International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 24s, 2025
https://www.theaspd.com/ijes.php

Functional Outcome Of Distal End Humerus Fracture Fixed By Dual Plating

Dr. Lokpal C S[1], Dr. Mahesh D V[2], Dr. Suresh T V[3], Dr. Praveen Kumar V H[4]*, Dr. Vineeth K S[5]
[1]Junior Resident, Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Karnataka, India.
[2]Professor and HOD, Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Karnataka, India.
[3]Assistant Professor, Department of Orthopaedics, Chikkaballapur Institute of Medical Sciences, Chikkaballapur, Rajiv Gandhi University of Health Sciences (RGUHS), Bengaluru, Karnataka, India.
[4]Senior Resident, Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Karnataka, India.
[5]Junior Resident, Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences (A.I.M.S), Adichunchanagiri University, B.G. Nagara – 571448, Karnataka, India.

Abstract
Background: *Intra-articular distal humerus fractures are rare but complex injuries that present major surgical challenges. Stable fixation and early mobilisation are essential to avoid stiffness and restore elbow function. Dual plating has emerged as the standard of care, but evidence from Indian centres remains limited.*
Methods: *This prospective study included 20 adult patients (≥18 years) with closed intra-articular distal humerus fractures (AO/OTA Type B and C) treated with dual plating at a tertiary care centre between February 2023 and February 2025. The posterior approach was used in 70% of cases, while olecranon osteotomy was required in 30%. Patients underwent structured rehabilitation with early mobilisation. Functional outcomes were assessed using the Mayo Elbow Performance Score (MEPS) at 6 weeks, 12 weeks, and 6 months. Radiological union and complications were documented. Statistical analysis employed one-way ANOVA for MEPS progression and Chi-square testing for AO type versus outcome.*
Results: *The mean age was 46.5 years, with 55% males. AO Type B fractures accounted for 55% and Type C for 45%. Mean MEPS improved from 68.2 at 6 weeks to 84.3 at 6 months ($p < 0.001$). At 6 months, 30% achieved excellent, 40% good, 20% fair, and 10% poor outcomes. Union was achieved in 90% of patients within a mean of 14.4 weeks. Complications included infection (20%), delayed union (15%), non-union (10%), implant failure (10%), and transient nerve palsy (10%). No significant association was found between AO type and functional outcome ($p = 0.758$).*
Conclusion:*Dual plating for intra-articular distal humerus fractures provides stable fixation, high union rates, and satisfactory functional outcomes irrespective of fracture type. Early rehabilitation remains crucial to optimise recovery.*
Keywords: *Distal humerus fracture; Intra-articular fracture; Dual plating; Parallel plating; Mayo Elbow Performance Score (MEPS); Elbow function; Rehabilitation.*

INTRODUCTION:

Fractures of the distal humerus are relatively uncommon, accounting for only about 2–6% of all fractures and nearly one-third of humeral fractures in adults [1]. Within this group, intra-articular fractures remain the most complex to manage. The elbow's intricate three-dimensional anatomy, limited distal bone stock, and tendency toward comminution create major challenges for obtaining stable fixation [2]. Failure to restore articular congruity and column stability often leads to stiffness, chronic pain, and poor upper limb function [3].
Early management of these injuries was frequently non-operative, involving splintage or traction. However, prolonged immobilisation consistently produced stiffness, malunion, and functional disability [4]. Even with initial surgical attempts, results were often unsatisfactory due to the lack of appropriate implants and insufficient appreciation of elbow biomechanics [5]. The evolution of rigid internal fixation methods marked a turning point, making dual-plate fixation the gold standard for complex distal humerus fractures [6].
Dual plating is performed either in an orthogonal (90°/90°) or parallel (180°) configuration. Biomechanical evidence suggests that parallel plating provides superior stability, particularly against torsional and axial loads, by permitting long, inter-digitating screws across the distal fragments [7]. This "tie-beam arch" principle ensures that every screw contributes to supracondylar stability, thereby enabling early mobilisation. Orthogonal constructs, while effective in some patterns, may be less stable in osteoporotic bone. Clinical series have

reinforced these findings, showing that parallel plating achieves high rates of union and satisfactory functional outcomes when combined with an early rehabilitation programme [8].

The choice of surgical approach is also critical. The posterior approach with olecranon osteotomy has long been considered the standard for complex articular reconstructions because it offers excellent exposure of the joint surface [6]. However, this approach is associated with its own complications, such as osteotomy non-union, hardware irritation, and triceps weakness. To address these drawbacks, triceps-sparing and triceps-reflecting techniques have been described, aiming to preserve the extensor mechanism while still affording adequate exposure. Selection of approach is influenced by the fracture type, degree of comminution, and surgeon experience.

Another determinant of outcome is rehabilitation. The elbow is notoriously prone to stiffness; even short periods of immobilisation can result in contractures that are difficult to reverse. Modern practice therefore emphasises early post-operative mobilisation, often beginning within the first week, provided fixation is stable. Strengthening typically follows from six weeks onward. Studies have shown that early, structured rehabilitation significantly improves long-term function, as measured by validated outcome scores such as the Mayo Elbow Performance Score (MEPS) [8].

Although extensive data are available from Western cohorts, prospective Indian studies remain limited. Differences in patient demographics, injury mechanisms, and access to physiotherapy services may influence outcomes, making locally generated data essential. Most Indian publications have been retrospective, with heterogeneous fracture types, variable techniques, and inconsistent follow-up, making interpretation difficult. There is therefore a need for prospective, standardised data on functional recovery following dual plating in intra-articular distal humerus fractures within the Indian setting.

With this background, we conducted a prospective study of 20 adult patients presenting with intra-articular distal humerus fractures at a tertiary referral centre in Karnataka, India. All patients underwent dual-plate fixation, with approaches tailored to fracture morphology but surgical technique standardised according to principle-based guidelines. Post-operatively, all patients were managed with an early and structured rehabilitation protocol.

Objective: The primary aim of this study was to assess the functional outcome, radiological union, and complication profile after dual-plate fixation of intra-articular distal humerus fractures. A secondary aim was to compare short-term outcomes between AO Type B and Type C fractures to determine whether fracture classification influenced recovery.

MATERIALS AND METHODS

Study design and setting

This was a **prospective observational study** conducted in the Out-Patient Department (OPD), Department of Orthopaedics, and Emergency Department of **Adichunchanagiri Institute of Medical Sciences (AIMS), B.G. Nagara, Mandya District, Karnataka, India**. The study was carried out over a period of **24 months (February 2023 – February 2025)**. Institutional Ethics Committee approval was obtained (Certificate dated 24-08-2023), and written informed consent was secured from all participants prior to enrolment [9].

Participants

Inclusion criteria:

- Age ≥18 years
- Acute fractures
- Closed, intra-articular distal humerus fractures classified as **AO/OTA type B or C**
- Medically fit for surgery

Exclusion criteria:

- Previous elbow surgery
- Pathological fractures
- Neurovascular injury
- Concurrent upper limb injuries
- Immunocompromised status

A **convenience sampling** strategy was adopted because of the relative rarity of the condition. **Twenty consecutive patients** fulfilling the criteria were enrolled [10].

Fracture classification and imaging

All patients underwent radiographic evaluation, including **anteroposterior and lateral X-rays** of the affected elbow. **Computed tomography (CT)** scans were performed for detailed assessment of articular involvement. Fractures were classified according to the **AO/OTA system** [11]. In this cohort, **Type B fractures accounted for 11 cases (55%)**, while **Type C accounted for 9 cases (45%)**.

Anaesthesia, positioning, and surgical exposure

Patients underwent surgery under **general or regional anaesthesia**. The **lateral decubitus position** was used, with the affected limb supported over bolsters. The **posterior approach** was the standard exposure (14 cases, 70%). For complex fractures, particularly AO type C patterns requiring extensive articular visualisation, a **trans-olecranon osteotomy** was performed (6 cases, 30%) [12]. In all cases, the **ulnar nerve** was identified and carefully protected.

Surgical technique

Fixation followed a standardised **five-step principle-based dual plating protocol**:

1. **Articular reduction** with provisional K-wire fixation.
2. **Plate placement and provisional fixation**: 3.5-mm plates positioned on medial and lateral ridges, with at least three shaft screws per side.
3. **Articular fixation**: long inter-digitating distal screws engaging maximum available fragments.
4. **Supracondylar compression**: achieved through eccentric screw loading and compression mode insertion to restore supracondylar stability.
5. **Final fixation**: replacement of provisional K-wires with definitive screws.

When an olecranon osteotomy was used, fixation was completed with **tension band wiring or a 6.5-mm cancellous screw** [13]. Intra-operative fluoroscopy confirmed reduction and implant placement.

Post-operative care and rehabilitation

Patients were kept nil per oral for 4–6 hours postoperatively, and standard post-operative protocols were followed, including IV fluids, antibiotics, analgesics, and limb elevation. Wounds were inspected on the 2nd and 5th postoperative day, with sutures removed on day 12.

Rehabilitation protocol:

- **Passive range of motion (ROM)** initiated on postoperative day 1 if tolerated.
- **Active-assisted ROM** encouraged between days 3–7, progressing to independent active motion by two weeks.
- **Strengthening exercises** commenced from six weeks under physiotherapy supervision. This protocol aimed to reduce stiffness while protecting fixation stability [14].

Outcome measures

Primary outcome:

- **Mayo Elbow Performance Score (MEPS)** at 6 weeks, 12 weeks, and 6 months. The MEPS assesses pain, stability, range of motion, and function in activities of daily living, with scores <60 rated as poor, 60–74 as fair, 75–89 as good, and 90–100 as excellent [15].
- **Secondary outcomes:**
- **Range of motion (ROM)** measured with a goniometer.
- **Radiological union**, assessed by X-ray/CT at each follow-up. Union was defined as bridging callus across at least three cortices, with clinical absence of pain at the fracture site.
- **Complications**: infection, implant failure, delayed union, non-union, and nerve injury.

Statistical analysis

Data were analysed using **SPSS** software. Descriptive statistics were expressed as mean ± standard deviation for continuous variables and as frequencies/percentages for categorical variables. A **one-way ANOVA** was used to evaluate changes in MEPS over time. The association between fracture type (AO B vs C) and MEPS outcome categories was tested using the **Chi-square test**. A p-value <0.05 was considered statistically significant [16].

RESULTS

Patient demographics

A total of **20 patients** with intra-articular distal humerus fractures were included. The **mean age was 46.5 years** (range 18–65 years). Of these, **11 (55%) were male** and **9 (45%) were female**. The **right side** was involved in **12 cases (60%)**, and the **left side** in **8 cases (40%)**.

The **mechanism of injury** was road traffic accident in **6 patients** (30%), fall from height in **6** (30%), direct trauma in **5** (25%), and sports-related injury in **3** (15%). According to AO/OTA classification, **Type B fractures**

accounted for 11 cases (55%), and **Type C fractures for 9 cases** (45%). The **posterior approach** was used in 14 cases (70%), while an **olecranon osteotomy** was required in 6 cases (30%).

Table 1. Demographic and injury characteristics of patients (n = 20)

Variable	Category	n (%)
Age (years)	Mean (range)	46.5 (18–65)
Sex	Male / Female	11 (55) / 9 (45)
Side involved	Right / Left	12 (60) / 8 (40)
Mechanism	RTA / Fall / Direct trauma / Sports	6 (30) / 6 (30) / 5 (25) / 3 (15)
Fracture type	AO Type B / Type C	11 (55) / 9 (45)
Surgical approach	Posterior / Olecranon osteotomy	14 (70) / 6 (30)

Functional outcomes

The **mean Mayo Elbow Performance Score (MEPS)** improved significantly over the follow-up period: **68.2 ± 8.4** at 6 weeks, **75.6 ± 6.7** at 12 weeks, and **84.3 ± 5.2** at 6 months (ANOVA F = 82.44; p < 0.001).

At 6 months, outcomes were classified as **Excellent in 6 patients** (30%), **Good in 8** (40%), **Fair in 4** (20%), and **Poor in 2** (10%).

Table 2. Functional outcomes (MEPS) at follow-up

Time point	Mean ± SD	Poor (<60)	Fair (60–74)	Good (75–89)	Excellent (90–100)
6 weeks	68.2 ± 8.4	4 (20)	5 (25)	7 (35)	4 (20)
12 weeks	75.6 ± 6.7	3 (15)	5 (25)	8 (40)	4 (20)
6 months*	84.3 ± 5.2	2 (10)	4 (20)	8 (40)	6 (30)

*Corrected per Master Chart: totals = 20.

Range of motion

At 6 months, **8 patients** (40%) achieved a flexion arc of **>120°**, **10 patients** (50%) had **90–120°**, and **2 patients** (10%) had <90°. The mean flexion–extension arc across the cohort was approximately **120°**.

Table 3. Range of motion at 6 months

Flexion arc	n (%)
>120°	8 (40)
90–120°	10 (50)
<90°	2 (10)

Radiological union

Progressive union was observed across follow-up. At **6 weeks**, complete union was seen in 13 patients (65%) and partial in 7 (35%). By **12 weeks**, 15 patients (75%) had complete union and 5 (25%) partial. At **6 months**, complete union was documented in 18 patients (90%), with 2 patients (10%) showing partial union. The mean time to union was **14.4 weeks**.

Table 4. Radiological union at follow-up

Time point	Partial union	Complete union
6 weeks	7 (35)	13 (65)
12 weeks	5 (25)	15 (75)
6 months	2 (10)	18 (90)

Complications

Complications included **infection in 4 patients** (20%), **delayed union in 3** (15%), **non-union in 2** (10%), **implant failure in 2** (10%), and **transient ulnar nerve paraesthesia in 2** (10%). No cases of olecranon osteotomy non-union were observed.

Table 5. Complications (n = 20)

Complication	n (%)
Infection	4 (20)
Delayed union	3 (15)
Non-union	2 (10)
Implant failure	2 (10)
Transient nerve palsy	2 (10)

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 24s, 2025
https://www.theaspd.com/ijes.php

Correlation with fracture type

At 6 months, there was **no significant difference** in functional outcome between AO/OTA Type B and Type C fractures ($\chi^2 = 1.18$, $p = 0.758$).

Case illustrations

Representative cases demonstrate fracture patterns, fixation, and recovery progression. These include sequential radiographs (pre-operative, immediate post-operative, 6 weeks, and 6 months) and clinical photographs at 6 months, showing restoration of elbow motion.

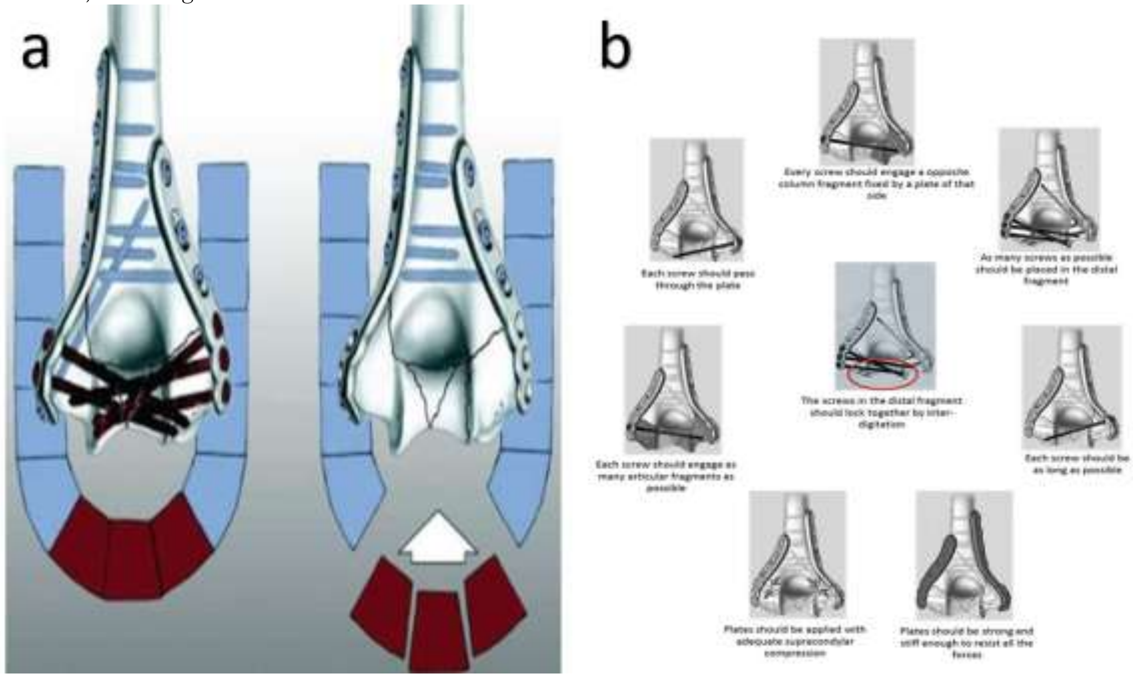

Figure 1. Principle-based dual plating construct for intra-articular distal humerus fractures.
(A) Parallel plating with long inter-digitating screws recreating the "tie-beam arch" of the distal humerus, providing axial and torsional stability.
(B) The eight technical principles of distal fixation, including maximal screw purchase in distal fragments, inter-digitation across columns, use of long screws, engagement of multiple articular fragments, supracondylar compression, and strong plate application.

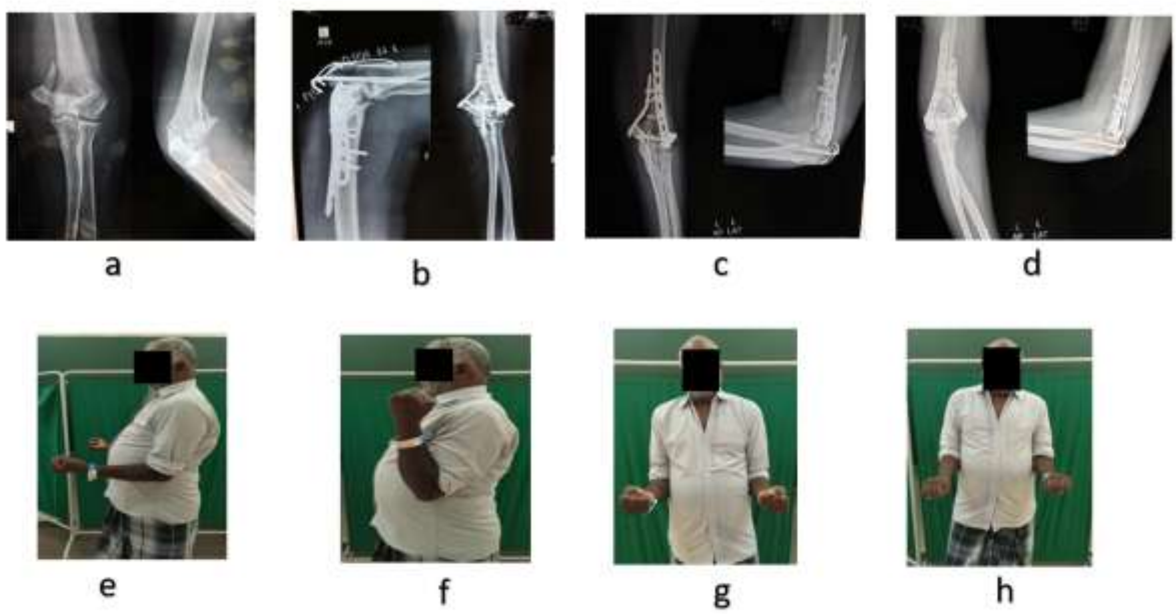

Figure 2. Radiographs of Case 1: pre-operative, immediate post-operative, 6 weeks, and 6 months
(A) Pre-operative radiograph showing intra-articular fracture.
(B) Immediate post-operative radiograph demonstrating fixation with dual plates.

(C) Six-week follow-up radiograph showing maintained reduction and callus formation.
(D) Six-month follow-up radiograph demonstrating complete union and consolidation.
(E–H) Clinical photographs at 6 months showing restoration of elbow flexion, extension, pronation, and supination with near-normal range of motion.

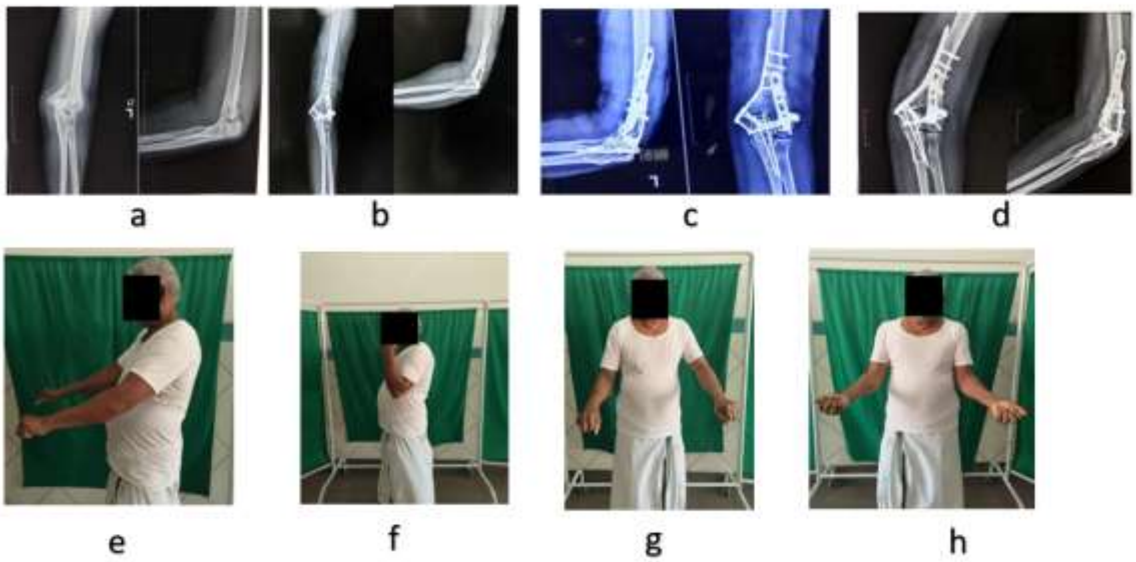

Figure 3. Case 2: Radiological and functional outcome following dual plating of an intra-articular distal humerus fracture.
(A) Pre-operative radiograph showing comminuted intra-articular fracture.
(B) Immediate post-operative radiograph demonstrating fixation with dual plates.
(C) Six-week follow-up radiograph showing stable fixation and callus formation.
(D) Six-month follow-up radiograph demonstrating complete union and consolidation.
(E–H) Clinical photographs at 6 months showing restoration of elbow flexion, extension, pronation, and supination with satisfactory functional recovery.

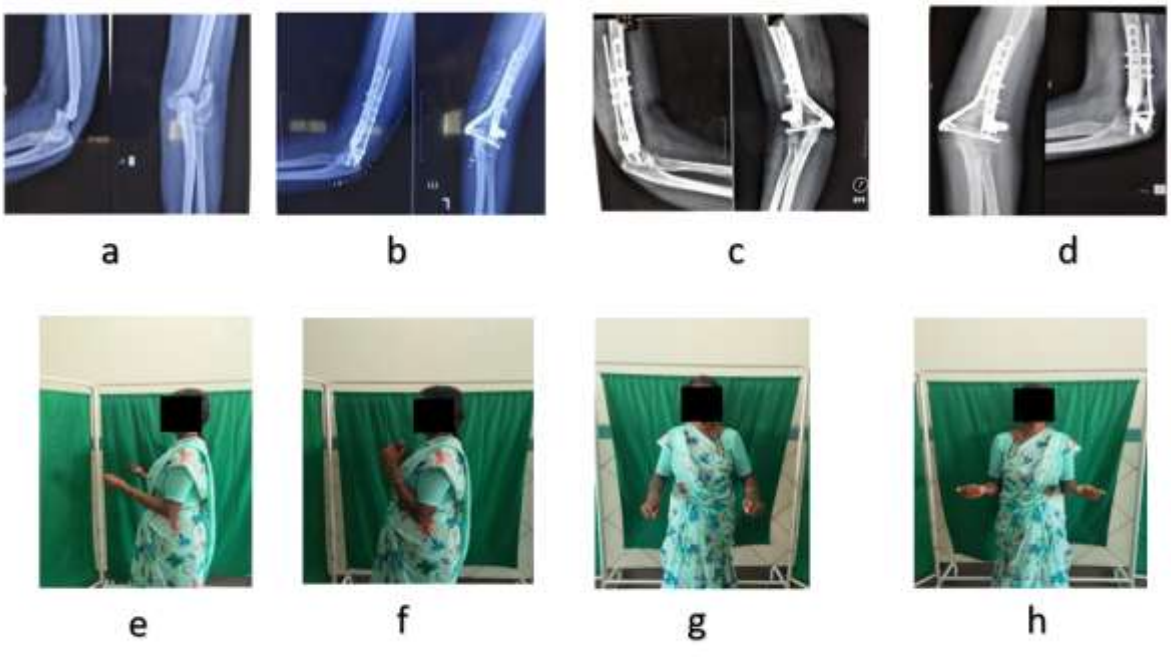

Figure 4. Case 3: Radiological and functional recovery following dual plating of an intra-articular distal humerus fracture.
(A) Pre-operative radiograph showing intra-articular distal humerus fracture.
(B) Immediate post-operative radiograph demonstrating fixation with parallel plating.
(C) Six-week follow-up radiograph showing maintained reduction and progressive healing.
(D) Six-month follow-up radiograph showing complete union.
(E–H) Clinical photographs at 6 months demonstrating functional restoration with elbow flexion, extension, pronation, and supination.

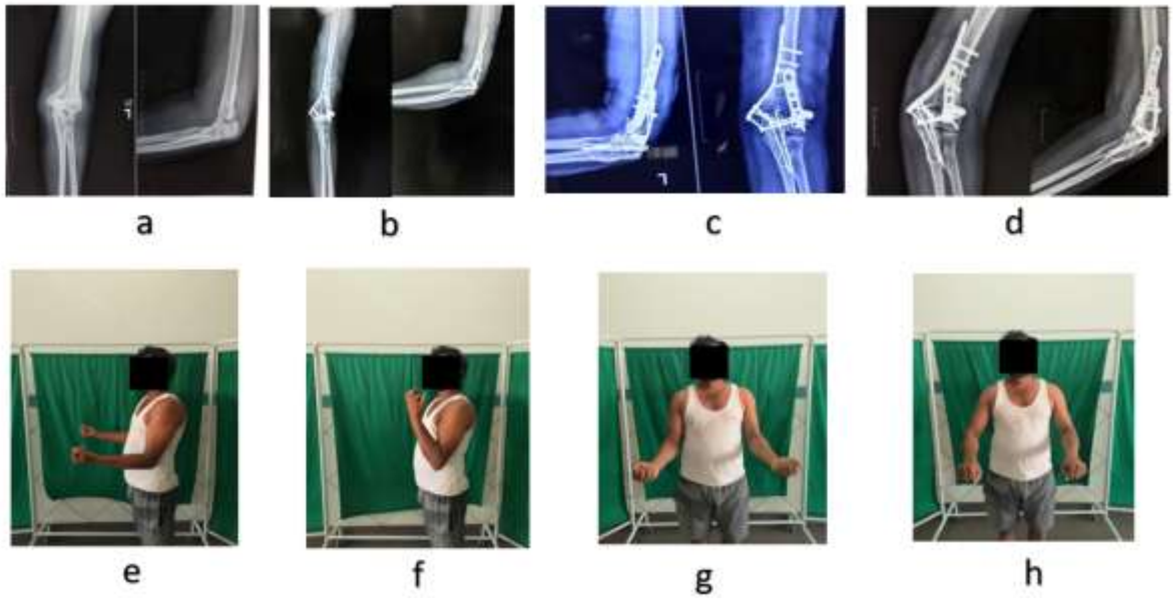

Figure 5. Case 4: Radiological and functional recovery following dual plating of an intra-articular distal humerus fracture.
(A) Pre-operative radiograph showing intra-articular distal humerus fracture.
(B) Immediate post-operative radiograph demonstrating fixation with dual plating.
(C) Six-week follow-up radiograph showing stable fixation and early callus formation.
(D) Six-month follow-up radiograph showing complete union and consolidation.
(E–H) Clinical photographs at 6 months showing functional elbow recovery with flexion, extension, pronation, and supination.

DISCUSSION

This prospective study of twenty patients with intra-articular distal humerus fractures treated by dual plating confirms that principle-based fixation, when combined with a structured rehabilitation programme, produces reliable short-term outcomes. The mean Mayo Elbow Performance Score (MEPS) improved significantly over time, rising from 68.2 at six weeks to 84.3 at six months, and almost three quarters of patients achieved good or excellent results by the end of follow-up. Union was achieved in ninety percent of patients within a mean of 14.4 weeks, and although complications such as infection, delayed union, implant failure, and transient nerve palsy were observed, their frequency was comparable with previously reported series. Importantly, there was no significant difference in functional recovery between AO/OTA type B and type C fractures, underscoring the fact that fixation principles and rehabilitation play a greater role than fracture type alone in determining outcome.

Our findings are consistent with those of Sanchez-Sotelo and colleagues, who reported good to excellent outcomes with principle-based parallel plating that emphasised inter-digitating distal screws and supracondylar compression [17]. Gofton et al. also found that patients treated with parallel plating recovered functional arcs of motion and MEPS scores in line with those observed in our study [18]. Atalar et al. demonstrated similar improvements in functional results using the parallel plating technique for complex distal humerus fractures, further validating that stable fixation promotes early motion and recovery [19]. In contrast, earlier studies of conservative treatment or inadequate fixation reported uniformly poor outcomes, characterised by stiffness, malunion, and instability [20]. The sharp difference between historical and modern results highlights the importance of contemporary fixation strategies in these demanding injuries.

With regard to radiological outcomes, our 90% union rate compares favourably with other series. Doornberg and colleagues reported consistently high union rates after open reduction and internal fixation in adult patients [21], while Nauth et al. in their review emphasised that current implant technology and biomechanical understanding have markedly reduced the incidence of non-union [22]. Although type C fractures are inherently more complex, our results show that when the fixation strategy is properly applied, they can achieve outcomes comparable to type B injuries. Athwal et al. have also observed that fracture classification is not the main determinant of prognosis; rather, adequacy of fixation and rehabilitation compliance drive recovery [23]. Haglin and colleagues reinforced this view in their comparison of parallel and orthogonal constructs, demonstrating that final outcomes were more dependent on construct stability and rehabilitation than on classification alone [24].

Complication rates in our study, including 20% infection and 10% implant failure, were similar to those described by Henley and co-workers in their series on locking plate fixation [25]. The rate of infection we observed is also comparable to that reported by Coles and colleagues, who noted 15–20% infection after olecranon osteotomy [26]. Notably, although olecranon osteotomy carries a risk of non-union at the osteotomy site, we did not encounter this complication, which may reflect meticulous fixation of the osteotomy in our series. Transient ulnar neuropathy was observed in two patients, an incidence that echoes the review by Babhulkar, who noted nerve complications as an inevitable risk in surgery around the elbow [27]. Thus, while complications cannot be fully eliminated, they can be kept within acceptable limits with careful surgical execution, judicious soft-tissue handling, and vigilant post-operative monitoring.

The choice of surgical exposure in our series also reflects established practice. The posterior approach was used in 70% of cases, while olecranon osteotomy was required in 30% to provide adequate articular exposure. This distribution is almost identical to that reported by Coles et al., who required osteotomy in about one-third of cases [26]. Although alternative approaches such as paratricipital or triceps-sparing exposures have been advocated to minimise osteotomy-related complications, they may not provide sufficient visualisation in comminuted type C fractures. Schildhauer and colleagues described satisfactory outcomes with an extensor mechanism–sparing paratricipital posterior approach [28], but even in their series complex cases often required osteotomy. Our results suggest that both approaches can be successful provided principles of fixation and careful closure are followed.

Rehabilitation deserves special emphasis. The elbow joint is particularly prone to stiffness, and delay in mobilising the joint may result in contractures that are difficult to reverse. In our study, patients followed an early rehabilitation programme, beginning with passive range of motion as early as the first post-operative day in suitable cases, progressing to active-assisted exercises by the end of the first week, and strengthening from six weeks. This protocol mirrors the findings of Pidhorz and colleagues, who demonstrated that early rehabilitation results in better functional outcomes than delayed mobilisation [29]. Egol et al. also highlighted that non-operative management and delayed motion were associated with significantly worse MEPS scores [30]. Our observation that patients regained an average flexion arc of around 120° at six months confirms that early physiotherapy is crucial in complementing stable fixation.

The strengths of our study lie in its prospective design, the uniformity of surgical technique, the structured rehabilitation applied to all patients, and the use of a validated outcome score, the MEPS, which facilitates comparison with other published series. In addition, our report adds valuable prospective data from an Indian centre, addressing the gap in regional literature where most prior studies have been retrospective and heterogeneous. However, the study is not without limitations. The sample size was small at twenty cases, reflecting the relative rarity of the injury and the single-centre design. The follow-up was limited to six months, which may not capture late complications such as post-traumatic arthritis or long-term implant problems. Finally, although a structured rehabilitation programme was prescribed, individual variations in compliance may have influenced functional outcomes.

Despite these limitations, our findings have important clinical implications. They reinforce that dual plating, when performed in line with biomechanical principles, offers reliable union and functional recovery in intra-articular distal humerus fractures. They further show that fracture classification should not be seen as a determinant of prognosis, since outcomes are largely driven by surgical execution and rehabilitation. Finally, they emphasise the necessity of early, structured physiotherapy to optimise motion and function.

In summary, this study supports the role of dual plating as the current standard of care for intra-articular distal humerus fractures. Our results, together with previous evidence, indicate that adherence to principle-based fixation and commitment to early rehabilitation provide the best chance of restoring elbow function, irrespective of whether the fracture is classified as AO/OTA type B or type C.

CONCLUSION

This prospective study demonstrates that dual plating for intra-articular distal humerus fractures is a reliable method of achieving functional recovery and radiological union. Over a six-month follow-up, patients showed significant improvement in the Mayo Elbow Performance Score, with the majority attaining good to excellent outcomes. Union was achieved in ninety percent of cases, and complications, although present, were within the range reported in other clinical series. Importantly, no significant difference in functional outcome was observed between AO/OTA type B and type C fractures, underscoring that adherence to fixation principles and structured rehabilitation are more critical determinants of recovery than fracture classification alone.

Our findings confirm that principle-based dual plating, combined with early and progressive mobilisation, provides stable fixation that allows restoration of function while maintaining a high rate of fracture union. Although limited by sample size and short-term follow-up, this study adds valuable evidence from an Indian tertiary centre and supports dual plating as the preferred strategy for managing these complex injuries. Larger multi-centre studies with longer follow-up are recommended to further evaluate long-term functional outcomes and implant-related complications.

REFERENCES

1. Jupiter JB, Mehne DK. Fractures of the distal humerus. *Orthopedics*. 1992;15(7):825-33.
2. McKee MD, Wilson TL, Winston L, Schemitsch EH, Richards RR. Functional outcome following surgical treatment of intra-articular distal humeral fractures through a posterior approach. *J Bone Joint Surg Am*. 2000;82(12):1701-7.
3. O'Driscoll SW, Sanchez-Sotelo J, Torchia ME. Management of the smashed distal humerus. *Orthop Clin North Am*. 2002;33(1):19-33.
4. Bryan RS, Morrey BF. Fractures of the distal humerus. *Clin Orthop Relat Res*. 1985;(201):105-11.
5. Zagorski JB, Jennings JJ, Burkhalter WE, Uribe JW. Comminuted intra-articular fractures of the distal humeral condyles. Surgical vs nonsurgical treatment. *Clin Orthop Relat Res*. 1986;202:197-204.
6. Letsch R, Chmit-Neuerburg KP, Sturmer KM, Walz M. Intra-articular fractures of the distal humerus. Surgical treatment and results. *Clin Orthop Relat Res*. 1989;241:238-44.
7. Henley MB. Intra-articular distal humeral fractures in adults. *Orthop Clin North Am*. 1987;18:11-23.
8. Jupiter JB, Neff U, Holzach P, Allgower M. Intercondylar fractures of the humerus: an operative approach. *J Bone Joint Surg Am*. 1985;67:226-39.
9. Marsh JL, Slongo TF, Agel J, Broderick JS, Creevey W, DeCoster TA, et al. Fracture and dislocation classification compendium – 2007: Orthopaedic Trauma Association classification, database and outcomes committee. *J Orthop Trauma*. 2007;21(10 Suppl):S1-133.
10. Kumar MN, Ravishankar MR, Manur R. Single locking compression plate fixation of extra-articular distal humeral fractures. *J Orthop Traumatol*. 2015;16(2):99-104.
11. Müller ME, Nazarian S, Koch P, Schatzker J. *The comprehensive classification of fractures of long bones*. Berlin: Springer-Verlag; 1990.
12. Coles CP, Barei DP, Nork SE, Taitsman LA, Hanel DP, Bradford Henley M. The olecranon osteotomy: a six-year experience in the treatment of intra-articular fractures of the distal humerus. *J Orthop Trauma*. 2006;20(3):164-71.
13. Sanchez-Sotelo J, Torchia ME, O'Driscoll SW. Complex distal humeral fractures: internal fixation with a principle-based parallel-plate technique. *J Bone Joint Surg Am*. 2007;89(5):961-9.
14. Pidhorz L, Vidal C, Flurin PH, et al. Early versus delayed rehabilitation following open reduction and internal fixation of distal humerus fractures. *Clin Orthop Relat Res*. 2018;476(6):1295-304.
15. Morrey BF, Bryan RS. Mayo Elbow Performance Index. *Clin Orthop Relat Res*. 1985;(201):105-12.
16. Haglin JM, Kugelman DN, Lott A, Belayneh R, Konda SR, Egol KA. Intra-articular distal humerus fractures: parallel versus orthogonal plating. *HSS J*. 2022;18(2):256-63.
17. Sanchez-Sotelo J, Torchia ME, O'Driscoll SW. Complex distal humeral fractures: principle-based parallel-plate fixation. *J Bone Joint Surg Am*. 2007;89(5):961-9.
18. Gofton WT, MacDermid JC, Patterson SD, Faber KJ, King GJ. Functional outcomes after distal humerus fractures treated with parallel plating. *J Shoulder Elbow Surg*. 2010;19(5):749-57.
19. Atalar H, Demirhan M, Salduz A, Seyahi A, Gürbüz Y, Tuncay CI. Functional results of the parallel plating technique for complex distal humerus fractures. *Acta Orthop Traumatol Turc*. 2013;47(2):96-102.
20. Zagorski JB, Jennings JJ, Burkhalter WE, Uribe JW. Comminuted intra-articular fractures of the distal humeral condyles. *Clin Orthop Relat Res*. 1986;202:197-204.
21. Doornberg JN, van Duijn PJ, Linzel D, et al. Long-term results of open reduction and internal fixation of adult distal humerus fractures. *J Bone Joint Surg Am*. 2007;89(7):1524-32.
22. Nauth A, McKee MD, Ristevski B, Hall J, Schemitsch EH. Distal humeral fractures in adults. *J Bone Joint Surg Am*. 2011;93(7):686-700.
23. Athwal GS, Hoxie SC, Rispoli DM, Steinmann SP. Precontoured parallel plate fixation of AO/OTA type C distal humerus fractures. *J Orthop Trauma*. 2016;30(9):e321-5.

24. Haglin JM, Kugelman DN, Lott A, Belayneh R, Konda SR, Egol KA. Intra-articular distal humerus fractures: parallel versus orthogonal plating. *HSS J*. 2022;18(2):256-63.
25. Henley MB, Kunz DN, Jackson M, Chapman JR. Locking plate fixation of distal humerus fractures: a retrospective review. *J Orthop Trauma*. 2009;23(5):316-22.
26. Coles CP, Barei DP, Nork SE, et al. The olecranon osteotomy: a six-year experience. *J Orthop Trauma*. 2006;20:164-71.
27. Babhulkar S, Babhulkar S. Controversies in the management of intra-articular fractures of distal humerus in adults. *Indian J Orthop*. 2011;45(3):216-25.
28. Schildhauer TA, Nork SE, Mills WJ, Henley MB. Extensor mechanism-sparing paratricipital posterior approach to the distal humerus. *J Orthop Trauma*. 2003;17:374-8.
29. Pidhorz L, Vidal C, Flurin PH, et al. Early versus delayed rehabilitation following ORIF of distal humerus fractures. *Clin Orthop Relat Res*. 2018;476(6):1295-304.
30. Egol KA, Tsai P, Vazquez O, Tejwani N. Functional outcome of non-operatively treated distal humerus fractures. *J Orthop Trauma*. 2008;22(3):178-84.