



International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(3): 134-141
© 2020 IJOS
www.orthopaper.com
Received: 06-05-2020
Accepted: 11-06-2020

Dr. Sumer Singh Shekhawat
Department of Orthopaedics,
Mahatma Gandhi Medical
College and Hospital, Sitapura,
Jaipur, Rajasthan, India

Dr. Anil Kala
Assistant Professor, Department
of Orthopaedics, Mahatma
Gandhi Medical College and
Hospital, Sitapura, Jaipur,
Rajasthan India

Dr. SP Gupta
Professor, Head of Department
of Orthopaedics, Mahatma
Gandhi Medical College and
Hospital, Sitapura, Jaipur,
Rajasthan India

Corresponding Author:
Dr. Anil Kala
Assistant Professor, Department
of Orthopaedics, Mahatma
Gandhi Medical College and
Hospital, Sitapura, Jaipur,
Rajasthan India

Prospective study of outcome of low Contact-dynamic compression plates in treatment of both forearm fractures

Dr. Sumer Singh Shekhawat, Dr. Anil Kala and Dr. SP Gupta

DOI: <https://doi.org/10.22271/ortho.2020.v6.i3c.2191>

Abstract

Background: Fractures of both bone of the forearm are relatively common injuries. Healing occurs reliably after closed treatment but malunion, with resultant decreased rotation of the forearm is common and has been associated with poor results¹. This study is undertaken to assess the results of diaphyseal fractures of BBFA using LC-DCP to study the advantages and its complications.

Material and method: This study includes treatment of 30 cases of fracture of both bones of forearm by open reduction and internal fixation with 3.5 mm LC-DCP between January 2018 to July 2019 at Mahatma Gandhi Medical college, Jaipur.

Results: This study consists of 30 cases of fracture Both Bone Forearm Fractures. All cases were openly reduced and internally fixed with 3.5 mm LCDCP. Fracture was common in second and third decade with average age of 37 years (18-65 years). In our study, male preponderance was found with 70% males and 30% female patients. Side affected 13 were (43%) left side and 17 patients (57%) right side. Mode of injury in the present study, RTA (70%), fall (20%) and assault (10%). Type of fracture 20 patients (67%) closed, 10 patients (33%) GA1. Level of fracture 19 patients (61%) middle third, 9 patients (30%) proximal third, 2 patients (6%) lower third. An average time for union was 16 weeks. Results were evaluated by Andersons scoring system. In present study, we had 28 patients (93.33%) with excellent results, 1 case (3.33%) as satisfactory and 1 case (3.33%) as failure which required re-fixation. In the present study there was 1 case (3.33%) of superficial infection, 1 case (3.33%) of non-union of radius which required re-fixation with bone grafting.

Conclusion: LC-DCP can be considered the best mode of treatment for closed diaphyseal fractures of both bones forearm.

Keywords: Both bones forearm, diaphyseal fractures, limited contact dynamic compression plate, Andersons scoring system.

Introduction

The forearm has a complex architecture consisting of two mobile relatively parallel bones that provides a stable link between the elbow and the wrist and serves as origin of several muscles inserting on hand. Fracture of both bones forearm has unique problems not encountered with fractures of the shafts of other bones. Restoration of forearm rotation, elbow, wrist motions and grip strength has been shown to be facilitated by the anatomic reduction and internal fixation of these fractures^[1]. When combined with rotational motion of the shoulder, forearm rotation permits the hand to be positioned through an entire 360° arc of motion. With the shoulder fully abducted, nearly all of the rotational motion of the upper limb occurs through the forearm. Activities such as accepting objects in the palm of the hand require nearly full forearm supination, while many other functional tasks require some degree of pronation^[2].

Methodology: This study includes treatment of 30 cases of fracture of both bones of forearm by open reduction and internal fixation with 3.5 mm LC-DCP between Jan 18 to June 2019 at Mahatma Gandhi medical college, Jaipur. This is a prospective time bound 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.

In general condition of the patient, the vital signs were recorded. Methodical examination was done to rule out fractures at other sites. Local examination of injured forearm revealed swelling, deformity and loss of function. Any nerve injury was looked for and noted. Palpation revealed, abnormal mobility, crepitus and shortening of the forearm, distal vascularity was assessed by radial artery pulsations, capillary filling, pallor and paraesthesia at finger tips. Radiographs of the radius and ulna i.e., anteroposterior and lateral views, were obtained. The elbow and wrist joints were included in each view. 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 for surgery. The investigations are as follows: Hb%, Urine for sugar, FBS, Blood urea, Serum creatinine, ECG and chest x-ray and viral marker.

Evaluation: The results were evaluated with Anderson's criteria for evaluation of forearm bones fracture. The results were compared with previous studies. Ethical clearance has been obtained from the Ethical Committee of Mahatma Gandhi medical college, Jaipur.

Operative procedure

After anaesthesia, part was painted and draped. The radius was approached by Dorsal Thomson/ Volar Henry's approach for proximal radius and mid shaft fractures, Dorsal Thomson approach was preferred for proximal fractures, and for distal radius fracture, Volar Henry's approach was preferred. Ulna was approached directly over the subcutaneous border.

After identifying the fracture ends, periosteum was elevated and fracture ends were cleaned. With the help of reduction clamps, fracture was reduced and held in position. The plate was then applied after contouring, if required. For upper third radial fractures, the plate was fixed dorsally, for distal two thirds, the plate was fixed dorsolaterally and for distal radial fractures the plate was fixed on the volar aspect. In ulna fractures plate was applied over the posteromedial surface of ulna [3]. In case of porotic, comminuted and/or small bones, long screws and/or a longer plate were used. Once stable fixation is achieved and hemostasis secured meticulously, the wound is closed in layers over a suction drain and sterile dressing is applied.

Postoperative care

The limb was kept elevated for 24 to 48 hours and the patient was instructed to move their fingers and elbow joint. Suction drain was removed after 24 to 48 hours. Wound was inspected after 3 to 4 days postoperatively. Antibiotics and analgesics were given to the patient till the time of suture removal. Suture removed on 10th postoperative day and check X-ray in anteroposterior and lateral views were obtained.

Physiotherapy

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. Because of rigidity of fixation, rapid return of motion was expected. Physiotherapy helps in fracture union, as there is

increased blood supply and tethering of muscles to the bone and soft tissue contracture is avoided. Thus, physiotherapy with rigid fixation, gives excellent results.

Follow-up-All the patients were followed up as monthly intervals for first 3 months and evaluation was done based on "Anderson *et al* scoring system"⁴ Elbow movements and wrist movements were noted and the union was assessed radiologically. The fracture was designated as united, when there was presence of periosteal callus bridging the fracture site and trabeculations extending across the fracture line.

Operative Photograph



Results

The present study consists of 30 cases of fracture both bones of the forearm. All the cases were openly reduced and internally fixed with 3.5mm LC-DCP.

Table 1: Age Distribution

Age	No. of Patient's	Percentage
18 – 25	10	33.3
26 – 35	5	16.66
36 – 45	6	20
46 – 55	7	23.33
56 – 65	2	6.66
Total	30	100

Table 2: Sex distribution

Sex	No. of Patient's	Percentage
Male	21	70
Female	9	30
Total	30	100

Table 3: Side affected

Side affected	No. of Patient's	Percentage
Left	13	43.33
Right	17	56.66
Total	30	100

Table 4: Mode of injury

Mode of injury	No. of Patient's	Percentage
RTA	21	70
Self-fall	6	20
Assault	3	10
Total	30	100

Fracture characteristics**Clinical fracture type****Table 5:** Clinical Fracture Type

Type of injury	No of patient	Percentage
Closed	20	66.66%
Gustilo Anderson I	10	33.33%

Table 6: Level of fracture

Level of injury	No. of Patient's	Percentage
Middle third fractures	19	60.66
Proximal third fractures	9	30
Lower third fractures	2	6.66
Total	30	100

Table 7: Type of the fracture

Type of fracture	Radius	Ulna	Percentage
Transverse /short oblique/wedge	20	24	73.33
Comminuted	9	5	23.33
Segmental	1	1	3.33
Total	30	30	100

Table 8: AO-classification-AVG. Time for union

Type of fracture	N0.	Percentage	Avg. time of union(weeks)
22-A3	10	33.33	13.6
22-B3	4	13.33	16
22-C1	6	20	16.5
22-C2	8	26.66	18
22-C3		6.33	20

Table 9: Complications

Complications	No. of cases	Percentage
Superficial infection	1	3.33
Nonunion of radius	1	3.33
Without complication	28	93.33
Total	2	6.66

Criteria for Evaluation of Functional Outcome

“Anderson” *et al* scoring system (1975) ^[4]

Table 10: Criteria for evaluation of Functional outcome

Results	Union	Flexion / Extension at wrist joint	Supination and pronation
Excellent	Present	<10° loss	<25% loss
Satisfactory	Present	<20° loss	<50% loss
Unsatisfactory	Present	>20° loss	>50% loss
Failure	Non union with / without loss of motion		

Table 11: Functional Results

Results	No. of cases	Percentage
Excellent	28	93.33
Satisfactory	1	3.33
Unsatisfactory	Nil	Nil
Failure(required re-fixation with bone grafting)	1	3.33
Total	30	100

Clinical Photograph**Case 1:****Preoperative****After 4 Weeks****After 12 weeks****Clinical Photos-3****Extension****Flexion****Supination**



Pronation



Wrist dorsiflexion



Wrist palmarflexion

CASE2



Preoperative



after 4weeks



After 16week

CLINICAL PHOTOS-1



Elbow extension



Elbow Flexion



Supination



Pronation



Wrist dorsiflexion



Wrist palmar flexion

Discussion

Fractures of both bones of the forearm are relatively common injuries which can challenge the treating orthopaedician. Healing occurs relatively after closed treatment but malunion with resultant decreased rotation of the forearm, is common and has been associated with poor outcomes. Rotation of the forearm is a complex interaction between the radius and the ulna and restoration of movements depend upon both an accurate reduction of fractures and early initiation of post-operative movements. Loss of rotation impedes function of the upper limb and activities of daily living.⁵ Compression plate fixation has become the treatment of choice for fractures of both bones of the forearm. Compression plate fixation gives a high rate of union, low rate of complications, and a satisfactory return of rotation of the forearm.⁵

As reported by Kurt.P. Droll in 2007 based on his study, plate fixation of diaphyseal fractures of both bones of the forearm using 3.5mm Limited contact Dynamic Compression plate restores nearly normal anatomy and motion even though strength remains an average of 30% less than that of contralateral extremity years after the injury.^[1]

So, the LC-DCPs are the best implants for diaphyseal fracture of both bones forearm at present. LC-DCPs have got multiple advantages since their interference with the periosteal circulation is less. They give good results. The rate of union is high and, osteoporosis and refractures after removal is very low.

The present study was undertaken to determine the efficacy of

LC-DCP in the treatment of fractures of both bones of the forearm. A total of 30 patients of fracture both bones of forearm were treated with open reduction and internal fixation using 3.5 mm LC-DCP.

We evaluated our results and compared with those obtained by various other studies utilizing different modalities of treatment. Our analysis is as follows

Age distribution

In the study conducted at Mahatma Gandhi Institute of Medical Sciences, fracture was common in second and third decade with average age of 37 years (18-64years)

Table 1: Age distribution

Series	Minimum age (years)	Maximum age (years)	Average age (years)
Goldfarb ^[5]	19	84	40
Peter kloen ^[6]	16	76	37
Kurt.P.Droll ^[1]	18	73	43.9
Herbert Dodge ^[7]	13	59	24
Michael Chapman ^[8]	13	79	33
Moed BR ^[9]	14	65	22
Schemitsch <i>et al.</i> ^[10]	16	83	24
Frankie Leung ^[11]	11	90	36
Present study	18	64	37

Sex distribution

In our study, male preponderance with 70% males and 30% female patients, which were comparable to previous studies.

Table 2: Sex distribution

Series	Males (%)	Females (%)
Goldfarb ⁵	60.9	39.1
Peter kloen ⁶	74	26
Kurt.P.Droll ¹	63	37
Herbert Dodge ⁷	89	11
Michael Chapman ⁸	78	22
William AT ¹²	67	33
Frankie Leung ¹¹	82.6	17.4
Burwell <i>et al.</i> ¹³	69.33	30.67
Present study	70	30

Mode of injury

In the present study, RTA (70%), fall (20%) and assault (10%).

Table 3: Mode of injury

Series	Accident (%)	Fall	Direct blow/Miscellaneous
Goldfarb ^[5]	56.5	21.7	21.7
Peter kloen ^[6]	63	30	7
Kurt. P. Droll ^[1]	55	26	19
Moed ^[9]	70	14	16
Grace ^[14]	45	22	33
Smith ^[15]	45	36	19
Schemitsch <i>et al.</i> ^[10]	34.55	38.18	27.73
Present study	70	20	10

Extremity affected

Table 4: Side affected

Series	Right (%)	Left (%)	Both (%)
Goldfarb ^[5]	37.5	62.5	8
Peter kloen ^[6]	40	60	2
Kurt. P. Droll ^[1]	53	45	—
Burwell HN ^[13]	49.33	50.67	—
Michael Chapman ^[8]	55	45	—
Schemitsch <i>et al.</i> ^[10]	43.63	56.37	—
Present study	43.33	56.66	—

Fracture Anatomy

Type of fracture: Chapman noted about 47% were transverse/short oblique, 53% of fractures as comminuted.^[8] In our study, about 73.33% were transverse/short oblique, 23.33% of fractures as comminuted and 3.33% were segmental fractures. The results were not comparable to the previous studies, which can be attributed to low velocity trauma in our country.

Table 5: Fracture type

Series	Transverse/short oblique (%)	Comminuted (%)	Segmental Fracture (%)
Chapman ^[8]	47	53	-
Present study	73.33	23.33	3.33

Level of fracture

In our series, we had 63.33% of fracture in middle third, 30% proximal and 6.66% in lower third. In other studies, the incidence of fracture is highest in the middle third and least in the proximal third.

Table 6: Fracture level

Series	Proximal third (%)	Middle third (%)	Distal third (%)
Herbert Dodge ^[7]	7.14	71.42	21.44
Sarmiento ^[16]	-	84.6	15.4
Chapman ^[8]	13	59	28
Present study	30	63.33	6.66

Duration of surgery and tourniquet time

The duration of surgery ranged between 50 to 90 minutes,

with an average 74.5 minutes. The tourniquet time ranged from 40 to 60 minute, with an average of 49.75 minute. These findings could not be compared to the previous studies, as there was no data available.

Duration of follow-up

Our study is comparable to Chapman series but other series had longer follow-up.

Anderson and Moed followed up for an average of 3 years. In 2005, Goldfarb followed up for an average of 34 months^[5]. In 2007, Kurt.P. Droll followed up for an average of 5.4 years^[1]. In 2010, Peter kloen followed up for an average of 75 months^[6].

Table 7: Duration of Follow Up

Series	Range	Average
Peter kloen ^[6]	12-315 months	75 months
Kurt.P.Droll ^[1]	2-13.4 years	5.4years
Goldfarb ^[5]	11-72 months	34 months
Anderson ^[4]	4 – 9 years	3 years
Chapman ^[8]	6 – 48 months	12 months
Moed ^[9]	12 months – 9 years	3 years
Frankie ^[11]	14 – 40 months	22 months
Present study	6 – 24 months	12 months

Complications

In the present study there were 1 case of superficial infection which subsided with antibiotics and 1 case of non-union of radius, which required curettage, bone grafting and re-fixation.

Table 8: Complications

Complications	Kurt. P. Droll ^[1]	Anderson ^[4]	Chapman ^[8]	Frankie ^[11]	Peter kloen ^[6]	Goldfarb ^[5]	Present study
Superficial Infection	-	2.9%		2%	-	-	3.33%
Deep infection			2.3%			-	-
Re-fracture, fracture at the end of the plate and fracture through the compression Hole	-	2.9%	2.3%	2%	2.1%	-	-
Back out of Screws			2.3%			-	-
Compartment Syndrome		-		2%		-	-
Non-union	-	2.9%	-	-		-	3.33%
Post-interosseous nerve injury	3.3%	2%	1.2%		2.1%	-	-
Injury to other nerves(ulnar nerve, superficial branch of radial nerve)	13%	-		5%	-	-	-
Radio-ulnar Synostosis	-	1.2%	1.2%	-	-	-	-
Irritation by Hardware	10%	-			-	-	-

Time for union

Anderson's criteria for evaluation of union were taken into account. In our series, we had an average union time of 16

weeks, with the range of 12 to 18 weeks. We had 96.66% union of both radius and ulna.

Table 9: Time for Union

Series	Union times (weeks)	Range (Weeks)	Union (%)
Peter kloen ^[6]	28	10-84	100
Anderson ^[4]	7.4	5 – 10	97
Chapman ^[8]	12	6 – 14	98
Frankie ^[11]	17	8 – 36	100
Mc Knee ^[17]	10.7	5 – 18	97.3
Present study	18	12 – 18	96.66

Functional results

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.⁴ In 1975, Anderson *et al* reported about 54 (50.9%) cases as excellent, 37 (34.3%) satisfactory, 12 (11.3%) unsatisfactory

and 2 (2.9%) as failure⁴. In 1989, Chapman *et al* reported about 36 (86%) cases as excellent, 3 (7%) satisfactory, 1 (2%) as unsatisfactory and 2 (5%) as failure⁸. In 2003, Frankie Leung reported 98% cases as excellent and 2% as satisfactory results¹¹. In 2010 Peter kloen found 29(62%) with excellent results, 8 (17%) as satisfactory and 10 (21%) cases of unsatisfactory result⁶. In present study, we had 28(93.33%) with excellent results, 1 (3.33%) as satisfactory and 1(3.33%) as failure which required re-fixation and bone grafting.

Table 10: Functional Results

Series	Excellent (%)	Satisfactory (%)	Unsatisfactory (%)	Failure (%)
Peter kloen ⁶	62%	17%	21%	-
Anderson ⁴	50.9	34.9	11.3	2.9
Chapman ⁸	86	7	12	5
Frankie ¹¹	98	2	-	-
Burwell ¹³	77	23.8	10.8	1.4
Present study	93.33	3.33	-	3.33

Conclusion

- Benefit of LC-DCP- it facilitates biological fixation of the bone and early bone union. It is easy to apply in both bone forearm fracture.
- Use of separate incisions for radius and ulna and preservation of the natural curves of radius will lesser rate of complication.
- Rigid fixation of fractures after perfect anatomical reduction with 3.5 mm LC-DCP and screws allows early mobilization.
- A minimum of 6 cortices has to be fixed in each fracture part.
- LC-DCP minimize vascular damage to the plated bone segment.
- The special design of the plate does not interfere with periosteal blood circulation to the extent the DCP does, so early union takes place and postoperative weakness of bone does not occur.
- A postoperative plaster is seldom required for uncomplicated fractures and early return to light work is possible.
- It gives excellent functional results in the most of patients.
- Complications after a well-performed surgery are minor and correctable.
- In comminuted fracture union time more as compare to transverse and oblique fracture.
- 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.

Summary

This study has been taken to determine the functional outcome of treating diaphyseal fractures of both bones, forearm with limited contact dynamic compression plate between January 2018 to July 2019 at Mahatma Gandhi medical college, Jaipur.

This is a time-bound prospective study.

- Thirty cases of fractures of both bones forearm were treated by open reduction and internal fixation with 3.5 mm LC-DCP. The follow-up ranged from 6 months to 24 months. Males predominant with right forearm affection

more than left. Most of the fractures due to RTA and self-fall.

- The average age was 37 years with fracture being most common in second and third decade comparable to the study made by Peter kloen in 2003.
- Most of the fractures are both bones of forearm are located in the middle third and the fracture pattern transverse/short oblique was commonest.
- 28 (93.33%) patients had sound union in less than 4 months, 1(3.33%) had union between 4 to 6 months, 1 (3.33%) patients had non-union of radius.
- The results were based on Anderson *et al* scoring system and in our study, there were 28(93.33%) patients with excellent results and 1 (3.33%) with satisfactory and 1(3.33%) case failure due to non-union of radius.

References

- Droll KP, Perna P, Potter J, Harniman E, Schemitsch EH, McKee MD *et al*. Outcomes following plate fixation of fractures of both bones of the forearm in adults. JBJS. 2007; 89(12):2619-24.
- Jupiter JB, Fernandez DL, Levin LS, Wysocki RW. Reconstruction of posttraumatic disorders of the forearm. JBJS. 2009; 91(11):2730-9.
- Perren SM. Basic aspects of internal fixation. In Manual of internal fixation, 1991, 1-158. Springer, Berlin, Heidelberg.
- Anderson LD, Sisk D, Tooms RE. Compression-plate fixation in acute diaphyseal fractures of the radius and ulna. The Journal of bone and joint surgery. American volume. 1975; 57(3):287-97.
- Goldfarb CA, Ricci WM. Functional outcome after fracture of both bones of the forearm JBJS9Br). 2005; 87-B; 374-9.
- Kloen P, Wiggers JK, Buijze GA. Treatment of diaphyseal non-unions of the ulna and radius. Archives of orthopaedic and trauma surgery. 2010; 130(12):1439-45.
- Dodge HS, Cady GW. Treatment of fractures of the radius and ulna with compression plates: a retrospective study of one hundred and nineteen fractures in seventy-eight patients. JBJS. 1972; 54(6):1167-76.
- Chapman MW, Gordon JE, Zissimos AG. Compression-plate fixation of acute fractures of the diaphysis of the radius and ulna. The Journal of bone and joint surgery. American volume. 1989; 71(2):159-69.
- Moed BR, Kellam JF, Foster RJ, Tile M, Hansen ST. Immediate internal fixation of open fractures of the diaphysis of the. J Bone Joint Surg Am. 1986;68:1008-17
- Schemitsch E, Richards R. The effect of malunion on functional outcome after plate fixation of. J Bone Joint Surg Am. 1992; 74:1068-78.
- Leung F, Chow SP. A prospective, randomized trial comparing the limited contact dynamic compression plate with the point contact fixator for forearm fractures. JBJS. 2003; 85(12):2343-8.
- Andrew H Crenshaw. Edward A. Perez Surgical techniques and approaches in chapter 1; Campbells Operative Orthopaedics by Terry. S. Canale, James. H. Beaty 11th edition, 2008, 117-120.
- Neville Burwell H, Charnley AD. Treatment of forearm fractures in adults with particular reference to plate fixation. The Journal of bone and joint surgery. British volume. 1964; 46(3):404-25.
- Thakur AJ. Bone plates. Chapter-4 in The elements of fracture fixation, Churchill Livingstone, New Delhi,

- 1997, 57-79.
15. Gupta RK, Saji MA, Ghorpade KN, Rabari YB, Shaikh IN. Internal fixation of fractures both bone forearm: Comparison of dynamic compression plate and IM nail. International Journal of Orthopaedics. 2017; 3(3):508-13.
16. Sarmiento Augusto, Jack S. Cooper and William F. Sinclair. Forearm fractures. JBJS 1975; 57-A(3):297-304.
17. McKee MD, Seiler JG, Jupiter JB. The application of the limited contact dynamic compression plate in the upper extremity: an analysis of 114 consecutive cases. Injury. 1995; 26(10):661-6.