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Original Research Article

# Functional Outcome Assessment of Open Reduction and Internal Fixation of the Diaphyseal Fractures of Both Bones Forearm with Limited Contact Dynamic Compression Plate (LC-DCP) in Adults

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**Abstract**

**Aim:** The aim of the present study was to evaluate the results of open reduction and Internal fixation of the diaphyseal fractures of both bones forearm with limited contact dynamic compression plate (LC-DCP) in adults and its advantages and complications.

**Methods:** The present study was conducted in the Department of Orthopaedics at SKMCH, Muzaffarpur, Bihar, India for one year. The present study consists of 50 cases of fracture both bones of the forearm.

**Results:** The age of these patients ranged from 18-60 years with fracture being most common in 3rd decade and an average age of 31 years. Other common characteristics were males (80%), right forearm fracture (64%) and injury due to road traffic accidents (60%). Majority of the fractures were seen in the mid diaphysis of both bones. 35 (70%) patients had middle third fractures, 10 (20%) had proximal third fractures and 5 (10%) patients had lower third fractures both bones forearm. Only 10 (20%) of the patients had associated injuries. Majority of the fractures were transverse / short oblique. About 20% of radius and 30% of ulna fractures were comminuted. 45 (90%) patients had sound union in less than 6 months, 5 (10%) patients had delayed union. Postoperative complications such as Superficial Infections (4%), Posterior interosseous nerve injury (6%), Radioulnar synostosis (4%) were noted. Using the Anderson et al. scoring system we had 43 (86%) patients with excellent results, 5 (10%) patients with satisfactory results and 2 (4%) patients with unsatisfactory result (radioulnar synostosis).

**Conclusion:** Advantages of LC-DCP, it facilitates biological fixation of the bone and early bone union. It is easier to apply in comminuted and segmental fracture and short oblique fractures. It gives excellent functional results in the majority of patients.

**Keywords:** limited contact dynamic compression plate, forearm fracture, radius, ulna



## Introduction

It is essential to regain length, apposition, axial alignment and normal rotational alignment while treating diaphyseal fractures of the radius and the ulna to gain good range of pronation and supination. The chances for the occurrence of malunion and non-union are greater because of the difficulties in reducing and maintaining the reduction of two parallel bones in the presence of the pronating and supinating muscles, which have angulatory as well as rotatory influences. [1] Open reduction and internal fixation with plating is generally accepted as the best method of treatment for displaced diaphyseal fractures of the forearm in the adult. [2] The value of compression in obtaining rigid internal fixation had been noted by various authors. [3–5] Compression techniques have a lower incidence of non-union and are found to hasten rehabilitation, with less joint stiffness. [6–11] In conventional plating, the actual stability results from the friction between the plate and the bone, which in turn may prevent periosteal perfusion.

n conventional plating, the actual stability results from the friction between the plate and the bone, which in turn may prevent periosteal perfusion. [12,13] The biologic plating entails a sufficiently stable fixation of the bone fragments, allowing early mobilization without major disturbance of the vascularization. [14] The limited contact dynamic compression plates (LC-DCP), developed in 1991, was said to reduce the bone-plate contact by approximately 50% to minimise the disruption of periosteal blood vessels beneath the plate. [13] But the LC-DCP still relied on the plate-bone interface

for stability [12,13] and the problem of confluent contact areas was not completely resolved. Later on, the Point Contact Fixator (PC-Fix), which did not have surface contact with the bone but only point contacts, was developed. [12] Leung et al. in a prospective, randomized trial comparing the LC-DCP with the PC-Fix in the treatment of forearm fractures concluded that the two implants appeared to be equally effective for the treatment of diaphyseal forearm fractures. [12]

Point contact fixator (PC Fix), was the first implant that did not confide on the plate bone interface for stability as it further diminished the contact area to mere point contacts of the plate with the bone.[12] Then originated the concept of locking compression plates (LCP), which incorporated the features of LCDCP and PC-Fix and had the provision of a combined hole which can entertain an unlocked compression screw or a locking screw. [12] They can aid biological fixation by being placed in a bridge plate technique in a comminuted fractures and have been asserted to allow rapid bone healing thus abbreviating union complications. [13,15]

The aim of the present study was to evaluate the results of open reduction and Internal fixation of the diaphyseal fractures of both bones forearm with limited contact dynamic compression plate (LC-DCP) in adults and its advantages and complications.

## Materials and Methods

The present study was conducted in the Department of Orthopaedics at SKMCH, Muzaffarpur, Bihar, India for one year. The present study consists of 50 cases of fracture both bones of the forearm.

### Inclusion Criteria

Patients 18-60 years, with closed diaphyseal fractures of both bones of forearm, medically fit for surgery.

### Exclusion Criteria

Those patients who are below 18years and above 60 years. Patients with severe osteoporosis. Open fractures. Segmental fracture of radius and ulna.

A written informed consent was taken from patient/relatives for participation in study. On admission of the patient, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and the local injury. Local examination of injured forearm revealed swelling, deformity and loss of function. Any nerve injury was looked for and noted. Radiographs of the radius and ulna with elbow and wrist joints (AP and lateral views) were obtained. The limb was then immobilized in above elbow Plaster of Paris slab with sling. The patient was taken for surgery after routine investigations and after obtaining fitness towards surgery. The investigations are as follows: Hb%, Urine for sugar, FBS, Blood urea, Serum creatinine, ECG and chest x-ray. Proximal radius was approached by Dorsal Thompson incision and Volar Henry approach was used for middle and distal radius. A narrow 3.5 mm LC-DCP was used and a minimum of 5 cortices were engaged with screw fixation in each fragment. In ulna fractures plate was applied over the posteromedial surface of ulna. Once stable fixation is achieved and hemostasis secured meticulously, the wound is closed in layers over a suction drain and sterile dressing is applied. The limb was kept elevated for 24 to 48 hours and the patient was instructed to move their fingers and elbow joint. A posterior plaster splint was applied for comfort for 2 to 3 days. Patient was encouraged to perform both active and active-assisted range of motion exercises of shoulder and hand. Elbow range of motion, supination and pronation exercises were begun as soon as remission of pain and swelling of forearm permits, usually after 2 to 3 days. All the patients were followed up as monthly intervals for first 3 months and evaluation was done based on "Anderson et al. scoring system".3 Patients clinical, operative and follow-up details were entered in Microsoft excel sheet and analysed descriptively in form of mean value and percentages.

## Results

**Table 1: General characteristics**

| Age groups in years | N | % |
|---|---|---|
| 18 – 20 | 6 | 12 |
| 21 – 30 | 24 | 48 |
| 31 – 40 | 11 | 22 |
| 41 – 50 | 4 | 8 |
| 51 – 60 | 5 | 10 |
| Sex – Male/ Female | 40/10 | 80/20 |
| Side affected - Right/Left | 32/18 | 64/36 |
| **Mode of injury** | | |
| RTA | 30 | 60 |
| Fall | 15 | 30 |
| Assault | 5 | 10 |

The age of these patients ranged from 18-60 years with fracture being most common in 3rddecade and an average age of 31 years. Other common characteristics were males (80%), right forearm fracture (64%) and injury due to road traffic accidents (60%).

**Table 2: Fracture characteristics and type of fracture**

| **Level of injury** | **N** | **%** |
|---|---|---|
| Middle third fractures | 35 | 70 |
| Proximal third fractures | 10 | 20 |
| Lower third fractures | 5 | 10 |
| **Associated Injury** | | |
| Supracondylar Fracture femur (Rt) | 2 | 4 |
| Fracture BB (Rt) leg | 3 | 6 |
| Fracture shaft humerus(Rt) | 3 | 6 |
| Fracture shaft femur | 2 | 4 |
| **Type of fracture** | **Radius** | **Ulna** |
| Transverse /short oblique | 40 | 35 |
| Comminuted | 10 | 15 |

Majority of the fractures were seen in the mid diaphysis of both bones. 35 (70%) patients had middle third fractures, 10 (20%) had proximal third fractures and 5 (10%) patients had lower third fractures both bones forearm. Only 10 (20%) of the patients had associated injuries. Majority of the fractures were transverse / short oblique. About 20% of radius and 30% of ulna fractures were comminuted.

**Table 3: Duration of fracture union**

| **Duration** | **N** | **%** |
|---|---|---|
| < 4 months (16 weeks) | 31 | 62 |
| 4-6 months (16 – 24 weeks) | 14 | 28 |
| 6 months - 1 year (24-36 weeks) | 5 | 10 |

45 (90%) patients had sound union in less than 6 months, 5 (10%) patients had delayed union.

**Table 4: Complications**

| **Complications** | **N** | **%** |
|---|---|---|
| Superficial infection | 2 | 4 |
| Posterior interosseous nerve injury | 3 | 6 |
| Radioulnar stenosis | 2 | 4 |

Postoperative complications such as Superficial Infections (4%), Posterior interosseous nerve injury (6%), Radioulnar synostosis (4%) were noted.

**Table 5: Functional outcome**

| **Results** | **Union** | **Flexion / Extension at elbow joint** | **Supination and pronation** | **No. of cases** | **Percentage** |
|---|---|---|---|---|---|
| Excellent | Present | $<10^0$ loss | <25% loss | 43 | 86 |
| Satisfactory | Present | $<20^0$ loss | <50% loss | 5 | 10 |
| Unsatisfactory | Present | $>20^0$ loss | >50% loss | 2 | 4 |

Using the Anderson et al. scoring system we had 43 (86%) patients with excellent results, 5 (10%) patients with satisfactory results and 2 (4%) patients with unsatisfactory result (radioulnar synostosis).

**Discussion**

Forearm plays a cardinal role in the function of upper extremity. Fractures involving both bones of forearm have been acknowledged as articular fractures as even minor aberration in the spatial orientation of radius and ulna can appreciably debilitate the performance of hand. [16-18] To acquire adequate range of pronation and supination, reclamation of length, apposition, axial and rotational alignment is paramount. Deforming muscular forces make union complexities more plausible. [19]

The age of these patients ranged from 18-60 years with fracture being most common in 3rd decade and

an average age of 31 years. Other common characteristics were males (80%), right forearm fracture (64%) and injury due to road traffic accidents (60%). Majority of the fractures were seen in the mid diaphysis of both bones. 35 (70%) patients had middle third fractures, 10 (20%) had proximal third fractures and 5 (10%) patients had lower third fractures both bones forearm. Only 10 (20%) of the patients had associated injuries. Much work had not been done on PC- fixators and as reported by Frankie Leung et al.. they have no added advantage over theLC-DCP. [12] The LC-DCP is the technically a further development of the DCP. The symmetrical self-compressing plate hole and deletion of the elongated distance between the innermost screw holes makes the LC-DCP more versatile for use in any fracture type. Grooves on the under surface of the LC-DCP serve three purposes: Improved blood circulation by decreased damage to contact between plate and bone. Allows for a small bone bridge beneath the plate at the most critical area, which is otherwise weak due to a stress concentration effect. More even distribution of the plate than in conventional plates. [20]

Analogous biomechanical properties of LCPs and DCPs have been delineated in a radius cadaver model by Gardner et al. [21] However, Snow et al, in a biomechanical study of an osteoporotic bone model discovered the LCPs to perform better in the axial compression test when used as a bridge plate against the conventional plates. [22] Furthermore, Doornink et al validated that hybrid plates impart higher torsional strength, similar bending strength, and a minimal decrease in axial strength than all locked plates in a biomechanical study of an osteoporotic diaphyseal fracture model. [23] Majority of the fractures were transverse / short oblique. About 20% of radius and 30% of ulna fractures were comminuted. 45 (90%) patients had sound union in less than 6 months, 5 (10%) patients had delayed union. Postoperative complications such as Superficial Infections (4%), Posterior interosseous nerve injury (6%), Radioulnar synostosis (4%) were noted. Using the Anderson et al. scoring system we had 43 (86%) patients with excellent results, 5 (10%) patients with satisfactory results and 2 (4%) patients with unsatisfactory result (radioulnar synostosis). Anderson et al [24] reported about 54 (50.9%) cases as excellent, 37 (34.3%) satisfactory, 12 (11.3%) unsatisfactory and 2 (2.9%) as failure. Chapman et al[25] reported about 36 (86%) cases as excellent, 3 (7%) satisfactory, 1 (2%) as unsatisfactory and 2 (5%) as failure.

## Conclusion

Advantages of LC-DCP, it facilitates biological fixation of the bone and early bone union. It is easier to apply in comminuted and segmental fracture and short oblique fractures. It gives excellent functional results in the majority of patients. Complication after a well-performed surgery is minor and easily correctable. Until newer implants are devised and extensively assessed as the versatile LC- DCP these should be used as the implant of choice for all closed displaced diaphyseal fractures of both bones forearm.

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