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Internal fixation of fracture both bone forearm: Comparison of dynamic compression plate and IM nail

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Abstract

Open reduction and internal fixation can be considered as the treatment of choice if there were no contraindications for this because it is important to maintain length, opposition, axial alignment and rotational alignment if a good range of movement of forearm is to be restored. This is achieved in the present study. Anatomical reduction and internal fixation of forearm fractures can facilitate restoration of function. Any axial or rotatory malalignment or any narrowing of interosseous space produces disproportionate loss of pronation and supination. In addition proximal and distal radioulnar joints do not function properly if there is significant shortening of either bone. 50 cases of fracture both bones forearm were attended in the casualty and OPD and admitted in the hospital were treated by open reduction and internal fixation with Dynamic Compression Plate and Intramedullary nailing by Square nail. The study was conducted between June 2016 to May 2017 at Pravara Rural Hospital, Loni. 25 cases were treated by open reduction and internal fixation with dynamic compression plate, and 25 cases were treated with closed or open reduction and internal fixation with IM nails. Most common age group recorded in our study 20-30 (46%), and 32 (64%) cases are Male and 18 (36%) cases are Female. Anderson Scoring System 25 cases of DCP 76% were excellent, 24% were satisfactory and 25 cases of Intramedullary nailing with square nails 56% were excellent, 16% were satisfactory, 20% were unsatisfactory, 8% had failure results. Open reduction and plating fixation of fracture both bone forearm are better than intramedullary nailing. To conclude DCP offers excellent results in displaced diaphyseal fracture of forearm bone in adults and to be considered as first line of management.

Keywords: Internal fixation, fracture both bone forearm, dynamic compression plate, IM nail

Introduction

Open reduction and internal fixation with dynamic compression plate is a common procedure done for fractures of both bones forearm^[1]. Even newer modalities of plate osteo synthesis such as locking plate and limited contact plate have been introduced, the DCP is still a choice for many surgeons^[2]. Bone fractures are commonly encountered in today's industrial era. Various treatment modalities were introduced from time to time and each of them had some edge over the previous one. Fractures of the forearm bones may result in severe loss of function unless adequately treated. The number of forearm fractures is increasing faster than the predicted rate due to rapid industrialization, increased incidence of violence, road traffic accidents and various sports activities, increasing of fall and direct blow.

Traditionally, In general, complications are more common and prognosis is worse for displaced both bone fractures and for open fractures in adults. On an average, un-displaced fractures take six to eight weeks to heal, and displaced fractures take 3 to 5 months. Function may be most obviously affected with loss of pronation/ supination^[3], and as many as half of patients with both bone forearm fractures will have obvious loss of forearm pronation, which may or may not be functionally significant. Loss of forearm rotation is most likely when fractures occur in the middle third of the forearm.

Excellent results for plate fixation in displaced diaphyseal fractures of both bone of forearm have been reported by various authors, but only a few authors have focused on plate fixation in the management of open diaphyseal fractures of both the radius and ulna^[4-8]. Fracture both bone forearm treated with various surgical modalities like open reduction and internal fixation

with Dynamic Compression Plating, Limited contact Dynamic Compression Plating, Semi-tubular plating or closed reduction and internal fixation with Intramedullary nail. This study is undertaken to provide satisfactory functional outcome using two different surgical modalities like Dynamic Compression Plating, and Intramedullary nailing. 50 cases of fracture both bones forearm were selected after the inclusion and exclusion criteria, which were treated with Dynamic Compression Plating, and intramedullary nailing in the Pravara Rural Hospital, Loni.

Aims of study

To evaluate the results of the management of diaphyseal fractures both bones of forearm in adults by internal fixation using dynamic compression plate's vs intramedullary nails.

Materials and Methods

50 cases of fracture both bones forearm were attended in the casualty and OPD and admitted in the hospital were treated by open reduction and internal fixation with Dynamic Compression Plate and Intramedullary nailing by Square nail between June 2016 to May 2017 at Pravara Rural Hospital, Loni. Out of all 50 cases, 25 cases were treated by open reduction and internal fixation with dynamic compression plate, and 25 cases were treated with closed or open reduction and internal fixation with IM nails.

We collected records of the patients by asking the patients history and examining the patients. Essential investigations of all the patients were done. The patients were operated by open reduction and internal fixation with Dynamic Compression Plate and closed or open reduction and internal fixation with IM Nails by same surgeon. Patients followed up at regular interval.

Inclusion Criteria

- Patients- after growth completion.
- Male and female patients.
- All patients with fracture both bone forearm attending orthopaedic OPD and Casualty.
- Displaced diaphyseal fractures both bones in forearm.
- Compound fractures (Type-1, Type-2).

Exclusion Criteria

- Fractures both bone of forearm in children.
- Multiple fractures with head injuries.
- External fixation.
- Crush injuries of both bones forearm.
- Metaphyseal fractures are excluded.
- Monteggia and Galeazzi fractures.

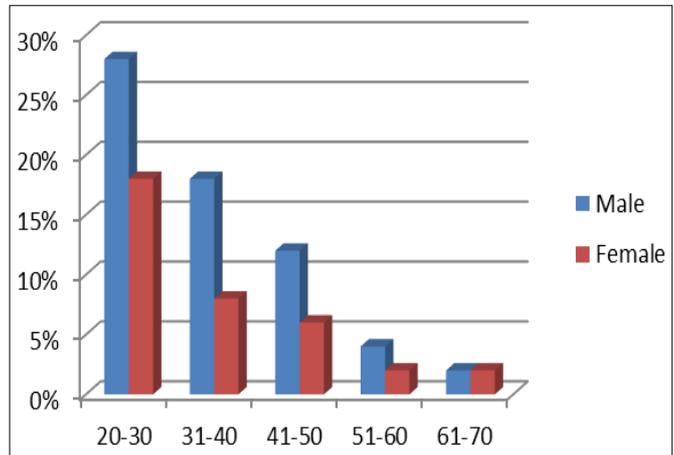
Observations

50 cases of fracture both bones forearm were attended in the casualty and OPD and admitted in the hospital were treated by open reduction and internal fixation with Dynamic Compression Plate and Intramedullary nailing by Square nail. 25 cases were treated by open reduction and internal fixation with dynamic compression plate, and 25 cases were treated with closed or open reduction and internal fixation with IM nails.

In our study, maximum cases were recorded in the age group of 20-30 (46%), 32 (64%) cases are Male and 18 (36%) cases are Female.

Table 1: Age wise and Gender wise distribution of cases

Age Group (Yrs)	Male	Female	Total	Percentage (%)
20-30	14 (28%)	9 (18)	23	46
31-40	9 (18%)	4 (8%)	13	26
41-50	6 (12%)	3 (6%)	9	18
51-60	2 (4%)	1 (2%)	3	6
61-70	1 (2%)	1 (2%)	2	4
Total	32 (64%)	18 (36%)	50	100

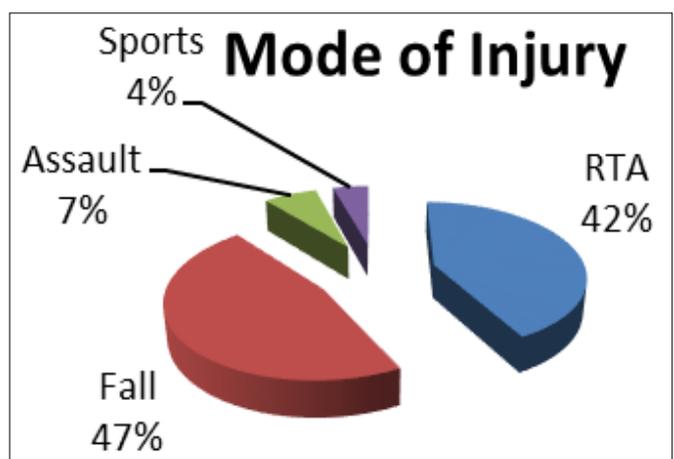


Graph 1: Age wise and Gender wise distribution of patients

In our study, maximum cases were reported in Fall (42%), followed by RTA (38%), least was in assault (12%) and sports (8%). Significantly more number of injuries were reported in the right side (60%) compared to left side (40%). In our study, 21 cases (42%) had middle 3rd, followed by 14 cases (28%) had middle and lower 3rd fracture, 11 cases (22%) had lower 3rd fracture and lastly 9 cases (18%) had middle and upper 3rd fracture.

Table 2: Distribution of Patients according to mode of injury

Mode of Injury	Number of cases	Percentage (%)
Fall	21	42
RTA	19	38
Assault	6	12
Sports	4	8



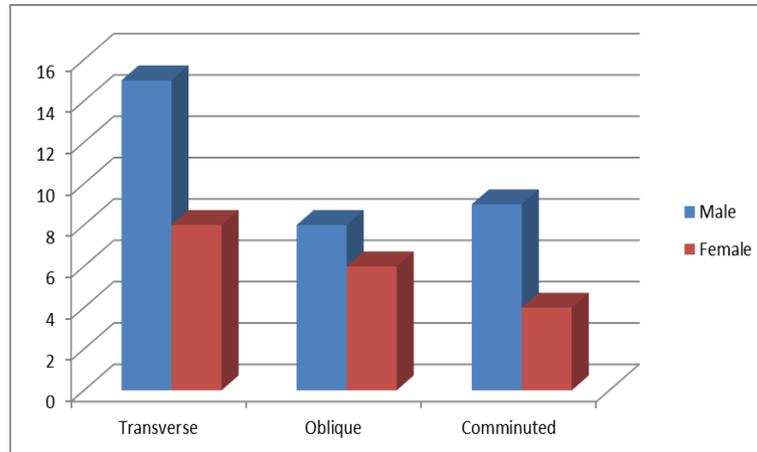
Graph 2: Distribution of patients according to mode of injury

Type of injury

In our study, maximum fractures were of Transverse type (46%), followed by Oblique (28%) and least was in Comminuted (26%). In our study, DCP implants were used for male 64% and female 36%, followed by IM Nail, implant used for male 64% and female 36%. In our study, a non-significant association was observed between implant used and weeks for union.

Table 3: Distribution of patients according to type of fracture with gender wise

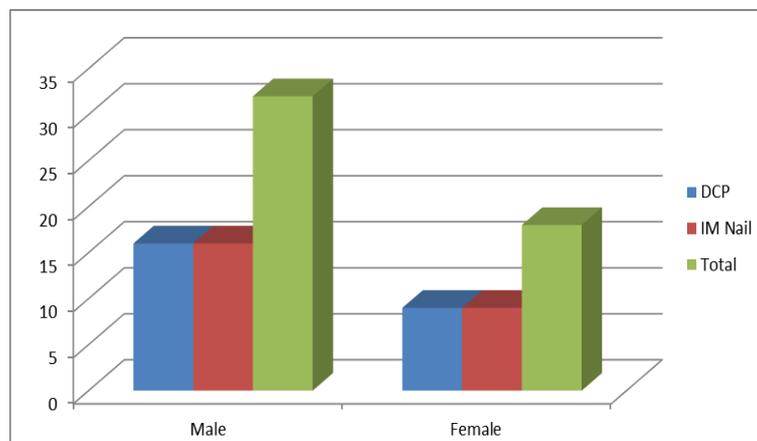
Type of Fracture	Male	Female	Total	Percentage (%)
Transverse	15	8	23	46
Oblique	8	6	14	28
Comminuted	9	4	13	26
Total	32	18	50	100



Graph 3: Distribution of patients according to type of fracture with gender wise

Table 4: Distribution of patients according to implant uses with gender wise

Use of Implant	Male	Female	Total
DCP	16 (64%)	9 (36%)	25 (100%)
IM Nail	16 (64%)	9 (36%)	25(100%)
Total	32 (64%)	18 (36%)	50 (100%)



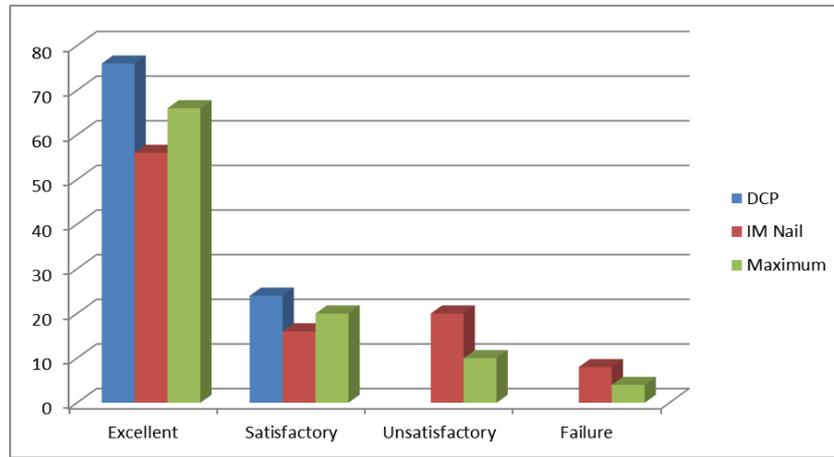
Graph 4: Distribution of patients according to implant uses with gender wise

In our study, less than 14 weeks of union time seen in 19 cases of DCP and 14 cases of IM Nail, 14-18 weeks of union in DCP 6 cases and IMN 4 cases, more than 17 weeks seen 5 cases treated with IMN. Non-union occurred in 2 cases treated with IMN. In our study, 21 cases of DCP implants had the flexion and extension <math><25^{\circ}</math> and 4 cases <math><50^{\circ}</math> and 13 cases of IMN implant had flexion & extension <math><25^{\circ}</math>, 9 cases <math><50^{\circ}</math> and 4 cases had >math>50^{\circ}</math>. In our study, 19 cases of DCP implants had the supination and pronation <math><10^{\circ}</math> and 6 cases <math><20^{\circ}</math> and 15

cases of IMN implant had supination and pronation <math><10^{\circ}</math>, 7 cases <math><20^{\circ}</math> and 3 cases had >math>20^{\circ}</math>. In our study, excellent results were obtained through DCP implant (76%), satisfactory (24%) which was followed by IMN maximum excellent result (56%), satisfactory (16%), unsatisfactory (20%) and only cases was failure (8%). The maximum excellent results were obtained through DCP and IM nails 66%, satisfactory 20%, unsatisfactory 10% and failure 4%.

Table 5: Distribution of patients according to uses of implant with gender wise

Use of Implant	Excellent	Satisfactory	Unsatisfactory	Failure	Total
DCP	19 (76%)	6 (24%)	-		25 (100%)
IM Nail	14 (56%)	4 (16%)	5 (20%)	2 (8%)	25 (100%)
Maximum	33 (66%)	10 (20%)	5 (10%)	2 (4%)	50 (100%)



Graph 5: Distribution of patients according to uses of implant with gender wise

Results

The results were based on Anderson *et al.* scoring system and modified from Morrey BF, *et al.*: Functional evaluation of elbow. 25 cases of DCP 76% were excellent, 24% were satisfactory. Out of 25 cases of Intramedullary nailing with square nails 56% were excellent, 16% were satisfactory, 20% were unsatisfactory, 8% had failure results.

Open reduction and internal fixation is a treatment of choice for the majority of the fractures of the both bones forearm in adult. While reducing the fractures it is important to correct the angulation radial bowing and rotation deformities. The axis of rotation of the forearm bones extends from center of the head of the radius to the insertion of the triangular fibro cartilage at the base of the styloid process of the ulna. If the relation of the forearm axis is altered by angulation the mechanism of the radio ulnar joint are deranged and permanent limitations of the rotation will occur. Rotational deformities will also limit the radio- ulnar movement.

The supinator muscles are inserted proximally and the pronators are inserted distally. Consequently the fracture of mid shaft of the radius takes place. The proximal fragment supinates and the distal fragment pronates which is seen in the X-Ray as a striking discrepancy in the width of the interosseous space between the proximal and distal fragments. Open reduction and internal fixation is always recommended in these cases as the maintenance of the reduction in plaster casing is difficult as there is every chance of displacement occurs. We had 25 patients of which 33 patients had excellent results (66%) with full, pain free, function of the extremity. We had 10 patients with satisfactory result (20%); 5 patients with unsatisfactory result (10%) and 2 patients had union and failure (4%).



Radiograph 2: Fracture Both Bone Forearm Treated with IM Nail (Square Nail) Fixation

Discussion

Functional forearm is very essential for an individual for social and economic thriving. Fractures of the forearm bones may result in severe loss of function unless adequately treated. The relationship of the radio humeral, radio ulnar, ulnohumeral, radio carpal, distal radio ulnar joint and maintenance of interosseous space must be perfect, otherwise some functional impairment will result [9]. In addition to regaining length, opposition and axial alignment, achieving rotational alignment is necessary, if a good range of pronation and supination is to be restored [10]. Malunion and nonunion occur more frequently because of difficulty in reducing and maintaining reduction of two parallel bones in the presence of the pronating and supinating muscles that have angulatory as well as rotational influences [11], because of these factors surgical management for displaced diaphyseal fractures in adult is generally accepted. In our series 50 patients were treated by two different surgical modalities. Open reduction internal with dynamic compression plating and closed or open intramedullary nailing using IM Nails randomly. In our series 25 patients were treated with dynamic compression plate and screws, 25 patients with intramedullary nails.

Open reduction and internal fixation is a treatment of choice for the majority of the fractures of the both bones forearm. While reducing the fractures it is important to correct the angulation radial bowing and rotation deformities. The axis of rotation of the forearm bones extends from center of the head of the radius to the insertion of the triangular fibro cartilage at the base of the styloid process of the ulna. If the relation of the forearm axis is altered by angulation the mechanism of the radio ulnar joint are deranged and permanent limitations of the rotation will occur. Rotational deformities will also limit



Radiograph 1: Fracture Both Bone Forearm treated with DCP Fixation

the radio- ulnar movement. The supinator muscles are inserted proximally and the pronators are inserted distally. Consequently the fracture of midshaft of the radius takes place. The proximal fragment supinates and the distal fragment pronates which is seen in the X-Ray as a striking discrepancy in the width of the interosseous space between the proximal and distal fragments.

Open reduction and internal fixation is always recommended in these cases as the maintenance of the reduction in plaster casing is difficult as there is every chance of displacement occurs. In this series out of 50 cases 33 (66%) cases are graded excellent and 10 (20%) satisfactory, 5 (10%) cases unsatisfactory and 2 (4%) cases failure. 5 cases were immobilized with above elbow slab and bandage, delayed union 1 case, infected nonunion 1 case. However, union rate and union time in our study were compatible with values in several other reports, including other series of closed fractures [12-16]. This emphasizes the value of fixation with a DCP in achieving union of fractures of both the radius and ulna, even in open fractures. Good early reduction and rigid fixation restore forearm stability earlier and limit dead space produced as a result of shortening and malposition [17]. The operation can be performed on a routine list in the best available time as an elective procedure. The study is limited in the fact there is no control group and therefore it provides no basis for firm conclusions, or statistical analysis. However the study does demonstrate that the DCP appears to be an effective and reliable means of fixing both bone forearm fractures.

In our study the age distribution was between 20-70 years. The youngest patient was 20 years and the oldest was 68 years. The commonest age group was 20-30 years (46%). In our study, 64% were males and 36% were females. In H.Dodge, [18] study, 89% were males and 11% were females. In Chapman, [19] series, average age was 33 years and in Herbert Dodge series, the mean age was 24 years.

By compression the fracture united by primary bone healing, if the fragments were rigidly fixed with their blood supply disturbed as little as possible, under these conditions resorption and bone formation occurred simultaneously in fractures treated by rigid fixation. When the fracture gap obliterated or greatly diminished by a compression plate the capillaries are able to grow into the medullary callus at an early stage in the healing process. Their integrity is protected by the rigidity of the fixation and thus the mesenchymal cells in a well oxygenated environment may readily differentiate directly into osteoblasts.

In our study we found that fixation with the square nails is not rigid enough to withstand the torsional, rotational and angulating forces of the muscles of the forearm. We had non-union, in our series of IM nailing because, distraction at the fracture site after nailing, decreased vascularity due to subcutaneous location of bones especially ulna.

Conclusion

Increased incidence of forearm fractures were probably due to increasing road traffic accidents and fall. Forearm fractures occurred more commonly in second and third decade. Predominance of males were seen in these fractures. Open reduction and internal fixation can be considered as the treatment of choice if there were no contract indications for this because it is important to maintain length, opposition, axial alignment and rotation alignment if a good range of movement of forearm is to be restored. This is achieved in the present study

Our study has proven that open reduction and internal

fixation of diaphyseal fractures of radius and ulna can be best done with dynamic compression plating technique which has given an excellent result. The complications of the procedure are negligible. The technique of DCP fixation is a simple procedure which can be done by the junior orthopedic surgeon with an excellent result. The soft tissue care is utmost important i.e. minimum periosteal stripping on the surface of the bone on which plate is applied. This maintains optimal vascularity at the fracture site. Proper preoperative planning, operative technique and postoperative rehabilitation program are key points for the excellent outcome.

In results of plating for fracture both bone forearm are better than intramedullary nailing of both bones. To conclude DCP offers excellent results in displaced diaphyseal fracture of forearm bone in adults and to be considered as first line of management.

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