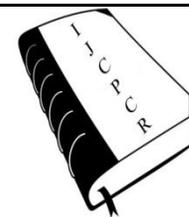




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### STUDY OF FUNCTIONAL OUTCOME OF FRACTURE FOREARM BONES BY OPEN REDUCTION AND LC-DCP FIXATION

Prakash S<sup>1</sup> and Basanthi BS<sup>2</sup>

<sup>1</sup>Assistant Professor, Department of Orthopedics, MVJ Institute, RGUHS University, Bangalore, India.

<sup>2</sup>Assistant Professor, Department of Obstetrics and Gynecology, MVJ Institute, RGUHS University, Bangalore, India.

#### ABSTRACT

Fracture of both bones of forearm pose a unique management problem. Return of function depends on union of the bones and motion of forearm. Conservative therapy often results in malunion, non-union or synostosis. Older methods of plating produce large frictional force leading to periosteal vascular compromise and healing. Limited contact dynamic compression plate has emerged as a better alternate to older plating. To know the injury profile and functional outcome of forearm bone fractures treated by LC-DCP. 30 cases of both bone forearm fracture were treated by open reduction and internal fixation with 3.5 mm LC-DCP, were followed up for 6-24 months and functional outcome assessed by our criteria. Middle third of the bones were the most affected region being caused commonly by RTA, with a higher rate in men. Excellent and good functional results were seen in >85% of cases with fewer complications. LC-DCP plating of both bones of forearm produces excellent results when applied properly.

**Key words:** Fracture forearm bones, LC-DCP, Functional outcome.

#### INTRODUCTION

Fractures of the forearm present a unique management problem from years. Function of the forearm and hand is dependent on the combination of stability and mobility. Thus return of function of forearm injuries depends on union of the fracture and motion of the forearm [1]. A forearm fracture involving both bones requires open anatomical reduction with stable fixation [1]. Conservative treatment has resulted in malunion, non-union, synostosis and ultimately poor functional outcome [2]. 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 can be achieved by plating [3].

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 causes vascular disturbance, especially in the periosteum. This observation has led to the development of limited contact dynamic compression

plate (LC-DCP), which decreases the bone contact area to approximately 50% of the total area of the under surface of the plate, it does not hinder periosteal circulation. So, fracture healing is good and refracture is less [4]. To know the functional outcome, advantages and complications of the LC-DCP present study was undertaken. The functional outcome was graded using Andersons et al scoring system [5], AO Group Criteria [1] and Our Criteria and variables like restriction of movement and functional outcome were considered.

objectives of the present study to provide early and complete functional activity of the upper extremity and to study the functional outcome of open reduction and internal fixation of fracture both bone forearm with LC-DCP.

#### METHODOLOGY

Present study included treatment of 30 cases of fracture both bones of forearm by open reduction

Corresponding Author :- **Dr. Prakash Savakkanavar** Email:- prakashortho@gmail.com

and internal fixation with 3.5mm LC-DCP at a medical institute in Bangalore, between 2004-August to 2006-August.

#### **Inclusion criteria**

- Patients with both fresh and old diaphyseal fractures of both bones of forearm.
- Patients above the age 16years.

#### **Exclusion criteria**

- Compound fractures, segmental fractures of forearm.
- Pathological fractures, infected fractures, non-union, malunion, delayed union.
- Monteggia and Galeazzi fractures.

On admission of the patient, a careful history was taken from the patient 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.

Necessary investigations including Radiographs of the radius and ulna i.e., anteroposterior and lateral views including elbow and wrist joints were done. The limb was then immobilized in above elbow plaster of Paris slab with cuff and collar sling.

Patients were taken for surgery after obtaining informed consent and fitness for surgery. Proximal radius was approached by Dorsal Thompson incision and Volar Henry approach was used for middle and distal radius. Ulna was approached by (Boyd's) an incision along the subcutaneous border of ulna. After identifying the fracture ends, periosteum was stripped sparingly with a periosteal elevator. Fracture ends were cleaned and with the help of the reduction clamps fractures were reduced and held in position. A plate of at least 6 holes was chosen and longer plates were applied in spiral, and comminuted fractures after contouring if required.

For upper third radial fracture, the plate was fixed dorsally and for distal radial fractures it was fixed on the volar aspect. For middle third of the radius either one of them were used. In ulnar fractures the plate was applied over the posteromedial surface of the ulna. Using neutral guide drill, drills were made into the exact center of the plate hole without imparting any compression. After the first hole, proper screw length was determined with the depth gauge, holes were tapped to accommodate the threads of the screw, and initial screws were inserted. Next, drills were made at the nearest available hole on the opposite side of the fracture from the initial screw using the eccentric drill guide. The arrow on the eccentric guide always pointed towards the fracture; Neutral screw was seated completely followed by eccentric screw in their respective holes. The contour between the plate and the screw head of the eccentrically placed screw moved the screw head towards the center of the plate until the deepest portion of the hole was reached. The bone fragment into

which the screw was being inserted was moved in the same direction so that the fragments were impacted. Remainder of the screws was inserted using the neutral drill guide. In case of porotic bone long screws were used and in case of comminuted fractures, long plates were used. A narrow 3.5mm LC-DCP was used and a minimum of 6 cortices were engaged with screw fixation in each fragment.

The LC-DCP, 3.5 mm is available in length 51mm to 155mm, with 4-12 holes. Important dimensions were thickness 4.0mm, width 11mm, hole spacing 13mm and hole length 7mm.

Post-operative above elbow POP slabs were applied. Physiotherapy advised and follow up done after 8, 12, 16 and 24 weeks to know functional outcome and complications if any. Based on Anderson's criteria [5] and AO Criteria [1], we formulated Our-Criteria as shown in Table 1 and assessed the functional outcome result according to it.

#### **Statistical Analysis**

95% confidence intervals were calculated to find the significance of study parameters. Student t test was used to find the significance of union of time with surgical type. SPSS 11.0 and Systat 8.0 were used for the analysis of the data and Microsoft Word and Excel were used to generate graphs and tables.

#### **RESULTS**

Age of the patients ranged from 16-60 years with fracture being most common in 2<sup>nd</sup> and 3<sup>rd</sup> decade with an average age of  $32.27 \pm 10.93$  years. Out of 30 patients, 25 patients (83%) were males and 5 patients (17%) were females with a mean age of  $30.44 \pm 9.73$  and  $41.40 \pm 13.26$  respectively.

Road traffic accident was the mode of injury in 56.7% of cases, fall in 33.3% and assault in 10% of cases. Fracture both bones of left forearm was 60% with 95 % Confidence Interval of 42.32-75.41%, which is border line significant. Injury profile is shown in Table No. 2.

36.75% of cases had comminuted fracture (Radius 10 cases, Ulna 12 cases) and transverse/ short oblique fractures in 63.3% of cases (Radius 20 cases, Ulna 18 cases). 3.3% each of the cases had associated abdominal, fracture of left tibia, fracture of right tibia, head injury, rib fracture and right colle's fracture.

Thomson surgical approach was employed in 23.33% and Henrys in 76.67% of cases. In 26.7% of cases Tourniquet time was 40-50min, 51-60min in 73.3% with a confidence interval of 55.55-85.82%.

16.6% had postoperative complications in the form of superficial infection (10%), postoperative interosseous nerve injury (3.3%, recovered in about 12 weeks) and radioulnar synostosis (3.3%) and none had intraoperative problems. Functional outcome was assessed by our criteria and the same is shown in Table 3.

**Table 1. Our Criteria employed to evaluate functional outcome**

Result	Union	Restriction of Movement	Function
<b>Excellent</b>	Union	Flex/ Ext Nil to 15	No loss of function, No Pain
		Pron/ Supin Nil to 15	
		Dors/ Palmflex Nil to 15	
<b>Good</b>	Union	Flex/ Ext 15 to 30	Able to perform all the function, Mild pain.
		Pron/ Supn 15 to 25	
		Dors/ Palmflex 15 to 25	
<b>Fair</b>	Union	Flex/ Ext 25 to 35	Moderate restriction of function, Moderate pain.
		Pron/ Supn 25 to 35	
		Dors/ Palmflex 25 to 35	
<b>Poor</b>	Nonunion	With or without restriction of movement	Complete loss of function, Severe Pain.

**Table 2. Depicts injury profile of the patients**

Trait	Number (n=30)	%	95% CI <sup>47</sup>
<b>Side of Injury</b>			
Left	18	60.0	42.32-75.41
Right	12	40.00	24.59-57.68
<b>Fracture site</b>			
Proximal third	7	23.33	11.79-40.33
Middle third	16	53.33	36.14-69.77
Lower third	7	23.33	11.79-40.93

**Table 3. Functional outcome based on our criteria**

Functional Outcome	Number (n=30)	%	95% CI <sup>47</sup>
Excellent	21	70.0	52.12-83.34
Good	5	16.7	7.34-33.56
Fair	3	10.0	3.46-25.52
Poor	1	3.3	0.6-16.7

**Table 4. Comparison of functional outcome between different studies**

Series	Excellent (%)	Satisfactory/Good (%)	Unsatisfactory/Fair (%)	Failure/ Poor (%)
Andreson <sup>5</sup>	50.9	34.9	11.3	2.9
Chapman <sup>7</sup>	86	7	12	5
Frankie <sup>4</sup>	98	2	-	-
Aljo a Matejcic <sup>1</sup>	62	16	12	10
<b>Present study</b>	<b>70</b>	<b>16.7</b>	<b>10</b>	<b>3.3</b>

## DISCUSSION

To provide functional rehabilitation of forearm, anatomic reduction and rigid fixation is mandatory. This can be achieved by open reduction and internal fixation with limited contact dynamic compression plate and screws [5,6]. We evaluated the results and compared them with those obtained by various other studies. Our analysis as follows:

In our study fracture both bones of forearm was common between age group of 20-40 years with an average of 32.26 years (16-60 year). Our findings are comparable to the study series made by Matejcic AA [1] found average age as 43 years, Frankie L [4] accounted an average age of 36 years (11-90 years), Chapman M [7] reported average of 33 years (13-79 years), Burwell HN [8] found the average age as 44.8 years, Herbert SD [9] found 24 years as the

average age and Moed BR [10] found the average age as 22 year. Our series had male predominant with 83% male patients and 17% female patients, which were comparable to previous studies by Herbert SD [3], noted 89% males, Frankie L [4] series showed 82.6% males and 17.4% females, Chapman MW [11] noted 78% males and William [12] in his series had 67% males. This higher incidence in male adults could be due to higher exposure to riskier environment and employment in hard labor.

In our study 56.7% of patients had sustained fracture from road traffic accidents, 33.3% from fall and 10% due to direct blow (assault). Our studies are comparable to previous studies by Moed BR [10] accounted 50% to RTA, 20% to industrial accidents, 14% to fall, 12% to direct blow and 4% to gunshot injuries; Thomas Grace et al [13] noted about 45% patients with automobile/

motorcycle accident, 22% with fall, 3% gunshot wounds and remainder with other miscellaneous types of injuries; Smith [14] noted 45% due to RTA, 36% due to fall and 19% due to industrial accidents. Road Traffic accidents are still the leading cause in developed and developing countries.

We have found 40% incidence of fracture both bones in right extremity, which is in contrast to the previous studies by Burwell HN [8] and Chapman MW [11], who report an equal or a higher incidence in the right forearm (50 & 55% respectively). This could be because of a higher incidence of RTA in our set up compared to western studies where trauma has occurred at industries, due to fall and assaults making more used right limb prone for fracture.

63.3% of fractures were transverse/ short oblique and 36.7% were comminuted. The results are not comparable to Chapman MW [11] series, noted 53% as comminuted. Herbert DS [3] documented 71.5% at middle third, 21.5% at distal third and 7% at proximal third. Sarmiento A [15] noted 84.6% of fracture on both bones at middle third and 15.4% at lower third both bones, Chapman MW [11] also noted 59% and 40% of fractures in middle third of radius and ulna, 13% and 21% in proximal third of radius and ulna and 28% and 12% in lower third of radius and ulna respectively [16]. This can be attributed to low velocity trauma, different manner of production of injury in our nation.

Duration of surgery ranged between 60 to 90 minutes, with an average 77.83 minutes. The tourniquet time ranged from 40 to 60 minutes, with an average of 50.66 minutes. These findings could not be compared to the

previous studies, as there was no data available in our literature search. Apart from the rate of superficial infection and posterior interosseous nerve injury which were negligible high, rates of Nonunion and Radioulnar synostosis were similar to or even less than the study series of Frankie L [4], Anderson [5] and Chapman MW [11]. We do not believe that infection or nerve injury is related to the method of fixation: but rather to level of fracture and the degree of comminution.

In our series we had 70% cases with excellent results, 16.7% good, 10% fair, and 3.3% case of poor result. The functional result was assessed according to Our criteria. Comparison between the different studies is shown in table 4. The difference in the functional outcome is an apparent data because of utilization of different criteria by authors in evaluating the outcome and it doesn't reflect any flaw in the therapy, as all the cases in our series had complete union.

## CONCLUSION

Open reduction and internal fixation with narrow LC-DC plating is an excellent mode of fixations as it gives good result and minimizes the complication of non-union, refracture and synostosis. It is important for 6 cortices to be fixed on either side of fracture; however length of the plate was depended on the degree of comminution. The site of ulnar plate application was on subcutaneous border. The site of majority of radial plate application was on volar aspect. To obtain excellent results proper preoperative planning, minimal soft tissue dissection, strict asepsis, fixation technique by AO principles, post-operative rehabilitation and patient education are mandatory.

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