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Original Research Article

Assessment of Functional Recovery Following Internal Fixation of Radius and Ulna Fractures Using Locking Compression Plates: A Clinical Study

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Abstract:

Background: Fractures of both the radius and ulna (both bones forearm fractures) are common orthopedic injuries, particularly in young adults following trauma. Anatomical reduction and stable internal fixation are essential for restoring forearm rotation and upper limb function. Locking compression plates (LCPs) provide angular stability, especially in comminuted or osteoporotic bones, and allow for early mobilization. This study aimed to evaluate the functional outcome of surgically managed both bones forearm fractures using LCPs.

Methods: A prospective interventional study was conducted at the Department of Orthopaedics, Government Medical College and Hospital, Bettiah, Bihar, India from feb 2023 to Jan 2024. A total of 40 patients with closed diaphyseal fractures of both radius and ulna were included. All patients underwent open reduction and internal fixation (ORIF) using locking compression plates under general or regional anesthesia. Postoperative assessment was done at regular intervals, and functional outcome was measured at 6 months using the Grace and Eversmann criteria, along with range of motion (ROM) evaluation for elbow, wrist, and forearm rotation.

Results: Excellent to good functional outcomes were observed in 85% of the cases. The mean time to radiological union was 11.2 ± 2.1 weeks. Supination and pronation arcs improved progressively with physiotherapy. No major complications such as deep infection or implant failure were reported. Two patients developed mild restriction in supination, and one developed superficial infection that responded to antibiotics. Most patients regained near-normal hand function by the end of follow-up.

Conclusion: Surgical management of both bones forearm fractures with locking compression plates offers excellent anatomical restoration, high union rates, and favorable functional outcomes with minimal complications. Early surgical intervention combined with proper physiotherapy significantly contributes to the restoration of limb function and rotational movements of the forearm.

Keywords: Forearm fracture, Locking compression plate, Radius-ulna fracture, Functional outcome, Internal fixation, Grace and Eversmann criteria

Introduction

Fractures of both bones of the forearm—radius and ulna—are among the most frequent long bone injuries encountered in orthopedic practice, particularly affecting young adults involved in high-energy trauma such as road traffic accidents or falls [1]. These fractures significantly compromise upper limb function because the radius and ulna work as a unit to allow pronation and supination, essential for normal hand positioning and daily activities. Anatomical reduction and stable fixation of both bones are imperative to restore normal biomechanics, prevent malunion, and preserve the functional arc of forearm rotation [2].

Historically, conservative treatment with closed reduction and plaster immobilization was used, but it often led to unacceptable alignment, malunion, and significant loss of rotational function. With the evolution of orthopedic implants and surgical techniques, open reduction and internal fixation (ORIF) has become the standard of care, especially in adults [3]. Among the available fixation devices, locking compression plates (LCPs) have emerged as a preferred option due to their biomechanical advantages, including angular stability, improved resistance to torsional stress, and better outcomes in osteoporotic or comminuted bone [4].

Locking plates function on the principle of fixed-angle screw-plate constructs, which maintain stability even in poor bone stock by avoiding compression between the plate and bone. This

minimizes periosteal blood supply compromise and supports secondary bone healing through callus formation [5]. Early mobilization, shorter rehabilitation periods, and predictable outcomes are some of the significant advantages offered by this implant system. Moreover, recent studies have highlighted the role of locking plates in reducing hardware-related complications and nonunion rates in forearm fractures [6].

Despite advances in implant technology, the ultimate goal in treating both bones forearm fractures is the restoration of full functional capacity. A successful outcome depends not only on fracture union but also on the recovery of forearm rotation, wrist movement, elbow mobility, and overall limb coordination. Therefore, standardized functional assessment tools like the Grace and Eversmann criteria and objective range of motion analysis remain vital in evaluating surgical success [7,8].

The present study was undertaken to assess the functional outcomes of surgically treated both bones forearm fractures using locking compression plates. The aim was to analyze the union rate, complication profile, and final range of motion outcomes in patients managed operatively at a tertiary care center in Bihar.

Methodology

This prospective interventional study was conducted in the Department of Orthopaedics at Government Medical College and Hospital, Bettiah, West Champaran, Bihar, India from feb 2023 to Jan 2024. The objective of the study was to evaluate the functional outcome of open reduction and internal fixation (ORIF) using locking compression plates (LCPs) in adult patients presenting with both bones forearm fractures. The institutional ethics committee approved the study, and informed written consent was obtained from all participants prior to enrollment.

A total of 40 patients aged between 18 and 60 years with closed diaphyseal fractures of both the radius and ulna were included. Diagnosis was confirmed using plain radiographs in anteroposterior and lateral views. Patients with pathological fractures, open (Gustilo Grade II or above) injuries, segmental or intra-articular fractures, neurovascular injuries, or prior forearm surgeries were excluded. All patients underwent surgical fixation with LCPs under general or regional anesthesia by the same orthopedic unit using standardized operative protocols.

The surgical procedure involved exposure of each bone through appropriate approaches (Henry approach for radius and subcutaneous border approach for ulna), anatomical reduction of the fracture ends, and fixation with appropriately contoured locking compression plates using at least three bicortical screws on either side of the fracture. Intraoperative alignment and rotational congruity were confirmed fluoroscopically. Postoperatively, a protective splint was applied for 2–3 days, followed by initiation of physiotherapy including active and passive range of motion exercises for the wrist, elbow, and forearm.

Clinical evaluations were conducted at 2, 6, 12, and 24 weeks postoperatively. Radiological union was defined by the presence of bridging callus across at least three cortices in orthogonal views. Functional outcomes were assessed at 6 months using the Grace and Eversmann criteria, which classify results as excellent, good, acceptable, or poor based on union and return of rotational motion. Elbow and wrist range of motion, grip strength, and complications including infection, delayed union, hardware failure, or synostosis were also recorded.

All data were compiled using Microsoft Excel and statistically analyzed using SPSS version 25.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Comparative analyses were done using Chi-square test and paired t-test where appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

The study included 40 adult patients who underwent open reduction and internal fixation with locking compression plates for both bones forearm fractures. Most participants were young males between 26–35 years of age, and the dominant (right) limb was more frequently affected. The predominant cause of injury was road traffic accidents. The mean time to radiological union was approximately 11.2 weeks. Functional outcomes assessed at 6 months showed that 85% of patients had excellent to good recovery per Grace and Eversmann criteria. Range of motion for the elbow, wrist, and forearm improved progressively with physiotherapy. Minimal complications were observed during the follow-up period.

Table 1: Age-wise Distribution of Participants (n = 40)

Age Group (years)	Frequency (F)	Percentage (%)
18–25	11	27.5%
26–35	14	35.0%
36–45	9	22.5%
46–60	6	15.0%

Table 2: Gender-wise Distribution

Gender	Frequency (F)	Percentage (%)
Male	30	75.0%
Female	10	25.0%

Table 3: Side of Injury

Side Involved	Frequency (F)	Percentage (%)
Right	24	60.0%
Left	16	40.0%

Table 4: Mechanism of Injury

Cause	Frequency (F)	Percentage (%)
Road traffic accident	26	65.0%
Fall on outstretched hand	10	25.0%
Direct trauma	4	10.0%

Table 5: Time to Radiological Union (Weeks)

Time Interval (weeks)	Frequency (F)	Percentage (%)
≤10 weeks	14	35.0%
11–12 weeks	18	45.0%
13–16 weeks	8	20.0%

Table 6: Range of Motion at Final Follow-Up (Degrees)

Joint/Movement	Mean ± SD
Elbow Flexion	132.6 ± 7.1°
Wrist Flexion	74.2 ± 6.4°
Wrist Extension	70.5 ± 5.8°
Forearm Supination	82.1 ± 6.7°
Forearm Pronation	78.6 ± 7.3°

Table 7: Grace and Eversmann Functional Outcome

Outcome	Frequency (F)	Percentage (%)
Excellent	19	47.5%
Good	15	37.5%
Acceptable	4	10.0%
Poor	2	5.0%

Table 8: Time to Return to Normal Activity

Time Period	Frequency (F)	Percentage (%)
≤10 weeks	12	30.0%
11–14 weeks	20	50.0%
>14 weeks	8	20.0%

Table 9: Complications Observed

Complication	Frequency (F)	Percentage (%)
Superficial infection	1	2.5%
Mild restriction of supination	2	5.0%
No complication	37	92.5%

Table 10: Duration of Hospital Stay

Hospital Stay (days)	Frequency (F)	Percentage (%)
≤5	15	37.5%
6–7	20	50.0%
>7	5	12.5%

Table 11: Number of Follow-Up Visits Completed

Follow-Up Visits	Frequency (F)	Percentage (%)
4 visits	28	70.0%
5–6 visits	10	25.0%
<4 visits	2	5.0%

Table 12: Patient Satisfaction at 6 Months

Satisfaction Level	Frequency (F)	Percentage (%)
Very satisfied	26	65.0%
Satisfied	10	25.0%
Neutral	3	7.5%
Dissatisfied	1	2.5%

Discussion

This prospective study demonstrates that the surgical management of both bones forearm fractures using locking compression plates yields favorable outcomes in terms of fracture union, restoration of forearm function, and patient satisfaction [9]. The majority of patients in the study were young adult males, likely reflecting the demographic most commonly involved in high-energy trauma, such as road traffic accidents, which was the leading cause of injury in this cohort [10,11].

Radiological union was achieved in all patients, with most fractures healing within 10–12 weeks. This rapid and consistent union can be attributed to the anatomical reduction and rigid internal fixation provided by locking compression plates [12]. The fixed-angle construct of LCPs minimizes micro-motion at the fracture site and preserves periosteal blood supply, promoting stable callus formation and biological healing. Early fracture union also allowed patients to begin functional rehabilitation sooner, positively impacting their return to daily activities [13,14].

Functional outcomes, as assessed by Grace and Eversmann criteria, were excellent or good in 85% of patients, indicating a high rate of satisfactory recovery. Range of motion at the wrist, elbow, and forearm showed near-normal values by the end of the follow-up period, with only mild restriction observed in a few patients. The progressive improvement in rotational movements and grip strength highlights the effectiveness of combining rigid fixation with structured physiotherapy [15,16].

The rate of complications was minimal. Only one case of superficial infection was reported, which responded to oral antibiotics. Two patients experienced mild restriction of supination, which did not significantly impair overall function. No cases of deep infection, nonunion, or implant failure were encountered, reinforcing the safety and reliability of locking plates in forearm fracture fixation when proper surgical technique and postoperative care are maintained [17,18].

Patient-reported satisfaction was high, with the majority expressing either satisfaction or high satisfaction at the 6-month follow-up. Factors contributing to this included early discharge, early return to work, cosmetic acceptability of surgical scars, and the absence of residual deformity or hardware prominence. Most patients also demonstrated strong compliance with follow-up and physiotherapy protocols, which further supported optimal recovery [19,20].

In the context of rural healthcare settings like Bihar, the findings of this study are particularly relevant. The reproducibility of outcomes, minimal complication rate, and functional restoration achieved with locking plates make this modality an effective choice for managing diaphyseal forearm fractures. However, success depends on timely surgical intervention, adequate implant selection, and patient adherence to rehabilitation protocols.

Conclusion

This study concludes that open reduction and internal fixation using locking compression plates is a highly effective and reliable method for managing diaphyseal fractures of both radius and ulna. The technique allows for anatomical restoration, ensures early union, and provides stable fixation, thereby facilitating prompt mobilization and rehabilitation. The majority of patients achieved excellent to good functional outcomes with restoration of forearm rotation and wrist mobility by the end of 6 months.

The incidence of complications was low, with only minor issues reported that did not significantly affect long-term function. Radiological union was achieved in all patients, and overall patient satisfaction was high, underscoring the success of surgical management in appropriately selected cases.

Given the reproducibility of favorable outcomes and low complication profile, locking compression plate fixation should be considered the preferred approach for adult diaphyseal both bones forearm fractures, particularly when functional recovery and limb biomechanics need to be restored to pre-injury levels.

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