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Functional Outcome of Plating versus Nailing in Adult Midshaft Radius-Ulna Fractures

Ashish Agarwal[1], Prashant N. Gedam[2], Hiren B Patel[3], Rajendra Phunde[4], Anuj Bharuka[5]

1- Professor, Nair Hospital, Mumbai
2- Professor, Nair Hospital, Mumbai
3- SMO, Nair Hospital, Mumbai
4- Assistant Professor, Nair Hospital, Mumbai
5- D.Orth DNB Orth , SR, Nair Hospital, Mumbai

Abstract

Objectives: *Study regarding mode of injury and restore anatomical alignment. Comparison of various functional parameters among study group post-operatively.* ***Methods:*** *Study was conducted by collecting data of 90 adult cases of either sex with mid-shaft radius ulna fractures among them 45 underwent plating while rest 45 cases underwent nailing and followed for 6 months post-operatively for assessment of functional outcome in form of pain, tenderness, stiffness, grip strength, pain while weight bearing.* ***Results:*** *Complication rate was less in plating (13.33 Percent) as compared to nailing, which was (26.66 Percent). The average period for immobilization was less in plating (2-4 weeks) as compared to nailing (4-6weeks).* ***Conclusions:*** *Open reduction and internal fixation with plating remains the treatment of choice in most of the forearm fractures. Well-contoured intramedullary nail system is not superior to plate fixation but can be considered as an alternative to that method for selected diaphyseal fractures of the forearm in adults.*

Keywords*: Midshaft forearm fractures; Radius plating; Radius-ulna nailing*

Address for correspondence: Dr. Hirenkumar Bhanuprasad Patel, Orthopaedic Office (No.18), Department Of Orthopaedics, TNMC and BYL Nair Hospital, Agripada, Mumbai, India Zip Code: 400008. Contact No.: +919004861878, Email Id: hirenbhpatel@gmail.com

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Introduction

The presence of proximal and distal radio-ulnar joints in forearm allow pronation and supination movements.[1-6]Diaphyseal fractures of the radius and the ulna present specific problems in addition to problems common to all fractures of shafts of long bones. The chances of malunion and nonunion are greater because of the difficulty of reducing and maintaining reduction of two parallel bones in the presence of pronating and supinating muscles, which have angular as well as rotatory elements. Union with restoration of normal anatomy is particularly critical to achieve an optimal outcome for diaphyseal fractures of the shafts of the radius and ulna in adults. These goals have most often been met by open reduction and plate findings, and work status.[4,7,8] In previous studies, however, outcome measures other than union have received scant attention, and the inclusion of fractures of a single bone with fractures of both bones has made interpretation of results difficult. The purpose of this study is to determine the relationship of outcome to the method of treatment, type of fracture (open or closed), and presence of associated injuries in adults who sustained fractures of the shafts of both bones of the forearm. The outcome measures investigated were patient satisfaction (amount of pain), forearm rotation, radiographic appearance of union.

Materials and Methods

The randomized control comparative prospective study was conducted in a tertiary institute by collecting data of 90 adult cases of either sex with mid-shaft radius ulna fractures.

We have excluded skeletally immature patients & fractures of radius-ulna other than mid-shaft & cases with proximal or distal radio-ulnar joint injury. Purposive sampling was used to include the patients & followed by simple random sampling to divide cases into two groups to avoid bias. Group A consist of 45 patients with midshaft radius ulna fractures underwent plating. Group B consist of 45 similar patients underwent nailing. The study was conducted from December 2014 to April 2016 and followed up till next 6 months post operatively. The study started after institutional ethics committee approval.

Operative details

Most middle-third forearm fractures are easily approached with the patient in the supine position and the arm extended on an arm board or hand table. Lidocaine wasused for axillary nerve block. Pads were applied over all the upper- and lower-extremity bony prominences outside the surgical field. Appropriately sized padded tourniquet was applied.

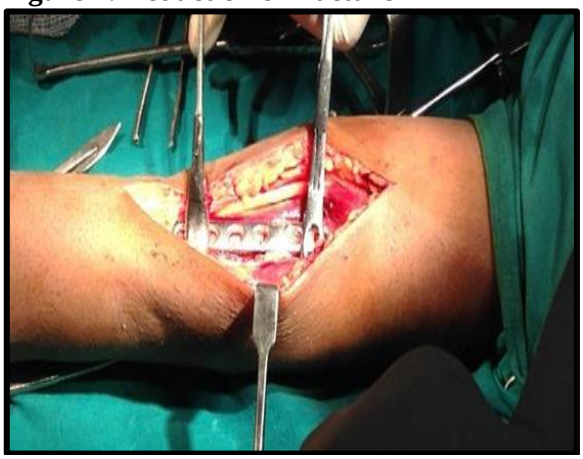
Radius-ulna plating

The radial approach, volar or dorsal, exposes the radius. Reduce the radius fracture with sharp or dull fracture reduction forceps as the assistant applies longitudinal traction. Apply a compression plate, and place an inter-fragmentary compression screw through or outside the plate, as the fracture dictates. A C-arm radiograph can be used quickly to check alignment and screw placement (Figure 1).

Approach the subcutaneous border of the ulna with the arm flexed 90 degree flexion. Reduce the ulna fracture. Apply a small-fragment 3.5-mm dynamic compression plate or a limited-contact dynamic compression plate. A minimum of three cortices above and below the fracture site is indicated. Whenever possible, inter-fragmentary compression screw fixation should be performed, either through or outside the plate fixation. Check with the c-arm as needed. Irrigate the wounds.

If necessary, perform a bone graft. Although it is controversial, bone grafting may be applied to grossly comminuted fractures. Care in bone graft placement is necessary to avoid violation of the interosseous membrane and to prevent synostosis. Release the tourniquet, and obtain hemostasis. Drains may be used, according to the surgeon's preference. Close the wound. If the tension is too great, leave the wound open and return in 2-3 days for delayed primary closure. Apply sterile dressings, and protect the forearm with a sugar-tong splint or a functional fracture brace for support.

Figure 1: Reduction of fracture



Radius-ulna nailing

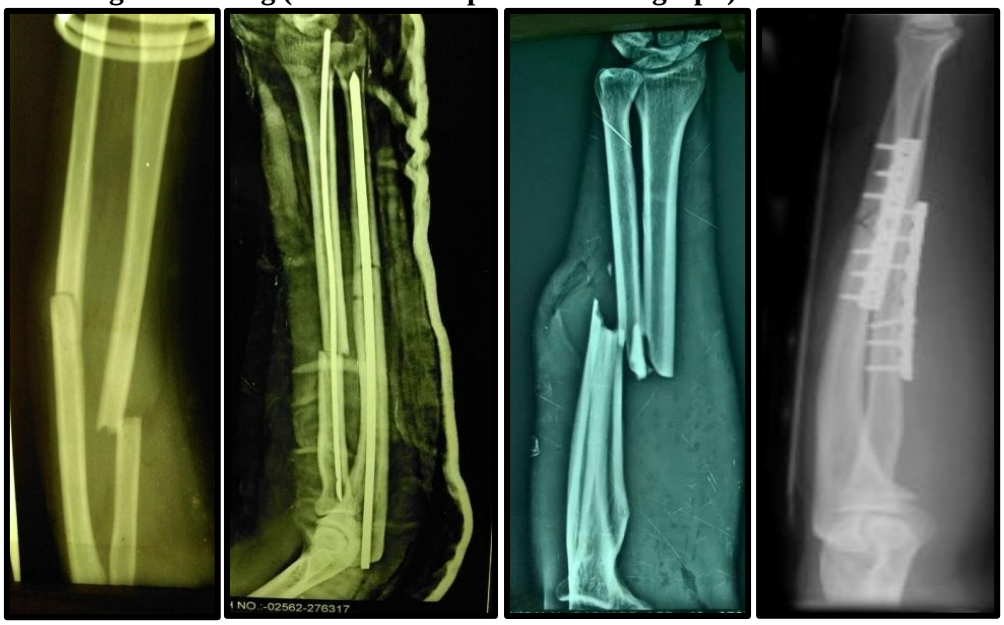
In the forearm, only the radial nail needs to be bent, at its head end. This will ensure that, with the nail in situ, no forces will be generated that could act on the wrist. To facilitate insertion, the nail is bent towards the radial aspect of the forearm only when it is about two-thirds in the bone. Apart from this, the nail is kept straight. The ulnar nail is always used straight. Fractures near the elbow joint are managed with a special nail; this nail is thicker than the other forearm nails, and tapers distally. This pattern is required since the nail must be particularly firmly seated at the fracture site, and must also be capable of being impacted sufficiently far down the ulna to prevent it backing out. Also, the head end of the nail is broad, to provide maximum contact with the cancellous bone; a thin nail would cut through the soft spongy bone.

Postoperative care

Beginning on postoperative day 1, a physical therapist was consulted to assist in digital range of motion. To avoid hematoma formation, progressive wrist and elbow motion were delayed for 3-5 days.

Radiological findings

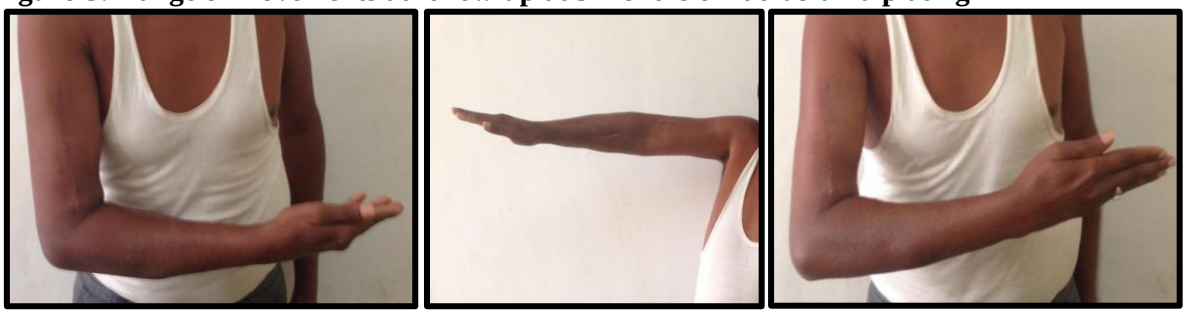
Figure- 2: Nailing and Plating (Pre and Postoperative Radiograph)



Pre and Postoperative (Plating) **Pre and Postoperative (Nailing)**

Functional evaluation

Figure-3: Range of movements at follow-up at 3 months of radius-ulna plating

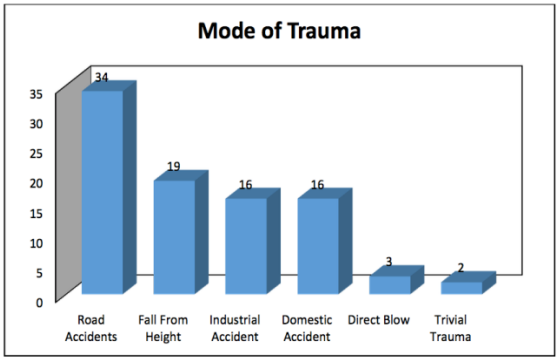


Supination **Pronation** **Mid-prone position**

Results

Out of 90 patients, 55 were male and 35 were females while 48 patients had fracture to the right forearm while 42 had fracture to left forearm.

Graph 1: Distribution of mode of trauma



The average time to fracture healing was fourteen weeks (range, nine to thirty-two weeks). There was one non-union following an open comminuted fracture of the middle third of the ulna. In this case, complete radiographic consolidation was achieved sixteen weeks following removal of the nail and application of a plate supplemented with autologous iliac crest bone graft. The mean pronation and supination were 85° (range, 82°to89°) and 87° (range, 83° to 90°), respectively, following treatment of the isolated ulnar fractures; 84° (range, 79° to 87°) and 87° (range, 84° to 90°), respectively, following treatment of the isolated radial fractures; and 79° (range, 68° to 84°) and 81° (range, 70° to 88°), respectively, following treatment of the both-bone fractures.

One patient with an open fracture had a superficial infection, which resolved after the administration of oral antibiotics. There were no cases of deep infection, radioulnar synostosis between the forearm bones, mechanical irritation by nails or interlocking screws at the distal part of the radius or at the olecranon, compartment syndrome, failure of fixation or breakage of a device (a nail or a locking screw), or refracture. Five nails were removed at the patient's request, at an average of twenty months. According to the Grace and Eversmann rating system, seventy-two (80%) of the ninety forearms had an excellent result, ten (11.1%) had a good result, and eight (8.9%) had an acceptable result. One of the two acceptable results was attributed to an ulnar nonunion requiring plate fixation and bone-grafting, and the other was attributed to an ipsilateral humeral fracture as well as ulnar nerve and radial nerve injuries.

Since the observations are on ordinal scale, we have used Wilcoxon signed rank test to test the effect in group A and group B. From above table we can observe that p-values for both the groups are less than 0.05 hence we conclude that the effect observed in both groups are significant. Further we can observe that, effect observed in group A was 82.8% while effect observed in group B was 66.7%. While evaluating tenderness & stiffness, effect observed in group A was 75.4% & 82.8% while effect observed in group B was 67.8% & 63.9% respectively. Evaluation of grip strength & pain during weight bearing shows %effect in group A were 87.3% & 81.5% while effect observed in group b were 70.0% & 64.7% (Table 1).

Table 1: Evaluation of functional outcome

Pain	Median		Wilcoxon	p-value	% effect	Result
	Bt	At	signed rank w			
Plating	3	0.5	-4.028[a]	0.000	82.8	Significant
Nailing	3	1	-3.992[a]	0.000	66.7	Significant
Tenderness						
Plating	3.5	1	-3.992[a]	0.000	75.4	Significant
Nailing	3	1	-4.088[a]	0.000	67.8	Significant
Stiffness						
Plating	3	0.5	-3.998[a]	0.000	82.8	Significant
Nailing	3	1	-4.088[a]	0.000	63.9	Significant
Grip strength						
Plating	3	0	-4.053[a]	0.000	87.3	Significant
Nailing	3	1	-4.064[a]	0.000	70.0	Significant
Pain during weight bearing						
Plating	3	0.5	-4.035[a]	0.000	81.5	Significant
Nailing	3	1	-4.072[a]	0.000	64.7	Significant

Discussion

In our study, complication rate was less in plating (13.33%) as compared to nailing, which was (26.66%). The average period for immobilization was less in plating (2-4 weeks) as compared to nailing (4-6weeks).

The advantages of using an intramedullary device is that periosteal stripping is unnecessary, the skin incisions are smaller, and there is less soft-tissue dissection, resulting in preservation of the osseous blood supply, which aids in fracture union. Also, unlike compression plates, intramedullary implants are stress-sharing rather than stress-shielding, which leads to a peripheral periosteal callus that may facilitate stronger fracture union. Despite this abundant callus, a mechanical block to forearm rotation has not been reported, to our knowledge. In our study, there were no cases of radioulnar synostosis. There was one nonunion, of a grade-III-a open comminuted fracture with soft-tissue damage and periosteal stripping.

The disadvantage of this procedure is that it requires a longer duration of immobilization (until bridging callus is observed) compared with that required following plate osteosynthesis, and the patient must wear a brace. However, since the procedure does not expose the wrist or elbow joint, no patient lost mobility of these joints. Even with the

disadvantage of longer immobilization of the forearm, we believe that intramedullary nailing is a reasonable approach that has had good results in selected cases.

The restoration of the radial bow is considered important in terms of reconstituting the normal forearm architecture and restoring forearm rotation and grip strength. In our opinion, this prebent nail cannot restore normal radial bowing accurately in every patient. However, no significant functional impairment will result if forearm angulation is reduced to 10° in any plane ($p > 0.01$). We found that fixation of diaphyseal fractures of the forearm in adults with an interlocking contoured intramedullary nail has several merits. In addition, it requires no periosteal stripping and the incisions are smaller than those required for plate fixation, making the technique particularly appealing when the overlying soft-tissue envelope is tenuous.

Our experience indicates that well-contoured intramedullary nail system is not superior to plate fixation but can be considered as an alternative to that method for selected diaphyseal fractures of the forearm in adults.

Plate fixation has been considered the gold standard for fixation of both bone forearm fractures. Several studies have shown good results [5,11] possible complications includes compartmental syndrome, delayed union or non-union and difficulty in removing re-fractures after extraction of the plate long duration of operation, long exposure and striping of more soft tissue.[5,10]a high frequency of intraoperative nerve injuries has also been reported. The reported incidence of transient dorsal nerve paresis is 7-10% of all patients with radius fracture treated by plating. Incidence of radio-ulnar synostosis of the plate fixation is reported in the literature is 2- 9%.[5,9]

On the other hand, intramedullary fixation is comparatively a simpler technique requiring inexpensive surgical devices and also leads to less soft tissue damage, thus intramedullary fixation has wider practical utility and this should be kept in mind while treating poor patients in a developing country like India to carter to the needs of the common man most of which are from rural areas.

Conclusion

Open reduction and internal fixation with plating remains the treatment of choice in most of the forearm fractures. Functional results of plating and nailing are comparable if anatomical alignment is well achieved. Therefore, intramedullary fixation, which is relatively simpler and wider practical utility, should be kept in mind during decision-making.

Conflict of Interest: *None declared*
Source of Support: *Nil*
Ethical Permission: *Obtained*

References

1. Singh RP, Sharma M. Primary internal fixation of fracture both bones of forearm by intramedullary nailing. J Inst Med 2007;29:2-25.
2. Gadegone W, Salphale YS, Lokhande V. Screw elastic intramedullary nail for the management of adult forearm fractures. Indian J Orthop 2012;46:65-70.
3. Saka G, Sağlam N, Kurtulmuş T, Ozer C, Uğurlar M, Akpınar F. Interlocking intramedullary ulna nails in isolated ulna diaphyseal fractures: a retrospective study. Acta Orthop Traumatol Turc 2013;47:236-43.
4. Lil NA, Makkar DS, Adatia AA. Results of closed intramedullary nailing using talwarkar square nail in adult forearm fractures. Malays Orthop J 2012;6:7-12.
5. Ozkaya U, Kiliç A, Ozdoğan U, Beng K, Kabukçuoğlu Y. Comparison between locked intramedullary nailing and plate osteosynthesis in the management of adult forearm fractures. Acta Orthop Traumatol Turc 2009;43:14-20.
6. Leeyh, Leesk, Chungms, Baekgh, Gonghs, Kimkh. Interlocking contoured intramedullary nail fixation for selected diaphyseal fractures of the forearm in adults. J Bone Joint Surg Am 2008;90:1891-8.
7. Schemitsch EH, Richards RR. The effect of malunion on functional outcome after plate fixation of fractures of both bones of the forearm in adults. J bone Joint Surg 1992;74a(7):1068–1078
8. Smith H, Sage FP. Medullary fixation of forearm fractures. J bone Joint Surg 1957;39-a:91–98
9. Anderson ID, Sisk D, Tooms RE, Park WI. Compression-plate fixation in acute diaphyseal fractures of the radius and ulna. J bone Joint Surg Am 1975;57:287-97.
10. Hidaka S, Gustilo RB. Refracture of bones of the forearm after plate removal. J Bone and Joint Surg1984;66:1241-2.
11. Rehman S, Sokunbi G. Intramedullary fixation of forearm fractures. Hand Clin. 2010;26(3):391-40.