



## INTERNAL FIXATION OF ADULT DIAPHYSEAL BOTH BONE FOREARM FRACTURES USING LOCKING COMPRESSION PLATE

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**ABSTRACT** **Background:** Fractures involving the bones of forearm may result in severe loss of function unless adequately treated. The aim of this prospective study was to evaluate the outcomes of locking compression plate (LCP) for the treatment of adult diaphyseal both bone forearm fractures.

**Materials and Methods:** This study conducted in the Orthopaedics Unit of Usha Hospital, Muzaffarpur, Bihar included 36 patients with 72 fractures. Operative time, callus formation, functional outcome, and complications were recorded.

**Results:** Mean operative time for the LCP fixation was 70.25 min. The time for callus formation and mean time to bone union was significant. However, overall functional outcome was good. One patient developed superficial infection.

**Conclusion:** In this prospective study involving fixation of diaphyseal both bone forearm fractures using LCP, the outcomes were good in terms of final functional outcomes, mean operating time, callus formation, and mean time to bone union.

**KEYWORDS :** Diaphyseal, Forearm, Limited contact dynamic compression plate, Locking compression plate, Radius and ulna

### INTRODUCTION

Forearm fractures can be regarded as articular fractures as slight deviations in the spatial orientation of the radius and ulna will significantly decrease the forearm's rotational amplitude and thereby impair the positioning and function of the hand. Thus, the management of these fractures and their associated injuries deserve special attention as their treatment is not the same as the treatment of other diaphyseal fractures. Imperfect treatment of fractures of the radius and ulna diaphyses leads to a loss of motion as well as muscle imbalance and poor hand function.

Since radius and ulna articulate with one another at both distal and proximal end, the integrity of these joints is a further essential ingredient in achieving excellent long-term result after injury. Malunion and nonunion are more frequent because of the difficulty in reducing and maintaining the reduction of two parallel bones in the presence of pronating and supinating muscles that have angulating and rotational influence. Because of these factors, open reduction and internal fixation for diaphyseal fracture in the adults are generally accepted as the best method of treatment, even though closed reduction may be achieved.

Treatment by closed reduction and cast immobilization results in a poor functional outcome with unsatisfactory results reported in upto 92% of cases, usually caused by malunion, nonunion, or syntonosis.

The newly developed locking compression plate (LCP) consists of self-compression plate and screw system where the screws are locked in the plate. This locking minimizes the compressive forces exerted on the bone by the plate. This means that the plate does not need to touch at all. With conventional implants, the achievement of interfragmentary compression is associated with a substantial degree of surface pressure on the bone surface and the periosteum beneath the plate. This mechanical stress on the periosteal layer might alter the vascularization of the fractured bone and thereby impede the healing process.

LCP can be used in forearm fractures in the conventional plating technique (compression method - principle of absolute stability) for simple transverse or oblique fracture with low soft tissue compromise or in the bridging technique (internal fixator method - principle of relative stability) for comminuted fractures if required; or in the

combination technique (compression and bridge technique) in special situation (e.g., segmental fracture with two different fracture pattern - one simple and one multifragmentary). It is unclear whether a bridging technique or a combination of compression and bridging is beneficial for simple transverse or oblique forearm fractures.

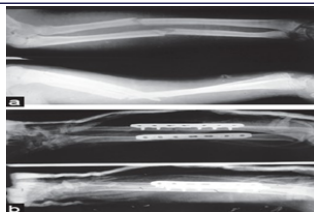
### AIM AND OBJECTIVE

The aim and objective of this prospective study was to analyze the outcomes of using the LCP for internal fixation in adult diaphyseal both bone forearm fractures in terms of fracture union, range of motion, and functional outcome.

### MATERIAL AND METHODS

We conducted a prospective study on patients with age ranging from 18 years and above with fresh fractures (<21-days-old) of both bones of the forearm. Study included closed or type I open simple, transverse, or short oblique fractures of shaft of both bones of forearm without comminution. Patients with pathological fractures, type II or higher or associated neurological injury, and lost on follow-up were not included. Thirty-six patients with 72 fractures of forearm were treated with open reduction and internal fixation with 3.5 mm stainless steel LCP in the Orthopaedics unit of Usha Hospital, Muzaffarpur, Bihar. All fixation in both groups were done using plate fixation in noncompression mode.

On admission of patient, a thorough clinical examination was done including systemic examination to rule out any associated any injury. Anteroposterior and lateral radiographs of affected forearm including elbow and wrist joint were done. The radius was exposed through the anterior Henry approach and the plate applied to volar surface, when the fracture was on the lower two-third or through the dorsal Thompson approach and the plate placed on the dorsal plate when the fracture was on upper third. The ulna was exposed through the posteromedial subcutaneous surface and the plate was applied on the posterior surface since it is the tension side of ulna. Radius was fixed first followed by ulna. We used only noncompression mode (here it was bridging mode) for plate fixation for both LCP fixation [Figure 1]. In all patients, 3.5-mm LCP plates were used. After the tourniquet was removed and hemostasis was obtained, a drain was placed and the wound was closed. A splint was applied for 2 weeks. Elbow and wrist exercises were started immediately, while the arm was still in the splint.



**Figure 1 :**

- (a) Pre operative radiograph showing diaphyseal both bone forearm fracture  
 (b) Post operative radiograph after fixation with LCP

The patient were called for checkup first on 14<sup>th</sup> postoperative day and then on completion of 4 weeks and later after every 2 weeks. The results were evaluated on the basis of fracture union, range of motion, and complications.

Leung and Chow defined bone union as obliteration of fracture gap or the presence of bridging periosteal callus in radiograph. Callus formation in the fractures is classified as: None, minimal, moderate, and abundant.

The criteria of Anderson *et al.*, were used in determining status of union.

**Union:** Fractures which healed in less than 6 months.

**Delayed union:** Those which required more than 6 months to unite, but without any additional operative procedures.

**Nonunion:** Those which failed to unite without another operative procedure.

Criteria for functional results.

Subjective assessment was done using the shortened disabilities of the arm, shoulder, and hand questionnaire (QuickDASH) score. Statistical analysis was made using the software Statistical Package for Social Sciences (SPSS) 20. Difference was considered significant when the *P*-value was <0.05.

## RESULTS

There were 24 males and 12 females in the study. Male outnumbered females. The mean age of patient in LCP fixation was 31.15 years.

There were 22 fractures of both bone of forearm on left side and 14 on right side in LCP fixation. Thus, there was predominant involvement of the forearm of the left side and a consequent higher rate of involvement of the nondominant forearm in both groups in our study. The causes of injury was road traffic accidents in 18 cases, fall from height in 11 cases, assault in five cases, and sport injury in two case in LCP group. RTA was found to be most common mode of injury in both groups followed by fall.

There were 20 cases of both bone of forearm fractures involving middle third region, 11 cases involving lower third, and five cases in upper third in LCP fixation. In our study, middle third region was most commonly involved in fracture of both bones of forearm in adult.

The average age of fractures at surgery in LCP group was 5.10 days. Standard AO principles were followed and the surgeries were done according to the AO accepted standard procedures. Bone graft was not used in any of our patient in any groups. Average operating time in LCP fixation was 70.25 min.

In our study, abundant callus formation was present in 14 cases, moderate in 12 cases, and minimum in five cases in LCP fixation. Thus, callus formation was seen in 86% in LCP group. There was 100% union rate with LCP fixation. The mean time to union was 12.80 weeks in LCP fixation.

We had excellent functional outcome in 31 patients (90%) and satisfactory in five cases (10%) in LCP fixation with no failure.

Two patient developed superficial infection. Infection was controlled with appropriate antibiotics after culture and sensitivity.

The QuickDASH questionnaire was used to assess the outcome subjectively. The raw score ranged from 0 to 29.42 in LCP fixation. Overall the patients were satisfied with the outcome. In our study, we struck on the principle of not removing the implant for at least 18 months after plating or unless clearly indicated. Five implant removal was done and no implant related complications was observed in our study.

## DISCUSSION

In our present study; the average age of patient in LCP fixation was 30.55 years (SD  $\pm$  11.50) with range being 18-64 years. This data is similar to the finding of Marya *et al.*, where the average ages was 29 years, Leung and Chow where the mean age was 35 years, and Sharma *et al.*, where the mean age was 34 years. Overall there were 24 males in the group comprising 66%, male to female ratio being 1.5:1. The predominance of male may be because of the fact that they are more exposed to outside environment like riding vehicle, heavy manual work, and sports in comparison to their female counterparts. The difference between the two groups was insignificant (*P* > 0.05). This finding is similar to Saikia *et al.*, where males constituted 70% and female 30%, and Manjappa *et al.*, where 75% were males and 25% were females.

There were 22 fractures (61%) on the left side and 14 fracture (39%) on the right forearm in LCP group. The difference is insignificant (*P* > 0.05). This data is similar to the finding of Manjappa *et al.*, where left forearm was involved in 12 patients (60%) and right forearm fracture was seen eight patients (40%). Majority of patients had fractures in their nondominant forearm as in LCP group nondominant forearm was involved in 70% cases. The difference between the two groups was statistically insignificant (*P* > 0.05). This data is similar to observation made by Manjappa *et al.*, that reported involvement of the nondominance extremity in 58% of the cases. In our present study, RTA was most common cause of injury in 18 cases (50%), followed by fall from height in 11 cases (30%), assault in five cases (14%), and sport injuries in two cases (6%) in LCP group. This data is similar to study conducted by Singh *et al.*, where RTA constituted 64% of cases and fall from height (12%). Marya *et al.*, reported RTA to be responsible for 88% of fractures of both bones of the forearm.

There were 20 cases (55%) of both bone of forearm fractures in middle third region, followed by 11 cases (30%) in lower third, and five cases (15%) in upper third in LCP group. This date is similar to study conducted by Marya *et al.*, where middle third of the forearm bones were involved in 52% of fractures. In the study by Manjappa *et al.*, 60% patients had diaphyseal fracture involving middle third region, 25% had proximal third fracture, and 15% had lower third fracture.

The mean age of fracture in LCP group was 5.10 days, range being 3-21 days in both groups. Sixty percent of patient in LCP group were operated within 1 week of their presentation to our institution. Though there was no case of nonunion, we feel that operating upon 1<sup>st</sup> week after the injury is technically a bit easier since the organization of the exudates and shortening of the muscle later on, may make the surgery more difficult.

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