 4<sup>th</sup> week, six-month, and one-year follow-up visits, patients' functional outcome was analyzed through MEPS. We discovered that functional outcome improved over time from poor to good to outstanding; however, at the end of one year, only three cases had poor outcome and four patients had fair outcome. Figure 1 displayed that the

remaining patients demonstrated good (20 patients) and outstanding (35 patients) domains (Figure No. 1.). However, certain complications were also recorded in patients with poor and fair categories *i.e.* wound infections (11%), implant failure (27%), loss of range of motion (35%), nerve injury (9%), non-union (7%) and mal-union (11%), respectively (Figure No. 2).



**Figure No. 1: Assessment of patients' functional outcome using MEPS at follow-up visits (n= number of patients).**



**Figure No. 2: Complications associated with functional outcome of distal humerus fractures treated with ORIF**

**Table No. 1: Demographic data of study patients**

S. No	Demographic variable	Patients (n)	Frequency (%)	F-value	p-value
1	Age (years)			66.888	0.00001*
	18-30	32	51.61		
	31-50	17	27.41		
2	Gender (n)			800.0	0.00001*
	Male	51	82.25		
	Female	11	17.74		
3	BMI (kg/m <sup>2</sup> )			317.2	0.00001*
	Underweight	08	12.90		
	Normal	15	24.19		
4	Side				
	Overweight	39	62.90		

	involvement (n)	33 29	53.22 46.77	6.4	<b>0.03526*</b>
	Left Right				
5	Fracture type (n)	57 05	91.93 8.07	1802.66	<b>0.00001*</b>
	Open Closed				

\*indicated that the value is significant (p<0.05)

**Table No. 2: Mode of injuries of distal humerus fractures.**

S. No	Mode of injury	Number of patients (n)	Frequency (%)	F-value	p-value
1	Fall	37	59.67	160.538	0.00001*
2	Direct trauma	11	17.74		
3	Road accidents	09	14.51		
4	Sport injuries	02	3.22		
5	Others	02	3.22		

\*indicated that value is significant (p<0.05)

**Table No. 3: Assessment of patients using MEPS standard scoring system**

S. #	MEPS Score	Standard score	Number of patients (n)	Frequency (%)	F-value	p-value
1	Excellent	90-100	32	51.61	135.03	0.00001*
2	Good	75-89	21	33.87		
3	Fair	60-74	7	11.29		
4	Poor	<60	2	3.22		
5	Excellent	90-100	32	51.61		

\*indicated that value is significant (p<0.05)

## DISCUSSION

Our findings indicated that falls were the leading cause of distal humerus fractures in patients, subsequently direct trauma, road incidents and sport-related injuries. Functional outcome of patients were assessed through MEPS system, whereby 51.61% of patients received an outstanding score on MEPS standard scoring scale, which ranged from 90 to 100. Preponderance of patients with distal humerus fractures had favorable outcomes on MEPS standard scoring system and functional outcome improved over time from poor to good to excellent. However, certain complications were also recorded in patients *i.e.* wound infections (11%), implant failure (27%), loss of range of motion (35%), nerve injury (9%), non-union (7%) and mal-union (11%), respectively.

A similar nature study was conducted in Bangalore and reported that mean of 39.68 years. 11 (36.7%) of the fractures occurred on the right humerus, while 19

(63.3%) occurred on the left humerus. Every patient underwent trans olecranon osteotomy and bicolumn locking compression devices to stabilize fractures. In last follow-up, elbow flexion of majority of patients was excellent, with an average arc of 117.33°, mean extension deficit of 8.67°, mean pronation of 70.83°, and mean supination of 70.83°, concluding that bi-columnar locking compression plates offered secure fixation for humerus fractures. Due to its increased stability, the device facilitated early mobilization, even in cases of comminuted fractures.<sup>20</sup> ORIF with bicolumn locking compression plates is treatment of choice for AO type 3 C humerus fractures. Nonetheless, optimal placement of two surfaces in relation to one another is subject of debate. Three studies compared these two approaches, whereby Jacobson and colleagues concluded that orthogonal plating gave structure with superior stability, whereas Schemitsch and Self concluded that parallel plating was more effective.

Our findings were consistent with research performed at Shaikh Zayed Hospital Lahore, revealing that within a week of initial injury, 72 cases of distal humerus fractures in participants were managed. The results revealed that 56.94% study patients had an outstanding outcome, 21 (29.17%) had a good outcome, 6 (8.33%) had an acceptable outcome, and 4 (5.56%) had a poor outcome. It was concluded that use of pre-contoured parallel plates for treating bi-columnar type C fractures of the distal humerus in adults yielded an outstanding clinical outcome.<sup>19</sup> At the end of follow-up, MEPS was excellent in 35 patients, good in 8 patients, average in 5 patients, and poor in 1 patient. Low scored individuals suffered from severe stiffness and had complicatedness conducting every day activities.<sup>21</sup>

## CONCLUSION

Distal humerus fractures are complex injuries, necessitating proper management for optimal outcomes. Good to excellent functional outcomes were observed in majority of patients following ORIF through bi-columnar plating for treating these fractures. To minimize risk of complications and obtain the best possible outcome, however, careful patient selection, an appropriate surgical technique, and postoperative rehabilitation are essential. To confirm our findings, however, additional research with larger sample sizes and extended follow-up periods is required.

### Author's Contribution:

Concept & Design of Study: Muhammad Asghar Essa  
 Drafting: Yousaf Gul, Inamullah  
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 Revisiting Critically: Muhammad Asghar Essa, Yousaf Gul  
 Final Approval of version: Muhammad Asghar Essa

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

## REFERENCES

1. Ul Islam S, Glover AW, Waseem M. Challenges and Solutions in Management of Distal Humerus Fractures. *Open Orthop J* 2017;11:1292-1307.
2. Savvidou OD, Zampeli F, Koutsouradis P, Chloros GD, Kaspiris A, Sourmelis S, Papagelopoulos PJ. Complications of open reduction and internal fixation of distal humerus fractures. *EFORT Open Rev* 2018;3(10):558-567.
3. Roccia F, Boffano P, Bianchi FA, Zavattero E. Maxillofacial Fractures due to Falls: does Fall Modality Determine the Pattern of Injury? *J Oral Maxillofac Res* 2014;5(4):e5.
4. Amir S, Jannis S, Daniel R. Distal humerus fractures: a review of current therapy concepts. *Curr Rev Musculoskelet Med* 2016;9(2):199-206.
5. Jagadish U, Kumar K V, Shanthappa A H (January 09, 2023) Functional Outcome of Distal Humerus Fractures Treated With Open Reduction and Internal Fixation With Bicolumnar Plating in a Tertiary Care Setting. *Cureus* 15(1): e33540.
6. Chen C, Xiao D, Li T, Gong M, Zha Y, Hua K, Sun W, Ji S, Jiang X. Comparative study of functional outcomes between OTA/AO type C, Gustilo type I/II open fractures and closed fractures of the distal humerus treated by open reduction and internal fixation. *BMC Musculoskelet Disord* 2021;22(1):939.
7. Fernandes JCF, Milan TV, Ribeiro HAMF, Stein HE, Ribas HC, Carula BC. Distal humeral fracture: an epidemiological analysis of orthopedic patients for children. *Acta Ortop Bras* 2019;27(5):261-264.
8. Gallusser N, Barimani B, Vaclair F. Humeral shaft fractures. *EFORT Open Rev* 2021;6(1):24-34.
9. Tomori Yuji, Nanno, Takai M, Shinro. Outcomes of nonsurgical treatment for transcondylar humeral fractures in adults: Clinical results of nonoperative management. *Med* 2019; 98(46):pe17973.
10. Saracco M, Smimmo A, De Marco D, Palmacci O, Malerba G, Vitiello R, et al. Surgical approach for fracture of distal humerus: Posterior vs lateral. *Orthop Rev (Pavia)* 2020;12(Suppl 1):8664.
11. Morrey ME, Morrey BF, Sanchez-Sotelo J, Barlow JD, O'Driscoll S. A review of the surgical management of distal humerus fractures and nonunions: From fixation to arthroplasty. *J Clin Orthop Trauma* 2021;20:101477
12. Vaclair F, Goetti P, Nguyen NTV, Sanchez-Sotelo J. Distal humerus nonunion: evaluation and management. *EFORT Open Rev* 2020;5(5): 289-298.
13. Tyllianakis M, Solou K, Lakoumentas J, et al. Long-Term Functional Outcomes and Complications of Intra-Articular (AO type B, C) Distal Humerus Fractures in Adults: A Retrospective Review. *Cureus* 2022;14(1): e21094.
14. Moursy M, Wegmann K, Wichlas F, Tauber M. Distal humerus fracture in patients over 70 years of age: results of open reduction and internal fixation. *Arch Orthop Trauma Surg* 2022;142(1):157-164.
15. Xiong G, Bhashyam AR. Review: A Concise Review on Surgical Fixation of Distal Humerus Fractures. *Orthoped J* 2020:233420.
16. Acar N, Karakaşlı A, Gürsan O, Hüsemoğlu RB. The evaluation of a de novo biplanar distal humerus plate: A biomechanical study. *J Dis Relat Surg* 2022;33(2):345-351.
17. Park SG, Seok HG. Bi-columnar locking plate fixation through a combined medial and lateral approach for the treatment of low transcondylar fractures of the distal humerus in the elderly. *BMC Musculoskelet Disord* 2022;23(1):764.
18. Shah SWA, Bashir T, Aslam MU. Functional Outcomes of Pre-Contoured Parallel Plates in Distal Humerus AO/OTA Type C Fractures in adults. *Pak J Med Health Sci* 2020;14(4):906-908.
19. Azim Q, Khan AH, Mufti AJ. Functional outcome of distal humerus intercondylar fractures treated with dual plating. *Rawal Med J* 2022;47(2): 373-376.
20. Pantalone A, Vanni D, Guelfi M, Belluati A, Salini V. Double plating for bicolumnar distal humerus fractures in the elderly. *Injury* 2017;48(3):S20-S23.
21. Mundotiya PK, Saini RK, Kumar A, Lal R. A Hospital Based Observational Study to Assess the Early Mobilization and Functional Outcome of Distal Humerus Fracture (AO Type 13-C) Treated with Open Reduction and Internal Fixation with Bi-Columnar Plating at Tertiary Care Centre. *European Mol Clinic Med* 2022;9(3): 10936-10944..