

Functional and Radiological Outcome of Distal Humerus Intercondylar Fracture Treated With Bicolumnar Plating (Medially by LCP Plate and Laterally by J Plate)

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Abstract

Background: Distal humerus intercondylar fractures are complex intra-articular injuries that pose significant challenges in achieving stable fixation and functional recovery. Bicolumnar plating with a medial locking compression plate and a lateral J plate offers rigid stabilization, promotes fracture union, and allows early postoperative elbow mobilization with favorable clinical and radiological outcomes.

Aims: This study aimed to evaluate the functional and radiological outcomes of distal humerus fractures treated with anatomically pre-contoured locking compression plate medially and J plate laterally.

Materials and Methods: This prospective interventional study was conducted at Government Medical College, Jammu, and included 20 adult patients aged 20–65 years with distal humerus intercondylar fractures. All patients underwent open reduction and internal fixation using anatomical pre-contoured locking compression plate medially and J plate laterally, through a posterior approach with olecranon osteotomy. Early postoperative physiotherapy was initiated. Clinical and radiological follow-up was performed at regular intervals up to 9 months. Functional outcomes were assessed using the Mayo Elbow Performance Score, and fracture union was evaluated using serial radiographs.

Results: Road traffic accidents were the most common mechanism of injury. Intra-articular fractures accounted for 80% of cases. Radiological union was achieved in all patients, with a mean union time of 13 weeks. The mean flexion–extension arc achieved was 107°. According to MEPS, outcomes were excellent in 76% of patients, good in 16%, satisfactory in 4%, and poor in 4%. Complications were minimal, with one case of olecranon osteotomy non-union, two cases of transient ulnar nerve neuropraxia, and two cases of postoperative stiffness.

Conclusion: Anatomically pre-contoured locking compression plates medially and J plate laterally provide stable fixation and excellent functional outcomes in distal humerus fractures with minimal complications, making them a reliable option for surgical management.

Keywords: Distal humerus fractures, locking compression plate, J plate, Open reduction and internal fixation, Bicolumnar fixation, Mayo Elbow Performance Score.

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Introduction

Distal humerus fractures account for approximately 2% of all fractures [1] and can lead to significant morbidity, particularly in adults. These fractures exhibit a bimodal distribution, with high-energy trauma affecting younger individuals and trivial injuries causing fractures in the elderly [2], often due to osteoporosis.

Clinical presentation typically includes pain, swelling, and decreased elbow mobility, with potential neurovascular compromise in severe

cases. Accurate reduction and stable fixation immediately at the time of the injury is usually the best treatment. Malunion is an infrequent complication when current surgical techniques of rigid internal fixation are used [3].

A thorough physical examination and imaging studies, including standard radiographs and CT scans with 3D reconstruction, are essential for diagnosis and preoperative planning. The AO/OTA classification system categorizes these fractures

based on anatomic location and complexity. The olecranon osteotomy approach is commonly employed, offering wide exposure of the distal humerus, particularly the dorsal two-thirds. This approach facilitates effective management of intra-articular fractures. However, it also introduces an additional fracture site requiring fixation, which can lead to potential complications such as non-union and hardware issues, as reported in various studies. In contrast, triceps split or triceps-sparing approaches are less frequently used or investigated, despite their potential benefits [4].

Treatment has evolved, with non-operative management reserved for non-displaced fractures and surgical intervention often required for intra-articular fractures. Anatomically pre-contoured locking compressive plates medially and J plate laterally have improved outcomes by providing stable fixation, even in osteoporotic bone. Fixation with two plates at 90 degrees angle with one another or parallel plate arrangement has become the standard against which all other treatments are measured. This study evaluates the outcomes of patients with distal humerus fractures treated with anatomically pre-contoured locking compressive plates medially and J plates laterally.

Distal humerus fractures are complex injuries that pose significant treatment challenges due to intricate elbow anatomy, limited bone stock, frequent intra-articular involvement, and a high risk of postoperative stiffness. This study evaluated the functional and radiological outcomes of distal humerus fractures treated with anatomically pre-contoured locking compression plates medially and J plate laterally and demonstrated predominantly excellent to good results.

Radiological union was achieved in all patients, with a mean time to union of approximately 13 weeks, confirming the effectiveness of locking plate technology in providing stable fixation, even in comminuted and osteoporotic fractures. Bicolumnar fixation allowed restoration of distal humeral anatomy, maintenance of articular congruity, and preservation of elbow alignment, which are critical for optimal functional recovery.

The mean flexion–extension arc achieved was 107 degrees, enabling most patients to perform activities of daily living without significant limitation. Functional evaluation using the Mayo Elbow Performance Score showed progressive improvement during follow-up, with the majority of patients achieving excellent outcomes.

The posterior approach with olecranon osteotomy provided adequate exposure for accurate reduction and implant placement, contributing to stable fixation and early mobilization. Although olecranon osteotomy introduces an additional

potential site for complications, only one case of osteotomy non-union was observed, which was successfully managed with revision fixation. Transient ulnar nerve neuropraxia occurred in a small number of patients and resolved spontaneously, emphasizing the importance of careful intraoperative nerve handling. Postoperative stiffness was minimal and did not significantly impair functional outcomes. No major complications such as deep infection, implant failure, malunion, heterotopic ossification, or instability were encountered. Compared with conventional plating systems, anatomically pre-contoured locking compression plates medially and J plates laterally provide biomechanical advantages, including angular stability and reliable fixation in compromised bone, thereby reducing the risk of fixation failure.

Despite limitations such as small sample size and 9 months follow-up duration, the consistent radiological union and satisfactory functional recovery observed in this study support the use of bicolumnar plating anatomically pre-contoured locking compression plate medially and J plates laterally as a reliable and effective option for the management of distal humerus fractures.

Materials and Methods

Study Design: Prospective interventional study.

Study Setting: Department of Orthopaedics, Government Medical College, Jammu.

Study Duration: Patients were followed for a period of 9 months postoperatively.

Study Population: A total of 20 patients with distal humerus fractures admitted to Government Medical College, Jammu.

Age Group: Patients aged 20 to 65 years.

Ethical Clearance

- The study was conducted after obtaining approval from the Institutional Ethics Committee.
- Written informed consent was obtained from all patients prior to enrolment.

Preoperative Management

- On admission, the skin condition at the fracture site was assessed.
- Patients were immobilized using an above-elbow posterior slab with limb elevation.
- Analgesics were administered for pain control.
- All patients underwent pre-anesthetic evaluation and were optimized for surgery.
- Open reduction and internal fixation (ORIF) were performed without undue delay.

Surgical Technique

- All surgeries were performed under appropriate anesthesia.
- Patients were positioned in the lateral decubitus position with elbow support.
- A posterior midline approach to the elbow was used.
- The ulnar nerve was carefully identified, isolated, and protected throughout the procedure.
- A chevron-shaped olecranon osteotomy was performed to achieve optimal exposure of the distal humerus.
- Fracture reduction was achieved and confirmed intraoperatively using C-arm fluoroscopy.
- Orthogonal bicolunar fixation was performed using anatomically pre-contoured locking compression plates (LCPs) medially and J plate laterally.
- The olecranon osteotomy was fixed using modified tension band wiring (TBW).
- Wound closure was performed in layers using standard techniques.
- A postoperative above-elbow slab with limb elevation was applied.

Postoperative Care

- Wound inspection and dressing were performed on the second postoperative day.
- Sutures were removed on the 14th postoperative day.
- Gentle physiotherapy was initiated from the third postoperative day, including:
 - Active-assisted elbow flexion-extension exercises
 - Finger range-of-motion and strengthening exercises

Follow-Up Protocol

- Patients were followed up at one and half month, three months, five months, seven months and 9 months postoperatively.
- Radiological assessment using X-rays was performed at one and half month, three months, five months, seven months, and nine months to assess fracture union.
- Functional outcome was assessed using the Mayo Elbow Performance Score (MEPS) at each follow-up visit.

Inclusion Criteria

1. Adult patients (>18 years) with:
 - Closed inter - condyler humerus fractures
 - Intra-articular surface fractures involving the capitellum or trochlea
2. Patients who provided informed written consent.

Exclusion Criteria

1. Patients who refused consent.
2. Patients aged below 18 years.
3. Open (compound) fractures.
4. Fractures associated with vascular injury or elbow dislocation.
5. Patients who were medically unfit for surgery or aged above 80 years.
6. Patients with polyarthritis, rheumatoid arthritis, or psoriatic arthritis, which could affect functional outcome assessment.

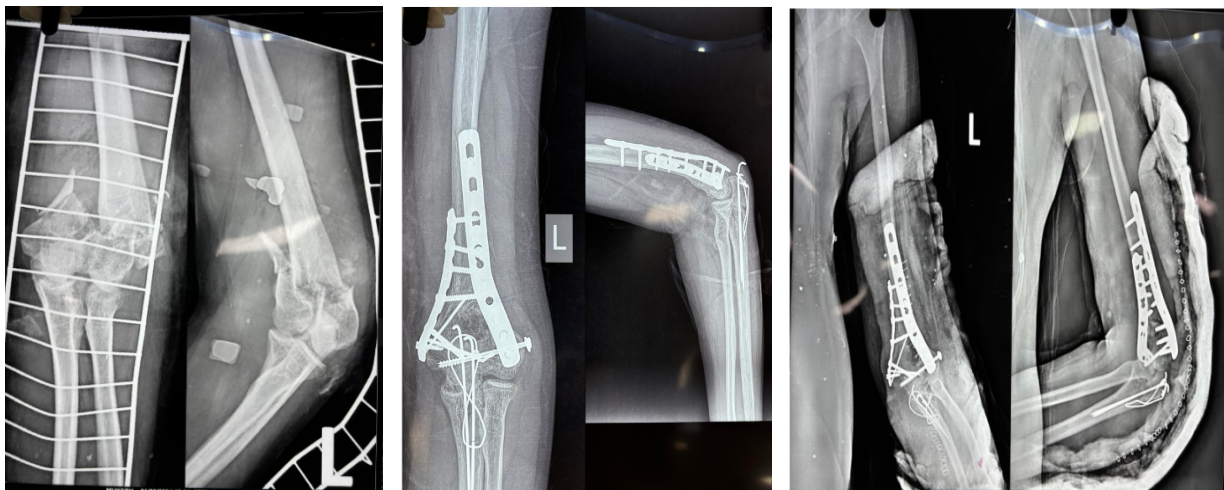


Figure 1: Preoperative and postoperative X-ray



Figure 2: Postoperative range of motion of the elbow



Figure 3: 3 Month and 5 Month Follow up X ray (Patient 1)

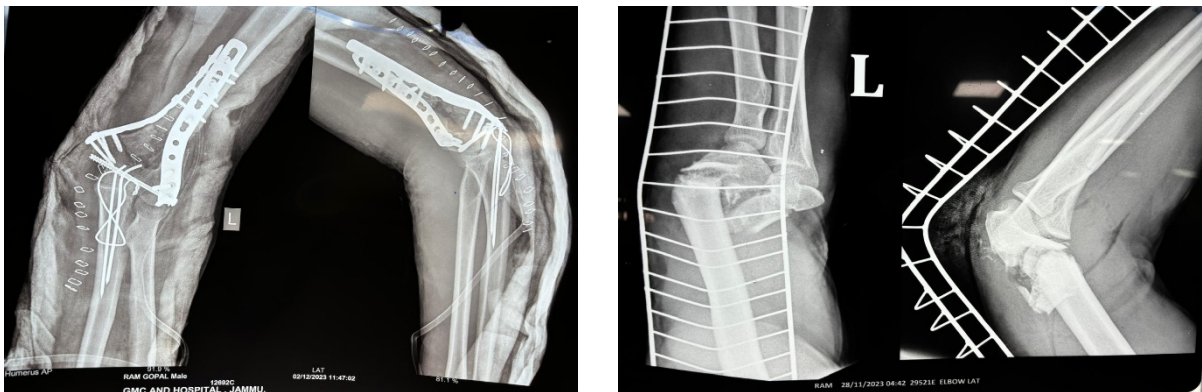


Figure 4: Preoperative and postoperative X-ray



Figure 5: Postoperative range of motion of the elbow

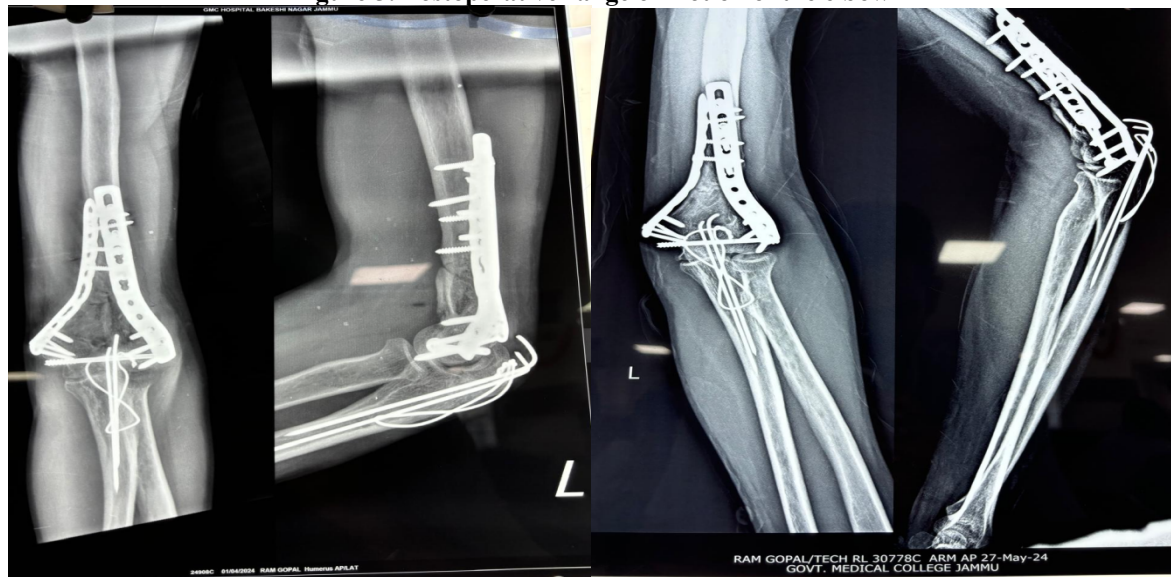


Figure 6: 3 Month and 5 Month Follow up X ray (Patient 2)

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and Graph Pad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and Graph Pad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables

were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher’s exact test for small sample sizes) were used for categorical data comparisons.

P-values ≤ 0.05 were considered statistically significant.

Results

Table 1: Age Distribution of Patients (n = 20)

Age Group (years)	Number of Patients (n)	Percentage (%)
20–40	5	25.0
41–60	6	30.0
>60	9	45.0
Total	20	100

Table 2: Mode of Injury

Mode of Injury	Number of Patients (n)	Percentage (%)
Road traffic accident	11	55.0
Fall from height	9	45.0
Total	20	100

Table 3: Operative and Radiological Outcomes

Parameter	Value
Mean age (years)	42.5
Mean operating time (minutes)	152
Mean time to radiological union (weeks)	13
Mean flexion–extension arc (degrees)	107
Radiological union rate	100%

Table 4: Post-Operative Complications

Complication	Number of Patients (n)	Percentage (%)
Surgical site infection	0	0
Fracture non-union	0	0
Olecranon osteotomy non-union	1	5.0
Ulnar nerve neuropraxia	2	10.0
Elbow stiffness	2	10.0

Table 5: Functional Outcome Assessment Using MEPS

Follow-up Period	Mean MEPS Score
1.5 months	76
3 months	82
5 months	92
7 months	95
9 months	97

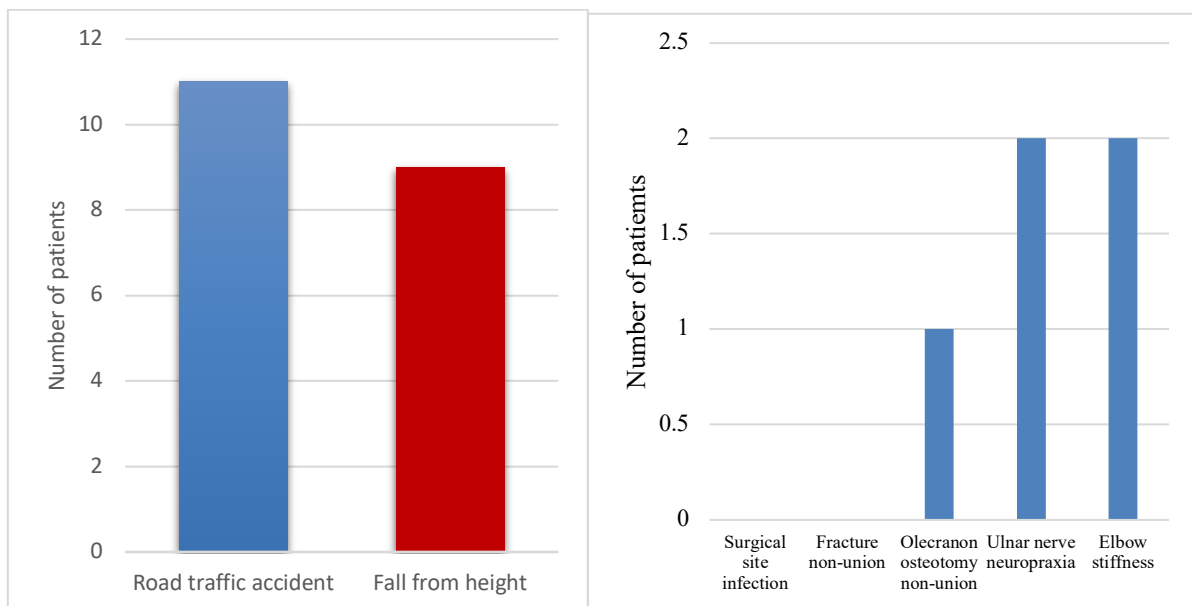


Figure 6: Mode of Injury

A total of 20 patients were included in the study. The majority of patients were aged more than 60 years (45%), followed by the 41–60 years age group (30%) and 20–40 years age group (25%). Road traffic accidents were the most common mode of injury, accounting for 55% of cases, while falls from height constituted 45%.

The mean age of the patients was 42.5 years. The mean operating time was 152 minutes. Radiological evaluation showed a mean time to union of 13 weeks, with a radiological union rate of 100%. The mean flexion–extension arc achieved at final follow-up was 107 degrees, indicating satisfactory restoration of elbow range of motion.

Post-operative complications were minimal. There were no cases of surgical site infection or fracture non-union. Olecranon osteotomy non-union was observed in one patient (5%). Ulnar nerve neuropraxia occurred in two patients (10%) and elbow stiffness was noted in two patients (10%).

The mean MEPS score showed progressive improvement over time. It increased from 76 at 1.5 months to 82 at 3 months and 92 at 5 months. Further improvement was observed at 7 months (95) and 9 months (97), indicating steady recovery and excellent functional outcomes during the later follow-up period.

Discussion

The distal humerus possesses a complex 3-dimensional geometry, characterized by medial and lateral supracondylar ridges forming an arc, areas of bone deficiency due to the olecranon and coronoid fossae, a pulley shaped trochlea, and a round shaped capitellum. The sigmoid notch of the ulna articulates with the trochlea, forming a hinge pivot type elbow joint [6].

In our study was most common cause of the fracture were the road traffic accidents, more commonly from two-wheelers. For elderly patients, fall was the more common cause of fracture while for the younger patient's high velocity injury was the predominant cause. Intra-articular fractures were the most common. No pre-operative nerve injury was noted.

Conservative treatment for displaced distal humerus fractures, including intra-articular bicolunar and extra-articular metaphyseal fractures, often yields suboptimal outcomes. This approach is associated with increased risks of nonunion, malunion, elbow stiffness, reduced functional capacity, persistent pain, Sudeck's atrophy, and instability [7].

Traditional surgical methods using conventional reconstruction plates, 1/3 tubular plates, or dynamic compression plates often yield suboptimal results. Studies have consistently shown that these implants

are associated with higher rates of nonunion and implant failure [8]. Our study investigated the outcomes of open reduction and internal fixation using anatomically pre-contoured locking compression plates (LCPs) medially and J plate laterally for complex elbow fractures. Given the intricate anatomy and limited space in the elbow region, traditional reconstruction plates often pose challenges for stable fixation. In contrast, anatomically pre-contoured locking compression plate (LCP) medially and J plate laterally can leverage the bone stock of the two columns, trochlea, and capitellum to achieve mechanically stable and rigid fixation, thereby optimizing outcomes [9].

In our study, the posterior approach was the most common, with olecranon osteotomy performed in all displaced intra-articular bicolunar fractures for better visualization, aiding in the perfect anatomical reduction of intra articular fragments. Anterior transposition of the ulnar nerve was not performed in all cases. The bicolunar orthogonal fixation with anatomically pre-contoured locking compression plate medially and J plate laterally fixation was chosen and implemented. According to some studies, there is no functional or mechanical difference (in terms of stiffness, axial loading, and plastic deformation) between parallel or orthogonal types of LCP plate fixation. The average time for fracture union was 12-16 weeks. A notable improvement in range of movement was observed from the first week to 12 weeks, after which there was no significant further improvement, consistent with findings from previous studies. As patients progressed, pain gradually decreased, and by the end of 20 weeks, most were able to perform daily activities within an excellent to good range. According to the Mayo Elbow Performance Score (MEPS), the outcomes were excellent in 76% of patients, good in 16%, satisfactory in 4%, and poor in 4%. These results are comparable to those reported in earlier series, such as the studies by Jupiter JB et al. [10] and Aslam N et al. [11], indicating similar effectiveness in treatment outcomes.

The success of our study can be attributed to bicolunar fixation using anatomically pre-contoured locking compression plates (LCPs) medially and J plate laterally, which outperformed conventional plates. Notably, postoperative wound healing was uneventful in all patients, with no instances of deep infection, heterotopic ossification, deep vein thrombosis (DVT), malunion, implant failure, or instability. This favorable outcome is likely due to meticulous soft tissue handling and the use of optimal implants, specifically anatomically pre-contoured locking compression plate (LCP) medially and J plate laterally, which provided stable fixation and

promoted healing. Our small-scale study demonstrates that open reduction and internal fixation (ORIF) using anatomically pre-contoured locking compression plates (LCPs) medially and J plate laterally yields excellent to good results in patients with distal humerus fractures, with minimal postoperative complications. The success of this approach can be attributed to the anatomical design and secure purchase provided by these plates. These findings are consistent with previous studies, such as those by Jaya kumar et al. [12] and Lim JR et al. [13], which also reported favorable outcomes with pre-contoured LCP fixation.

Limitation

Absence of a comparison group and relatively small number of cases were the important limitation of this study. A comparative study comparing various other management options and larger studies would be required to further substantiate the results of our study.

Conclusion

The study revealed that distal humerus fractures treated with anatomically pre-contoured locking compression plates (LCPs) medially and J plate laterally yield excellent to good results. This outcome was consistent across both young and elderly patient groups. The use of these plates facilitated optimal fracture union times, provided exceptional stability, and resulted in minimal pain.

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