Original article

Primary internal fixation of fractures of both bones forearm by intramedullary nailing

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Background: Both bone fracture of forearm is a common injury, if not treated properly causes severe functional disability to the patients.

Materials and Methods: In this study 40 patients each with diaphyseal fractures of both bones forearm treated by square nail were evaluated.

Results: Conservative treatment with poor results and prolonged cast immobilization of 2-3 months adds to socio economic burden of patients. Hence various internal fixation devices were developed to achieve good results. Unstable fractures of radius and ulna with subluxation or dislocation of superior or inferior radio-ulnar joints and open fractures with skin loss need internal fixation.

Conclusion: Intramedullary nailing is a simple method of treating forearm fractures with better results than conservative methods.

Key words: Fracture – Both Bones Forearm Intramedullary Nailing

Introduction

In diaphyseal fractures of both bones of forearm in addition to regaining length, apposition and axial alignment, correct rotational alignment must be attained so as to preserve a good range of supination and pronation. It is difficult to correct the rotational deformity by closed methods and complications like displacement, residual rotational deformity, and malunion, delayed union and even non-union are common if conservative treatment is instituted. Fractures of both bones of forearm are usually classified according to the level of fracture, the degree of displacement and angulations, the presence or absence of communition, and whether they are open or closed.

Knight and Purvis found unsatisfactory results with a rotational deformity of 25-60% of patients treated with conservative methods[1]. Bolton & Quinlan[2] Smith also observed disappointing results with conservative methods[3].

Over the year many methods of open reduction and internal fixation have been advocated. In 1940s medullary nailing became popular for the treatment of fractures femur, various devices for medullary fixation of radius and ulna were used. Smith and Sage[3] in a series of 555 fractures in which some form of Medullary fixation by k-wirw, rushpin, Steinmann pin, lottes nail and knail had been used reported nonunion in over 20% of cases with poor function. Caden reported a non union rate of 16.6% in forearm fracture treated with rushpins[4].

Sage developed triangular nails with prebent curves for radius and straight nails for ulna for more rigid fixation and found good results[5]. Talwalkar then developed square nails for more rigid fixation and early removal of plaster[6].

Intramedullary nailing can be done by close or open method, the advantage is minimal surgical trauma, short operating time, low incidence of refracture and infection and fewer scars.

Materials and Methods

The 40 adult patients of either sex with diaphyseal fractures of both bones forearm without any other skeletal injury,

who attended the hospital within a week of sustaining trauma were taken up for the study. Radiographs in two planes were taken and necessary investigations were done. The operation was conducted under G/A or with brachial block. The Radius was exposed by posterior Thompson approach in proximal and middle 1/3 rd fractures and by Henry's approach for lower 1/3rd fractures. Ulna was exposed by posterior subcutaneous approach.

After correction of axial and rotational displacement the radial nail was passed from radial styloid or lateral to Lister's tubercle and in case of ulna it was passed from olecranon process. The reduction was achieved on table and wound closed in layers. Both the nails in radius and ulna were kept 1.3cms out from radial styloid and olecranon process respectively. POP cast immobilization was given in all cases.

Within 24 hours of surgery the check x-ray both AP and lateral were taken and position of fracture fragments, nails and correction of rotation assessed. Patients were discharged from the hospital along with cast and asked to come for follow up at 3,6,9,12 and 16 weeks. Stiches were removed after 10 days. The cast was removed at 6 weeks. Check X-rays were taken. These patients were followed up at 3 weeks intervals. At 16 weeks the final assessment was done and patients allowed going for their jobs. Then the follow up was done at 3-6 months intervals for at least 2 years and results analyzed. The final analysis of results was done on the criteria of rate of union and functional recovery of rotation of forearm. The rotation was measured in comparison with that of normal side. The grading is shown as under in *(Table 1)*.

Table 1: Rotation of forearm

1. Excellent :	Union of fracture with 90% of rotational are present.
2. Good :	Union of fracture with 80% of rotational is present.
3. Acceptable :	Union of fracture with 60% of rotational are present.
4. Unacceptable:	Union of fracture with >60% of rotational are present.

Results

The age of the patients ranged between 17-51 years with an average age of 32 years. Majority of the patients (80%) were in the age group of 20-39 years. The male to female ratio was 6:2. This can be compared with series of Burwell and Charnley and Moda et al[7-8].

The fractures of patients were caused by vehicular accidents (12%), fall (68. %), direct injury (14. %) and industrial accidents (6%). The ratio of closed and open fractures (type 1 compound) was 6:1. This correlates with the series of Smith and Sage, Moda et al and Khare et al[3, 8, 9]

The upper 1/3 rd of both bones forearm was involved in 18% middle 1/3rd, 58% in lower 1/3rd and 24% in upper1/3rd cases. Hence middle 1/3 rd was the commonest site involved. In 4 cases the associated injuries included radial nerve palsy.

In the present series the radius was fractured transversely in 58%, obliquely in 38. % and was comminuted in 4% cases. Incase of ulna there were 24% transverse, 52% oblique and 24% comminuted fractures.

Few patients had swelling of hand and fingers

Table 2: Clinical follow up

		Immediate Post-operative Period	Weeks 03	06	09	12	16
1.	Swelling of hand and fingers						
	a. Present	10	05	01	01	01	00
	b. Absent	30	30	39	39	39	40
2.	Neurovascular status Wrist drop	04	04	04	02	02	02
3.	Condition of surgical wound						
	a. Healed	-	39	39	40	40	40
	b. Infected	-	01	01	01	01	00
4.	Tenderness at Fracture site Fracture site						
	a. Present	-	40	36	36	38	40
	b. Absent	-	0	04	4	2	0

Table 3: Radiological follow up

		Immediate Post-operative Period		Weeks 03		06		09		12		16	
1.	Position of	R	U	R	U	R	U	R	U	R	U	R	U
	Fragments	38	36	38	36	38	36	38	36	40	36	26	28
	a. Satisfactory	2	4	4	4	2	4	2	4		4	4	2
	b. Unsatisfactory												
2.	Amount of bridging												
	callus	-	-	40	40	38	38	28	28	38	36	0	4
	a. Minimal	-	-	-	-	2	2	12	12	2	4	40	36
	b. Adequate												
3.	Status of internal fixation												
	device	-	-	40	40	40	40	40	40	40	40	40	40
	a. Satisfactory	-	-	0	0	0	0	0	0	0	0	0	0
	b. Unsatisfactory												

postoperatively.

Wrist drop in two patients did not improve by the end of 16 weeks. One case developed infection at 3 weeks with gapping of wound. Majority of cases had fracture site tenderness present upto 6 weeks and in two cases it continued upto 12 weeks *(Table 2)*.

In group II patients with square nails, four ulnar fractures were not rigidly fixed because of comminution but in due course of time these fragments got incorporated with in callus. Three patients with infection had minimal callus formation at four months. The nails were in satisfactory position in all cases *(Table 3)*.

Maximum number of patients were immobilized by POP cast for 6 to 8 weeks. In 4 patients the cast was continue for more than 12 weeks because of infection. The average cast immobilization was 6 weeks *(Table 4)*.

Table 4: Duration of External Immobilization

Duration (In weeks)	No	%
No Immobilization	0	0
Immobilization for 3 weeks	0	0
Immobilization for 6 weeks	32	80
Immobilization for 9 weeks	2	5
Immobilization for 12 weeks	2	5
Immobilization for more than 12 weeks	04	10

In patients rate of union in radial fractures was 95% and 90% in ulna fractures. In patients radial fractures showed delayed union in 5% and 10% patients in ulna *(Table 5)*

Table 5: Final radiological assessment

Status of union	Radius No	Ulna No
United	38	36
Delayed Union	02	04
Total	**40**	**40**

Movements at other joints were restricted by more than 50% in 2 cases because of associated injuries and infection. In 75% cases the rotation are of 90% was achieved *(Table 6)*

Table 6: Final Functional Assessment

	No	%
1. Range of rotational of Forearm		
a. 90% of normal arc	30	75
b. 80% of Normal arc	4	10
c. 60% of Normal arc	4	10
d. <60% of normal arc	2	5
2. Movement of other joints		
a. Normal	38	95
b. More than 50%	2	5

Table 7: Final Analysis of Results

Grading	No	%
Excellent	27	67.5
Good	6	15
Fair	6	15
Unacceptable	1	2.5

Final analysis of the results were done depending on overall functional recovery of the patients. 67.5 % of the patients

Various complication were observed after intramedullary nailing. Deep infection was seen in 5% . 2 patients developed olecranon bursitis (5%) . Delayed union was seen in (15%). Subluxation of inferior radio-ulnar joint was not seen *(Table 8).*

Table 8: Complication

Complications	No	%
Infection	2	5
Olecranon Bursitis	2	5
Loosening of device	-	-
Delayed Union	6	15
Subluxation of inferior Radio ulnar joints	-	-

Discussion

The relationship of radius and ulna are important for the range of wrist and elbow movements, because of the consistently poor results with conservative methods, surgery of fractures in both bones forearm has been advocated.

Open reduction and plate fixation has been the most accepted method of treatment of forearm fractures. In 1975, Anderson et al. reported union rates of 98% for fractures of the radius and 96% for fractures of the ulna[10]. An excellent or satisfactory result was achieved in 86% of the patients. Chapman et al. reported that 92% of their patients had an excellent or satisfactory functional result. The rate of infection was 2.3%[11].

Intra-medullary nailing of fractures in both bones forearm has been also advocated as it is a simple procedure involving less surgical exposure and minimum periosteal stripping and above all minimal instrumentation. Square nails provide rigid fixation and prevent rotational forces to act at fracture site. These nails being malleable and prebent, preserve normal curves of the radius.

In the present series 40 cases were fixed with square nails, the rate of union was 95% for radius and 90% for ulna. This correlates with series of Smith and Sage with a union rate of 80%. Sage has also reported 88.8% union rate[12]. However, Marek and Talwakar achieved 100% result. Khare et al showed union rate of 95.6% in a series of 46 cases and Moda et al have observed 90% union rate with square nails.

The average period of POP immobilization was 6 weeks. Smith & Sage showed that 88% of their patients need immobilization for 10 weeks. Talwalkar used cast for 10 days only, Moda et al used POP cast for an average of 11.3 weeks while using square nails. However Khare et al used

cast for 2 weeks only.

The overall results in terms of union and functional recovery were 85% satisfactory. The unsatisfactory results were 15% because of infection, comminution and inadequate fixation. Sage , Merek and Tawalkar have reported 70%, 84% and 100% results respectively with square nails/triangular nail. Very few complications in the form of infection (2 cases) Olecranon bursitis (2 Cases) are seen. Delayed union was seen in six cases (15%). Smith & Sage have reported delayed union rate of 14%. Moda et al reported in a series of 270 patients, infection in 27 cases, nail fracture or implant reaction in 45 cases, Olecranon bursitis in 36 cases and delayed and non-union in 27 cases. Khare et al reported loosing of nail in two ulnar fractures and non union in two cases of ulnar fracture.

With conventional plating, the screw acts as an anchor, with its axial force being exploited to press the plate against the bone. This produces a large frictional force at the bone-plate interface when the construct is loaded, and this force has been shown to cause vascular disturbance, especially in the periosteum[13]. This is avoided with nails.

Conclusion

Surgical treatment of the forearm fracture is established now, Plate is the treatment of choice. The technique of plate application requires special instrumentations. Whereas the technique of intramedullary nailing is simple compare to conventional plating and does not require special instruments and training. The implant as well as its removal is simple so the cost of the treatment is less compare to plating. Hence it is concluded that although plate application is the standard method of treatment for forearm fractures, intramedullary nailing is a simple method with better results than conservative methods.

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