



EVALUATION OF FUNCTIONAL AND RADIOLOGICAL OUTCOMES OF ADULT DIAPHYSEAL FRACTURES OF BOTH BONE FOREARM OPERATED WITH PLATING OR NAILING

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ABSTRACT

Background: Fractures of both radius and ulna are one of the most common fractures in adults in upper extremity .It is essential to regain length, apposition, axial alignment and normal rotational alignment while treating diaphyseal fractures of the radius and the ulna to gain good range of pronation and supination. Mal-union and nonunion occur more frequently because of the difficulty in reducing and maintaining the reduction of two parallel bones in the presence of the pronating and supinating muscles that have angulating and rotational influences). There lies a controversy with respect to choice of treatment as per chances of infection, duration of healing and the surgeon preferences. The present study is thus undertaken to compare functional outcome and radiological union using two different surgical modalities i.e. Dynamic Compression Plating and Intramedullary nailing. **Materials And Methods:** All adult patients(>12years) with diaphyseal fractures of both bones of forearm presenting to A&E department, requiring operative intervention were selected and were included in an interventional and comparative prospective cohort study.A total of 48 subjects fulfilling eligibility criteria were randomly divided into four groups A, B, C and D (12 each) using random number table. **Results:** Most cases with excellent to good functional outcome was seen in both bones plating group (100%) followed by hybrid techniques. Incidence of mal-union was seen in 2 cases each of both bone nailing and ulnar plating and radius nailing and in 1 case of radius plating and ulnar nailing. **Conclusion:** Among the four different fixation methods for treating both bone diaphyseal forearm fractures in adults, the method with both bone i.e. ulna and radius plate fixation showed good stability in biomechanics, the lowest complication rate and best functional recovery outcomes.

KEYWORDS : compression plating,intramedullary,hybrid fixation,diaphyseal

INTRODUCTION

The forearm consists of two parallel bones (radius and ulna) and radioulnar joints of the elbow and wrist, which play an important role in forearm rotation. Fractures of both radius and ulna are one of the most common fractures in adults in upper extremity (1). In this era of active life, rapid industrialisation, increasing road traffic accidents, competitive sports, the incidence of fractures of forearm bones are increasing in frequency (2).

It is essential to regain length, apposition, axial alignment and normal rotational alignment while treating diaphyseal fractures of the radius and the ulna to gain good range of pronation and supination. While closed methods of reduction and immobilization by conservative methods may be successful in diaphyseal fractures of radius and ulna in children(1), same is not true in case of diaphyseal fractures of radius and ulna in adults. 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 fractures occurs.

Diaphyseal fractures of the radius and ulna present specific problems in addition to the problems common to all fractures of the shafts of long bones. In addition to regaining length, apposition, and axial alignment, achieving normal rotational alignment is necessary if a good range of pronation and supination is to be restored. Mal-union and nonunion occur more frequently because of the difficulty in reducing and maintaining the reduction of two parallel bones in the presence of the pronating and supinating muscles that have angulating and rotational influences (3,4).

It is recommended that the shaft fractures of both forearm bones (SFBFBs) in adults should be treated surgically because of unsatisfactory outcomes of conservative management (5).

The gold standard of operative treatment is anatomical

reduction with open reduction and stable internal fixation using the dynamic compression plate (DCP). However, the disadvantages of plate fixation include a relatively large skin incision, interruption of bloody supply due to wide periosteal dissection of the forearm bone, or refracture following plate removal (5,6). Additionally, this method has some limitations in SFBFBs with extensive soft tissue damage, severe swelling, open fracture, segmental fracture, or a limited operation time due to associated injuries. In order to overcome these problems, intramedullary (IM) nail fixation can be used as an alternative method for treating SFBFBs (7-9).

Previous studies comparing the two modalities have shown no significant difference. However, there lies a controversy with respect to choice of treatment as per chances of infection, duration of healing and the surgeon preferences. The present study is thus undertaken to compare functional outcome using two different surgical modalities i.e. Dynamic Compression Plating and Intramedullary nailing.

MATERIALS AND METHODS

Study Population

Adult patients with both bones forearm fractures treated with Locking Compression Plates or intramedullary nail.

A total of 48 subjects fulfilling eligibility criteria were randomly divided into four groups A, B, C and D (12 each) using random number table:

Groups	Fractures of BBF with Radius and Ulna plating (A)	Fractures of BBF with Radius and Ulna nailing(B)	Fractures of BBF with Radius nailing and Ulna plating (C)	Fractures of BBF with Radius plating and Ulna nailing (D)
Number	12	12	12	12
Sample size	48			

Study Duration

October 2017 to September 2019

Inclusion Criteria:

- The following both bones forearm fractures treated with Locking Compression Plates or intramedullary nail:
- 1.Age > 12, both gender
- 2.Fractures of Both bones of forearm with Radius and Ulna plating
- 3.Fractures of Both bones of forearm with Radius and Ulna nailing
- 4.Fractures of Both bones of forearm with Radius nailing and Ulna plating
- 5.Fractures of Both bones of forearm with Radius plating and Ulna nailing.

Exclusion Criteria:

- 1.Periarticular fractures
- 2.Pathological fractures
- 3.Fractures requiring bone grafting
- 4.When additional implant was used.

Methodology

- 1.A written and Informed consent was obtained in the language that the patient understands.
- 2.Under all aseptic precautions and with appropriate anaesthesia, open reduction and internal fixation using plate and/or closed reduction with nailing of the both fractures of forearm bones was done.
- 3.Drain (if any) was removed on day 2.
- 4.Appropriate Post Op. X-Ray of forearm including wrist as well as elbow joint - AP, Lateral views were taken.
- 5.Physiotherapy was started from the second day of the surgery in patients belonging to group A whereas it was delayed for 6 weeks in case of group B, C and D
- 6.Sutures removed on day 12 or depending on the conditions of wound.
- 7.Prophylactic antibiotics were given :
 - a)For all the cases prophylactic antibiotic was given 1 hour prior to the incision
 - b)In the post operative period , intravenous antibiotics were given for 5 days in group A,C and D patients whereas it was given for 3 days in group B patients.
 - c)Later, oral antibiotics were given for a period of 10 days post op. in all 4 groups.
- 8.On first follow up after 3 weeks of surgery, patient was advised X-Ray to evaluate implant positioning.
- 9.At 6 weeks follow up, X-Rays were taken to see callus formation and degree of radiological union.
- 10.Degree of supination /pronation, range of motion of wrist and elbow joints was checked after 3 weeks onwards in group A patients whereas it was checked after 6 weeks in group B,C and D after the removal of long arm cast /slab.
- 11.Patient was followed up after 3 weeks, 6 weeks, 3 months, 6 months and 9 months of surgery and X-Rays were taken.
- 12.The final outcome of study was analyzed only after 9 months of follow up.
- 13.The results were assessed on the basis of the time to union, functional recovery (range of motion and functional outcomes [Grace and Eversmann rating system and DASH]), restoration of the ulna and the radial bow, operating time and incident complications.

RESULT

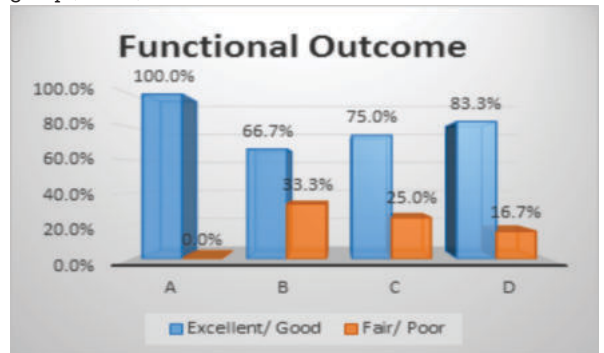
Table 1. Comparison Of Functional Outcome Among Study Group

Functional Outcome	Group			
	A	B	C	D
Excellent/ Good	12	8	9	10
	100.0%	66.7%	75.0%	83.3%
Fair/ Poor	0	4	3	2
	0.0%	33.3%	25.0%	16.7%

Total	0	2	2	0
	0.0%	16.7%	16.7%	0.0%

p<0.01

Most cases with excellent to good functional outcome was seen in both bones plating group (100%) followed by hybrid techniques of radius plating and ulnar nailing (83.3%), ulnar plating and radius nailing (75%) and lastly both bone nailing group (66.7%).

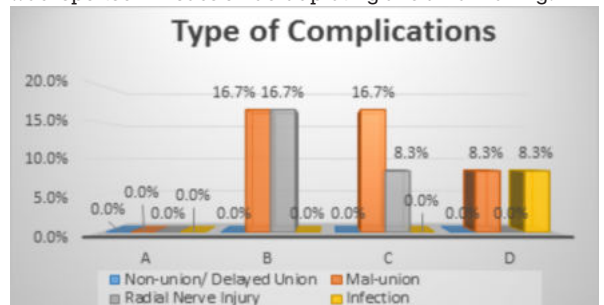


Graph 1. Comparison Of Functional Outcome Among Study Group

Table 2. Comparison Of Type Of Complications Among Study Groups

Complications	Group			
	A	B	C	D
Non-union/ Delayed Union	0	0	0	0
	0.0%	0.0%	0.0%	0.0%
Mal-union	0	2	2	1
	0.0%	16.7%	16.7%	8.3%
Radial Nerve Injury	0	2	1	0
	0.0%	16.7%	8.3%	0.0%
Infection	0	0	0	1
	0.0%	0.0%	0.0%	8.3%

Incidence of mal-union was seen in 2 cases each of both bone nailing and ulnar plating and radius nailing and in 1 case of radius plating and ulnar nailing. Radial nerve injury was reported in 2 and 1 cases of both bone nailing and ulnar plating and radius nailing respectively. Superficial infection was reported in 1 case of radius plating and ulnar nailing.



Graph 2. Comparison Of Type Of Complications Among Study Groups



Fig 1. 33yr Old Male With Left Both Bone Forearm Fracture Operated With Radius And Ulna Plating.



Functional Outcome At 9 Months

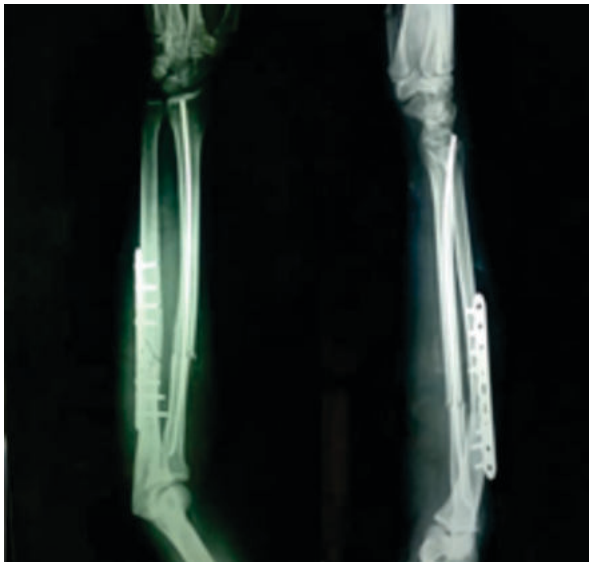


Fig 2. 39yr Old Female Case Of Right Both Bone Forearm Fracture Operated With Ulna Plating And Radius Nailing



Functional Outcome At 9 Months

DISCUSSION

Fractures of both radius and ulna are one of the common fractures in adults in upper extremity (30). Healing occurs relatively after closed treatment but mal-union with resultant decreased rotation of the forearm is common and has been associated with poor outcomes. Loss of rotation impedes the function of the upper limb and activities of daily living (31).

The treatment of displaced fractures of shafts of radius and ulna is primarily operative(32) . The closed reduction and cast immobilisation for the displaced fractures should only be taken if there is a specific contraindication to operative treatment (33)

Open reduction and compression plate fixation have become the treatment of choice for diaphyseal fractures of forearm bones in adults. Compression-plate fixation gives a high rate of union, low rate of complications and the satisfactory return of rotation of the forearm. Thus excellent results of this mode of treatment have been reported in many series (34) .

Mechanically intramedullary nails offer several advantages over the plate and screw fixation. Intramedullary nails are subjected to smaller bending loads than plates and are least likely to fail by fatigue. The reason is that they are closed to the mechanical axis than usual plate position on the external surface of the bone (35) .

Closed intramedullary nailing definitely has an advantage over the other modalities of treatment. It is minimally invasive procedure requiring shorter operating time. The biology of the fracture healing is not disturbed. Bone grafting is usually not needed. The risk of infection is minimal (36) . Intramedullary nails act as a load sharing devices in fractures with cortical contact. Stress shielding with resultant osteopenia commonly seen with plate and screws is minimised with intramedullary nails.

In present study, we aimed to evaluate the clinical and radiological union in adult diaphyseal fractures of both bones of the forearm fixed internally using plating and/ or nailing. A total of 48 subjects fulfilling eligibility criteria were randomly divided into four groups A, B, C and D (12 each) using random number table as follows: Group A: Both bones plating; Group B: Both bones nailing; Group C: Ulna plating and radius nailing and Group D: Radius plating and ulna nailing.

Functional Outcome

Most cases with excellent to good functional outcome was seen in both bones plating group (100%) followed by hybrid techniques of radius plating and ulnar nailing (83.3%), ulnar plating and radius nailing (75%) and lastly both bone nailing group (66.7%).

Sadek et al. (22) aimed to study the pattern of the diaphyseal fractures of the forearm in adults, to decide the modalities of surgical management. The study included 46 fractures, treated by open reduction and rigid fixation with DCP plates and 44 fractures, treated by closed reduction and fixation with nailing. Excellent to good outcome was reported in 100% of plating group vs. 86% in the nailing group. Kumar HK et al.(24) aimed to study different modalities of surgical treatment of diaphyseal fractures of forearm in adults. Authors have fixed 17 patients with Dcp, 13 patients with Lcdcp, 14 patients with Semitubular plating and 16 patients with Intramedullary nailing. By Anderson Scoring System out of 14 cases of Dcp 75% were excellent, 25% were satisfactory. Out of 11 cases of Lcdcp 72.7% were excellent, 18.2% were satisfactory, 9.1% were unsatisfactory. Out of 13cases of Semitubular plating 69.2%were excellent, 23.1% were satisfactory, 7.7% were unsatisfactory. Out of 14 cases of Intramedullary nailing, 42.9% were excellent, 21.4% were satisfactory, 21.4% were unsatisfactory, 14.3% had failure results. Kim SB et al.(21) aimed to compare the functional results of plate fixation only (A) and combined plate and intramedullary (IM) nail fixation (B). Groups A and B comprised of 31 and 16 cases, respectively. According to the Grace and Eversmann rating system, group A had excellent results in 15 cases, good in 14, acceptable in one, and unacceptable in one. Group B had excellent results in three cases, good in nine, acceptable in two, and unacceptable in two. Zhang XF et al.(26) conducted a similar study like ours, with all combination of fixation: both-bone plate fixation or both-bone intramedullary nailing, plate fixation of ulna and intramedullary nailing of radius and intramedullary nailing of ulna and plate fixation of radius. However, their observations varies with ours in regard that in their study they observed, patients receiving intramedullary

nailing of ulna and plate fixation of radius showed the best functional recovery outcome followed by both plating group.

Complications

Incidence of complications was maximum in both bone nailing group (33.3%) followed by hybrid techniques i.e. ulnar plating and radius nailing (25%) and radius plating and ulnar nailing (16.7%) followed by both bones plating (0%). Incidence of mal-union was seen in 2 cases each of both bone nailing and ulnar plating and radius nailing and in 1 case of radius plating and ulnar nailing. Radial nerve injury was reported in 2 and 1 cases of both bone nailing and ulnar plating and radius nailing respectively. Radial nerve injury was exclusive associated with nailing in present study. This could be explained by the rotational alignment, which is difficult with IM nailing and thus it is associated with the risk of neurovascular injury (42).

On comparing Plating versus Nailing in both bone diaphyseal fracture, Sadek et al. (22) reported delayed and non-union results were in 9% of the nailing group as compared to none in plating group. Kumar HK et al.(24) in their study observed major complication rate in nailing group as 14.3% as compared to none in DCP group. Kim SB et al.(21) in a study comparing Plating and Plating +Nailing observed non-union in 3 out of 16 cases (18.75%) of hybrid group as compared to none in plating group. Zhang XF et al.(26) observed a slightly varies results from present study in terms of complication rates. They observed least complications (4.4%) in radius plating and ulna nailing group and maximum in both bone nailing group (28.6%). Baldwin K et al.(29) in a meta-analysis aimed to determine which method of operative fixation, plate and screw, or intramedullary nails (IMN) fixation is superior. They reported that delayed unions and non-unions were rare but slightly more common in nailing group.

Thus to summarize, it was found in our clinical study that the patients in group A (Both bone plate fixation) presented fewer complications and better functional outcomes compared with other three methods. The advantage of plate fixation was the rigid stabilization, which limits the rotation of the bone, thereby providing torsional stability. The plate fixation of radius was also beneficial for the construction of radial bow.

CONCLUSION

We thus conclude that among the four different fixation methods for treating both bone diaphyseal forearm fractures in adults, the method with both bone i.e. ulna and radius plate fixation showed good stability in biomechanics, the lowest complication rate and best functional recovery outcomes. Hence, it seemed that it was a better option as treatment for both-bone diaphyseal forearm fractures in adults in clinical practice, but the type of fracture and the quality of plate reduction for the radius could also influence the clinical outcome.

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