



# Functional and Radiological Outcomes of Distal Humerus Fractures Treated with Orthogonal Plating: A Study Based on the Mayo Elbow Performance Score

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## KEYWORDS

Distal humerus fracture, orthogonal plating, Mayo Elbow Performance Score, functional outcome, radiological outcome, fracture fixation

## ABSTRACT:

**Background:** Distal humerus fractures are not rare but complex injuries requiring stable fixation for optimal recovery. Orthogonal plating has emerged as a reliable surgical method, promoting early mobilization resulting in better functional outcome.

**Aim & Objectives:** This study aimed to evaluate the functional and radiological outcomes of distal humerus fractures treated with orthogonal plating, focusing on treatment duration, fracture union, functional recovery, and complications.

**Patient & Methods:** A total of 30 patients with AO Type C distal humerus fractures, aged 18-60, were treated with orthogonal plating at Sree Balaji Medical College between May 2022 and May 2024. Functional outcomes were assessed using the Mayo Elbow Performance Score (MEPS), and radiological union was monitored.

**Results:** The mean age was 40 years, and the most common cause of injury was road traffic accidents. Radiological union was achieved in all cases, with 90% uniting within 12-16 weeks. The mean MEPS score was 86, with a success rate of 88.9% in patients younger than 40 years and 93.3% in those older than 40 years. Complications were minimal.

**Conclusion:** Orthogonal plating is a highly effective method for treating distal humerus fractures, providing stable fixation, early recovery, and minimal complications, making it ideal for patients needing rapid rehabilitation.

## Introduction:

Distal humerus fractures are relatively not rare but complex, often resulting from high-energy trauma or trivial fall in elderly patients<sup>1</sup>. The intricate anatomy and biomechanical demands of the elbow joint make these fractures challenging to treat. To achieve anatomical fixation and functional stability, it is crucial to reconstruct the metaphyseal-diaphyseal region meticulously. Historically, distal humerus fractures were deemed challenging to treat surgically, leading to

conservative management<sup>2</sup>. This often resulted in long-term complications, such as joint stiffness in the affected area<sup>3-4</sup>. Orthogonal plating, involving the placement of two plates at a 90-degree angle to each other, offers a robust solution for fracture fixation, ensuring early mobilization and reducing post-surgical complications such as joint stiffness<sup>5-9</sup>. This study aimed to assess the functional and radiological outcomes of distal humerus fractures treated with orthogonal plating using the MEPS.



### Materials and methods:

This observational study was conducted at Sree Balaji Medical College & Hospital between May 2022 and May 2024. A total of 30 patients with intra-articular fractures of the distal humerus underwent osteosynthesis using orthogonal plating. Patients were evaluated clinically and radiologically at regular intervals, and functional outcomes were assessed using MEPS. The inclusion criteria were patients aged 18-60 with type C distal humerus fractures according to the AO classification, and the exclusion criteria are ages <18, >60, extra-articular fractures, fractures resulting from tumours or other diseases, elbow joint pathologies that had undergone previous surgical intervention for either non-traumatic or traumatic conditions were not included, traumatic cases presented after more than two weeks were excluded, patients who were skeletally immature were excluded, grade 2 & 3 open injury were excluded and associated neurovascular impairment were excluded. A preliminary assessment was conducted to rule out any associated injuries. A detailed patient history was

obtained, and a general examination was performed to identify any comorbidities. Local examination focused on ruling out associated wounds and neurovascular damage. Radiological evaluation of the affected elbow included anteroposterior, lateral, and oblique X-ray views. For preoperative planning, CT scans of the elbow were also obtained. Routine diagnostic tests, such as a complete blood count, renal function tests, viral screenings, chest X-ray, and electrocardiogram, were performed for all patients.

An above-elbow plaster slab and bandage were applied to stabilize the fracture until definitive surgical fixation was undertaken. After completing preoperative screenings, patients were scheduled for surgery, with written informed consent obtained. On average, surgery was performed on the third day post-injury, within a range of 2 to 8 days. In cases of significant swelling, limb elevation with anti-edema measures was employed. Surgery was postponed until substantial reduction of swelling was noted.



Figure 1: images showing the initial radiographic investigation done for the distal humerus fracture which is x-ray (on the right) and CT-scan 3d reconstruction (on the left)

### Procedure:

Patients were administered either general anaesthesia or a nerve block, with a pneumatic tourniquet applied and

were positioned laterally on the operating table with the injured arm supported by bolsters.



Figure 2: patient positioning

A midline posterior incision was made to expose the subcutaneous tissue and deep fascia. The ulnar nerve was identified, carefully isolated, and gently retracted using a cotton tape. Various surgical approaches were employed depending on the case, including the TRAP (Triceps-Reflecting Anconeus Pedicle), para-tricipital, triceps splitting, triceps reflecting, and olecranon osteotomy techniques. The orthogonal fixation technique involved initially realigning the fracture and temporarily stabilizing the fragments with Kirschner wires. Appropriate plate sizes were selected and positioned on the medial and dorsolateral sides to avoid stress on the diaphysis. Posterolateral plates were placed first, secured with 3.5 mm cortical screws, and confirmed using an image intensifier. Medial plates were then positioned behind the intermuscular septum, ensuring attachment to the medial collateral ligament (MCL). In case of olecranon osteotomy, tension band wiring was performed, and the olecranon osteotomy was fixed with Kirschner wires or a 6.5 mm cancellous screw, with careful wound closure and drainage.

#### Post-operative care and rehabilitation:

Post-surgery, sterile dressings were applied, and the limb was elevated for 2-3 days. Patients were encouraged to move their fingers and wrists starting on the first day. Intravenous antibiotics were administered for two days followed by oral antibiotics. On the second day, the dressing and drain was removed. Postoperative X-rays were taken to assess fracture fixation. Elbow exercises began on day 3, including active-assisted movements like flexion, pronation, and supination. Passive extension exercises were limited to patients with extensor mechanism procedures. Patients were discharged on the fifth day, followed up on the 12th day for suture removal. Clinical and radiological evaluations were conducted at 1, 3, and 6 months, with functional outcomes assessed via the Mayo Elbow Performance Score (MEPS). Regular activities were resumed at six months, while extension strengthening was postponed for 12 weeks until radiographic union was confirmed. Patients were monitored weekly for two months, then monthly for three months, and every three months thereafter until healing and full range of motion were achieved.





Figure 3: Preoperative and postoperative X-ray image reduction with early rehabilitation protocol. (a) Preoperative X-ray image. (b) Immediate postoperative x ray image showing well-achieved reduction. (c) 6 months postoperative X-ray showing well-sustained reduction. (d-g) active full range of movements permitted after 6 months.

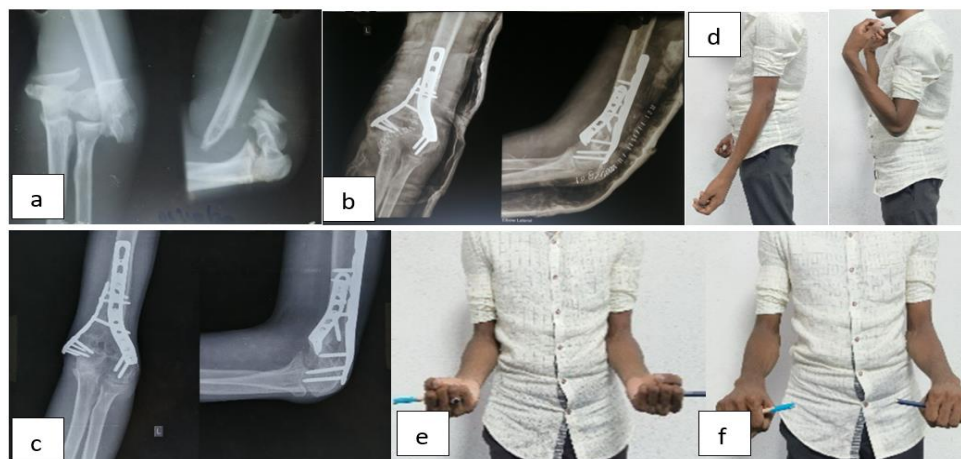


Figure 4: Preoperative and postoperative X-ray image reduction with early rehabilitation protocol. (a) Preoperative X-ray image. (b) Immediate postoperative x ray image showing well-achieved reduction. (c) 6 months postoperative X-ray showing well-sustained reduction. (d-g) active full range of movements permitted after 6 months.

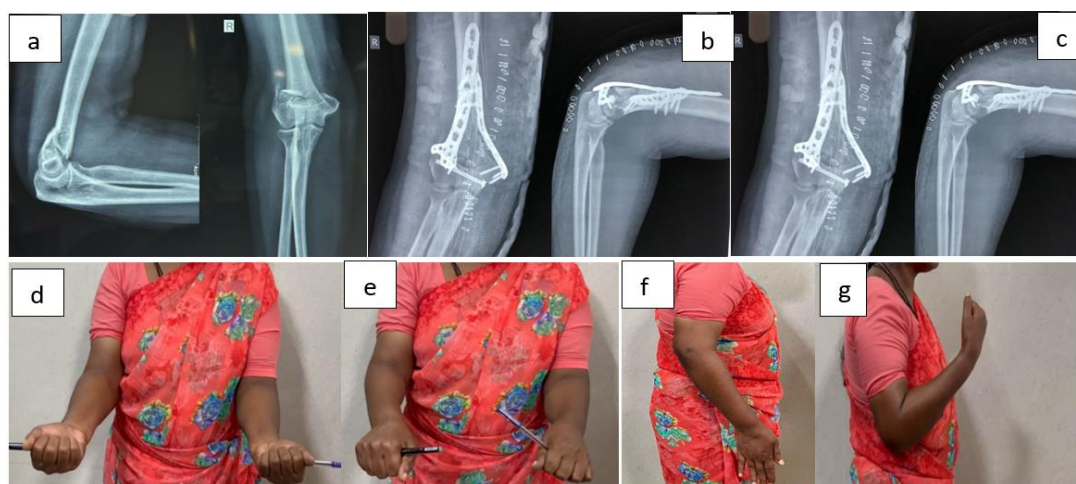


Figure 5: Preoperative and postoperative X-ray image reduction with early rehabilitation protocol. (a) Preoperative X-ray image. (b) Immediate postoperative x ray image showing well-achieved reduction. (c) 6 months postoperative X-ray showing well-sustained reduction. (d-g) range of movements permitted after 6 months.

### Results:

Out of 30 patients, the average age was 40 years. The most common cause of injury was road traffic accidents (67%), followed by trivial fall (33%). The fractures were classified as AO type C, with C2 being the most prevalent. Orthogonal plating yielded excellent results, with 88.9% success in patients under 40 years and 93.3% in those over 40 years. Radiological union was achieved in 90.9% of patients within 12-16 weeks, while the

remaining 9.1% united between 17-21 weeks. The mean Mayo Elbow Performance Score (MEPS) was 86, reflecting successful functional outcomes. Complications were minimal, with 2 patients experiencing elbow stiffness which was eventually functional elbow movements was achieved with continues physiotherapy, 1 patient experienced superficial wound infection for which patient was treated with supportive



antibiotics and regular dressings. Two patients who underwent triceps splitting approach reported extensor weakness of elbow, which was effectively managed with physiotherapy.

## Discussion:

The orthogonal plating technique has proven effective for treating complex distal humerus fractures<sup>10-13</sup>. By providing stable fixation, it facilitates early mobilization, which is crucial for optimal functional recovery.

In a study conducted by K Holub et al.,<sup>14-16</sup> a sample size of fifty-one patients was treated with open reduction and internal fixation and analysed to assess functional outcomes using the Mayo Elbow Performance Score (MEPS) which resulted to be 83.6 as average MEPS score. Over all the study showed an excellent result and good functional outcome with significant p-value which yielded 0.046.

Similarly, our study, which followed a similar methodology with the same sample size of thirty patients, produced a p-value of 0.0019 when analysed with MEPS scoring system<sup>17-19</sup>. This significant p-value demonstrates a notable improvement in functional outcomes, suggesting that orthogonal plating may result in better clinical results. The discrepancy between the two studies may be attributed to differences in patient selection or postoperative management.

Various co-founding factors like surgical approach, age, post operative care, early mobilization and rehabilitation were also contributing to the part of good to excellent functional outcomes. Despite the influence of various confounding factors, our study primarily emphasizes the principles of orthogonal plating and its impact on functional outcomes. The results align closely with previous findings, underscoring that orthogonal plating offers superior biomechanical stability compared to other studies reported by various authors<sup>20</sup>. This enhanced stability contributes significantly to improved functional recovery, reinforcing orthogonal plating as a reliable and effective approach for managing complex distal humerus fractures.

Shin et al<sup>21</sup> conducted a study comparing two dual plating methods for intra-articular lower end fractures of humerus, with an average patient age of 42, similar to our study's mean age of 40.

Emmanuel et al<sup>22</sup> found that triceps-sparing method improved elbow range of movements and triceps strength, with both methods achieving consistent bone union and comparable functional results. In our study, we used various surgical approaches, extensively utilizing the triceps-splitting strategy, which had a success rate of 88.9%.

Soo-Hong-Han et al. reported 4 cases of wound infection in a retrospective study on complications associated with open reduction and internal fixation for adult distal humerus fracture<sup>23-24</sup>. In our study, 1 patient had superficial wound infections treated with antibiotics, and one required wound debridement & antibiotics therapy<sup>25-27</sup>.

The average Mayo Elbow Performance Score was 86, indicating good to excellent outcomes in most cases with significant p-value (0.0019). In future to know more about the supremacy of orthogonal plating over other techniques, a detailed comparative study helps in clear choices.

## Conclusion:

Orthogonal plating is a reliable surgical method for managing type-C intra-articular distal humerus fractures for early mobilization and better functional outcome, especially in patients requiring early rehabilitation. The technique's high success rate, minimal complications, and ability to restore functional mobility make it a preferred option in management of complex distal humerus fractures of orthopaedic surgery.

**Clinical message:** Orthogonal plating is a reliable technique for distal humerus fractures, ensuring stable fixation, early mobilization, and excellent functional outcomes with minimal complications, ideal for rapid rehabilitation.

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**CONSENT-** Consent of the patient has been taken so that his photo and details can be published in the case report.

**COMPETING INTERESTS-** Authors declare that there is no competing interest.

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