

Stabilization of diaphyseal fractures of both bones forearm with limited contact dynamic compression plate - A prospective study

Subhash Patil¹, Kanakachalapati^{2*}

¹Associate Professor, ²Assistant Professor, Department of Orthopaedics, Rims, Raichur, INDIA.

Email: drkcp01@yahoo.com

Abstract

Background: The term limited contact dynamic compression plate (LC-DCP) stands for a new approach to plate fixation, reduced trauma to the bone, preservation of blood supply, avoidance of stress raisers produced at implant removal and improved healing. This study has been taken up 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. **Material and Methods:** Present study was conducted in patients 18-60 years, with closed diaphyseal fractures of both bones of forearm, medically fit for surgery underwent open reduction and internal fixation of the diaphyseal fractures of both bones forearm with limited contact dynamic compression plate (LC-DCP). **Results:** The present study consists of 30 cases of fracture both bones of the forearm. 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 (60%) and injury due to road traffic accidents (60%). Majority of the fractures were seen in the mid diaphysis of both bones. 21(70%) patients had middle third fractures, 6(20%) had proximal third fractures and 3 (10%) patients had lower third fractures both bones forearm. Only 6 (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. In our study, we noted the duration of surgery ranged from 60 to 95 minutes, with average time of 80 minutes. The tourniquet time ranged from 40 to 60 minutes, with average time of 49 minutes. 27(90%) patients had sound union in less than 6 months, 3 (10%) patients had delayed union. There were no cases of intraoperative complications. Postoperative complications such as Superficial Infections (3.3%), Posterior interosseous nerve injury (6.7%), Radioulnar synostosis (3.3%) were noted. Using the Anderson *et al.* scoring system we had 26 (86.7%) patients with excellent results, 3 (10%) patients with satisfactory results and 1 (3.3%) patients with unsatisfactory result (radioulnar synostosis). **Conclusion:** 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.

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

*Address for Correspondence:

Dr Kanakachalapati, Assistant Professor, Department of Orthopaedics, Rims, Raichur, INDIA.

Email: drkcp01@yahoo.com

Received Date: 29/10/2020 Revised Date: 15/12/2020 Accepted Date: 16/01/2021

DOI: <https://doi.org/10.26611/1031721>

This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/). 

Access this article online

Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 13 February 2021

INTRODUCTION

The supporting skeleton and articulations of the upper extremity (arm and forearm) serve to position its terminal unit, the hand, in space. In the adult, exacting management of diaphyseal fractures of the radius and ulna is necessary to ensure forearm motion. These injuries can even be viewed as intra-articular fractures with the forearm "joint" providing supination and pronation. Unsatisfactory treatment can lead to loss of motion as well as muscle imbalance and disability of hand function.¹ Conservative treatment has resulted in malunion, non-union, synostosis

and ultimately poor functional outcome. Hence perfect fracture reduction and rigid fixation is mandatory and achieved by plating. With conventional plating, the screw acts as an anchor, with its axial force press the plate against bone, which produces large frictional force at the bone plate interface and this force has been shown to cause vascular disturbance, especially in the periosteum. The term limited contact dynamic compression plate(LC-DCP) stands for a new approach to plate fixation, reduced trauma to the bone , preservation of blood supply, avoidance of stress raisers produced at implant removal and improved healing.² This study has been taken up 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.

MATERIAL AND METHODS

Present study was a prospective, observational study conducted between DEC 2017 to DEC 2018 at Department of Orthopaedics at Raichur Institute of Medical Sciences, Raichur. Ethical clearance has been obtained from the RIMS institutional ethics committee, Raichur.

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

The present study consists of 30 cases of fracture both bones of the forearm. 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 (60%) and injury due to road traffic accidents (60%).

Table 1: General characteristics

	No. of Patient's	Percentage
Age		
18 – 20	3	10
21 – 30	15	50
31 – 40	6	20
41 – 50	3	10
51 – 60	3	10
Sex – Male/ Female	24/6	80/20
Side affected - Right/Left	18/12	60/40
Mode of injury		
RTA	18	60
Fall	9	30
Assault	3	10

Majority of the fractures were seen in the mid diaphysis of both bones. 21(70%) patients had middle third fractures, 6(20%) had proximal third fractures and 3 (10%) patients had lower third fractures both bones forearm. Only 6 (20%) of the patients had associated injuries.

Table 2: Fracture characteristics

Fracture characteristics	No. of Patient's	Percentage
Level of injury		
Middle third fractures	21	70
Proximal third fractures	6	20
Lower third fractures	3	10
Associated Injury		
Supracondylar Fracture femur (Rt)	1	3.3
Fracture BB (Rt) leg	2	6.7
Fracture shaft humerus(Rt)	2	6.7
Fracture shaft femur	1	3.3

Majority of the fractures were transverse / short oblique. About 20% of radius and 30% of ulna fractures were comminuted.

Table 3: Type of the fracture

Type of fracture	Radius	Ulna
Transverse /short oblique	24	21
Comminuted	6	9

In our study, we noted the duration of surgery ranged from 60 to 95 minutes, with average time of 80 minutes. The tourniquet time ranged from 40 to 60 minutes, with average time of 49 minutes. 27(90%) patients had sound union in less than 6 months, 3 (10%) patients had delayed union.

Table 5: Duration of fracture union

Time of union	No. of cases	Percentage
< 4 months (16 weeks)	18	60
4-6 months (16 – 24 weeks)	9	30
6 months - 1 year (24-36 weeks)	3	10

There were no cases of intraoperative complications. Postoperative complications such as Superficial Infections (3.3 %), Posterior interosseous nerve injury (6.7 %), Radioulnar synostosis (3.3 %) were noted.

Table 5: Complications

Complications	No. of cases	Percentage
Superficial infection	1	3.3
Posterior interosseous nerve injury	2	6.7
Radioulnar stenosis	1	3.3

Using the Anderson *et al.* scoring system we had 26 (86.7%) patients with excellent results, 3 (10%) patients with satisfactory results and 1 (3.3%) patients with unsatisfactory result (radioulnar synostosis).

Table 6: Functional outcome

Results	Union	Flexion / Extension at elbow joint	Supination and pronation	No. of cases	Percentage
Excellent	Present	<10° loss	<25% loss	26	86.7
Satisfactory	Present	<20° loss	<50% loss	3	10
Unsatisfactory	Present	>20° loss	>50% loss	1	3.3
Failure	Non union with / without loss of motion				

DISCUSSION

Fracture both bones of forearm are commonly encountered in day-to-day orthopaedic practice in our hospital and it presents a formidable challenge to the orthopaedicians, as the various muscle forces acting upon the fracture tend to displace it. Hence to provide the functional rehabilitation of the upper limb, anatomic reduction and rigid fixation is mandatory. As reported by Knight and Purvis closed

reduction and its maintenance is difficult.⁴ Intramedullary nails have got high failure rate. Though there are few advantages like closed nailing, minimal tissue dissection and hospital stay. So, the best option is plating. Different types of plates are available. The dynamic compression plates (DCP) give good results, but there are few disadvantages. Since these plates interfere with periosteal circulation, osteoporosis and refracture are very common

after plate removal. Much work had not been done on PC-fixators and as reported by Frankie Leung *et al.* they have no added advantage over the LC-DCP.⁵ 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.⁶ In the present study, fracture was common in third and fourth decade with average age of 31 years (18-55 years). Chapman *et al.* noted 70% of patients between third and fourth decade and an average of 33 years.⁷ Frankie Leung and Shew Ping chow accounted an average of 36 years (11-90 years).⁵ Chapman *et al.* noted about 78% males and 22% females.²⁵ Frankie-Leung series showed 82.6% males and 17.4% females⁷ In our study, male preponderance with 80% males and 20% female patients, which was comparable to previous studies. Moed BR *et al.* accounted 50% of his cases to RTA, 20% due to industrial accidents, 14% due to fall, 12% due to direct blow and 4% due to gunshot injuries.⁸ In the present study, RTA (60%), fall (30%) and assault (10%) of patients. Chapman *et al.* series noted about 53% of fractures as comminuted and 47% were transverse/short oblique.⁷ In present study accounted 75% of fractures as transverse/short oblique and 25% were comminuted. The results were not comparable to the previous studies, which can be attributed to low velocity trauma in our country Sarmiento A *et al.*⁹ noted about 84.6% of fracture on both bones were in middle third and 15.4% of cases had lower third fracture of both bones.¹⁹ Herbert Dodge and Cady GW documented 71.5% fracture on both bones in middle third, 21.5% in distal third and 7% in proximal third.¹⁰ In our series, we had 70% of fracture in middle third, 20% proximal and 10% in lower third. In the present study, there was one case of superficial infection. It was treated with appropriate antibiotics and the wound healed without any problem. There were two cases of posterior interosseous nerve palsy. These case was treated conservatively and there was spontaneous resolution of the nerve injury. We had a case of proximal radio-ulnar synostosis. We do not believe that this complication is related to the method of fixation, but rather to level of fracture and the degree of comminution. Chapman *et al.* and Anderson *et al.* noted similar complications. Anderson's criteria for evaluation of union were taken into account. In our series, we had an average union time of 12.2 weeks, with the range of 9 to 28 weeks. We had 100% union of both radius and ulna. The

results of our present study are comparable to the previous studies.^{3,5,7} Fracture union and range of movements are the two factors, which affect the functional outcome. So early mobilization prevent soft tissue contracture, muscular tethering and improves the vascularity. Anderson's *et al.* scoring system was used as a measure for the functional outcome.³ Anderson *et al.*³ 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.*¹¹ reported about 36 (86%) cases as excellent, 3 (7%) satisfactory, 1 (2%) as unsatisfactory and 2 (5%) as failure. Frankie Leung reported 98% cases as excellent and 2% as satisfactory results.⁷ In present study, we had 26 (86.7%) with excellent results, 3 (10%) as satisfactory and 1 (3.3%) cases of unsatisfactory results. LC-DCP has got multiple advantages, since their interference with the periosteal circulation is less. They give good results. The rate of union is high, osteoporosis and refracture after removal is very low.

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 are 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.

REFERENCES

1. Schemitsch, Emil H, Robin R. Richards. The effect of malunion on functional outcome after plate fixation of fractures of both bones of forearm in adults. JBJS 1992; 74-A (7): 1068-1078.
2. Perrens M, Allgower M, Brunner H, Burch HB, Cordey J, Ganz R *et al.*. The concept of biological plating using the limited contact dynamic compression plate (LC-DCP). Injury 1991; 22 (1): 1-41.
3. Anderson LD, Sisk TD, Tooms RE, Park W, I III. Compression: Plate fixation in acute diaphyseal fractures of radius and ulna. JBJS 1975; 57-A: 287-297.
4. Knight RA, Purvis GD. Fractures of both bones of the forearm in adults. JBJS 1949; 31-A: 755-764.
5. Leung, Frankie, Shew-Ping Chow. A prospective, randomized trial comparing the LC-DCP with the point contact fixator for forearm fractures. JBJS 2003; 85A (12): 2343-2348.
6. Perren SM, Klaue K, Pohler O, Predieri M. Steinems, Gautier E *et al.*. Limited contact dynamic compression plate (LC-DCP). Arch Orthop Trauma Surg 1990; 109 (6): 304-310.
7. Chapman, Michael W, Gordon JE, Zissimos BS, Anthony G *et al.*. Compression plate fixation of acute fractures of the diaphyses of radius and ulna. JBJS 1989; 71-A (2): 159-169.

8. Moed, Berton R, Kellam James F, Foster Robert J, Tilemaa. Immediate internal fixation of open fractures of the diaphysis of forearm. JBJS 1986; 68 (7): 1008- 1016.
9. Sarmiento, Augusto, Jack S. Cooper and William F. Sinclair. Forearm fractures. JBJS 1975; 57-A (3): 297- 304.
10. Dodge, Herbert S., Gerald W. Cady: Treatment of fractures of the radius and ulna with compression plates. JBJS 1972; 54-A (6): 1167-1176.
11. Chapman, Michael W, Gordon JE, Zissimos BS, Anthony G *et al.*. Compression plate fixation of acute fractures of the diaphyses of radius and ulna. JBJS 1989; 71-A (2): 159-169.

Source of Support: None Declared
Conflict of Interest: None Declared

