International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2022; 8(3): 293-302
© 2022 IJOS
www.orthopaper.com
Received: 10-06-2022
Accepted: 18-07-2022

Dr. Shashank Kumar
Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Bihar, India

Dr. Sajan Thakur
Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Bihar, India

Dr. Kumar Vaibhav
Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Bihar, India

Dr. Kumar Anshuman
Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Bihar, India

Corresponding Author:
Dr. Shashank Kumar
Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Bihar, India

Functional outcome of dynamic compression plating and intramedullary nailing of diaphyseal fracture of both bones forearm

Dr. Shashank Kumar, Dr. Sajan Thakur, Dr. Kumar Vaibhav and Dr. Kumar Anshuman

DOI: https://doi.org/10.22271/ortho.2022.v8.i3e.3212

Abstract
Background: 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.
Aim: This present study is aimed to assess the functional outcome of dynamic compression plating and intramedullary nailing of diaphyseal fracture of both bones forearm.
Methods: This series consists of 50 cases of fracture both bone of forearm by open reduction and internal fixation with dynamic compression plate, closed reduction with intramedullary nailing by TENS between the period of 2 years at a tertiary care hospital after obtaining the clearance by the hospital ethical committee.
Of the above cases 25 patients were treated by open reduction and internal fixation with dynamic compression plate and 25 cases were treated with closed reduction and internal fixation with TENS.
Results: Even though, plate osteosynthesis is still the most commonly used form of fixation in adult both bone forearm fractures, both titanium elastic nail and interlocking nail fixation are relatively newer techniques which offer a viable and more efficient alternative especially in fixation of fractures involving shafts of radius and ulna.
Conclusions: Increased incidence of forearm fractures was probably due to increasing road traffic accidents and fall. Forearm fractures occurs more commonly in second and third decade. Male predominance was seen. Open reduction and internal fixation can be considered as the treatment of choice if there is no contraindication. It is important to maintain length, opposition, axial alignment, and rotational alignment in order to restore good range of movement of forearm. This is achieved in the present study.

Keywords: Diaphyseal fracture, both bones forearm, dynamic compression plating, intramedullary nailing

Introduction
Open reduction and internal fixation with dynamic compression plate is a common procedure done for fractures of both bones forearm [1]. Newer modalities of plate osteosynthesis such as locking plate and limited contact plate have been introduced, DCP is still a choice of many surgeons [2].

Bone fractures are commonly encountered in today's industrial era. Various treatment modalities have been introduced from time to time and each of them have some edge over the previous one. Fracture 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, fall, road traffic accidents, various sports activities and direct blow.

In general, complications are more common and prognosis is worse for displaced both bone fracture and for open fractures in adults. On an average, undisplaced fracture takes six to eight weeks to heal, and displaced fracture takes 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 present study is aimed to assess the functional outcome of dynamic compression plating and intramedullary nailing of diaphyseal fracture of both bones forearm.

Methodology

This series consists of 50 cases of fracture both bone of forearm by open reduction and internal fixation with dynamic compression plate, closed reduction with intramedullary nailing by TENS between the period of 2 years at a tertiary care hospital after obtaining the clearance by the hospital ethical committee.

Of the above cases 25 patients were treated by open reduction and internal fixation with dynamic compression plate and 25 cases were treated with closed reduction and internal fixation with TENS.

Ethical consideration

The study protocol, informed consent form and case report form were submitted to the ethical committee of Narayan Medical College and Hospital, Jamuhar, Sasaram for approval. Study was done after taking approval from institute ethical committee. Written informed consent was taken from each participant of the study.

Study Design

Prospective study

Study Period: Data was collected between June 2019 to July 2021

Patients admitted in Narayan Medical College and Hospital, Jamuhar Sasaram with fractures of both bones forearm after meeting the inclusion and exclusion criteria were selected for the study.

50 sites of Diaphyseal fracture of both bones forearm.

Patients selected for the study were further grouped randomly as 25 sites.

Each into 2 groups as follows:

Group A- Dynamic Compression Plating

Group B- Intramedullary Nailing

Study Population

Patients above 8 years of age with both bone forearm fracture admitted at Narayan Medical College and Hospital, Jamuhar.

Inclusion criteria

- Age should be between 8-60 years
- Both bone forearm within 2 weeks of injury.
- Open fractures type 1 only.

Exclusion criteria

- Non-union of both bones forearm fracture without infection.
- Non-union of both bones forearm with infection.
- Multiple fractures with head injuries.
- External fixation.
- Crush injuries of both bones forearm

Operative Technique

In the first group, we used a 4.5 mm narrow dynamic compression plate (DCP) and in second group standard intramedullary nail (IMN) was used.

Treatment protocol

After clinical evaluation radiograph of the affected forearm with wrist and elbow joint was taken in both anterior-posterior and lateral view. The limb was immobilized in above elbow POP slab with positioning the forearm according to the site of fracture. Routine examination of urine, Random blood Sugar, Erythrocyte Sedimentation Rate, Hepatitis C virus anti- body Test, Human Immunodeficiency Virus antibody test, Hepatitis-B Surface Antigen Test, Complete Blood Count, Bleeding Time, Clotting Time, Chest X-Ray.

Fasting blood sugar, Postprandial-Blood Sugar Creatinine and Electrocardiogram was done in elderly patients wherever required.

Pre-operative planning for intramedullary nailing and pre-operative planning for DCP was done and proper surgical technique for nail and DCP were done.

After prior informed consent, a pre-operative anesthetic evaluation was done. Pre-op planning of fixation was done.

Under anesthesia, 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 was done.

Post–operatively limb was immobilized in arm pouch. mobilization was started in the second week with pendulum exercises as per patient's tolerance. Immediate post-op X-Rays was done to assess the reduction of fracture and stability of fixation. Most of the suture removal were done on 12th day. Patients was followed from 6 weeks to 1 year. The results were based on Anderson *et al*. scoring system.

Results

Data was analysed using Statistical Package for Social Sciences (SPSS) version 21, IBM Inc. Descriptive data was reported for each variable. Descriptive statistics such as mean and standard deviation for continuous variables was calculated.

Summarized data was presented using Tables and Graphs. Shapiro Wilk test was used to check the normality of the data. As the data was found to be normally distributed bivariate analyses was performed using Independent t test and. Comparison of categorical variables was done using Chi square test. Level of statistical significance was set at p-value less than 0.05 and was denoted as

Table 1: Age wise distribution of Subjects

Age group (in yrs.)	Group A		Group B		P. Value
	N0.	%	N0.	%	
10-25	7	28	9	36	0.451
26-41	11	44	10	40	
42-57	4	16	4	16	
>57	3	12	2	8	
Total	25	100	25		
Mean±SD	34.72±14.68		31.60±15.12		

Table 1 shows Comparison of Mean age in study groups. No significant difference was seen in the distribution of mean age in Group A and Group B subjects when compared using independent t test as $p>0.05$.

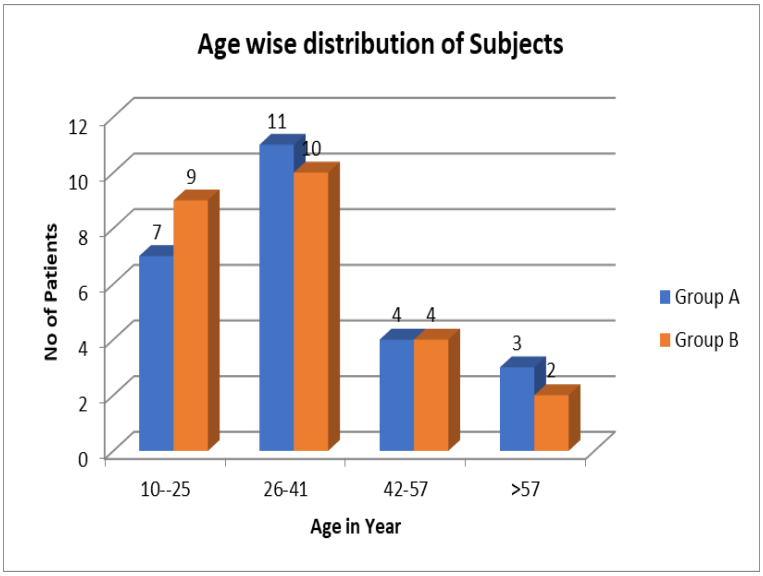


Fig 1: Age wise distribution of Subjects

Table 2: Gender wise distribution of Subjects

Gender	Group A		Group B		P. Value
	N0.	%	N0.	%	
Male	18	72	13	52	0.249
Female	7	28	12	48	
Total	25	100	25	100	

Table 2 shows Gender wise distribution of subjects in study group. No significant difference was seen in the distribution of male and female subjects in two study groups when compared using Chi square test as $p>0.05$.

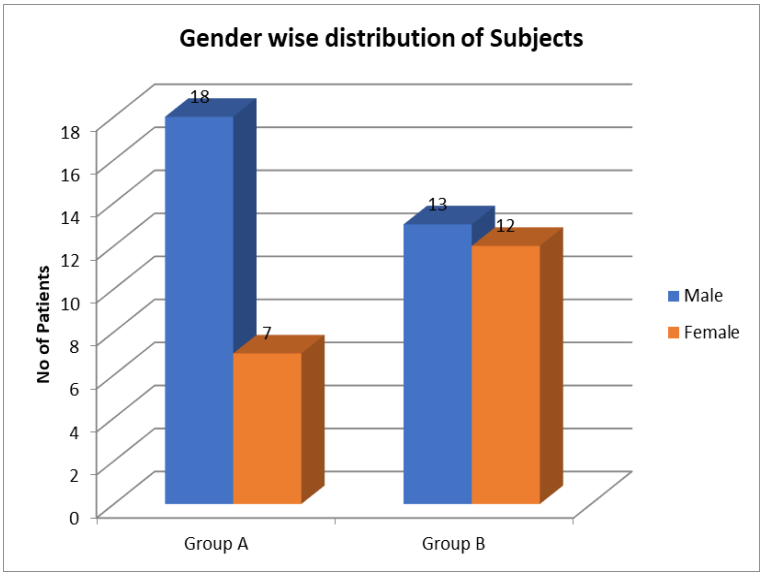


Fig 2: Gender wise distribution of Subjects

Table 3: Type of Fracture

Time of Fracture	Group A				Group B				P. Value
	Radius		Ulna		Radius		Ulna		
	No	%	No	%	No	%	No	%	
Transverse	19	76	12	48	19	76	12	48	
Oblique	6	24	13	52	0	0	0	0	**0.743**
Comminuted	0	0	0	0	6	24	13	52	
Total	25	100	25	100	25	100	25	100	

Table 3 shows Distribution of study subjects according type of fracture. No significant difference was seen in the distribution of mechanism of injury in two study groups when compared using Chi square test as $p>0.05$.

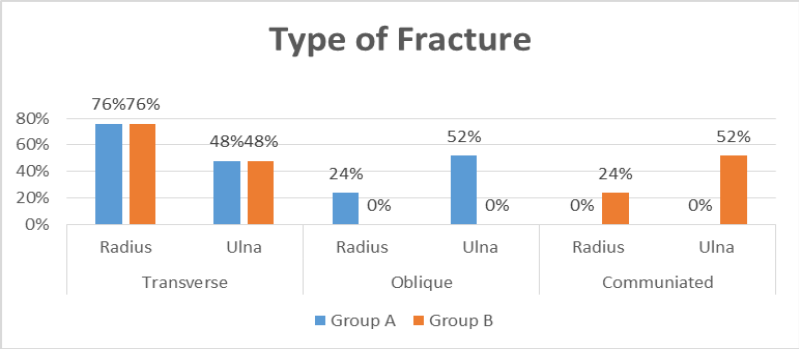


Fig 3: Type of Fracture

Table 4: Clinical Assessment (Pain)

Clinical Assessment (Pain)	Group A		Group B		P. Value
	N0.	%	N0.	%	
Present	24	96%	23	92%	0.530
Absent	1	4%	2	8%	
Total	25	100	25	100	

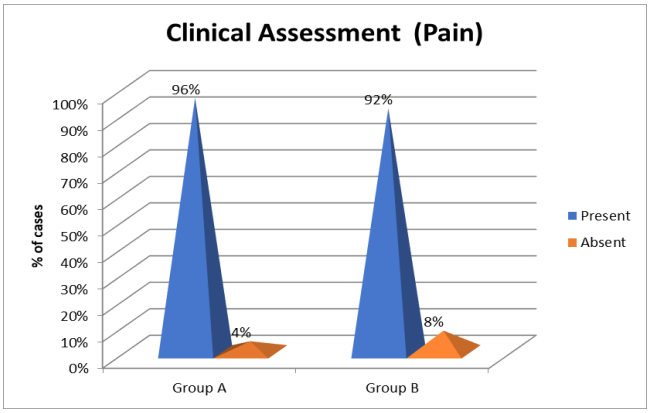


Fig 4: Clinical Assessment (Pain)

Table 5: Clinical Assessment (Swelling)

Clinical Assessment (Swelling)	Group A		Group B		P. Value
	N0.	%	N0.	%	
Present	20	80%	23	92%	0.564
Absent	5	20%	2	8%	
Total	25	100	25	100	

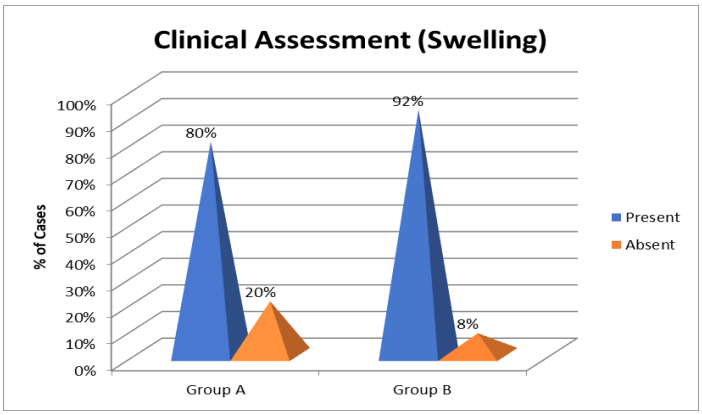


Fig 5: Clinical Assessment (Swelling)

Table 6: Clinical Assessment (Tenderness)

Clinical Assessment (Tenderness)	Group A		Group B		P. Value
	N0.	%	N0.	%	
Present	15	60%	17	68%	0.451
Absent	10	40%	8	32%	
Total	25	100	25	100	

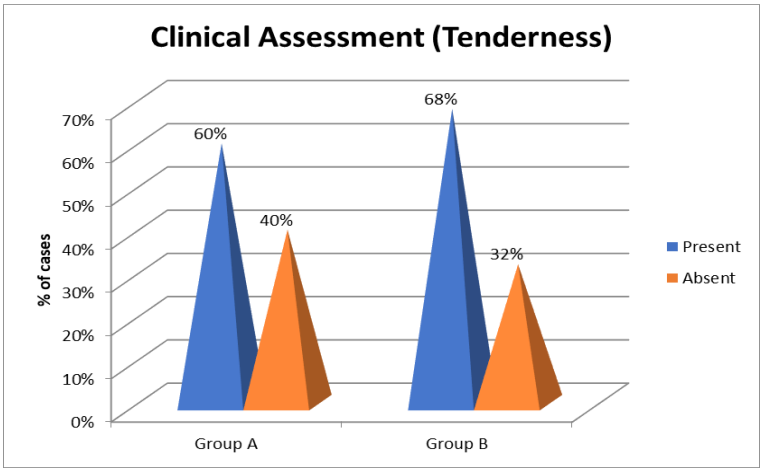


Fig 6: Clinical Assessment (Tenderness)

Table 7: Clinical Assessment (Movements at Elbow)

Clinical Assessment (Movements at Elbow)	Group A		Group B		P. Value
	N0.	%	N0.	%	
Present	20	80%	18	72%	0.623
Absent	5	20%	7	28%	
Total	25	100	25	100	

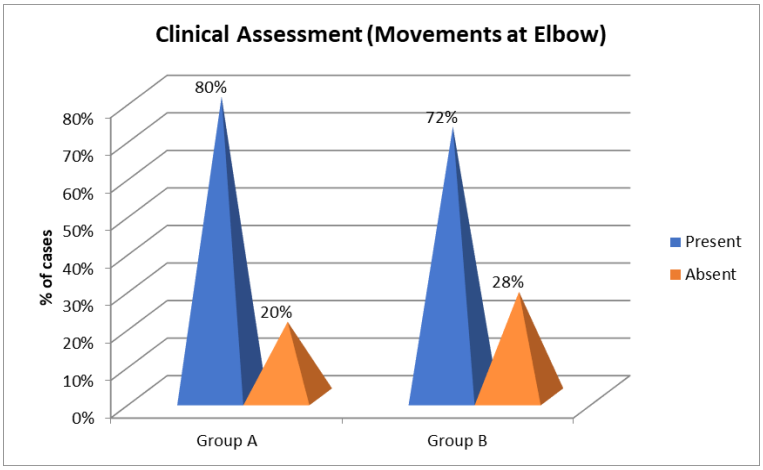


Fig 7: Clinical Assessment (Movements at Elbow)

Table 8: Follow up (4TH Weeks)

Follow up (4TH Weeks)	Group A		Group B		P. Value
	N0.	%	N0.	%	
Present	19	76%	18	72%	0.728
Absent	6	24%	7	28%	
Total	25	100	25	100	

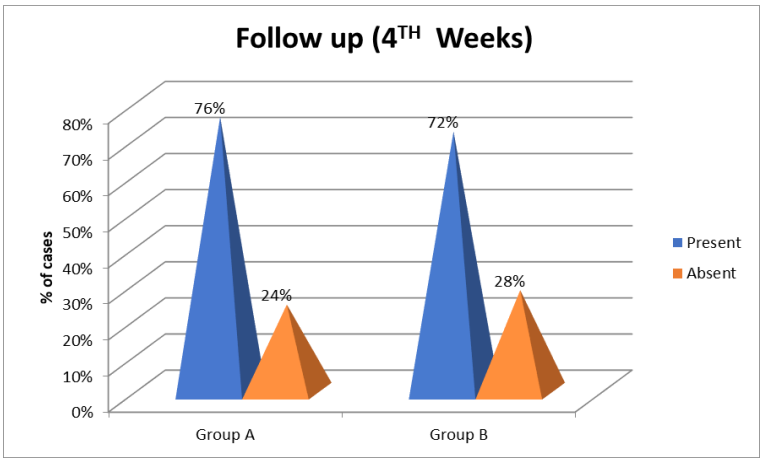


Fig 8: Follow up (4TH Weeks)

Table 9: Follow up (8 TH Weeks)

Follow up (8TH Weeks)	Group A		Group B		P. Value
	N0.	%	N0.	%	
Present	13	52%	15	60%	0.692
Absent	12	48%	10	40%	
Total	25	100	25	100	

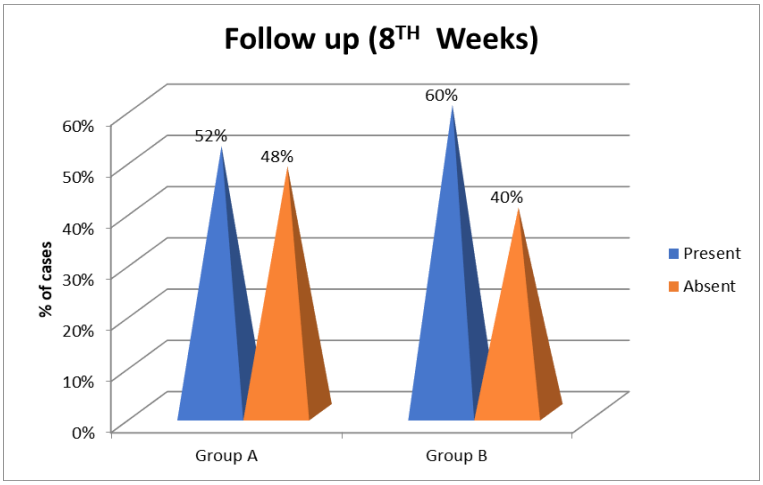


Fig 9: Follow up (4TH Weeks)

Table 10: Follow up (12 TH Weeks)

Follow up (12 TH Weeks)	Group A		Group B		P. Value
	N0.	%	N0.	%	
Present	10	40%	9	36%	0.874
Absent	15	60%	16	64%	
Total	25	100	25	100	

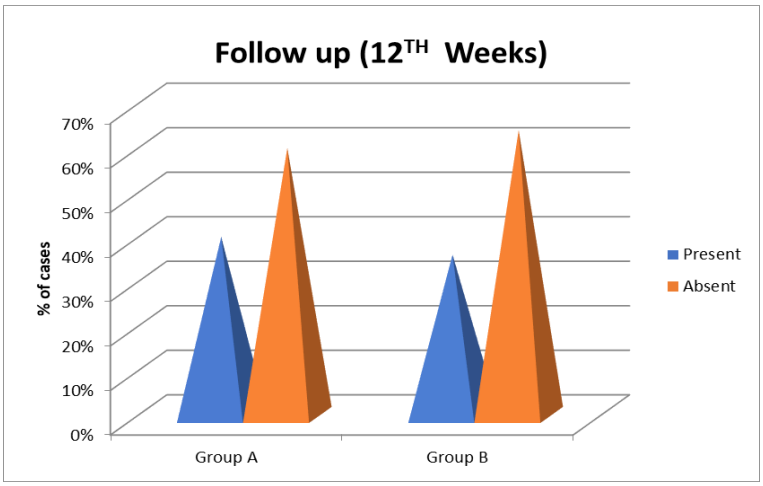


Fig 10: Follow up (12 TH Weeks)

Table 11: Follow up (After 6TH months)

Follow up (After 6 TH months)	Group A		Group B		P. Value
	N0.	%	N0.	%	
Present	7	28%	8	32%	1.000
Absent	18	72%	17	68%	
Total	25	100	25	100	

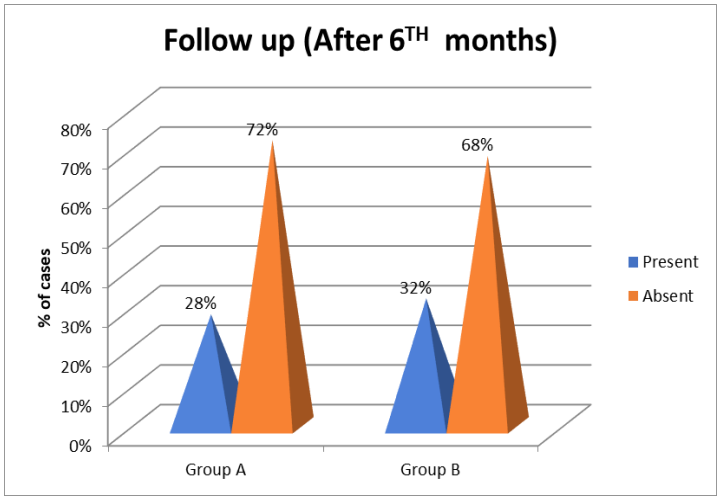


Fig 11: Follow up (After 6TH months)

Table 12: Overall results seen in both groups

Result	Group A		Group B		P. Value
	N0.	%	N0.	%	
Excellent	15	60%	13	52%	0.184
Fail	1	4%	1	4%	
Satisfactory	6	24%	7	28%	
Unsatisfactory	3	12%	4	16%	
Total	25	100	25	100	

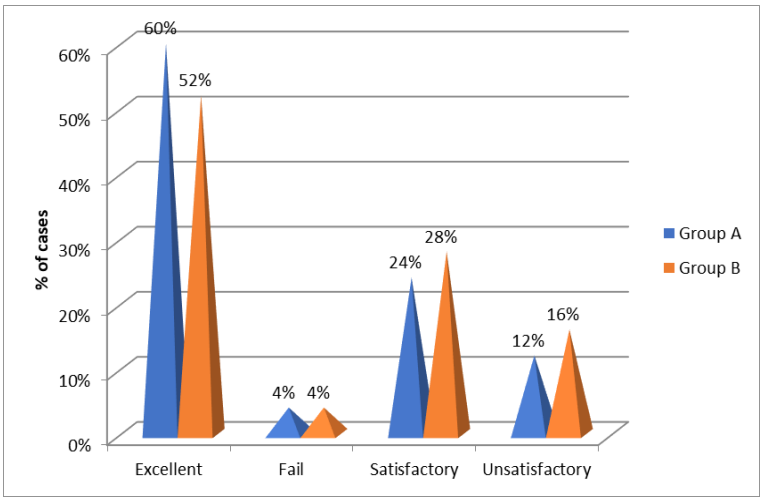


Fig 12: Overall results seen in both groups

Discussion

Diaphyseal fractures of the radius and ulna present specific problems not encountered with fractures of shaft of long bones. To achieve a satisfactory result, diaphyseal fracture of radius and ulna needs a near anatomical reduction as well as correction of displacement and restoration of normal length, axial alignment and rotational alignment.

Chapman *et al* [9], Herbert *et al* [10] and Frankie Leung *et al* [11] and Harsh Kumar [12] *et al* conducted study, in their study they concluded that there was no significant difference between male and female. Our study included 50 patients with 31 males and 19 female. Our study had a male preponderance of 72%.

During plate osteosynthesis, to minimize further injury to blood supply of the bone, the periosteum was stripped sparingly with a periosteal elevator and only sufficiently for applying a plate. The fragments were carefully reduced with interdigitating bone spicules being fitted properly. Comminuted fragments were fitted accurately in place. The plates were selected such that at least there were six cortical purchases on either side of fracture fragments. The plates were contoured before they were applied to the bone. Our study has showed good fracture union occurred in 80% of cases.

While using intramedullary device for fixing the adult forearm fractures involving both bones, rotational control in fractures near the metaphyseo-diaphyseal junction was difficult because of wide medullary canal. Interference fit nails do not maintain bone length if associated with bone loss. When an intramedullary fixation is used, errors in selecting the proper diameter or length of the nail and operative technique contributed to poor results. In case of the titanium elastic nail, the distal end of nail must abut subchondral bone to prevent shortening. The lower modulus of elasticity of titanium nails allow easier insertion and provide more load sharing with the bone. Titanium elastic nails produced interference fit which was responsible for the return of forearm rotation and grip strength.

Our study had showed that good to excellent union occurred with 90% of fractures fixed with titanium elastic nail and excellent union in 70% with interlocking nail fixation.

Fracture pattern in our study were 46.2% of transverse, 32.7% oblique and 21.2% of comminuted fractures of radius. 50% of transverse, 32% of oblique, 18% of comminuted fractures of ulna. When compared with other study Street DM [13] *et al*, Moda K [14] *et al*., Patwa JJ [15] *et al*., and Buhroo AM [16] *et al*, it was reported tranverse type of fracture was more common.

Compression plate fixation has become the treatment of choice for fractures of both bone forearm. Several studies have shown good results [17]. Droll *et al* compared injured arms to uninjured arms, following internal fixation of the forearm fractures, and found that injured arms had reduced strength of forearm pronation (70%) of that of the normal arm, forearm supination (68%), wrist flexion (84%), wrist extension (63%), and grip (75%). In addition, the injured arms had a significantly reduced active range of forearm supination (90%), forearm pronation (91%) and wrist flexion (82%) [18]. Possible complications include compartmental syndrome, delayed union or non-union and refractures after extraction of the plate [19, 20]. A high frequency of intraoperative nerve injuries has also been reported. The reported incidence of transient dorsal nerve palsy is 7 to 10% of all patients with radius fracture treated by plating. Incidence of radioulnar synostosis of the plate fixation is reported in the literature is 2% to 9%. Though plating for both forearm bones fracture is a sound practice and adheres to the principles of osteosynthesis, a straight plate is unable to maintain and preserve the radial bow, essential for normal rotational movements of the forearm. Use of closed intramedullary nails for treatment of diaphyseal fractures of forearm in nailing group can achieve good results.

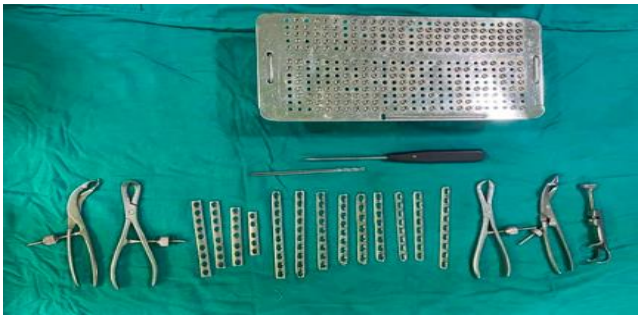
Conclusion

Increased incidence of forearm fractures was probably due to increasing road traffic accidents and fall. DCP and TENS offers excellent results in displaced diaphyseal fractures of forearm bones in adults. It can be considered as first line of management depending upon surgeons choice and experience. Intramedullary nailing with tens nails can be considered as first line of management. Even though, plate osteosynthesis is still the most commonly used form of fixation in adult both bone forearm fractures, both titanium elastic nail and interlocking nail fixation are relatively newer techniques which offer a viable and more efficient alternative especially in fixation of fractures involving shafts of radius and ulna.

Case Illustrations

Dynamic Compression Plating

Armamentarium



Pre-Operative

Intraoperative

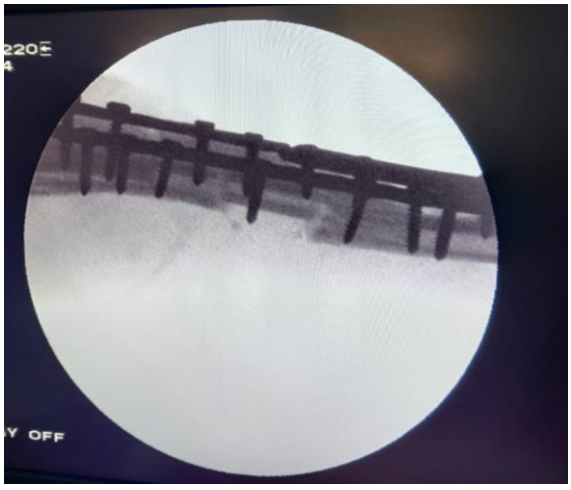


Image intensifier picture

Post-operative

Follow up radiograph – 6th month
Intramedullary nailing

Armamentarium

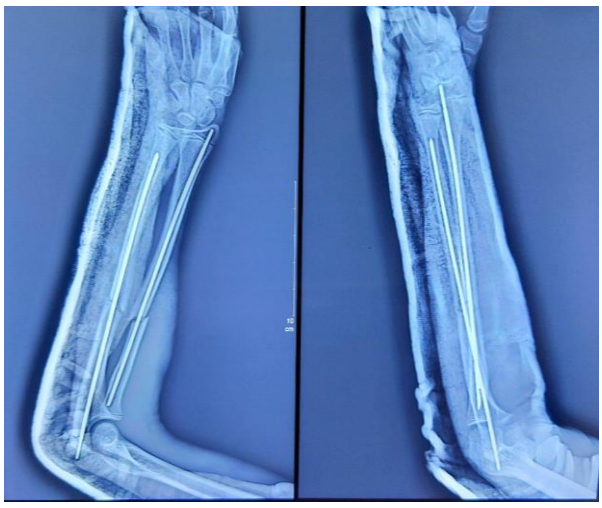
Pre-Operative

Radiograph

Intraoperative

Image intensifier picture

Post-operative



Follow Up Radiograph – 6th Month

References

1. Campbell's Operative Orthopaedics. 8th edition, Thomas, A Russel. Classification of Diaphyseal fractures; 728-30, 2.
2. Saikia KC, Bhuyan SK, Bhattacharya TD, Borgohain M, Jitesh P, Ahmed F. Internal fixation of fractures of both bones forearm: Comparison of locked compression and limited contact dynamic compression plate. Indian journal of orthopaedics. 2011;45(5):417.
3. Anderson LD *et al*. Compression-plate fixation in acute diaphyseal fractures of the radius and ulna. J Bone Joint Surg Am. 1975;57(3):287-297.
4. Naima PT, Schein AJ, Siffert RS. Use of ASIF compression plates in selected shaft fractures of the upper extremity. A preliminary report. Clin Ortho. 1970;71:208-16.
5. Duncan R, Geissler W, Freeland AE, Savoie FH. Immediate internal fixation of open fracture of the diaphysis of the forearm. J Ortho Trauma. 1992;6:25-31.
6. Reilly TJ. Isolated and combined fractures of the diaphysis of the radius and ulna. Hand Clin. 2002;18:179-94.
7. Knight RA, Purvis GD. Fractures of both bones of the forearm in adults. J Bone Joint Surg Am. 1949;31:755-64.
8. Moore TM, Klein JP, Patzakis MJ, Harvery JP. Results of compression- plating of Galeazzi fractures. J BoneJoint Surg Am. 1985;67:1015-21
9. Chapman Michael W. Eric Gordonse and Anthony Zissions AG. Compression plate fixation of acute fractures of the diaphyses of the radius and ulna. J. Bone & Joint Surgery. 2017;71A:159-169.
10. Dodge HS, Cady GW. Treatment of fractures of the radius and ulna with compression plates. A retrospective study of one hundred and nineteen fractures seventy eight patients. J Bone and Joint Surgery. Sept. 2009;45(A):1 167-1176
11. Alonso JE, Hunter J, Leung F, Prein J, Quintero J, Rommens PM. 4 Luis Parra is new AOLAT Regional Director 4 Reto Babst appointed professor of surgery 5 ORP attends its first AOAA Symposium 6 Hurricane Katrina touches an AO surgeon.
12. Kumar KH. Study of different modalities of surgical treatment of diaphyseal fractures of forearm in adults. Journal of Evolution of Medical and Dental Sciences. 2015 Sep 3;4(71):12340-50
13. Street DM. Intrameduallary forearm nailing. C.O.R.R. 2005;212:219-30.
14. Moda K, Chaddha NS, Anirodh Aggarval and Alok Garg, Ind. J Ortho. 2007;22:22-28.
15. Patwa JJ, Vaidya DD. A study of 200 consecutive cases of closed intramedullary nailing of radius and ulna. md. J Ortho. 2009;24(2):169-72.
16. Buhroo AM. Primary internal fixation of fracture both bones of forearm by intramedullary nailing. md. J Ortho. Oct. 1998; 32(4).
17. Hadden WA, Reschauer R, Seggi W. Results of AO plate fixation of forearm shaft fractures in adults. Injury. 1985;15:44-52.
18. Droll KP, Perna P, Potter J, Harniman E, Schemitsch EH, McKee MD. Outcomes Following Plate Fixation of Fractures of Both Bones of the Forearm in Adults. J Bone Joint Surg (Am) 2007;89(12):2619-2624.
19. Hadden WA, Reschauer R, Seggi W. Results of AO plate fixation of forearm shaft fractures in adults. Injury. 1985;15:44-52.
20. Dodge H, Cady G. Treatment of fractures of the radius and ulna with compression plates. J Bone Joint Surg [Am] 1972;54-A:1167-76.