



International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2018; 4(4): 486-489
© 2018 IJOS
www.orthopaper.com
Received: 10-08-2018
Accepted: 11-09-2018

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Original research article

Closed intramedullary nailing in forearm bone fractures without use of intraoperative imaging

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DOI: <https://doi.org/10.22271/ortho.2018.v4.i4f.51>

Abstract

Purpose: The upper limb is an important integral part of body and loss of whole upper limb according to Workman Compensation Act takes away 90% of the earning capacity of an individual. The successful treatment of forearm fractures means that union of fracture is achieved and there is minimum or no restriction of rotations with full movements of wrist and elbow joints. Failure to achieve these will compromise functional results.

Aims & Objectives: The aim of our study is to find the efficacy of closed intramedullary nailing and compare its results with extra-medullary fixation methods.

Material & Methods: A study of 50 patients with minimum follow up of 3 months, out of total 74 patients was carried out in Department of Orthopaedics at tertiary care centre. All the patients were immobilised in form of above elbow plaster of Paris immediately after surgery. This plaster was continued for 4-6 weeks. The criteria for clinical union include no local tenderness over fracture site and attempted supination and pronation are not very painful.

Results & Discussion: The age of patients in the present series is from 13 years to 90 years. 76% patients were below the 50 years of age. About half of these men were labourers by occupation with indirect mode of injury to the non-dominant hand leading to two thirds with closed both bones radius ulna fractures. Out of 46 patients with 79 radius ulna fractures, 40 patients (87%) achieved full elbow & wrist flexion and extension. 10 patients (15%) had severe restriction of pronation-supination. 36 patients (88.26%) had excellent to good outcomes while 3 patients (6.53%) had poor outcome due to non-union and infection. Advantages of intramedullary fixation include minimal operating time and no need of intravenous drip for the procedure. Surgery can be done under local or regional anaesthesia. Small incisions are required and only 2-3 stitches for closure. Cosmetically very well accepted scar by all patients (mainly females) which is almost invisible. Infection rate is almost negligible. In this method there is no soft tissue damage, periosteal stripping or neurovascular damage. Clinically as well as radiologically the union time is equivalent (if not less) than extra medullary fixation.

Conclusion: Almost all patients achieved good functional range of movements and returned to pre injury occupation. There were no neurovascular complications. All patients were satisfied from treatment.

Keywords: Intramedullary nailing, forearm bone, fractures

Introduction

The upper limb is an important integral part of body and loss of whole upper limb according to Workman Compensation Act takes away 90% of the earning capacity of an individual [1, 5]. The residual deformity of the forearm fractures may lead to a crippled individual. The integrity of forearm bones is required to perform pronation and supination.

The successful treatment of forearm fractures means that union of fracture is achieved and there is minimum or no restriction of rotations with full movements of wrist and elbow joints. Failure to achieve these will compromise functional results. Due to various tensile and rotatory forces exerted by the forearm muscles, reduction and its maintenance is difficult in forearm bones which are parallel [6, 10].

The two basic modes of surgical treatment for fractures of forearm bones in adults are intramedullary fixation (open & closed) and extra-medullary fixation. Open intramedullary

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fixation has disadvantages like long exposure, increased chances of infection leading to non-union or delayed union. Extra medullary fixation using dynamic compression plate is an accepted mode of treatment for fractures of radius and ulna. However, it leads to long operative time, more stripping of soft tissue and periosteum, longer hospital stay, higher chances of neurovascular damage and growth problems especially in children [11, 13].

Aim & Objectives

The aim of our study is to find the efficacy of closed intramedullary nailing and compare its results with extramedullary fixation methods.

Materials and Methods

A study of 50 patients with minimum follow up of 3 months, out of total 74 patients was carried out in Department of Orthopaedics at tertiary care centre. 4 patients were excluded from the study because nailing was not possible in these patients due to comminution. So, the study of 46 patients with 79 radius-ulna fractures was carried out. The patients on admission were examined for radius and ulna fractures. After getting x rays done, fractures were splinted with temporary plaster till surgery was performed.

Surgical Technique

After general anaesthesia or regional anaesthetic block, parts were prepared, painted and isolated with sterile drapes with a trolley beside the operation table. The length of rush pins were measured preoperatively. In case of radius, it was measured from tip of styloid process to radial head with elbow in 90° flexion and forearm in mid prone position. For ulna, it was measured in similar fashion from the tip of olecranon to styloid process. The diameter of pin was decided by measuring the canal diameter on x-ray after radiological magnification was subtracted. In case of both bone fractures, the bone having a transverse fracture line was fixed first.

For radius, a small incision was made on the tip of styloid process and the tendons of 1st and 2nd extensor compartments were retracted. An entry point was made with an awl which was initially introduced vertically along the line of the bone. Entry in medullary canal was confirmed by visualizing the fat globules of bone marrow. The rush pin of determined length was introduced in the distal fragment with its flat end facing the opposite cortex so that penetration could be avoided. Then the reduction was carried out by traction. While maintaining the reduction, the pin was hammered in the medullary canal of the proximal fragment.

For ulna, 10 mm incision was made over the tip of olecranon and entry point was made in the medullary canal with an awl after splitting the insertion of triceps. The pin was introduced in the proximal fragment and after doing reduction, it was gently hammered in distal one. Follow up radiographs were taken and pins were found at satisfactory placement accordingly.

All the patients were immobilised in form of above elbow plaster of Paris immediately after surgery. This plaster was continued for 4-6 weeks. The criteria for clinical union include no local tenderness over fracture site and attempted supination and pronation are not very painful. On radiograph, attempted bridging callus is visible and overall alignment was maintained. Ulnar sleeve plaster was applied till radiological union was visible till four to six weeks. Ulnar sleeve plaster protects the forearm but the patient was able to move elbow and wrist which was equivalent to functional mobilization.

Results

The present study is of 46 patients with 79 fractures fixed with intra medullary rush pins as shown in Table 1. The age of patients in the present series is from 13 years to 90 years. 76% patients were below the 50 years of age as shown in table 2. There were more males having radius ulna fractures than females in our series. About half of these men were labourers by occupation with indirect mode of injury to the non-dominant hand leading to two thirds with closed both bones radius ulna fractures. More than 60% had transverse fractures at the level of middle third shaft of both radius and ulna. Almost all of them were operated within one week of injury. Patients were kept immobilized in ulnar sleeve plaster for 2 weeks till suture removal. Minimum follow up was 2-3 months and maximum follow up was of 2.8 years with mean follow up of 14.7±2.3 months.

Out of 46 patients with 79 radius ulna fractures, 40 patients (87%) achieved full elbow & wrist flexion and extension. 10 patients (15%) had severe restriction of pronosupination.

Table 1: Demographic data of the patients operated with intramedullary nail.

Age (Years)	Number	Percentage
<20 Years	05	10.87
21-30	11	23.91
31-40	13	28.26
41-50	06	13.04
>50	11	23.91
Total	46	100

Table 2: Number of females and males operated with intramedullary nail for forearm fractures

Gender	Number	Percentage
Male	31	67.39
Female	15	32.61
Total	46	100

We also had few complications. Two patients developed non-union which was then revised with plating. Two patients developed infection at the wire insertion site leading to back out of the wires which were revised.

The criteria for the assessment at the follow-up include movements at the elbow and wrist joints, clinical union, radiological union and resumption of duty within three months. 36 patients (88.26%) had excellent to good outcomes while 3 patients (6.53%) had poor outcome due to non-union and infection. All the results had p value more than 0.05 (clinically not significant).

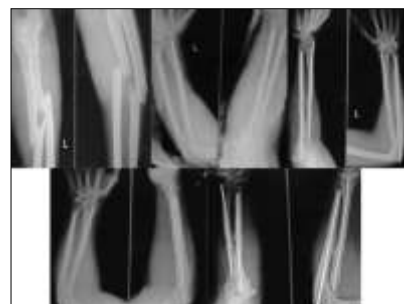


Fig 1: 34 year male patient with left both bone forearm closed fracture operated with intra medullary nails showing pre-operative, immediate post-operative and follow up radiographs showing complete bony union at 3 months.

Discussion

Indirect trauma is the most common mode of injury for such type of fractures. The results of conservative treatment are poor due to pull of muscles. So, proper internal fixation is necessary to achieve good results [14, 15]. There are common forces which are responsible for displacement of fractures of forearm bones. Insertion of pronator quadratus over volar aspect of distal radius rotates it towards ulna and pulls it in proximal and volar direction. The brachioradialis tends to use the distal radio-ulnar joint as pivot on which it rotates the distal radius causing shortening. Supinator muscle inserts over upper third of radius and rotates upper third of radius into supination. Pronator teres inserts over middle third of lateral border of radius and pulls the radius into pronation. So, fractures of both bones of forearm are difficult to treat conservatively due to factors mentioned above [16, 17]. Extra-medullary fixation requires longer incisions, soft tissue dissection and prolonged hospitalization. Some of the advantages of intramedullary fixation include minimal operating time and no need of intravenous drip for the procedure. Surgery can be done under local or regional anaesthesia. Small incisions are required and only 2-3 stitches for closure. Cosmetically very well accepted scar by all patients (mainly females) which is almost invisible. Infection rate is almost negligible. In this method there is no soft tissue damage, periosteal stripping or neurovascular damage. Clinically as well as radio logically the union time is equivalent (if not less) than extra medullary fixation. On radiological examination, there is no difficulty in judging the

union. Immediate cast can be applied as compared to extra medullary fixation. Removal of implant is easy and does not require protective cast. No chances of re-fracture after implant extraction.¹⁸⁻²⁰ No need of tourniquet, so tourniquet palsy is out of question. Post-Operative hospitalization is very less, so it is most ideal method for general hospitals. Period of immobilization is also very less. Post-operative range of motion is very good and patient can go back to his/her duty early. No primary bone grafting is required. Cost wise the operation is very cheap. The advantages of doing operation of radius ulna without use of image intensifier are:

1. Minimal to no radiation exposure to the operating staff.
2. Developing the clinical skills of the post graduate residents.
3. Such fractures can be managed in a busy set-up where only one image intensifier (usually taken for major surgeries) is available. Thus increasing work output and return to investment.
4. Reduction in hospital stays for the patient. Usually these patients are discharged within 24 hours.
5. Especially useful in rural hospitals where electricity supplies is poor or image intensifier is non-functional.

Disadvantages include the cases of very narrow medullary canals this procedure is difficult. Two assistants are required, one for traction and the other for counter-traction. Our results (78.26%) are comparable to acceptable results in Smith's (64%) and Street's (83.5%) series.

Table 3: Comparison of our study with other studies in the literature regarding intra medullary rush pin for forearm fractures

	Acceptable		Unacceptable	
	Excellent	Good	Fair	Poor
Anderson	54 (50.9%)	37 (34.5%)	12 (12.7%)	3 (2.7%)
Chapman	36 (85.7%)	3 (7.1%)	1 (2%)	2 (4.8%)
Smith	92 (37%)	17 (27%)	11 (18%)	0 (0%)
Street	71 (69%)	15 (14.5%)	8 (8%)	9 (8.5%)
Present series	22 (47.83%)	14 (30.43%)	7 (15.21%)	3 (6.53%)

Conclusion

The fracture incidence was more common in young and middle age group ranging from 20-40 years and there was male preponderance. Indirect injury was the commonest factor for injury. All patients were treated with closed intramedullary Rush Nailing. The failure rate of not achieving close nailing was 4.4%. Almost all patients were immobilized in form of AEPOP on table and ulnar sleeve was given as per decision of clinical union. Sleeve was removed when the fracture was radio logically united. Average period of above elbow immobilization was 6-8weeks. Non-union was present in 3 patients, so union rate is 93.47%. Almost all patients achieved good functional range of movements and returned to pre injury occupation. There were no neurovascular complications. All patients were satisfied from treatment.

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