International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2017; 3(1): 785-791

www.orthopaper.com
Received: 22-11-2016
Accepted: 23-12-2016

Dr. Ranganath HD
Professor, Department of Orthopedics, Kempegowda Institute of Medical Science and Research Centre, Bengaluru, Karnataka, India

Dr. Channappa TS
Professor, Department of Orthopedics, Kempegowda Institute of Medical Science and Research Centre, Bengaluru, Karnataka, India

Dr. Suhas BD
Postgraduate, Department of Orthopedics, Kempegowda Institute of Medical Science and Research Centre, Bengaluru, Karnataka, India

Dr. Somashekhar S
Professor, Department of Orthopedics, Kempegowda Institute of Medical Science and Research Centre, Bengaluru, Karnataka, India

Correspondence
Dr. Channappa TS
Professor, Department of Orthopedics, Kempegowda Institute of Medical Science and Research Centre, Bengaluru, Karnataka, India

A study of surgical management of fracture both bones forearm treated with limited contact dynamic compression plate and screws

Dr. Ranganath HD, Dr. Channappa TS, Dr. Suhas BD and Dr. Somashekhar S

DOI: http://dx.doi.org/10.22271/ortho.2017.v3.i1l.112

Abstract
Background and Objective: Fractures of the forearm bones may result in severe loss of function unless adequately treated. In addition to regaining length, apposition and axial alignment and normal rotational alignment is necessary for good range of pronation and supination. Bone healing of both radius and ulna is slow because of small contactsurfaces at the fracture site and is the reason why stable fixation of fragments is necessary.
The advantages of plating are.
1) Excellent control of fracture fragments
2) Anatomical realignment is possible.
3) Very low rate of non-union.
4) Good to excellent functional results.
So we decided to study and evaluate the results of internal fixation with LC-DCP to confirm its present day relevance.

Keywords: Forearm, LC-DCP, fixation

Introduction
Fractures of the forearm bones may result in severe loss of function unless adequately treated. Severe loss of function may result even though adequate healing of the fracture occurs[1]. Fractures of the forearm present a unique management problem for years. A forearm fracture involving both bones requires open anatomical reduction with stable fixation.[2] various treatment modalities were introduced from time to time and each of them had some edge over the previous one. The forearm represents the critical anatomic unit of upper limb, permitting the effector organ of the upper limb, the hand, to perform multiaxial daily activities of living.
Historically, the closed management of forearm fractures has been met with frustration in adults and resulted in poor functional outcome, hence perfect fracture reduction and rigid fixation is mandatory and achieved by plating.[3]The number of forearm fractures is increasing faster than the predicted rate due to increasing number of road traffic accidents, increased incidence of violence, rapid industrialization, and various sports activities.
Conservative treatment has resulted in malunion, non-union, synostosis and ultimately poor functional outcome[4]. In older methods of plating, the screw acts as an anchor, with its axial force**.** Compressing the plate against bone, which produces large frictional force at the bone plate interface and this force cause vascular disturbance, especially in the periosteum.
This observation has led to the development of Limited Contact Dynamic Compression Plate, by Perren S.M which decreases the bone contact area to approximately 50% of the total area of the under surface of the plate. So does not hinder the periosteal circulation. So, fracture healing is good and re fracture is less.[5]

Materials and methods
The proposed study is a hospital based prospective study centered in Kempegowda institute of medical sciences, Bangalore during the term between Nov 2014 to April 2016.

In this study period a total of 30 cases of fracture both bones forearm were operated with open reduction and internal fixation with limited contact dynamic compression plate.

Inclusion criteria

1) Age Group of More Than 18 Yrs
2) Simple and Gustillo-Anderson Type 1 Fractures
3) Fresh Fractures
4) With or Without Neurological Involvement

Exclusion criteria

1) Gustillo-Anderson Classification Type Ii and Iii A, Iiib, Iiic
2) Associated Compartment Syndrome
3) Old Fractures
4) Ipsilateral Limb Fractures
5) Infected Fractures

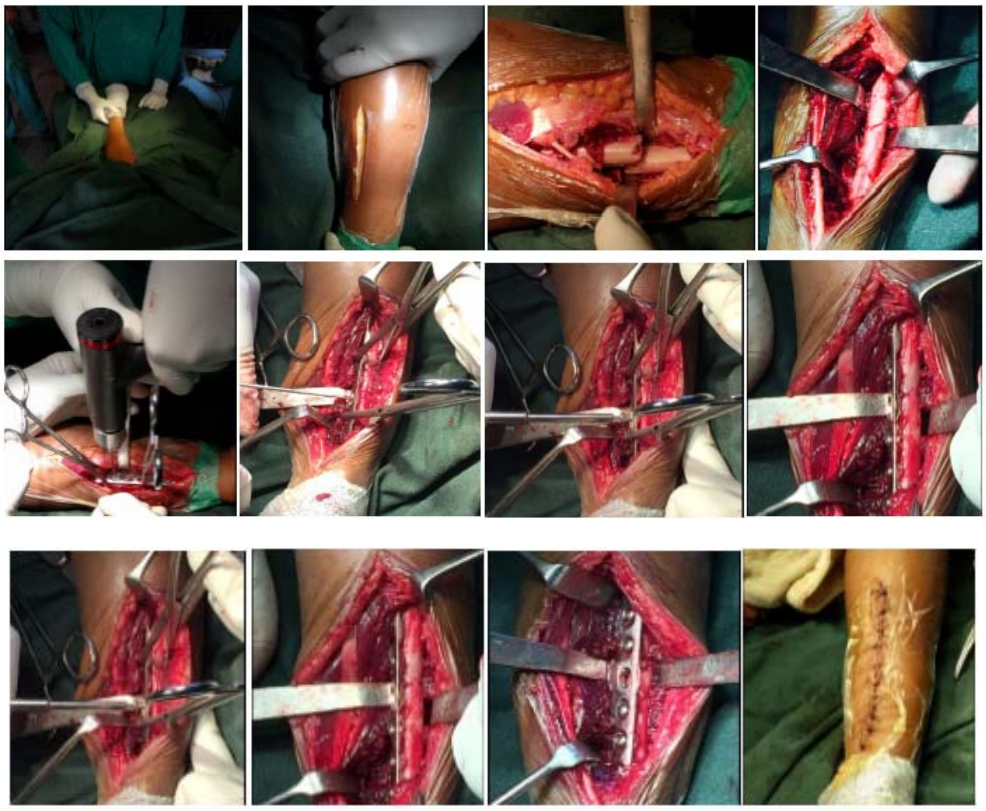
Preoperative Planning

- A written and informed consent was taken.
- Appropriate length of the plate to be used was assessed with help of radiographs.
- A dose of IV antibiotic was given 1 hour before the start of surgery

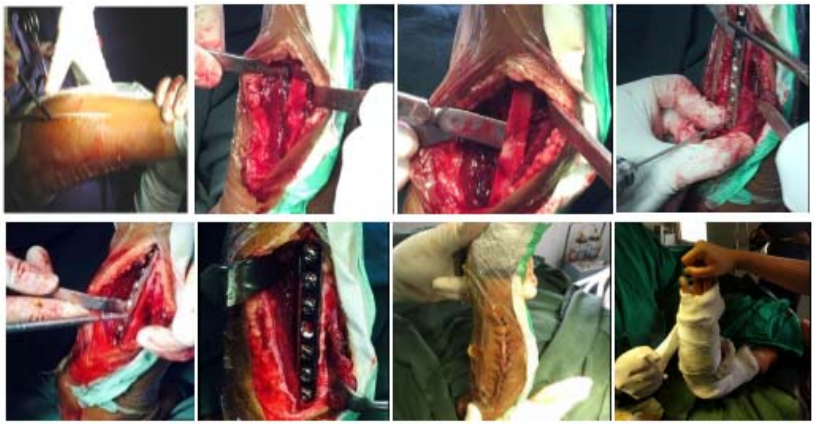
Operative procedure

- Type of anesthesia: General anesthesia or brachial block.
- Pneumatic tourniquet was applied, the tourniquet was inflated just before the start of surgery and deflated before the start of closure and the time was noted.
- Painting and draping of the part done
- The radius was approached using either dorsal Thompson or Volar Henry's approach. For proximal radius Dorsal Thompson approach was preferred and for distal two thirds
- Radius fractures Volar Henry's approach was preferred. Ulna was approached directly over the subcutaneous border.
- The skin, subcutaneous tissue and the muscle is retracted.
- Once the periosteal stripping is achieved the fracture ends are reduced as anatomical as possible. it is then held in position with the bone clamps and the reduction is achieved
- A plate of at least 6 holes was chosen and longer plates were used in spiral, and comminuted fractures.
- The plate is placed and is fixed with the clamps and is held in position. Now the bone is drilled using the sleeve. The placement of the first screw has to be central in position and the neutral drill guide has to be used.
- The bone is then tapped, the size of the screw determined with the help of a depth guage. After the first hole has been drilled, determine the proper screwlength with the depth gauge and the screw has to inserted
- The other remaining screws are inserted using neutral drill guide.
- In case of porotic bone long screws used, in case of comminuted long plates were used.
- Tourniquet released, haemostasis was achieved.
- Muscles, subcutaneous tissue, skin are closed, aseptic dressing applied and compression bandage applied.
- Postoperative above elbow POP slab applied.

Fig: Operative Photos for Radius



Operative photos for ulna



Postoperatively

Wound inspected after 48 hrs, Drain removed.
Antibiotics & analgesics continued for 5 days.
Suture removal done after 10 days.
Depending on the degree of comminution slab was discarded after Suture removal at 3wks Active elbow, wrist& finger movements encouraged.
Patient was followed up regularly at 6 wks, 12 wks & 24 wks & Evaluation done using "Anderson" *et al* scoring system (1975) [12]. 22

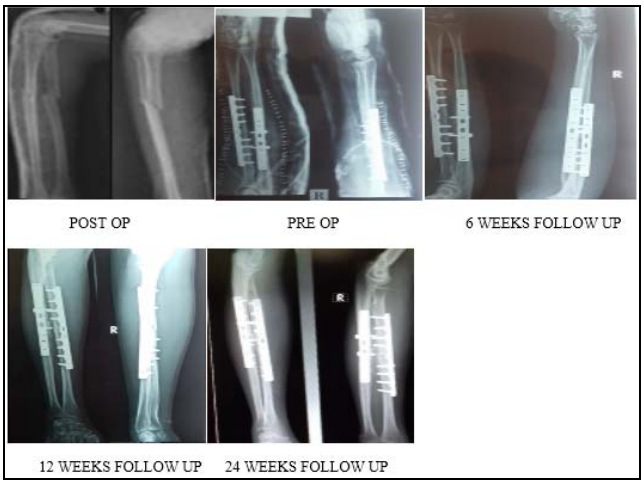
Implant used in our study

Clinical photos:
Case 1

X-ray photos

Case 2

X-rays



Results and discussion

Fracture both bones forearm presents a challenge to the orthopaedician as the muscle force acting upon the fracture fragments tends to displace it. The return of function depends on union of fracture and motion of forearm. Hence anatomical reduction and rigid fixation is mandatory.

This can be achieved by ORIF with LC-DCP and screws The present study was undertaken to evaluated the outcome of 30 patients treated by open reduction and internal fixation with limited contact dynamic compression plate and screws to radius and ulna. The results obtained from our study was compared with the similar studies conducted worldwide. The present study of both bones fracture of forearm treated with LC-DCP is compared with S Singh *et al* study, KC Saikia *et al* study and Frankie Leung *et al* study.

In our study the age distribution was in between the age group of 20 to 70 yrs with a mean average age group of 41.7yrs.

In our study we found out that there was a predominance of male patients 66.7% and the female population was found to be 33.3% which was comparable with other studies. In our study it was found out that 16 patients had a history of self fall, 13 patients had a history of RTA and 1 patient had history of assault.In our study we found out that left forearm was affected in 17 pts (56.7%) and right forearm in 13 pts (43.3%).

Type of fracture

Type of fracture	Number of participants	Percentage
Comminuted	11	36.7
Oblique	5	16.7
Transverse	14	46.6
Total	30	100

In our study we found out that 46.6% had transverse fracture, 36.7% had communited fracture and 16.7% had oblique fracture.

Fracture site

Fracture site	Number of participants	Percentage
Lower 3rd	7	23.3
Middle3rd	16	53.4
Proximal3rd	7	23.3
Total	30	100

In our study there was an incidence of 53.4% fractures in the middle1/3, 23.3% fractures occurred at the proximal 1/3 and 23.3% fractures at the distal1/3.

Similarly in the ulna transverse fracture of the ulna was most common which accounted to 40% of the fractures.

There were 2 patients in the study group who had associated headinjury, 1patient had rib fracture and 1 patient had associated splenic injury.

The middle and proximal 3rd fracture of the radius was approached through the volar henrys approach which included 73.3% of cases performed.

The dorsal Thompsons approach was for patients with proximal 3rd fracture which accounted for 26.7%.

It was found out from the study that the mean duration of the surgery was 87.4 minutes and tourniquet time was 66 minutes.

Time duration

Time duration	Mean	Standard deviation	95% CI formean	
Surgery duration (in mins)	87.4	9.1	88.0	90.8
Tourniquet Time (In mins)	66.0	8.4	62.8	69.2
Time for union (in weeks)	13.6	3.2	12.4	14.7

It was found out from the study that the mean duration of the surgery was 87.4 minutes and tourniquet time was 66 minutes.

Time taken for union of the bone

Time taken for union	Number of participants	Percentage	95% CI
<16 weeks	20	67	48.8-80.8
16-24weeks	10	33	19.2-51.2
Total	30	100	

It was found out in our study that there was 100% union of the fractures .67% of the patient had union within 16 weeks and 33% between 16 to 24 weeks. The mean duration of union is 13.6 weeks.

A study conducted by S Singh in the year 2003 showed the average time of union of 13.6 weeks and 72.1% union was achieved by 12 weeks.

KC Saikai conducted a study in the year 2006 to 2009 which showed a mean period of union being 17 weeks.

A study by Marya KM in the year 1996 to 2000 showed a average time of union of 12.3 weeks A study by Frankie Leung in the year 1996 to 2001 showed a mean time of union of 17 weeks A study conducted by Chapman in the year 1989 showed average time of union of 12 weeks

Series	Averagetimeofunion (weeks)
S singh	13.6
KCSaikai	17
Marya	12.3
Frankie	17
Chapman	12
Our study	13.6

Criteria for evaluation of results

"Anderson" *et al* scoring system (1975) [12].

"**Anderson's criteria"**

- **Excellent** – union + loss < 100 Flexion / Extension + loss of < 25% pronation/supination
- **Satisfactory** – union + loss of < 200 Flexion / Extension + loss of < 50% pronation / supination
- **Unsatisfactory** – Union + loss of > 300 Flexion / Extension + loss of 50% supination / Pronation
- **Failure** –Non-union with / without loss of motion

Binary outcome of surgery

Binary outcome	Number of participants	Percentage	95% CI
Satisfactory /unsatisfactory	4	13.3	(3.5-25.6)
Excellent	26	86.6	(74.4-96.5)
Total	30	100	

Functional results

In our study evaluated we found out that there was 86.6 % patients with excellent results, 6.7 % with satisfactory results, 6.7 % with unsatisfactory and 0 with poor results.

The functional outcome was assesed according to Anderson scoring system which included evaluation of the movements and the radiological union.

A study conducted by KC Saikai the year 2006 to 2009 showed excellent functional outcome in 89%, satisfactory 8% and poor in 1% of patients 38 A study conducted by Marya km 1996 to 2000 showed excellent results in 88%, satisfactory in 7%, unsatisfactory in 4% and failure in 1%36 A study conducted by Chapman in the year 1989 showed excellent results in 91% and satisfactory in 7%28

Series	Excellent	Satisfactory	Poor
KC Saikai	89%	8%	1%
Marya KM	88%	7%	1%
Chapman	91%	7%	1%
Our study	83.3%	6.7%	0

Complications

Complications	Number of participants	Percentage
Absent	27	90
Present	3	10
1. Stiffness	2	6.7
2. Superficial infection	1	3.3
Total	30	100

In our study group 3 patients developed complications post surgery.

In our study 1 patient encountered with superficial infections postoperatively which was treated with antibiotics. The infection subsided after the treatment. 2 patients had stiffness of the elbow and the wrist joint which was treated with regular physiotherapy Elbow and wrist stiffness and superficial infection was noted in the study conducted by S Singh 2 patients developed superficial infection in the study conducted by KC Saikai 1 patient developed superficial infection in the study conducted by Frankie Leung 5

Conclusion

In our study a total of 30 cases of post traumatic fracture both bones forearm treated with LC-DCP was evaluated in our hospital from the time period between Nov 2014 to April 2016. The efficacy, intraoperative, post operative and results of the treatment were evaluated.

We conclude that

1. The fracture both bones forearm is common in the male population between the age group of 30 to 55 years
2. Majority of the fractures encountered was due to self fall and the left side was the most commonly involved side
3. There was more number of transverse fractures which occurred more commonly in the middle third junction of the forearm
4. The complications which occurred in the study was minimum and hence can be concluded that operative treatment that is Open Reduction and Internal Fixation with LC-DCP had excellent results
5. A tourniquet was used during the surgery to create a blood less field and to lessen the duration of surgery.
6. A Volar Henry approach was used for the middle and lower third radius fracture and Thompsons approach for proximal third fractures.
7. 3.5mm LC-DCP is an excellent mode of fixation
8. A minimum of 6 cortices has to be fixed
9. Most of the fracture were found to be united by 6 months
10. Treatment by LC-DCP in both bone forearm fractures is successful method in achieving

A) Correction of deformity
B) Better union rate
C) Good range of motion
D) Restoration of function

Summary

Our study included 30 cases of both bone forearm fracture treated by Open Reduction and Internal Fixation with 3.5 mm LC-DCP, with a follow up range of 6-24 months.

- Self fall was the most common mode of injury, males were predominantly affected.
- Middle third of both bones were most affected region and transverse/ short oblique fractures were common due to low velocity injuries. Comminution were common in ulna than the radius because of the stationary bone and subcutaneous border
- Fractures united with an average of 13.6 weeks earliest being 10 weeks and longest union was 26 weeks. The results were based on our criterion, the combination of Anderson *et al* scoring system.
- In our study there were 83% (26 cases) excellent results, 6.6% (2 cases) satisfactory results, 6.6% (2 cases) unsatisfactory and no poor results were obtained.

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