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Original Research

Evaluation of the Functional Outcome of Surgical Management of Fractures of Both Bone Forearms in Adults Using a Locking Compression Plate (LCP): A Prospective Study

Dr. Sanjay Kumar[1], Dr. Kumar Anshuman[2]

[1]Senior Resident, Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India.
[2]Professor and Head of Department, Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India.

Corresponding Author: Dr. Sanjay Kumar
Senior Resident, Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India
Email: sanjay2k10@gmail.com

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Abstract

Background: Both bone forearm fractures in adults are the most commonly encountered fractures in day-to-day practice, accounting for almost 31% of all upper limb fractures.

Objectives: Evaluation of the functional outcome of surgical management of both bones for a forearm fracture with a locking compression plate.

Materials & Methods: The present prospective study consisted of 60 patients of both genders presenting with fractures of both bones of the forearm presented in the orthopaedic department. Approval was given by the institutional ethical committee, and informed consent was obtained from each patient.

Results: Out of 60 patients, 39 (65%) were males and 21 (35%) were females. The patients' ages ranged from 18 to 70 years were included in the present study. The mean age of patients was 34.50 years. The incidence of mode of injury causing both bone forearm fractures was found to be maximum in motorbike accidents 33(55%); 12 patients (20%) sustained fractures due to falls from height; and the minimum caused by physical assault was 3 patients (5%).

Conclusion: The present study indicates that open reduction and internal fixation of fractures in both bones of the forearm with a locking compression plate are safe and effective options for fixation and provide excellent functional outcomes.

Keywords: Both Bone Forearm Fracture; Open reduction and Internal fixation; Locking Compression Plate; Functional Outcome.

Introduction

Both bone forearm fractures in adults are the most commonly encountered fractures in day-to-day practice, accounting for almost 31% of all upper limb fractures [1]. The forearm has a complex architecture consisting of two mobile, relatively parallel bones, the radius and ulna, that provide a stable link between the elbow and wrist joint. Anatomic reduction and internal fixation of these fractures have been shown to restore forearm rotation, motion of the elbow and wrist joints, and grip strength [2]. Techniques of compression have a lower incidence of non-union and are found to facilitate rehabilitation with a decrease in joint stiffness [3]. Features of a limited contact dynamic compression plate and a point contact fixator were used to design a locking compression plate [4], which allowed for more rapid bone healing, decreased infection, less delayed union or non-union, and less frequent loss of reduction [5]. Open reduction and internal fixation (ORIF) in adults with plating is the standard procedure for both bone forearm fractures and isolated radius or ulna fractures with or without bone grafting. As recommended by the AO Association, internal fixation with a dynamic or locking compression plate gives rigid fixation, impaction, and compression at the fracture site. The advantage of using a locking plate construct is that it gives us a good amount of versatility in screw placement; the screw head locks securely to the plate, thereby increasing the inherent stability of the fixation. Locking plates also minimise the amount of soft tissue dissection required (the periosteum is left intact), thereby aiding in better fracture union. This new concept is more closely related to the concept of pure splinting. Plating provides rigid internal fixation and compression for diaphyseal forearm fractures to achieve union and restore functional movements in the forearm [6].

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Aims and Objectives: The present study was conducted to evaluate the functional outcome of patients with fractures of both bones in the forearm using open reduction and internal fixation with locking compression plates, duration of fracture union, range of motion with locking compression plates, and the complications of locking compression plates

Materials and Methods

The present prospective study consisted of 60 patients of both genders presenting with fractures of both bones of the forearm presented in OPD or emergency of the orthopaedic department at Narayan Medical College and Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India. Approval was given by the institutional ethical committee, and informed consent was obtained from each patient. The duration of the study was from May 2018 to March 2021.The study proposes to include patients with fractures of both bones in the forearm requiring surgical interventions after taking their consent and analysing them clinically and radiologically. Keeping power (1-beta error) at 80% and confidence interval (1-alpha error) at 95%, the minimum sample size required was 60 patients; therefore, we included 60 (The minimum required number of cases) patients in present study.

Inclusion criteria*:* age group 20–70 years, open fractures, radiologically diagnosed both bone forearm fractures (diaphyseal fractures both bone forearm), consent to participate in the study.

Exclusion criteria: open fractures, both bone fractures with compartment syndrome needing a fasciotomy, both bone fractures needing vascular repair, patient with multiple injuries, both bone fractures associated with the distal radius or ulna, and refusal to provide informed consent. Patients were examined clinically, assessed for the mechanism of injury and severity of trauma, evaluated to rule out other associated injuries, and examined locally to assess the extent of swelling, deformity, abnormal mobility, crepitus, limb length discrepancy, and distal neurovascular examination. A X-ray of the radius and ulna (shaft) in AP and lateral views was taken, and both elbow and wrist joints were taken separately in both views. The affected limb was immobilised with an above-the-elbow plaster slab and an arm sling. All routine pre-operative investigations were done, and pre-anaesthetic fitness was obtained. After the exposure, fracture ends are identified, edges are freshened with periosteum elevator, and reduction is done with a bone-holding clamp. After reduction, a 3.5 mm locking compression plate (LCP) was applied, and a plate with at least 6 holes was selected. In comminuted or segmental fractures, a plate with more than 6 holes was selected. The radius is fixed first, followed by the ulna and drain, and wound closure is done. A compression bandage applied with a crepe bandage and arm pouch was used, and the patient advised limb elevation and active finger movements. A suction drain was removed on post-op day 3, antibiotics and analgesics were given, and on post-op day 5, a post-op check x-ray in anterior-posterior and lateral views were done. The patient was then followed up, first on the 14th post-operative day, then on completion of 4 weeks, and later every 8 weeks up to 24 weeks. The results were then evaluated on the basis of fracture union, range of motion, and complications.

Statistical analysis: The data was analysed using Microsoft Excel (2016). Results were expressed as mean, frequency, and range. Tables and figures were used as required. The Quick DASH score was used for subjective evaluation. The statistical analysis by software Statistical Package for the Social Sciences (SPSS) version 22 was used. When the difference's p value was less than 0.05, it was considered significant.

Results

The prospective study consisted of 60 patients. Out of 60 patients, 39 (65%) were males and 21 (35%) were females. The patients' ages ranged from 18 to 70 years were included in the present study. The mean age of patients was 34.50 years. All patients underwent surgical intervention with a locking compression plate after initial preoperative investigations and a preoperative check-up.

Table 1: Demographic distribution of the age of the patients

Parameter	Minimum	Maximum	Mean ±SD
Age (years)	18	70	34.50±18.63

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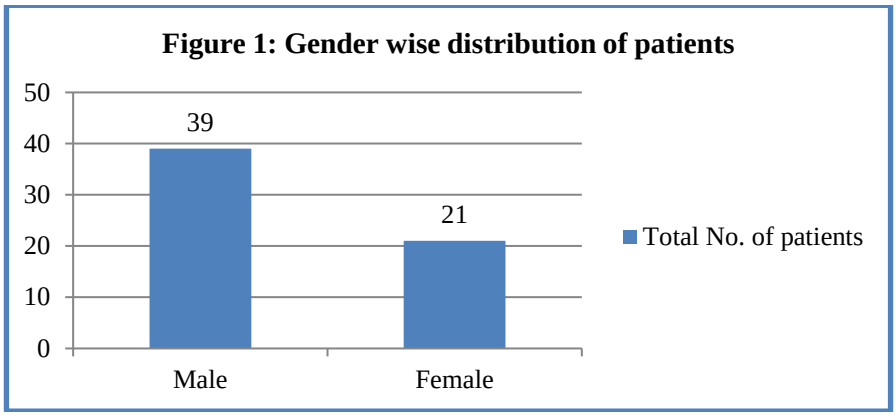

Table 2: Age-wise distribution of patients

Age (years)	No. of patients	Percentage
18-20	12	20
21-30	18	30
31-40	9	15
41-50	6	10
51-70	15	25
Total	60	100

The incidence of mode of injury causing both bone forearm fractures was found to be maximum in motorbike accidents 33(55%); 12 patients (20%) sustained fractures due to falls from height; and the minimum caused by physical assault was 3 patients (5%) (Table 3).

Table 3: Distribution of patients according to mode of injury

Type of mode of injury	No. of patients	Percentage
Fall from height	12	20
Hit by car	4	6.67
Motorcycle accident	33	55
Physical assault	3	05
Slip and fall	8	13.33
Total	60	100

Table 4: Pattern of Fracture

Type of fracture	Radius (%)	Ulna (%)
Transverse / oblique	39(65%)	41 (68.33%)
Comminuted	21(35%)	19(31.67%)
Total	60(100%)	60(100%)

Table 5: Surgical complications among patients

complications	No. of patients	Percentage
Not any	55	91.67
Superficial infection	5	8.33
Total	60	100

In the present study, 91.67% didn't have any post-operative infections, while 8.33% developed superficial surgical site infections (Table 5).

Table 6: Functional elbow flexion and extension range of motion after 6 months

Range of motion of elbow	No. of patients	Percentage
10 degrees loss	15	25
20 degrees loss	06	10
5 degrees loss	39	65
Total	60	100

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In the present study, follow-up was done every month up to 6 months. The flexion and extension ranges of motion of the elbow were evaluated on the final follow-up of 6 months. Out of 60 patients, 25% had a 10 degree loss of elbow range of motion, 10% had a 20 degree loss of elbow range of motion, and 65% had a 5 degree loss of range of motion.

Table 7: Functional outcomes

Parameters	No. of patients	Percentage
Excellent	48	80
Satisfactory	09	15
Unsatisfactory	00	0
Failure	03	5
Total	60	100

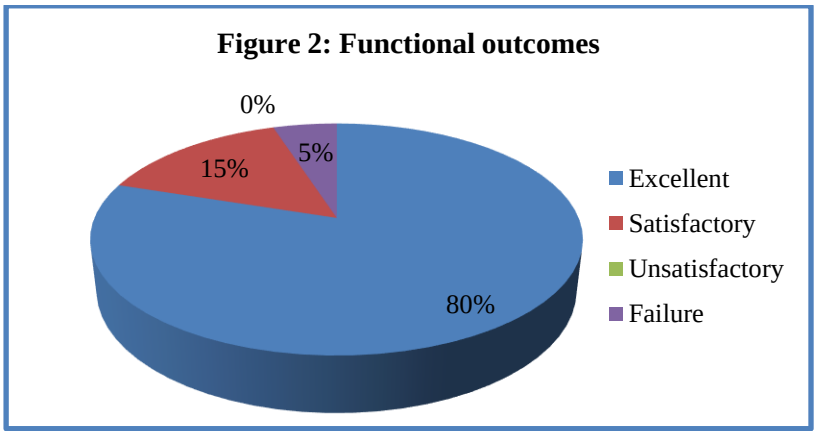

Table 7, Figure 2, Show that excellent results were found in 80% of patients and 15% of patients had satisfactory results based on the criteria of the Anderson et al. scoring system [7].
Preoperative, postoperative, and 6-month follow-up x-rays of one forearm and both bone fracture patients

Table 8: Time of union of the fracture

Duration	No. of patients	Percentage
16-18 weeks	51	85
20-24 weeks	05	8.33
≥26 weeks	04	6.67
Total	60	100

In the present study, 51 patients had complete union between 16 and 18 weeks; 5 patients had a union time of 20–24 weeks; and 4 patients had a union time of 26 weeks. In one patient, there was failure of union, which required re-osteosynthesis with bone grafting. We did not encounter any cases of implant failure in the present study.

Discussion

A fracture of both bones in the forearm is one of the most common injuries involving the upper extremity.
In the present study, fractures are more common in the age groups 21–30 and 51–70 years, with a mean age of 34.50 years (range, 18–70 years). This is similar to the finding of Leung F. et al. [4], where the mean age was 35 years (range, 12-70 years) and forearm fractures were treated by open reduction and internal fixation with 3.5-mm stainless steel LCPs. Saikia et al. [8], where the average age was 29 years. LCP has gained more popularity in orthopaedic practice in view of its efficacy and clinical outcome. This technique is more advanced and has a better clinical outcome, as stated by Sommer*et al.* [9].In our study, the incidence of both bone forearm fractures was found to be higher in males than females (1.86:1), with motorcycle accidents (55% being the most common type of mode of injury). The finding is similar to that of a study conducted by Singh S. et al. [10], where road traffic accidents constituted 64% of cases and falls from height (12%). Moed*et al.* [11] find industrial accidents to be the most common cause of injury. In the present study, transverse fractures are more common (in the radius, 65%, and the ulna, 68.33%), whereas Chapmann*et al.* [12] found comminuted fractures (53%), which are more common. In this study, 48 patients (80%) showed excellent results, 9 patients (15%) had satisfactory results, and 3 patients (5%) had failure. The assessment of functional outcome based on range of motion using Anderson *et al.'s [7]* scoring system while Chapman *et al.* [12] reported 36 (86%) cases as excellent, 3 (7%)

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satisfactory, 1 (2%) unsatisfactory, and 2 (5%) failures. Leung *et al*. [4] reported 98% of cases as excellent and 2% as satisfactory. In the present study, 51 patients had complete union between 16 and 18 weeks; 5 patients had a union time of 20–24 weeks; and 4 patients had a union time of 26 weeks. In one patient, there was failure of union, which required re-osteosynthesis with bone grafting. We did not encounter any cases of implant failure in our study. The present study showed that the minimum union time was found to be 16 weeks, and the maximum time was 26 weeks. The mean union time was found to be 15.80 weeks, similar to the study conducted by Saikia et al. [8], where the 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. [13] in their study of diaphyseal forearm bone fractures by locking compression plate (LCP) reported a mean union time of 12.6 weeks, with a range of 8–24 weeks. Leung F. et al. [4], in their study of locking compression plates in the treatment of forearm fractures, reported the mean union time to be 20 weeks (range 8–36 weeks). After ORIF with LCP, patients are post-operatively immobilised with an above-elbow plaster of Paris slab and supported with an arm pouch with limb elevation and active finger movements to avoid compartment syndrome.

In the present study, there were no implant-specific problems, and fracture non-union required secondary surgery for bone grafting, which went on to unite completely after 3 months. The present study shows that ORIF with LCP is an excellent treatment option for both bone and forearm fractures.

Limitation(s) of study

The study's small sample size and short duration.

Conclusion

The present study indicates that open reduction and internal fixation of fractures in both bones of the forearm with a locking compression plate are safe and effective options for fixation and provide excellent functional outcomes. Elderly patients should definitely consider LCP as a treatment option because it is also effective for treating osteoporotic bones.

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