



FUNCTIONAL OUTCOME IN PERCUTANEOUS ELASTIC STABLE INTRAMEDULLARY NAILING TECHNIQUE OF METACARPAL BONE FRACTURE

Orthopaedics

Dr. Sunil Malhotra	Assistant Professor, Department of orthopaedics, Subharti Medical college, Meerut, Uttar Pradesh.
Dr. Mohd. Shifa Hasan	Assistant Professor, Department of orthopaedics, Subharti Medical college, Meerut, Uttar Pradesh.
Dr. Arunim Swarup	Professor & Head, Department of orthopaedics, Subharti Medical college, Meerut, Uttar Pradesh.
Dr. Neeraj Kumar Verma*	Postgraduate Resident, Department of orthopaedics, Subharti Medical college, Meerut, Uttar Pradesh. *Corresponding Author

ABSTRACT

AIMS AND OBJECTIVES: The aim of this study was to evaluate functional outcome of metacarpal fractures managed by percutaneous elastic stable intramedullary nails along with its functional outcome. **METHOD:** The extra-articular metacarpal fracture were managed by inserting two pre-bent elastic stable nails in antegrade manner after making entry point (dorso-medially and dorso-laterally) through base of the metacarpal bone. The nails act as three point fixation and provide stable fixation. Early mobilisation is commenced for providing early healing and decrease post-operative decreased range of motion at metacarpophalangeal/interphalangeal joints and stiffness. Nails were removed 3 week after radiological sign of union. **RESULTS:** 32 extra-articular metacarpal fractures treated with percutaneous elastic stable nails were evaluated between 1 September 2018 to 31 August 2020. The functional outcome was assessed using disability arm shoulder and hand (DASH) score² with mean score of 2 at 6th month follow-up and total active motion (TAM) score¹ which was excellent in 81.2% of the patients (n=26), good in 9.4% of cases (n=3), fair in 9.4% of the cases (n=3). All fracture proceeded to bony union. **CONCLUSIONS:** It was concluded that indirect reduction and early fixation with percutaneous elastic stable intramedullary nailing with 2 nails is very safe and effective treatment modality for extra-articular metacarpal fracture with excellent functional outcome.

KEYWORDS

Metacarpal fracture, percutaneous elastic nail, Functional outcome and Radiological outcomes

INTRODUCTION:

Fractures of the metacarpal bones of the hand constitute between 14-28% of all visits to the hospital following trauma by various means like assault, road traffic accidents, industrial accidents, agricultural accidents etc.³ Fractures of the bones of the hand are among the commonest fractures in humans, but their management varies widely in the different regions of the world. This variability is due to many reasons, including availability of resources, social factors, geographic constraints, surgeon preference and experience, and local practice patterns. Developing countries are more likely to apply less expensive methods of managing hand fractures.⁴

Fracture healing in the hand is not an isolated goal rather the functional result is of paramount importance.⁵ Hand fractures can be complicated by deformity from no treatment, stiffness from over treatment and deformity or stiffness from poor treatment.⁶ Cadaveric studies showed, decreased hand function and metacarpal shortening beyond 5mm and angulation beyond 15 degree.⁷

Any rotation is poorly tolerated and need correction. Uncorrected bone deformity and stiffness resulting from metacarpal shaft fracture can produce significant functional and cosmetic deformity.^[8-9]

In recent past there has been a paradigm shift in treatment of metacarpal fractures from conservative management in the form of bandaging and casting to surgical management and numerous surgical techniques have been described which are percutaneous pinning, cerclage wiring, plating, lag screws, tension band wiring and external fixators. The specific technique used depends on the characteristics of the fracture and preferences of the surgeon. The Various fixation techniques in use are percutaneous Kirschner wire pinning, cerclage wiring, plating, lag screws, external fixators and titanium elastic nail system.^[10-11]

Recently, studies have shown good but varied clinical, radiological and functional results with surgical treatment of metacarpal fractures using intramedullary implants. Majority of these studies have used single pre bent titanium elastic nail, so may have had limitations of stable fixation.^[12-15]

This study describes a technique and evaluates the results of percutaneous fixation of extra articular metacarpal bone fractures using pre-bent elastic stable nails. The two intramedullary nail construct act on a 'true' three point intra medullary fixation similar to its use in long bone fixation elsewhere in body providing better angular or rotational stability and therefore lessens the chances of loss of fracture reduction or malunion. This stable fixation also expected result in early mobilization and use of hand functions.^[16-18]

This study was conducted on 32 patients with extra-articular metacarpal fractures treated with 2 elastic stable intramedullary nails in the department of orthopaedics, Chhatrapati Shivaji Subharti Hospital, Meerut between 1 September 2018 to 31 August 2020.

AIMS AND OBJECTIVES

1. To study the functional outcome of metacarpal fractures treated by percutaneous elastic stable intramedullary nailing.
2. To study the technical difficulties and complications of metacarpal fractures treated by percutaneous elastic stable intramedullary nailing.
3. To assess whether percutaneous elastic stable intramedullary nailing system gives better results than conservative or other methods of surgical management.

MATERIAL AND METHOD

INCLUSION CRITERIA:

This prospective study was conducted from 1st September 2018 to 31st August 2020. In this period 62 cases presented in our orthopaedic department with metacarpal fractures. Extra articular fractures of metacarpal bone of skeletally mature patients of any gender were included in this study.

EXCLUSION CRITERIA:

- Skeletally immature patients
- Intraarticular or metacarpal head fracture
- Fractures associated with nerve injuries, tendon injuries and badly crushed hand injuries
- Patient presenting at more than 3 weeks of trauma
- Metacarpal intramedullary canal diameter less than 2.5 mm.

SURGICAL TECHNIQUES:

The size of the nails was predetermined, by Flynn et al's formula¹⁹ i.e. (Diameter of nail = width of narrowest point of medullary canal on AP and lateral view X 0.4mm).



Figure 1: Images Showing Perforation Of Medial And Lateral Cortices With Help Of Awl.

2 entry points were made. Image intensifier was used to identify and select these insertion points over the base of the fractured metacarpal, dorso-medially and dorso-laterally where 2 small stab incisions were given. Blunt soft tissue dissection was carried down to the dorso-medial and dorso-lateral cortex, taking care of the extensor tendons that are in close proximity to the nail insertion site.



Figure 2: Image Showing Insertion Of First Nail Insertion

Dorso-medial and dorso-lateral metaphyseal cortices were perforated with the help of awl under C-Arm control and the nail was then introduced into the medullary canal.



Figure 3: image showing insersion of second nail.

The first nail was advanced to the level of the fracture site. The second nail was introduced from the opposite cortex to the first in similar fashion and advanced to the fracture site.

The fracture site was manipulated and reduced and nails were advanced across the fracture and into the distal fragment so that most convex part of the nail was laid at the fracture site with concavity facing each other.



Figure 4: Image Showing Advancement Of Both Nail In Distal Fragment

The nails were advanced across into the subchondral bone of the metacarpal head. Nails were then bent and cut off beneath the skin. Antiseptic dressing followed by ball and bandaging was done.

POSTOPERATIVECARE:

No additional support was anticipated because of nature of stable elastic nailing done except in comminuted fractures, where functional splintage was required till the time of radiological evidence of union.

Active/passive movement of both the metacarpophalangeal joints and interphalangeal joint were initiated from second post-operative day or as tolerable to the patient except those with severe comminution.

3 doses of antibiotics (pre-operative, post-operative and at 24 hour post-operative) were given and adequate analgesics were given as

required except in cases of open injuries where antibiotics were continued till wound healed.

Implant was removed 3 weeks after radiological signs of union were noted, under aseptic precautions as an outpatient procedure under local anaesthesia.

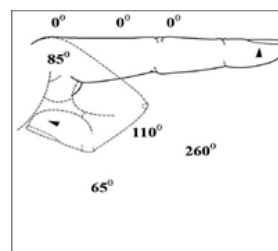
RESULT:

32 cases which were satisfying the inclusion criteria were managed by percutaneous elastic stable intramedullary nailing. Among these 32 cases 23 patients were male and 9 patients were female. 21 patients out of 32 cases had single metacarpal fracture and 11 patients had multiple metacarpal fractures and none of the patient had bilateral hand involvement.

The patients were followed up at 3 week interval post surgery till the fracture union. The wires were removed on outdoor procedure under local anaesthesia 3 weeks after the radiological signs of union. The final assessment was done at 6th month follow-up.

The functional score was evaluated using TAM¹ and DASH scores².

The TAM¹ score is the sum of active flexion at MCP, PIP and DIP joint in degrees of the individual fingers and subtracting the total active extension deficit of the same joint. The percentage of TAM¹ is calculated by dividing the TAM¹ of injured finger by the TAM¹ of the contralateral finger.

TOTALACTIVE MOTION SCORE**TAM from MCPJ to DIPJ: digit 2-5**

Degree of flexion	Rating
220-260	Excellent
180-220	Good
130-180	Fair
<130	Poor

TAM from MCPJ and DIPJ: thumb

Degree of flexion	Results
120-140	Excellent
100-120	Good
70-100	Fair
<70	Poor

The DASH² (Disabilities of the Arm, Shoulder, and Hand) questionnaire is used to measure disability and symptoms related to upper extremity musculoskeletal disorders. In this study DASH score has been used for hand functions.

e.g of DASH SCORE

	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Unable
Open a new or tight jar	1	2	3	4	5
Write	1	2	3	4	5
Turn a key	1	2	3	4	5
Prepare a meal	1	2	3	4	5

The total active motion (TAM¹) score at final follow-up, was excellent in 81.2% of the patients (26 out of 32 patients), good in 9.4% of cases (3 patients), fair in 9.4% of the cases (3 patients). The mean DASH² score at 3 weeks was 41, 32 at 6 weeks, 27 at 9 weeks, 18 at 12 weeks, 11 at 15 weeks, 6 at 18 weeks and 2 at 6 months follow-up. The radiological score at 6 months follow up 93.75% (30 cases) showed union without malunion, 6.25% (2 cases) showed union with angulation more than 15°. The treatment outcome score was 131 at 3rd weeks, 142.76 at 6th weeks, 168.83 at 9th weeks, 186.62 at 12th weeks, 216.48 at 15th weeks, 268.47 at 18th weeks and 312.56 at 6th months.

3 complications were registered (9.3%). In 2 patients malunion (6.25%) was noted and 1 patient (3.12%) had reduced range of motion at metacarpophalangeal joint / interphalangeal joints for whom physiotherapy was initiated and these patient showed improved range of motion. All 32 patients who underwent percutaneous elastic intramedullary nail for metacarpal fracture, achieved union (100%) with average duration of 7.8 weeks. The implant was removed on the basis of outdoor patient by giving local anaesthesia 3 weeks after the radiological reunion.

DISCUSSION:

In this study, Total Active motion (TAM¹) score showed excellent result in 81.2% of the patients (26 out of 32 patients), good in 9.4% of cases (3 patients), fair in 9.4% of the cases (3 patients) as in our studies seven patients had comminuted metacarpal fractures and among them 3 patients had severe comminuted fractures which lead to the fair TAM¹ scores in them (9.4%). At the final follow-up the mean total active motion was 216.87°. These findings were similar to study conducted by V. James et al²⁰ on 40 patients using internal fixation with k wire. A study by Shushant B. Ganjale²¹ showed excellent result in 95.7% out of 47 patients and good result in remaining 2 (4.3%) patients. Another study by Gupta et al³ showed excellent results in 47% (15 cases), good result in 47% (15 cases) and fair in remaining 2 cases (6%).

Table 1: Tam Score Comparison.

studies	Group	Excellent	Good	Fair	Poor
Shashikant B. Ganjale ²¹	47	95.7%	4.3%	-	-
Gupta et al ³	32	47%	47%	6%	-
V. James et al ²⁰	40	80%	10%	5%	5%
This study	32	81%	9%	9%	-

The DASH² score in this study was 39 at 1 month which improved significantly on subsequent follow-ups, being 27 at 2 months, 18 at 3 months and 2 at 6 months. This score was compared to Dumont and colleagues²² prospective study in clinical and functional outcomes of 12 patients with displaced, treated with open reduction with internal fixation using absorbable plate and screw constructs. Average postoperative DASH scores obtained at 6, 12, and 26 weeks were 30, 13, and 3, respectively with a mean of 2. A study by Kaiying and colleagues²³ the DASH score obtained had a mean of 1.7 at 6 month follow-up. DASH score in a study by Zyluk²⁴ obtained at 6, 12, 26 weeks were 28, 14 and 3 with a mean score of 3.

Table 2: Mean Dash Score In Comparative Studies

Study	Group	2 months	3 months	Mean DASH score at 6 months
Dumont and colleagues ²²	Absorbable plate and screw	30	13	3
Kaiying and colleagues ²³	TENS	-	-	1.7
Zyluk ²⁴	Conservative	28	14	3
This study	Percutaneous elastic stable nail	27	18	2

CONCLUSION

This methodology has numerous advantages over other prevailing extra articular metacarpal shaft fracture management modalities -

- by virtue of being percutaneous technique and being less time consuming it is highly beneficial in management of compound injuries and also chances of soft tissue necrosis/cicatrization/infection are very minimal,
- at the same time preservation of fracture haematoma chances of union are greatly increased,
- early functional mobilisation was possible which improved activities of daily living, helpful in confidence building and reduces loss of productive days,
- it was possible to remove implants in the outpatient department and does not require a second operation, which reduced the financial burden on the patients,
- it is a very cost effective method as compared with other operative techniques using anatomical plates/ fixators,
- one of the disadvantages is possibility of non-availability of proper instrumentation and custom-made implants and other are inadequate achievement of closed reduction of fracture especially in managing initial cases. At the same time chances of this gradually decreases with attainment of experience in indirect

reduction techniques of the fracture reduction.

Conflict of interest : None

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