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Functional Outcome of Surgical Management of Fracture Both Bone Forearm in Adults Using Locking Compression Plate (LCP)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: The forearm has a complex architecture consisting of 2 mobile relatively parallel bones radius and ulna, which provide a stable link between elbow and wrist joint. Anatomic reduction and internal fixation of these fractures is usually required to restore forearm rotation, elbow and wrist motion, grip strength. The objective of the study is to know the functional outcome, union time and complications of treating diaphyseal fractures both bones forearm with locking compression plates.

Methods: A prospective study was done among 30 patients presenting to department of Orthopaedics in a tertiary referral centre who were diagnosed clinically and radiologically as both bone forearm fracture and those meeting the criteria of the study. The patients were treated with open reduction and internal fixation with locking compression plate and the results was evaluated on the basis of fracture union, range of motion and complications.

Results: The study showed excellent elbow range of motion in 60% cases and satisfactory outcome in 40% of cases while range of motion of forearm was excellent in 83.3% of cases and satisfactory in 16.7% cases. Sixteen patients achieved union at 16 weeks, two cases united before 24 weeks and in one patient union were achieved after 24 weeks. Minimum union time was

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found to be 16 weeks and maximum time was 25 weeks. Mean union time was found to be 16.8 weeks.

Conclusion: Open reduction and internal fixation with Locking Compression Plate provides excellent functional outcome.

Keywords: Both bone forearm fracture; locking compression plate; functional outcome; criteria of anderson.

1. INTRODUCTION

The forearm has a complex architecture consisting of 2 mobile relatively parallel bones radius and ulna that provides a stable link between elbow and wrist joint. Anatomic reduction and internal fixation of these fractures have shown to restore forearm rotation, motion of elbow and wrist joints, and grip strength [1]. The forearm rotation is the most important factor for the rotational mobility of the upper limb. The interosseous membrane, which is considered as the ligament provides longitudinal stability to the forearm. Maintained radial bow favors good functional outcome. It is important to regain the adequate length of the bones, good apposition between the fracture fragments and alignment without any malrotation. The fracture must be reduced precisely. Restoring the length and axial and rotational alignment of the forearm is necessary. Anatomic reduction of the proximal and distal radioulnar joint is essential to allow full recovery of the supination and pronation. The plates most widely used for the internal fixation of the forearm fractures are 3.5 mm locking compression plate (LCP), dynamic compression plate, and limited contact dynamic compression plate. In the present study, diaphyseal fractures of both bones forearm are surgically treated with Locking Compression Plate (LCP) of 3.5 mm size. Plate fixation can be a good treatment modality for forearm fractures and can achieve good functional results with avoidable complications [2]. The value of compression in obtaining rigid internal fixation had been noted by various authors [2-4]. Techniques of compression have a lower incidence of non-union and are found to facilitate rehabilitation, with decrease in joint stiffness [5-10]. Anatomical reduction of the fracture fragments, stable internal fixation, preservation of blood supply to the bone fragment, early active pain free mobilization of the adjacent muscles and joints are the principle for fixation of both bone fracture in adults [11] Locking Compression Plate (LCP) can be an effective bridging device used for treating comminuted fractures [2]. Features of a limited contact dynamic compression plate and a Point Contact-Fixator was used to device locking compression plate [12] which allows for more rapid bone healing, decreasing infection, less delayed union/non-union and less frequently loss of reduction [13]. This study was conducted to evaluate the functional outcome of the patients with fractures both bones forearm with locking compression plates, duration of union with locking compression plates and the complications of locking compression plates.

2. MATERIALS AND METHODS

This prospective study was conducted consisting of 30 patients presenting with fracture both bone forearm presented in Orthopaedic department of tertiary referral centre for one year duration. Approval was given by the institutional review board and informed consent was obtained from each patient.

The study proposes to include patients with fracture both bones forearm requiring surgical interventions, after taking their consent, analyzed clinically and radiologically. All the patients selected for the study was noted, clinical and laboratory investigations carried out in order to get surgical fitness. Inclusion criteria were age group-19-70 years, radiologically diagnosed both bone forearm fractures (Diaphyseal fractures both bone forearm), consent to participate in the study. Exclusion criteria were open-fractures, both bone fracture with compartment syndrome needing fasciotomy, both bone fracture needing vascular repair, patient with multiple injuries, both bone fracture associated with distal radius/ulna and refusal to provide informed consent.

Patients subjected to surgery using 3.5 mm locking compression plate, were then followed up at regular intervals with clinical and radiological data. Assessment was then done based on type of fracture, surgical procedure, duration of hospital stay, initiation of mobilization, physiotherapy and development of surgical complications. The patient were then followed up, first on 14th post- operative day and then on

Table 1. Criteria of Anderson, et al. [3] to grade functional outcome

Results	Union	Flexion and extension at Elbow joint	Supination and pronation at forearm
Excellent	Present	< 10 degree Loss	< 25% loss
Satisfactory	Present	< 20 degree loss	< 50% loss
Unsatisfactory	Present	> 20 degree loss	> 50% loss
Failure	Non – union or unresolved chronic osteomyelitis		

completion of 4 weeks and later after every 8 weeks up to 24 weeks. The results was then evaluated on the basis of fracture union, range of motion and complications.

Bone union is defined as obliteration of fracture gap or the presence of bridging periosteal callus seen in radiograph [3].

The Criteria of Anderson, et al. [3] was used in grading the functional outcome, which is as follows: Table 1.

3. RESULTS

A total number of 30 patients were evaluated according to the inclusion criteria. Out of 30 patients 18 were males and 12 were females. All patients underwent surgical intervention with locking compression plate after initial preoperative investigations and preoperative checkup.

3.1 Distribution According to Age

Patients between ages of 19 to 70 were included in our study. Mean age was 36.77 (Table 2). In this series 60% cases were males and 40% cases were females.

3.2 Distribution According to Mode of Injury

Incidence of injury causing both bone forearm fracture was found maximum in motorbike accident (33.3%) and minimum caused by physical assault (6.7%) (Table 3).

3.3 Distribution According to Laterality

Table 4 shows 56.7% of cases had left sided fracture and 43.3% had right sided fracture (Table 4).

Among 30 cases closed midshaft fracture was found maximum (73.3%) and closed distal third shaft fracture was found minimum (3.3%) (Table 5).

In 80% of cases mobilization was initiated within 6th postoperative day and mobilization was initiated only at 21st post operative day in which fracture were comminuted (Table 6).

In our study, 93.3% didn't have any post operative infections while 6.7% developed superficial surgical site infection (Table 7).

In this study, flexion and extension range of motion of elbow was evaluated on the final follow up of 24 weeks. Out of 30 patients, 30% have 10 degrees loss of elbow range of motion, 10% have 20 degrees loss of elbow range of motion and 60% patient showed 5 degrees of range of motion. Excellent result was found in 60% patients and 40% patients had satisfactory result based on Criteria of Anderson, et al. [3] (Table 8).

Table 2. Distribution of patient according to age

	Minimum	Maximum	Mean	Standard deviation
Age	19	70	36.77	16.53

Table 3. Distribution of patients according to mode of injury

	Percentage	Frequency
Fall from height	13.3	5
Fall from tree	16.7	4
Hit by bus	20.0	6
Motorcycle accident	33.3	10
Physical assault	6.7	2
Slip and fall	10.0	3
Total	100	30

Table 4. Distribution of patients according to the side of injury

	Percentage	Frequency
Left	56.7	17
Right	43.3	13
Total	100	30

Table 5. Distribution according to type of fracture

	Percentage	Frequency
Closed midshaft fracture of radius and ulna	73.3	22
Closed proximal fracture shaft of radius and ulna	16.3	3
Closed distal third fracture shaft of radius and ulna	3.3	1
Comminuted midshaft fracture shaft of radius and ulna	13.3	4
Total	100	30

This study showed 50.0% of the patient has 10 degrees loss of forearm range of motion, 23.3% have 15 degrees loss of forearm range of motion, and 13.3% lost 30 degrees of forearm range of motion. Similarly, 6.7% lost 5 degrees of forearm range of motion and 3.3% of patient lost 20 degrees and 25 degrees of forearm range of motion at their final follow up. Excellent result was found in 83.33% cases and satisfactory forearm range of motion was found in 16.66% based on Criteria of Anderson, et al. [3] (Table 9).

Table 6. Time of initiation of mobilization

	Percentage	Frequency
21 days	3.3	1
14 days	16.7	5
6 days	80.0	24
	100	30

Table 7. Surgical complications among patients

	Percentage	Frequency
Not any	93.3	28
Superficial infection	6.7	2
Total	100	30

Table 8. Functional elbow flexion and extension range of motion at 24th week

	Percent	Frequency
10 degrees loss	30.0	9
20 degrees loss	10.0	3
5 degrees loss	60.0	18
Total	100	30

This study showed that 90% of cases achieved union at 16 weeks, 6.7% united before 24 weeks and in 3.3% patient union was achieved after 24 weeks. Mean union time was found to be 16.83 weeks (Table 10).

Table 9. Functional supination and pronation range of motion at 24th week

Forearm range of motion at 24 weeks	Percentage	Frequency
60 degrees supination and pronation	13.3	4
65 degrees supination and pronation	3.3	1
70 degrees supination pronation	3.3	1
75 degrees supination and pronation	23.3	7
80 degrees supination and pronation	50.0	15
85 degrees supination and pronation	6.7	2
	100.0	30

Table 10. Time of union of the fracture

	Percentage	Frequency
16 weeks	90	27
24 weeks	6.7	2
25 weeks	3.3	1
Total	100	30

4. DISCUSSION

Fracture of both bone forearm is one of the common injury involving the upper extremity. The necessity for gaining length, apposition and axial alignment, normal rotational alignment must be regained for range of motion of forearm, especially when fracture is comminuted and osteoporotic. In the present study; the average age of patient was 36.77 years (S.D±16.53) with

range being 19–70 years. This data is similar to the finding of Saikia, et al. [14] where average age was 29 years. Leung F, et al. [12] where the mean age was 35 years. Overall there were 18 males comprising 60%, and 12 females comprising 40%. The predominance of male may be because of the fact that they are more exposed to environment like riding vehicle, heavy manual work, sports in comparison to female. The finding is similar to Saika, et al. [14] In this series, 10 patients (33.3%) had motorcycle accident, 6 patients (20.0%) were hit by bus, 5 patients (16.7%) fell from the tree, 4 patients (13.3%) fell from the height and 2 patients (6.7%) were physically assaulted leading to fracture both bone forearm. The data is similar to study conducted by Singh S, et al. [15] where road traffic accidents constituted 64% of cases and fall from height (12%). This study showed 56.7% of cases had left sided fracture and 43.3% had right sided fracture. Data is similar to observation made by Singh S, et al. [15] who reported involvement of the non-dominance extremity in 58% of the cases. Manjappa CN, et al. [16] in their study found that 60% patients had diaphyseal fracture involving middle third region, 25% had proximal third fracture and 15% had lower third fracture. 30 patients treated with locking compression plate 28 did not have any post operative infections while two developed superficial surgical site infection. This finding was similar to Leung F, et al. [12] case series of 32 patients treated with locking compression plate had no deep infection but only 1 superficial infection. Our series showed that minimum union time was found to be 16 weeks and maximum time was 25 weeks. Mean union time was found to be 16.83 weeks alike to study conducted by Saikia, et al. [14], where mean time for union for the forearms fixed with LCP was found to be 14.16 weeks (range 8-21 weeks). Sharma S, et al. [17] in their study of diaphyseal forearm bone fractures by locking compression plate (LCP) reported mean union time of 12.6 weeks with range being 8-24 weeks. Leung F, et al. [12] in their study of locking compression plate in the treatment of forearm fracture reported mean union time to be 20 weeks (range 8-36 weeks). Criteria of Anderson, et al. [3] is used to grade functional outcome of the surgical management of both bone fracture forearm in the study.

In this series functional outcome was evaluated which showed excellent elbow range of motion in 60% cases and satisfactory outcome in 40% of cases while range of motion of forearm was excellent in 83.3% of cases and satisfactory in 16.7% cases. Chapman, et al. [5] reported 36 (86%) cases as excellent, 3 (7%) satisfactory, 1 (2%) unsatisfactory, and 2 (5%) failure. Similarly, Leung, et al. [12] reported 98% of cases as excellent and 2% of satisfactory results. Another study by, Saikia KC, et al. [14] observed excellent functional outcome in 32 patients (89%), satisfactory outcome in 3 patients (8%), and unsatisfactory outcome in 1% patient (3%) without any failure. Anderson et al. 3 reported excellent (50.9%), satisfactory (34.9%), unsatisfactory (11.3%), and failure (2.9%) in their study.

5. CONCLUSION

To conclude, the study indicates that open reduction and internal fixation of fracture both bone forearm with Locking compression plate provides excellent functional outcome.

CONSENT

As per international standard written participant consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard informed and written ethical permission has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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