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## Evaluation of the functional outcome of surgical management of both bones forearm fracture with locking compression plate: A prospective study

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### Abstract

**Objective:** The objective of the study is to evaluate the functional outcome of both bone forearm fractures with locking compression plate.

**Methods:** This prospective study was conducted in the department of orthopedics, MVJ Medical College and Research hospital, Bengaluru from June 2019 to January 2021. The patient's age group ranging from 18-60 years with closed both bone forearm fractures treated with locking compression plate for radius and ulna. Post operatively patients were evaluated using the Criteria of Anderson *et al.*

**Results:** A total of twenty patients were evaluated in our study of which there were 14 males and 6 females. Nineteen patients had complete fracture union and one patient had non-union. 17 patients showed excellent results, 2 patients had satisfactory results and 1 patient had a failure of the procedure.

**Conclusion:** Open Reduction and Internal Fixation of both bones forearm fracture with Locking Compression Plate is a safe and effective option in the fixation of closed both bone forearm fractures.

**Keywords:** Both bone forearm, locking compression plate, open reduction and internal fixation

### 1. Introduction

Both bone forearm fractures in adults are most commonly encountered fractures in day to day practice accounting for almost 31% of all upper limb fractures [1]. The forearm consists of radius, ulna, interosseous membrane with proximal and distal radioulnar joint and helps in supination and pronation movements. Radius and ulna articulate with one another at proximal and distal radioulnar joints, the stability of which is an essential pre requisite for long term functional outcome after injury [2].

Both bone forearm fractures if not treated properly will result in severe loss of function, hence appropriate management of such injuries is necessary to achieve proper range of movements and a good functional outcome. Closed reduction and cast immobilization of forearm fractures have yielded poor results as reported up to 92 % of cases owing to malunion, nonunion or synostosis [3-5]

The Open reduction and internal fixation (ORIF) in adults with plating is the standard procedure for both bone forearm fractures or isolated radius/ulna fracture with or without bone grafting. As recommended by AO association internal fixation with dynamic or locking compression plate gives rigid fixation, impaction and compression at the fracture site.

The advantage of using a locking plate construct gives us 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 (periosteum left intact) thereby aiding in better fracture union. This new concept is more closely related to the concept of pure splinting. Plating gives rigid internal fixation and compression for diaphyseal forearm fractures to achieve union and restore functional movements in the forearm [6].

### Aims and Objectives

This prospective study is to evaluate the outcomes of using Open Reduction Internal fixation with Locking Compression Plate for both bone forearm fractures in terms of fracture union, range of motion, and functional outcome.

### Materials and Methods

This prospective study is conducted in the Department of Orthopaedics, MVJ Medical College And Research Hospital, India from June 2019 to January 2021 after due clearance from the institutional ethical committee's approval. The study is conducted after obtaining written informed consent from the patient and patient attenders and patients who met the inclusion and exclusion criteria were studied

#### Inclusion criteria

1. Age above 18 years of age
2. Closed fractures
3. Transverse/short oblique and comminuted fractures

#### Exclusion criteria

1. Open fractures
2. Segmental fractures and grossly comminuted fractures
3. Intra-articular extension
4. surgically unfit patients
5. Polytrauma
6. Multiple co-morbidities affecting outcome

Patients examined clinically and assessed the mechanism of injury and severity of trauma and 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. X-Ray of radius and ulna (shaft) AP and lateral view were taken and also both elbow and wrist joints were taken separately both the views. The affected limb was immobilised with above elbow plaster slab with arm sling. All routine pre-operative investigations were done and pre-anaesthetic fitness obtained.

#### Operative Procedure

After patient positioning, painting and draping tourniquet was inflated. Radius was exposed with Henry's approach, fracture ends identified and edges freshened and after reducing the fracture a 3.5 mm LCP was used and minimum of 6 cortices were engaged with screws. Ulna was approached directly on the subcutaneous border of the shaft.

After the exposure fracture ends are identified and edges are freshened with periosteum elevator and reduction was done with bone holding clamp. After reduction 3.5 mm LCP plate was applied and plate was selected with at least 6 holes and in comminuted or segmental fractures plate of more than 6 in holes was selected.

The plate fixation in the upper third of the radius is on dorsal side, middle third dorsolateral side and distal third on the volar aspect. In ulnar fractures plate applied over posterior surface of ulna [7]

The drill sleeve was fixed in the locking screw slot near to the fracture site and drilled both cortices with 2.7mm drill bit, screw length was assessed with depth gauge after removing drill sleeve, 3.5 mm locking screws were inserted. The remaining screws were inserted in the same manner.

The radius is fixed first followed by the ulna and drain placed and wound closure done. Compression bandage applied with crepe bandage and arm pouch was used and patient advised limb elevation and active finger movements. Suction drain

was removed on post-op day 3 and antibiotics and analgesics given and on day 5 post-op check x-ray in Antero-posterior and lateral views done.

#### Post-operative rehabilitation/protocol

Patient discharged on day 5 and was kept on above short arm slab for 2 weeks and suture removal done on 14<sup>th</sup> post-op day. All the patients followed up at monthly intervals and evaluated as per Anderson *et al* scoring system [8]. The movements of elbow and wrist joint was assessed until fracture union.

The fracture is considered to be united when there is obliteration of fracture gap with presence of periosteal bridging callus seen on radiograph.

Delayed union is considered when union ensues without any operative intervention but takes more than 6 months for union.

Non-union: Fracture failed to unite without any intervention.

Criteria for functional results The Criteria of Anderson *et al*. [11] were used in grading the functional outcome, which is as follows

Results	Union	Flexion Extension At Elbow	Supination And Pronation
Excellent	Present	< 10 deg loss	<25 % loss
Satisfactory	Present	<20 deg loss	<50% loss
Unsatisfactory	Present	>20 deg loss	>50 % loss
Failure	Nonunion or unresolved chronic osteomyelitis.		

#### Statistical analysis

Data was analysed using Microsoft Excel (2010). Results were expressed as mean, frequency and range. Tables and figures were used as required. Subjective assessment was done using the Quick DASH score. Statistical analysis were made using the software SPSS 20. Difference was considered significant when the p value was < 0.05.

#### Results

A total of 20 patients were included in our study having met the inclusion criteria with gender incidence: 14 males (70%) and 6 females (30%). Our study population age ranged from 18 to 60 years, 18 years being the youngest patient and 60 years our oldest patient. Mean age of our study population is 32.6. Mechanism of injury -following were the causes /mechanisms of injury. Road traffic accident was the leading cause for both bones forearm fractures in our study: 10 patients (50%), 6 patients (30%) sustained fracture due to fall, and assault as the mode in 4 patients (20%). 16 patients were given a brachial plexus block and 4 patients were operated general anaesthesia. Associated injuries was seen in 6 patients (30%) - 3 had head injury, 1 had pelvic injury, 1 had contralateral femur shaft fracture, 1 had fracture of contralateral distal end radius. 2 patients had minor post-operative complications in the form of superficial infection. No case of neurovascular injury was encountered intraoperatively /post-operatively.

Follow-up was done every month up to 6 months. 16 patients had complete union between 14-16 weeks and 3 patients had a union time of 18-20 weeks. In one patient there was failure of union which required re-osteosynthesis with bone grafting. We did not encounter any case of implant failure in our study. In terms of functional outcome as assessed by Anderson *et al*. criteria 17 patients had excellent results, 2 had satisfactory result and 1 patient had failure of union.

**Table 1:** Age wise distribution of study population

AGE	n(%)
18-20	3 (15)
21-30	5(25)
31-40	4(20)
41-50	3(15)
51-60	5(25)
Total	20(100)

**Table 2:** Fracture pattern

Type of fracture	Radius (%)	Ulna (%)
Transverse /short oblique	12(60%)	14 (70%)
Comminuted	8(40%)	6 (30%)
Total	20(100%)	20(100%)

**Table 3:** Functional results

Excellent	Satisfactory	Unsatisfactory	Failure
17(85)	2(10%)	0	1(5%)

Preoperative, postoperative and 6 months follow up xrays of one of forearm both bone fracture patient.



**Discussion**

The fractures of both bone forearm is a big challenge to the orthopaedic surgeons due to the complex anatomy such as various muscular forces acting on the bony fragments which tends to displace fracture fragments. So anatomic reduction and rigid fixation is important to get good functional outcome. This can be achieved only by ORIF [9]

LCP has more popularity in orthopaedic practice in view of its efficacy and clinical outcome. This technique is more advanced with better clinical outcome as stated by Sommer *et al.* [10] In this study fractures are more common in age group 21-30 and 51-60 years with a mean age of 32.6(18-

60years).Similar mean age was quoted by Burwell and Charnley [11].The incidence of both bone forearm fracture in our study was found to be more in males than femles (2.3:1),with history of fall seen in 6 patients (30%), Road traffic accidents in 10 patients (50%), assault in 4 patients(20%).

Moed *et al.* [12] reported industrial accidents as a cause but none was encountered in this study.

In this study transverse fractures are more common (n=15,75%) but Chapmann *et al.* [13] reported comminuted fractures (53%) are more common.

LCP shows good union rates. Leung *et al.* [11] in his results

showed delayed union only in 2 out of 32 of their patients and there was no non-union. In our study 19 patients had complete fracture union, 1 patient had a non-union of both bones for which he underwent re-osteosynthesis with bone grafting. Cause for the failure of primary fixation was attributed to the gross comminuted nature of his primary injury.

In this study average time to union was 20 weeks (16-24 weeks) with 95% union rate of both radius and ulna and one patient showed non-union

The assessment of functional outcome based on range of motion using Anderson *et al.* scoring system. while Chapman *et al.* [13] reported 36 (86%) cases as excellent, 3 (7%) satisfactory, 1 (2%) unsatisfactory, and 2 (5%) failure. Leung *et al.* [11] reported 98% of cases as excellent and 2% of satisfactory results. In this study 17 patients (85%) showed excellent results, 2 patients (10%) had satisfactory results and one patient (5%) had failure.

Infection, non-union and radioulnar synostosis are reported complications seen in Chapman *et al.* [13]. In our study we had 2 cases of superficial infection, 1 case of non-union and no radioulnar synostosis complication.

In this study one patient has shown non-union. Leung *et al.* [11] reported superficial infection in one patient, refracture after implant removal in 2 patients. In our study 4 superficial infection was come across after the procedure and was managed with antibiotics. Average duration of surgery was 2 hours and tourniquet time 1 and half hours.

After ORIF with LCP post-operatively immobilized with above elbow plaster of paris slab and supported with arm pouch with limb elevation and active finger movements to avoid compartment syndrome.

In this study there was no implant specific problems and fracture non-union required secondary surgery for bone grafting which went on to unite completely after 3 months. This study of ORIF with LCP is an excellent treatment option in both bone forearm fracture.

## Conclusion

The incidence of both bone fractures are more in this modern era and if it is treated conservatively the results are poor and so requires a stable fixation to achieve fracture union with good functional outcome. In this study 20 patients underwent ORIF with locking compression plate of both bone forearm with most of them are male with RTA as mode of injury with majority of them falling in the age group 21-30 and 51-60 showed excellent outcome of 85%. LCP is also effective in osteoporotic bone and therefore absolute option to treat elderly. Hence ORIF with LCP is a safe and effective option in the fixation of both bone forearm.

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