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**Dr Addis**  
Assistant Professor,  
Department of Orthopaedics,  
Vinayaka Missions Medical  
College, Karaikal, Puducherry,  
India

## Functional outcome of surgically treated forearm fractures in adults: A clinical study

**Dr. Addis**

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### Abstract

**Background:** Malunion of forearm bones can cause problems in pronation and supination. Hence forearm fractures have to be treated with utmost care. Outcome of the treatment of fractures have to be considered anatomically and functionally as well. The outcome of the surgical procedures should be studied and reviewed periodically to aid the preparation of treatment protocol and future development in surgical techniques.

**Objectives:** To assess the outcome of the open reduction and internal fixation using plating technique used in the treatment of forearm fractures with respect to the union attained, restoration of normal forearm anatomy and the attainment of forearm movement.

**Materials and Methods:** A prospective study was conducted at a tertiary hospital in Bengaluru, India from July 2009 to July 2012. Patients with forearm fractures satisfying the inclusion criteria were treated by open reduction and internal fixation. These patients were followed up and at the end of 6 months, functional outcome was measured using Grace and Eversmann criteria. Results on continuous measurements were presented on Mean  $\pm$  Standard Deviation and results on categorical measurements were presented in Percentage.

**Results:** Thirty-Six patients were included in the study of which 24 were males and 12 were females. The mean age of the study group was  $40.47 \pm 9.12$  years. Excellent functional outcome was seen in 11 (30.6%) patients whereas 15 (41.6%) had a good functional outcome, 9 (25%) patients had an acceptable outcome and 1 (2.8%) patient had an unacceptable functional outcome

**Conclusion:** Functional outcome following treatment of fractures of the shafts of the radius and ulna were good to excellent after open reduction and internal fixation using plating technique. There was no case of malunion or non union and complication suggesting the importance of following the AO principles of internal fixation.

**Keywords:** Fracture ulna, fracture radius, functional outcome, fracture fixation, bone plates

### Introduction

With the increase in road traffic accidents in the past decades, the encounter of orthopedic surgeons with forearm fracture has become quite common. Forearm has been rightly called a functional joint and fracture of both bones of forearm has to be dealt with special attention, as malunion can cause problems in pronation and supination<sup>[1]</sup>.

Previously conservative treatment was used to treat the forearm fracture. It had resulted in higher incidence of nonunion and loss of forearm functions<sup>[2]</sup>. This led to the emergence and development of the operative methods of treating these injuries. The development of compression plating technique and the concept of rigid fixation and early mobilization led to an improvement in the outcome in most of the surgically treated cases.

The outcome of the surgical procedures should be studied and reviewed periodically to aid in the preparation of treatment protocol and future development in surgical techniques. While considering the outcome anatomically equal importance should be given to functional outcome without which it has no meaning<sup>[3]</sup>.

This study was conducted to assess the outcome of open reduction and internal fixation using plating technique in the treatment of forearm fractures with respect to the union attained, restoration of normal forearm anatomy and the attainment of forearm movement.

### Correspondence

**Dr. Addis**  
Assistant Professor,  
Department of Orthopaedics,  
Vinayaka Missions Medical  
College, Karaikal, Puducherry,  
India

**Materials and Method**

A prospective study was carried out at a tertiary hospital in Bengaluru, India from July 2009 to July 2012. Forty one patients presenting to the outpatient department or casualty with forearm fractures were included in the study after obtaining their consent. Our inclusion criteria included males and females above the age of 18 years sustaining closed and type 1 open diaphyseal fractures of forearm bones according to the modified Gustilo and Andersons Classification. Fractures associated with skin/soft tissue loss, neurovascular injuries, established compartment syndrome, joint dislocations and refracture of forearm were excluded. Diaphyseal fractures of forearm bones were classified according to the AO/OTA Classification.

All the patients underwent open reduction and internal fixation with plates as the definitive procedure at our hospital. Patients who were stable were discharged within a week following their surgery. Patients were followed up at 2<sup>nd</sup>, 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> weeks and 6 months to check and assess the progress they had made with respect to the range of movement attained, since their previous visit.

During the 12<sup>th</sup> post-operative week and 6<sup>th</sup> post-operative month, antero-posterior and lateral X-rays were taken of the operated forearm to assess whether radiological union had been attained. Fracture was considered to be united when there was obliteration of fracture gap or the presence of bridging periosteal callus in three of the four cortices on AP and Lateral radiographs. Fracture union was considered as delayed when there was presence of fracture gap or absence of progressive callus formation in the first 6 months postoperatively.

At the end of 6 months, functional outcome was measured using Grace and Eversmann criteria as given below

Result	Definition
Excellent	Fracture union with restoration of at least 90% of the normal rotation arc of the forearm
Good	Fracture union with restoration of at least 80% of the normal rotation arc of the forearm
Acceptable	Fracture union with restoration of at least 60% of the normal rotation arc of the forearm
Unacceptable	Fracture nonunion and /or restoration of less than 60% of the normal rotation arc of the forearm

The complete details of only 36 patients could be obtained as three patients were lost during follow up and two refused participation.

The data was entered in Microsoft Excel and analysed using SPSS version 16. Results on continuous measurements were presented on Mean ± Standard Deviation and results on categorical measurements were presented in Percentage.

**Results**

Thirty-Six patients were included in the study of which 24 were males and 12 were females. The mean age of the study group was 40.47±9.12 years. The highest incidence of cases was noted in the age group 28-37 years. (Table 1).

**Table 1:** Age wise distribution of the study population

Age	Patients	Percentage (%)
18-27	3	8.3
28-37	12	33.3
38-47	11	30.6
48-57	10	27.8
Total	36	100

Closed fracture were seen in 34 patients while 2 patients sustained type 1 Open fractures. Both bone fracture was seen in 29 patients (80.6%) while 5 patients had come with isolated fractures of ulna and two with isolated fracture of the radius. Comminution of fracture was seen in 15 cases (41.7%) while 21 (58.3%) did not have comminution.

The most common mode of injury was road traffic accidents which contributed to 63.9% (23) of the cases. The other modes of injury were domestic falls (27.8%, 10), work place injury (5.6%, 2) and assault (2.8%, 1).50% of the patients sustained forearm fractures to their dominant upper limb. (Table 2).

**Table 2:** Distribution of study subject according to the mode of injury

Mode of Injury	Patients	Percentage (%)
Road Traffic Accidents	23	63.9
Domestic Falls	10	27.8
Work Place Injury	2	5.6
Assault	1	2.8
Total	36	100

Radiological union was seen in all the patients 6 months of follow up



**Fig 1(a):** Pre operative X ray of both bones of forearm



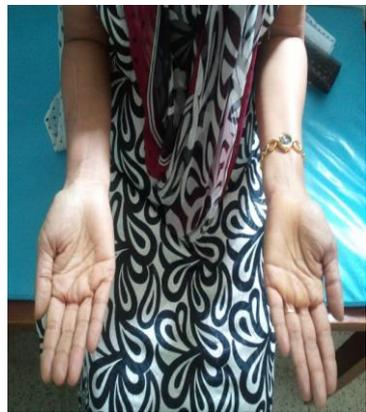
**Fig 1(b):** Post operative X ray of both bones of forearm

On assessing the rotation arc (pronation + supination) attained, it was found that in 30.6% (11) of the patients ≥90%

of the normal forearm rotation arc was restored, in 41.6% (15) of the patients  $\geq 80\%$  of the rotation arc was restored, in 25% (9) of the patients  $\geq 60\%$  of the rotation arc was restored and 2.8% (1) of the patients had  $< 60\%$  of their rotation arc restored.



**Fig 2(a):** Supination of forearm at the end of 6 months



**Fig 2(a):** Pronation of forearm at the end of 6 months

Among the 36 patients who underwent plate fixation, 11 (30.6%) had an excellent functional outcome, 15 (41.6%) had a good functional outcome, 9 (25%) patients had an acceptable outcome and 1 (2.8%) patient had an unacceptable functional outcome according to Grace Eversmann criteria. The patient who had an unacceptable outcome had achieved union but the rotation arc was less than  $60^\circ$  and had sustained a comminuted fracture of both the forearm bones. (Table 3)

**Table 3:** Distribution of study population according to grade of functional outcome

Outcome	Plating	Percentage (%)
Excellent	11	30.6
Good	15	41.6
Acceptable	9	25
Unacceptable	1	2.8
Total	36	100

**Discussion**

This was a prospective study to evaluate the functional outcome in patients sustaining forearm fractures treated surgically by plating method. Out of the 36 patients included in our study maximum were in 28 to 37 years age group. This was similar to study done by Michael W. Chapman *et al.*, (1989) series which showed average age as 33 years [4]. The study group included 24 males and 12 females. Male preponderance was seen in similar studies done by H Dodge

*et al.* and Talwalkar *et al.* where male population was 89% and 80% respectively [5,6].

In our study, road traffic accidents i.e 63.9% (23) was the most common cause of injury followed by domestic falls (27.8%, 10), work place injury (5.6%, 2) and assault (2.8%, 1). Road traffic accidents have increased in the previous decades all over the world. Other study done by Meeravali SK *et al.* noted that 56% patients had road traffic accident and 23% had history of falls [7].

Majority of the study subjects had sustained closed fractures i.e. 94.44% while remaining sustained type 1 Open fractures. This was similar to study done by Faisal *et al.* where the incidence of closed fractures (75%) was more as compared to type 1 fractures [8].

Both bone fracture was seen in 29 patients (80.6%) while 5 patients had isolated fracture of ulna and two had isolated fracture of the radius. Comminution at fracture site was seen in 15 cases (41.7%) while 21 (58.3%) did not have comminution.

At 6 months follow up, patients were assessed for radiological union as well as functional outcome. In our study, all the cases had attained radiological union by the end of six months and there were no complications. This is contrary to similar studies done by Raghvendra *et al.* where they found surface infection to be the most common complication [9].

The functional outcome was graded using Grace Eversmann criteria. Excellent to acceptable results were seen in 97% of the cases. In the current study only 2.8% had unacceptable outcome compared to 15% in the study done by Anderson *et al.* and 9% in the study done by Chapman *et al.* [10, 4] The patient who had an unacceptable outcome in our study had sustained a comminuted fracture of both the forearm bones. Grace and Eversmann had reported that more loss of motion is seen with injuries which are more severe i.e., comminuted fractures involving both the bones of forearm [11].

The major limitation of our study is the small number of patients. However this is mitigated as the study population was homogenous and consistently followed up for atleast six months. Further research is necessary to identify the use of different surgical techniques according to type of fractures.

**Conclusion**

Our study showed that the functional outcome following treatment of fractures of the shafts of the radius and ulna were good to excellent after open reduction and internal fixation using plating technique. There were no complications noted during the post-operative period. The importance of early diagnosis, meticulous interpretation of radiographs, formulating a plan of management involving anatomical fracture reduction and stable internal fixation using appropriate implants, followed by a structured rehabilitation programme cannot be over emphasized.

**Declarations**

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Conflict of interest: Nil

Ethical approval: Yes

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