

## Functional Outcome of Fracture Both Bone Fore Arm Treated with Compression Plate in Adults

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### Abstract:

**Background:** The fractures of both bones forearm are one of the commonest fractures (14%). These fractures can be treated by various methods. The accepted management for fractures of both bones forearm is open reduction and internal fixation using compression plating.

**Objective:** to study the functional outcome of treating diaphysial fracture both bone forearm using compression plating, duration of union with compression plating and its functional outcome.

**Methods:** This prospective study was carried out from January 2021 to June 2022 in Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, Mandya India, in this study period 33 cases of fracture both bones of forearm were treated by open reduction and internal fixation using Compression Plate.

**Results:** In our series, majority of the patients were males(70%), middle aged (avg age 34.8), with road traffic accidents being the commonest mode of injury(57.57%), involving middle third (72.72%) more commonly affecting the right forearm(51.51%). Transverse or short oblique fractures were most common. The fractures united in all 33 patients. Excellent or full range of mobility of elbow and wrist joints were present in 30 patients (90.09%) and 3(9.09%) patients having good range of movements according to F.M. Merck et al scoring system.

**Conclusions:** The compression plating of forearm fractures produce excellent results, the advantage being early mobilization, early union but the complication, duration of surgery and surgical techniques remains unchanged.

**Keywords:** shaft of both bones of forearm fractures, Dynamic compression plate, Locking compression plate, Open reduction and internal fixation.

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### Introduction

The forearm serves vital movements that are crucial in daily activities as an upper limb component. Pronation and supination are made possible by the forearm in conjunction with the proximal and distal radioulnar joints, which in turn aid multi-axial hand movements. If not properly treated, a fracture of the forearm bones could cause a serious loss of function. Therefore, to restore function, these fractures require adequate anatomical reduction and internal fixation. [1]

Although closed reduction was used in the past, it produced outcomes that were either non-union or motionless. Additionally, the forearm bone is subject to complicated stresses that make it challenging to maintain misplaced fracture fragments after reduction. [2] Any of the

procedures offered can result in union, but if properly managed with good technique and implants, serious loss of function could be the ultimate consequence. There has been a significant improvement in the management of forearm fractures since the invention of compression plate osteosynthesis, which offers a solid therapeutic choice and predictable results. [3] By firm fixation and early mobilisation, this approach aids in the correct reduction of fracture fragments in anatomical position, allowing for the fastest return of normal hand activities.

Dynamic compression plates were initially described by Bagby and Denham, and more recently produced by the AO School, they have an innate compression mechanism that eliminates the

need for lengthy dissection. The compression that is created when the screws are pushed home relies on the obliquity of cylindrical screw holes in the plate.

Compression plates, invented by the AO School in Switzerland, are the most efficient way to create Rigid internal fixation.

The goal of the current investigation is to determine how long compression plating keeps the union of the diaphysial fractured bones in the forearm, as well as how well it performs functionally.

The functional outcome was certified using "F.M.Mareketal, scoring system".

The variables taken into consideration were

- a. Union of the fracture,
- b. Range of elbow and wrist movements [4].
- c. Extent of functional capacity reached

To sum up, it is challenging to obtain and difficult to sustain adequate reduction of displaced fractures of the forearm bones using closed procedures. Therefore, it is feasible to accomplish excellent fracture reduction, rigid fixation, improved bone healing, and early mobilization with open reduction and internal fixation utilizing dynamic compression plate. Any time there is bone loss, cancellous bone grafting may be utilized.

**Materials and Methods:** The present study includes treatment of 33 cases of fracture both bones of forearm by open reduction and internal fixation with 3.5 mm LCP and DCP between December 2020 to August 2022 at Adichunchanagiri Hospital attached to the Adichunchanagiri Institute of Medical Sciences and Research Centre, B.G.Nagara, Mandya.

#### **Inclusion Criteria:**

- Patients with radiologically diagnosed diaphyseal fractures of both bones of forearm
- Patients above the age of 18years
- Male and female Patients fit for surgery

#### **Exclusion Criteria:**

- Compound fractures of forearm bones
- Patients not willing for surgery
- Patients medically unfit for surgery
- Both bone fractures with compartment syndrome and vascular injury

A thorough history was taken from the patient and/or any attendants at arrival in order to determine the mechanism of damage and the intensity of the trauma. The patients were subsequently given a clinical evaluation to determine their overall health and the extent of any local injuries.

The vital signs were noted together with the patient's overall state. A thorough inspection was

conducted to rule out fractures in additional locations. Swelling, deformity, and loss of function were discovered during a local assessment of the damaged forearm. Any nerve damage was searched for and recorded. Crepitus, aberrant mobility, and forearm shortening were all detected during palpation. Radial artery pulsations, capillary filling, pallor, and paraesthesia at finger tips were used to measure distal vascularity.

Anteroposterior and lateral radiographs of the radius and ulna, respectively, were taken. In each picture, the wrist and elbow joints were visible. The limb was then immobilized with a sling in a slab of plaster of paris above the elbow.

Following regular tests to determine the patient's suitability for surgery, the patient was taken for surgery. The tests include the following: ECG, Hb%, FBS, Blood urea, Serum creatinine, HIV, and HBSAg.

Dorsal Thompson incision was utilized to reach the proximal radius, while the volar Henry approach was employed to access the intermediate and distal radius. A minimum of six cortices were engaged with screw fixation in each fragment using a 3.5mm LCP, DCP, or LCDCP.

#### **Operative Procedure:**

General anaesthesia was used in 7 cases and brachial block in 26 cases.

Pneumatic tourniquet was applied: Time noted.

The Radius was approached using either Volar Henrys/ dorsal Thompson approach. For proximal radius dorsal Thompson approach was preferred and for middle and distal radius fractures Volar Henry's approach was preferred. Ulna was approached directly over the subcutaneous border.

The bone which was less comminuted and more stable was fixed first and later the other bone was fixed. [5] After identifying the fracture ends, periosteum was not 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.

A plate of at least 6 holes was chosen and longer plates were used inspiral, segmental and comminuted fractures. For upper third radial fractures, the plate was fixed dorsally. For middle third, the plate was fixed dorsolateral and for distal radial fractures the plate was fixed on the volar aspect. In ulnar fractures, plate was applied over the posterior surface of ulna [5].

- A drill sleeve or locking screw is fixed in the hole, near the fracture site, and 2.7 mm drill bit is use to drill both the cortex of the bone, the sleeve is removed and the screw length is measured with depth gauge

- After adaptation of the fragments, a screw hole for axial compression is drilled in the fragment which forms an acute angle near the plate. Here the load guide is used with the arrow pointing towards the fracture line to be compressed. At this position, a lag screw will be inserted for axial compression.
- The lag screw is applied by subsequently over drilling (3.5mm) the near cortex to create a gliding hole. The lag screw and remaining screws are inserted.
- Once stable fixation is achieved and hemostasis secured meticulously, the wound is closed in layers over a suction drain and sterile dressing is applied.

#### After treatment:

Following surgery, a crepe bandage was placed over the injured forearm, and an arm pouch was administered. The patient was told to move their fingers and elbow joint while maintaining the limb elevated. After 24-48 hours, the suction drain was removed. 3-4 days following surgery, the wound was examined. Upto the moment of suture removal, the patient received antibiotics and painkillers. On the tenth postoperative day, the sutures and staples were removed, and a check X-ray with anteroposterior and lateral views was taken. After the sutures and staples were removed, the patient was discharged while the forearm was in an arm pouch and instructed to move their shoulders, elbows, wrists, and fingers. Patients were told not to use their injured forearm or carry heavy objects.

#### Follow-up:

All of the patients underwent evaluated using the "F.M. Merck et al [4]" scoring method at monthly intervals of 1, 3, and 6 months. In addition to noting wrist and elbow motions, the union underwent a radiological evaluation. The fracture was designated as united when there was presence of periosteal callus bridging the fracture site and/or trabeculations extending across the fracture line.

#### Results:

The present study consists of 33 cases of fracture both bones of the forearm. All the cases were openly reduced and internally fixed with 3.5mm LCP and DCP. The study period was from FEBRUARY 2021 to AUGUST 2022.

The age of these patients ranged from 18-60 years with fracture being most common in 2nd and 3rd decade and an average age of 34.8 years. Out of 33 patients, 23 patients (70%) were male and 10 patients (30%) were females showing male preponderance because of working in factories, fields, traveling and sports. There were 17(51.51%) patients with right forearm fracture and 16(48.48%) patients with left forearm fracture.

#### Mode of Injury

In our study, there were 19(57.57%) patients with road traffic accidents, 12(36.36%) patients with fall, and only 2(6.06%) patients with assault.

**Table 1: Mode of Injury**

Mode of injury	No Of Patients	Percentage
RTA	19	57.57
Fall	12	36.36
Assault	2	6.06
<b>Total</b>	<b>33</b>	<b>100</b>

#### Fracture characteristics:

##### 1) Level of Fracture

Majority of the fractures were seen in the mid di-

aphysis of both bones of forearm. 24 (72.72%) patients had mid diaphyseal fractures, 4 (12.12%) had proximal third fractures and 5 (15.15%) patients had lower third fracture of both bones of forearm.

**Table 2: Level of fracture**

Level of Fracture	No of Patients	Percentage
Proximal Third	4	12.12
Middle Third	24	72.72
Distal Third	5	15.15
<b>Total</b>	<b>33</b>	<b>100</b>

**Type of Fractures:** Majority 78.78% of the fractures were transverse. About 13.63% of fractures were comminuted, 2.5% of segmental fractures and only 6.06 comminuted fractures were present.

**Table 3: Type of the Fracture**

Type Of Fracture	Radius	Ulna	Percentage
Transverse	25	27	78.78
Oblique	02	02	06.06
Comminuted	06	03	13.63
Segmental	00	01	1.15
<b>Total</b>	<b>33</b>	<b>33</b>	<b>100</b>

4(12%) of the patients had associated injuries.

**Table 4: Associated Injuries**

Associated Injuries	No Of Cases	Percentage
Closed head Injury	02	06
Olecranon Fracture	01	03
Ipsilateral Fracture humerus	01	03
<b>Total</b>	<b>04</b>	<b>12</b>

**Statistics of Surgery:**

Brachial blocks were employed during surgery in 26 of the 33 instances, while general anaesthesia was used on the remaining 7 patients.

Four patients had the dorsal Thompson method for the radius, whereas 29 patients received the volar Henrys approach.

Subcutaneously, one approached the ulna. In every instance, a pneumatic tourniquet was employed. Observations were made after 1, 3, and 6 months.

**Duration of Fracture Union:**

When there were no subjective symptoms and the fracture line was not evident on radiographs, the fracture was said to be unified. Delay union was used to fractures that healed after six months without requiring extra surgery. Non-union was defined as a fracture that did not heal after six months or that required an extra surgical treatment to heal. All patients (100%) had sound union in less than 6 months, none of the patients had delayed union or non-union.

**Table 5: Duration of Fracture Union**

Time Of Union	No Of Patients	Percentage
2-3 Months	--	--
3-4 Months	28	84.84
4-6 Months	05	15.15
<b>Total</b>	<b>33</b>	<b>100</b>

**Criteria for Evaluation of Results:**

F.M.Mareketal [4] scoring system

**Table 6: Criteria for Evaluation Of Results**

Results	Anatomical	Functional
<b>1. Excellent</b>	Anatomical alignment of fragments	90% of rotation of forearm 90% motion of shoulder, elbow, wrist and Fingers of hand.
<b>2. Good</b>	Slight step formation & angulation not > 10deg no rotational deformity	70-90% of normal rotation of forearm and similar motion of other joints of Upper extremity.
<b>3. Poor</b>	Narrowing of interosseous space	Less than 70% of motion of fore arm or other joints of upper extremity.

Using the F.M.Mareket, al scoring system we had 30(90.90%) patients with excellent results, 3 (09.09%) patients with good results.

**Complications**

Two patients had superficial infection which resolved with oral antibiotics.

**Discussion:**

We evaluated our results and compared them with

those obtained by various other studies utilizing different modalities of treatment. Our analysis is as follows.

In our study, fracture was commoner in the second and third decade, with average age of 34.8 years (18-55 years). Our findings are comparable to the study made by Herbert Dodge (1972) and Berton Moed (1986). In 1972, Herbert S. Dodge and Gerald W. Cady found 24 years as the average age in

their series<sup>6</sup>.

Our series had male preponderance with 70% male patients and 30% female patients which was comparable to previous studies. H. Dodge in his study noted about 89% males and 11% females<sup>6</sup>. Michael Chapman noted about 78% males and 22% females [7].

**Mode of injury:**

Moed B. R. et al, accounted 50% of his cases to road traffic accident, 20% due to industrial accident, 14% due to fall, 12% due to direct blow and 4% due to gunshot injuries [8]. Thomas Grace et al. noted about 29 (45%) patients with automobile or motorcycle accident, 14 (22%), in falls 2(3%), had gunshot wounds and remainder had other miscellaneous types of injuries [9].

Smith noted about 45% of his cases was due to RTA, 36% were due to fall and 19% were due to industrial accidents<sup>10</sup>.

**Extremity affected:**

H.N.Burwell and A.D. Charnley reported about 50% incidence of fracture both bones in right arm [11]. M.W.Chapman reported about 55% incidence of fractures of both bones in right extremity [7]. We accounted about 51.51% incidence of fracture both bones in left extremity.

**Fracture anatomy:**

**a) Type of fracture:**

M. W. Chapman et al, series noted about 53% of fractures as comminuted and 47% were transverse/short oblique [7]. Our series accounted 78.78% of fractures as transverse, 6.06% short oblique and 13.63 % were comminuted.

The results were not comparable to the previous studies, which can be attributed to low velocity trauma in our country

**b) Level of fracture:**

A. Sarmiento et al, noted about 84.6% of fracture both bones were in middle third and 15.4% of cases had lower third fracture of both bones [12]. H.S. Dodge and G.W. Cady documented 71.5% fracture both bones in middle third, 21.5% in distal third and 7% in proximal third [7].

M.W.Chapman et al noted about 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 [7].

**1) Time of union:**

In our series we had an average union time of 12 weeks with range of 8 to 20 weeks. We had 100% union of both radius and ulna.

**Table 7: Time for Union**

Series	Union time(wks)	Range(wks)	Union
Anderson	7.4	5-10	97
Chapman	12	6-14	98
McKnee	10.7	5-18	97.3
Frankie Leung	17	8-36	100
Present series	12	8-20	100

The results of our present studies are comparable to the previous studies

**2) Functional results:**

The range of motion was determined and F.M.Marek et al, scoring system was used as a measure for the functional outcome. [4] Anderson

et al reported about 54(50.9%) cases as excellent, 37(34.9%) satisfactory, 12(11.3%) unsatisfactory and 2(2.9%) failure. [13] Chapman et al reported 36(86%) cases as excellent, 3(7%) satisfactory, 1(2%) unsatisfactory and 2(5%) failure [7].

**Complications**

**Table 8: Complications**

Complications	Anderson	Chapman	Present study
Infection	2.9%	2.5%	6%
Nonunion	2.9%	2.3%	--
Posterior interosseous nerve injury	2%	1.5%	--
Radioulnar synostosis	1.2%	2.3%	--

In our series we had 2 cases of superficial infection which resolved with appropriate antibiotics.

**Duration of Follow Up**

We had a follow up which ranged from 5 months to

24 months with an average mean of 12 months, which is comparable to Chapman series but other series had longer follow up.

**Duration of surgery and Tourniquet time:**

The Duration of surgery ranged between 60-90 min, with an average of 77min. The tourniquet time ranged from 40-60 min, with an average of 54 min these findings could not be compared to the previous studies as there was no data available.

**Conclusion:**

Adults are more likely to sustain fractures to both forearm bones in their second and third decades of life. Due to physical labour and outdoor activities, fractures tend to occur more frequently in men. The majority of the fractures in the middle shafts of both fore arm bones were transverse or short oblique and resulted from falls or car accidents. The use of 3.5mm compression plates for the internal fixation of forearm bone fractures is highly recommended.

The rate of problems can be reduced by using a tourniquet, making separate incisions for the radius and ulna, and preserving the natural curvature of the radius. These fractures must be treated as soon as Possible, and for a great functional outcome, it's crucial to accomplish anatomical reduction and stable internal fixation. A minimum of 6 cortices has to be fixed on each fracture fragment.

After fixation, postoperative support, which is often provided in the form of an arm pouch, can be withdrawn if the soft tissues have healed and a rapid recovery to full, pain-free motion is anticipated. Most of the fracture united within 4 months. Plating of both bones forearm produces excellent results when applied properly.

Preoperative planning, limited soft tissue dissection, adherence to AO principles, tight asepsis, postoperative rehabilitation, and patient education must all be done well in order to get outstanding results.

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