

Role of Rush Nail in Fracture Forearm Bones with or Without Bone Graft

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Abstract: ***Background:** Rush nail is a very handy, low cost easily available implant. In the present study, we have tried to find out its applicability in fracture of both bones with ORIF with or without Bone graft. The objectives were to evaluate the results of intramedullary fixation of fractures of both bone forearm in terms of fracture union, range of movement complications and functional outcome. **Materials and Methods:** This study was conducted on 60 adult subjects. Skeletally mature subjects with Gustilo Type 1 open and closed subjects were included in the study while the subjects having Gustilo Type 2 & 3 open, with neurovascular deficit were excluded from the study. Stainless steel rush nails were used for all the patients for both radius and ulnar repair through conventional surgical approach to radius and ulna. In fractures older than ten days autogenous cancellous graft was used. Follow-up was done at 6, 12 weeks & till fracture union postoperatively. **Results:** Mean Age of the study was 36.2 years & mean time of union was 14.8 weeks. No intra-operative complication occurred, there was no case with nonunion of both bones, Hardware failure was noted in 4 cases, 2 cases developed ulnar non union, in one case due to physical activity ulnar nail bent and only one nail had protrusion of ulnar nail. Only 3 patients developed superficial stitch abscess which improved with antibiotics and none had deep infection. Using Andreson criteria results were evaluated and 48 patients (80%) had satisfactory to excellent results. **Conclusion:** Use of rush nails continues to have predictable and good results, complication results are lower when compared to plate osteosynthesis although application of above elbow cast after nailing is a downside of this procedure. Open reduction and fixation with rush nail still has a prospect in repair of forearm fractures considering its low complication rates, cost and acceptable results in a developing country like India where financial matters and non availability of C-arm image intensifier are to be considered.*

Keywords: Fracture both bone forearm, open reduction, rush nail, bone graft, management in a developing country

1. Introduction

Forearm skeleton in humans is adapted more for mobility than stability and plays an important role in upper extremity function. The presence of proximal and distal radio-ulnar joints allow pronation and supination movements. Moreover, forearm serves as the origin of muscles inserting on the hand, therefore fracture of forearm bones significantly affect a function of whole upper limb.

A developing country like India cannot afford the luxury of providing expensive surgical treatment to general public majority of which is still below poverty line. Often, traditional methods of closed reduction are followed to treat the patients of forearm fractures. Closed reduction and immobilization often shows good results in case of children as normal function of the affected limb can be restored due to remodeling, however the scenario is totally changed when fractures of the adults are treated. Diaphyseal fractures of the radius and the ulna present specific problems in addition to problems common to all fractures of shafts of long bones. In addition to regaining length, apposition, axial alignment achieving normal rotational alignment is necessary for restoration of good range of pronation and supination movement.^{[1],[2],[3]} The chances of malunion and non union 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 angulatory as well as rotatory elements.

Open reduction and internal fixation has many advantages over closed reduction in adults. ORIF has 3 fold aim; firstly to obtain more satisfactory reduction; secondly to improve the possibility of bone union; thirdly to achieve rigid fixation. With the unacceptable results of closed methods

and with the less than excellent results of a variety of intramedullary appliances, numerous investigators sought more rigid fixation by means of plates and screws.^{[4],[5],[6]}

Hidka and Gustilo^[7] disfavored plating because of various drawbacks:- long duration of operation, long exposure and stripping of more soft tissue, unsuitable for extreme one-fourth of bones, unsuitable for long, oblique, spiral or severely comminuted fractures, difficulty in removing plates and re-fracture after their removal. Intramedullary nailing has distinct advantages over the above mentioned disadvantages of plates. It is comparatively easier to use and causes minimal damage to the soft tissue at the fracture site, more cost effective and require less costly armamentarium and expertise. Rush nail can be used in the closed manner under C-arm control without injuring soft tissues and preserving the periosteal vascularity But in developing countries like ours where financial problem restrict the options Open reduction and internal fixation with rush nail could be handy in the both bone fractures of forearm.

In the present study, we have tried to find out its applicability in fractures of both bone forearm. The objectives were to evaluate the results of closed intramedullary fixation of fractures of both bone forearm in terms of fracture union, range of movement complications and functional outcome.

2. Materials and Methods

This case series prospective study was conducted on 60 adult subjects of fracture both bones forearm treated by open reduction and internal fixation with Rush nail, attending Orthopedic department of Rajindra hospital after getting clearance from the institutional ethics committee. Written

informed consent was taken from all the study participants for participation in this study.

Inclusion criteria

Skeletally mature subjects with Gustilo type 1 open and closed fractures without neurovascular deficit.

Exclusion criteria

Comprised of Gustilo type 2 or 3 open fractures and neurovascular deficit. Preoperative planning: On admission of the patient, careful history was elicited followed by physical examination. Radiographs were evaluated for each patient for type and location of fractures. The patients were taken up for surgery after routine investigations and pre-anesthetic check-up, Stainless steel rush nails were used for all patients for both radius and ulnar repair. Nail diameters were 2.0 mm, 2.5 mm, 3.0 mm, or 3.5 mm, with nail lengths from 16 to 36 cm for all surgical procedures.

Prior to surgery length of the nail is determined directly by measuring uninjured limb; Ulna from olecranon to ulnar styloid and Radius from radial head to radial styloid process. About ½ inch is subtracted from measurement to avoid risk of driving the nail through the end of the bone. Diameter is measured from the radiograph. Surgical technique for intramedullary nailing: Operations were performed through conventional approaches to radius and ulna, separate approach was used to avoid continuity of hematoma of two fracture sites with possible synostosis. In fractures older than 10 days autogenous bone graft was taken from patients iliac crest.

Post-operative care

all patients were immobilized with an AE slab and asked to perform active finger movements. Patients were discharged on the 7th day post-operatively. Suture removal was done in 2 weeks and another AE cast was applied with the elbow in 90° of flexion and the forearm in neutral rotation. Patients were evaluated at 6, 12 weeks and till union and then at 3 monthly intervals. When there is sufficient amount of callus usually at 8-10 weeks post-operatively, we removed cast and forearm was supported with forearm brace and patient was advised to perform elbow and wrist movement to avoid stiffness. External support was removed 8-12 weeks post-operatively. Results were assessed on the basis of the time to union, functional recovery and complications. Functional outcome was calculated using the system described by Anderson et al^[8]

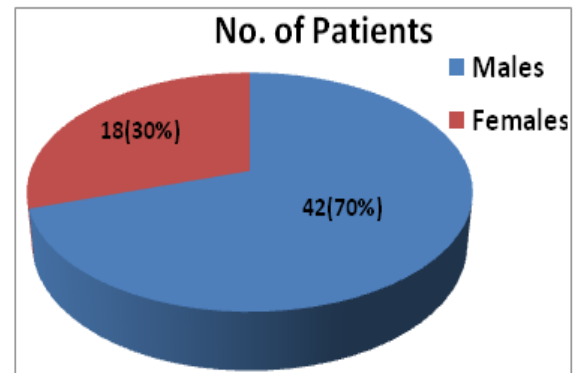
Table 1: Anderson criteria for functional assessment

Result	Union	Flexion-Extension of Wrist Joint	Supination and pronation
Excellent	Present	<10° loss	<25% loss
Satisfactory	Present	<20° loss	<50% loss
Unsatisfactory	Present	<30° loss	>50% loss
Failure	Non-union	With or Without loss of motion	With or Without loss of motion

3. Results

During the study period, 60 cases were selected in this study following inclusion criteria mentioned earlier. The mean age of study participants was 36.2 years (range: 18-60 years),

with a mean age in males of 39.42 years and mean age in females of 35.2 years (range: 18-60 year).



Pie Chart: Males were predominantly affected 42 patients (70%) while female were 18(30%).

The right limb was fractured in 34 subjects (56.67%) and left limb was fractured in 26 subjects (43.33%). The most common mode of injury was road traffic accidents 40 patients (66.67%), followed by household/accidental falls 14 (23.33%), fall from bicycle 4(6.67%), machine accident 1(1.67%), lathi blow 1(1.67%). Majority of the patients were engaged in active life e.g farmers, labourers 44 patients (73.3%) the remaining were housewives, students and unemployed 16 patients (26.6%).

Table 2: Type of Fracture

Type of Fracture	No. of Patients	Percentage
Transverse fracture of both bone	36	60%
Transverse fracture of either bone	18	30%
Oblique	2	3.33%
Communitied	4	6.67%
Closed	48	80%
Compound Gustilo grade 1	12	20%

Majority of fractures were simple 48 patients (80%) and 12 patients(20%) had compound Gustilo grade 1. Transverse fractures were the most common type of fracture in the present study 36 patients (60%) while 18 patients (30%) had transverse fracture of one bone and oblique of other bone either radius or ulna, comminuted in 4(6.67%) and oblique in 2(3.33%).

Table 3: Bone grafting required in Patients

Bone Grafting	No. of Patients	Percentage
Primary	14	23.3%
Secondary	2	3.33%

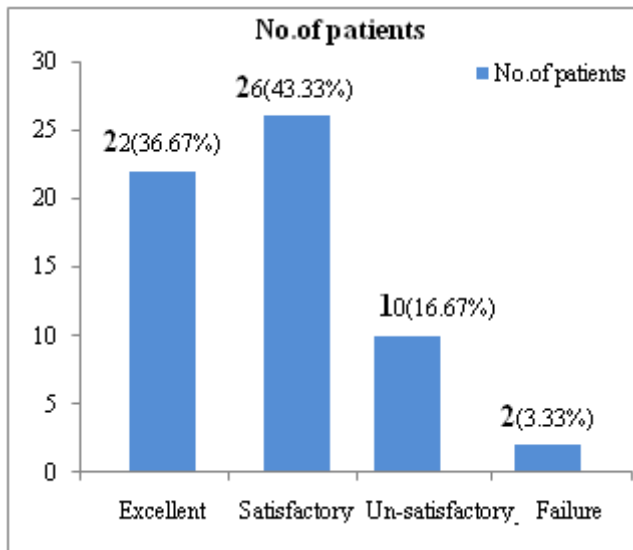
Primary Bone grafting was required in 14 patients (23.3%) and secondary bone grafting in 2 patients (3.33%).

Mean time of the union is 14.8 weeks (range: 12-18 weeks), No intraoperative complication occurred and Cast support was maintained for a mean of 7.5 weeks (range: 6-10 weeks) after that forearm brace was applied for a mean period of 6.1 weeks and continued until the radiographic union was seen.

Table 4: Complications

Complications	No. of cases	Percentage
Non-union: Both Bones	0	0
Non-Union:Ulna alone	2	3.33%
Infection:Superficial	3	5%
Infection:Deep	0	0
Implant bending	1	1.67%
Protusion of nail	1	1.67%
Radio-Ulnar synostosis	0	0

2 patients developed nonunion of the ulna while one patient had protusion of nail from ulnar side and one had ulnar nail bending,3 patients developed superficial infection while none developed deep infection.



Graph Chart Showing Results as per Anderson criteria



Figure 1: Pre-operative Xray



Figure 2: Post-operative Xray



Figure 3: Pre-operative Xray



Figure 4: Post-operative Xray



Figure 5,6,7,8: Showing Supination, Pronation, Extension, Flexion of Patient

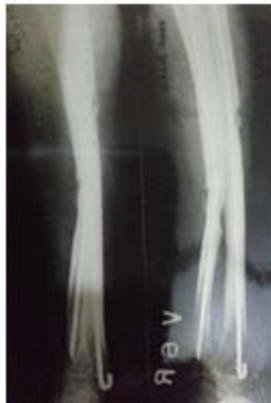


Figure 9: Xray showing ulnar nail bent with union



Figure 10: Xray showing ulnar non union

4. Discussion

Plate fixation has been considered the gold standard for fixation of both bone forearm fractures. Several studies have shown good results.^[5,9] Possible complications include 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 stripping of more soft tissue.^[5,7] A high frequency of intraoperative nerve injuries has also been reported. The reported incidence of transient dorsal nerve palsy 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%.^[5,8] On the other hand, intramedullary fixation is comparatively a simpler technique requiring inexpensive surgical devices and also leads to less soft tissue damage, total cost of rush nail instruments amounts to nearly 5000 rupees, while cost of plate and instruments varies from 15000 to 25000 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 cater to the needs of the common man most of which are ruralities.

The mean age of study participants was 36.2 years (range: 18-60 years), with a mean age in males of 39.42 years and mean age in females of 35.2 years (range: 18-60 year), similar observations has been reported by Patwa et al^[10], Ghosh et al^[11]. Males were predominantly affected 42 patients (70%) while female were 18(30%), similar findings has been reported by Ghosh et al^[11] and lil et al^[4]. The right limb was fractured in 34 subjects (56.67%) and left limb was fractured in 26 subjects (43.33%), similar finding in Ghosh

et al^[11], Kose et al^[12]. The most common mode of injury was road traffic accidents 40 patients (66.67%) and majority of the patients were involved in active life style 44 patients (73.3%), similar findings in Gadegone et al^[2].

Mean time of the union is 14.8 weeks (range: 12-18 weeks), similar findings were obtained in Ghosh et al^[11] with union in 14.32 weeks, In Kose et al^[12] union achieved in 11.3 weeks, in Gadegone et al^[2] average union achieved in 14 weeks, In lil et al^[4] average union time was 12.8 weeks. Primary Bone grafting was required in 14 patients (23.3%) as they have presented late in the hospital more than 10 days after injury and secondary bone grafting in 2 patients (3.33%) who had ulnar non union in whom the ulnar rush nail was removed and open reduction and internal fixation with plating with autogenous bone grafting from iliac crest was done and union was achieved later on in both the patients. Other complications involved superficial skin infection in 3 patients (5%) which improved with appropriate antibiotics after culture sensitivity and none patient had any deep infection. One patient had bending of ulnar nail patient was labourer by occupation and started to lift heavy weight before union resulting in bending of ulnar nail, adequate immobilisation was done in above elbow cast and union was obtained but resulted in restriction of activities in the patient (>50% loss of supination and pronation) and had not satisfactory result. One patient had ulnar protrusion of the rush nail. Cast support was maintained for a mean of 7.5 weeks (range: 6-10 weeks) after that forearm brace was applied for a mean period of 6.1 weeks and continued until the radiographic union was seen, similar findings were supported by Ghosh et al^[11], Lil et al^[4]. Union was achieved in 58 out of 60 patients (96.67%) and as per Anderson criteria Excellent to satisfactory results in 48 out of 60 patients (80%), similar results have been found in Gadegone et al^[2] and Ghosh et al^[11].

5. Conclusion

Use of rush nail continues to have predictable and good results. Complication rates are lower when compared to plate osteosynthesis although application of Above elbow cast after nailing is a downside of this procedure. The rush nail has still a future in repair of forearm fractures considering its low complications rates, cost and acceptable results in a developing country where financial matters are to be considered.

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