



FUNCTIONAL OUTCOMES OF INTRA-ARTICULAR DISTAL HUMERUS FRACTURE FIXATION USING THE DOUBLE PLATE TECHNIQUE: A RETROSPECTIVE OBSERVATIONAL STUDY

Orthopaedics

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ABSTRACT

Background: Distal humerus fractures are complex intra-articular injuries requiring precise anatomical reduction and stable fixation. The double plate technique improves stability and outcomes compared to single plate fixation. **Aim:** To evaluate functional outcomes of intra-articular distal humerus fractures treated with double plate fixation using the Mayo Elbow Performance Score (MEPS). **Methods:** This retrospective observational study at SN Medical College, Jodhpur, reviewed 80 patients (aged 18–60 years) with intra-articular distal humerus fractures treated with double plate fixation over 18 months. Functional outcomes (MEPS), pain levels (VAS), and complications were assessed at 1, 3, and 6 months postoperatively. **Results:** Mean age was 42.8 ± 10.4 years; 61.3% were male. Road traffic accidents caused 42.5% of injuries. MEPS improved from median 55 (1 month) to 83 (6 months) ($p < 0.05$). At 6 months, 75% achieved excellent/good outcomes. Mean VAS decreased from 4.08 postoperatively to 1.61 at 6 months. Complications occurred in 7.5%, including delayed union and stiffness. **Conclusion:** Double plate fixation provides excellent functional recovery with minimal complications in intra-articular distal humerus fractures.

KEYWORDS

Distal humerus fracture; Double plate fixation; Functional outcome; Mayo Elbow Performance Score

INTRODUCTION

Distal humerus fractures are complex injuries occurring at the lower end of the upper arm bone near the elbow, involving the articular surface and presenting significant management challenges[1,2]. The distal humerus comprises multiple articulating surfaces—the trochlea and capitellum—connecting with the ulna and radius respectively[3]. This anatomical complexity requires precise alignment and fixation to restore proper elbow function and prevent complications including stiffness, instability, and arthritis[3].

Treatment has evolved significantly. Initially managed conservatively with immobilization, close reduction, and casting, conservative approaches often yielded poor outcomes including stiffness, malunion, and non-union[4]. These limitations prompted surgical intervention development aimed at achieving better anatomical alignment and facilitating early mobilization, with subsequent advancements in surgical hardware and techniques improving fixation and outcomes.

Surgery aims to achieve anatomical reduction, stable fixation, and early mobilization. Open reduction and internal fixation (ORIF) is the most common method, utilizing plates and screws to stabilize fracture fragments, enabling early movement and reducing complications like non-union and malunion[5–7]. Single plate fixation, historically used, has limitations[8,9]: plates positioned posteriorly may inadequately stabilize complex intra-articular fractures, with higher hardware failure rates and insufficient fixation in osteoporotic bone[8,9]. The double plate technique was developed to address these limitations, placing two plates to provide increased stability and support, gaining popularity due to biomechanical advantages and improved clinical outcomes in complex fractures[10,11].

Despite significant advancements, consensus on optimal treatment remains elusive. Some studies advocate single plate fixation while others support double plating, each highlighting different advantages and drawbacks[7,8,12]. This study evaluates functional outcomes of intra-articular distal humerus fracture fixation using double plate technique, providing robust data on short-term and long-term outcomes.

AIM:

To evaluate functional outcomes of intra-articular distal humerus fracture fixation using double plate technique, measured by Mayo Elbow Performance Score (MEPS).

MATERIAL AND METHODS

Study Design: Single-center, hospital-based, retrospective observational epidemiological study conducted at the Department of Orthopaedics, SN Medical College, Jodhpur.

Ethical Clearance: Granted by Institute's Ethical Committee (protocol no. SNMC/IEC/2024/931, 25/07/2024).

Study Duration: 18 months.

Primary Outcome: Functional outcome measured using MEPS at baseline (pre-surgery), 1, 3, and 6 months post-surgery.

Secondary Outcomes: (i) Incidence of complications (infection, hardware failure), (ii) Pain levels using visual analog scale (VAS), (iii) Comparison between orthogonal and parallel plate techniques.

Intervention: Surgical fixation of intra-articular distal humerus fractures using double plate technique with two plates for stable fixation, allowing early mobilization and improved functional outcomes.

Study Participants: Adult patients aged 18-60 years with intra-articular distal humerus fractures.

Inclusion Criteria: Males and females aged 18-60 years with closed fracture intra-articular distal humerus without radial nerve palsy, and open fracture intra-articular distal humerus Gustilo Anderson I, operated with open reduction and internal fixation using double plate technique.

Exclusion Criteria: Pathological fractures, polytraumatized patients, and patients admitted for revision surgery.

Sample Size: 80 participants (calculated assuming standard deviation of 10, minimum detectable difference of 2.5 in MEPS, 95% confidence level, 80% power).

Sampling Methodology: Non-probability convenience sampling.

Informed Consent: Not required (retrospective study without direct patient interaction).

Data Collection: Medical records of patients who underwent intra-

articular distal humerus fracture fixation using double plate technique were identified from Department archives. Data extracted included: (i) demographic information (age, gender, patient identification), (ii) clinical details (fracture type, comorbidities, initial presentation), (iii) surgical details (specific technique, intraoperative findings, surgery duration, immediate complications), (iv) postoperative outcomes (discharge summaries, follow-up notes, complications, additional interventions), (v) MEPS parameters (pain, range of motion, stability, daily function) from follow-up visits at 1, 3, and 6 months, (vi) range of motion measurements (flexion, extension, supination, pronation) from physical examinations, (vii) complications (infection, hardware failure, adverse events) from follow-up records, and (viii) VAS pain scores at 1, 3, and 6 months post-surgery.

Statistical Analysis:

Conducted using Stata version 17.0. Descriptive statistics summarized demographic and clinical characteristics. Paired t-tests compared pre- and post-surgery MEPS scores at follow-up intervals (3 and 6 months). Range of motion and pain levels were analyzed similarly. Chi-square tests compared complication frequency across time points. Significance level set at $p < 0.05$.

Funding: No external funding.

Conflict Of Interest: None declared.

RESULTS

Participant Characteristics:

The study included 80 participants (mean age 42.8 ± 10.4 years, range 27-58 years). Males comprised 61.3%, females 38.8%. Most patients (58.8%) were from rural areas. BMI distribution: 50% overweight, 26.3% obese, 23.8% normal (Table 1).

Table 1: Characteristics Of Participants (n=80)

Variable	n	%
Age	Mean 42.8 (SD 10.4), Range 27-58	
Gender: Female	31	38.8
Male	49	61.3
Residence: Rural	47	58.8
Urban	33	41.3
BMI: Normal	19	23.8
Overweight	40	50
Obese	21	26.3

Injury Characteristics: Right-sided fractures occurred in 52.5%, left-sided in 47.5%. Injury causes: road traffic accidents (42.5%), falls (35%), blunt trauma (22.5%) (Table 2).

Table 2: Characteristics Of Injury (n=80)

Variable	n	%
Anatomical Side: Left	38	47.5
Right	42	52.5
Mode of Injury: RTA	34	42.5
Fall	28	35
Blunt Injury	18	22.5

Functional Recovery: MEPS showed progressive improvement. At 1 month: 60% poor, 40% fair, no excellent/good outcomes. By 3 months: 26.3% good, 48.8% fair. At 6 months: 75% achieved excellent to good outcomes (median MEPS 83), indicating significant functional improvement (Table 3).

Table 3: MEP Score During Follow-up (n=80)

Grading	1 Month (n/%)	3 Months (n/%)	6 Months (n/%)
Excellent	0/0	0/0	20/25.0
Good	0/0	21/26.3	40/50.0
Fair	32/40	39/48.8	15/18.8
Poor	48/60	20/25	5/6.25
Median	55	67	83

Pain Levels: VAS scores showed steady decline: mean VAS decreased from 4.08 postoperatively to 2.65 at 1 month, 2.14 at 3 months, and 1.61 at 6 months, demonstrating significant pain reduction (Table 4).

Table 4: VAS Score During Follow-up

Time	Mean	SD	Min	Max
Postoperative	4.075	0.823	3	5
1 Month	2.65	1.02	1	4

3 Months	2.138	1.088	0	4
6 Months	1.613	1.061	0	3

Complications: Minimal complications occurred. 92.5% had no complications. Delayed union occurred in 3.75%, hardware protrusion, heterotopic ossification with stiffness, and prolonged healing each occurred in 1.25% (Table 5).

Table 5: Complications Among Participants (n=80)

Complications	n	%
None	74	92.50
Hardware protrusion	1	1.25
Heterotopic ossification with stiffness	1	1.25
Delayed union	3	3.75
Delayed healing	1	1.25

DISCUSSION

MEP score distribution indicates progressive functional improvement following double plate fixation. At one month, 60% had "Poor" scores with 40% "Fair." By three months, significant improvement occurred: "Poor" reduced to 25%, with increases in "Fair" (48.8%) and "Good" (26.3%) categories, reflecting continued rehabilitation effects and gradual complication resolution. At six months, 25% achieved "Excellent," 50% "Good," 18.8% "Fair," and only 6.25% "Poor."

Early postoperative challenges align with Shaik RB et al. (2017), who reported similar initial difficulties achieving high functional scores[13]. However, rapid progression—26.3% achieving "Good" by three months and 25% reaching "Excellent" by six months—aligns with Saini R et al. (2023), who observed locking plates facilitated early mobilization and subsequent MEPS improvement[5].

At six months, 50% achieved "Good" and 25% "Excellent" scores (median MEPS 83), mirroring Atalar AC et al. (2009) findings (mean MEP score 86.1 with parallel-plate technique)[14]. This similarity suggests double plate technique effectiveness equals established methods in restoring elbow function through early active motion. Substantial improvement aligns with Mani KC et al. (2023), reporting good to excellent outcomes in most patients treated with orthogonal double plating[9]. Reduction in "Poor" category to 1.25% indicates positive long-term prognosis, consistent with lower poor outcome rates reported by Mani KC et al.[9].

Comparison of Endline MEP Score

Study	Excellent (%)	Good (%)	Fair (%)	Poor (%)
Present Study	25.0	50.0	18.8	6.25
Shaik RB et al.	20	50	25	5
Atalar AC et al.	33.3	52.4	9.5	4.8
Saini R et al.	25	35	30	10
Mani KC et al.	20.4	61.1	12.9	5.6

Complications: The study revealed relatively low complication incidence (92.5% complication-free). Most common was delayed union (3.75%), followed by hardware protrusion, heterotopic ossification with stiffness, and delayed healing (each 1.25%). Shaik RB et al. (2017) reported higher overall complication rates, including significant stiffness[13]. Delayed union, seen in 3.75% of patients, was common in other studies. Atalar AC et al. (2009) reported higher rates of delayed union and stiffness[14]. Mani KC et al. (2023) reported higher complication rates (20.4% major complications, including stiffness and hardware issues)[9]. Saini R et al. (2023) also reported stiffness and delayed healing complications[15].

CONCLUSION

Double plate fixation for intra-articular distal humerus fractures provides excellent functional and clinical outcomes with minimal complications. Most patients achieved good to excellent elbow function by six months post-surgery, reflected by significant MEPS improvement and consistent pain reduction. The method ensured stable fixation, allowed early mobilization, and minimized postoperative stiffness and hardware-related issues. Given its strong biomechanical stability and reliable functional recovery, double plate fixation is a preferred surgical approach for managing complex intra-articular distal humerus fractures. Further prospective studies with larger samples and longer follow-up are recommended to validate these findings.

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