



## Original Article

# Evaluation of outcome of intramedullary K-wire fixation in Phalanx fractures

Rajendraprasad R. Butala, Jaykumar C. Parsania, Varun S. Agarwal, Shivam Mehra

Department of Orthopaedics, Padmashree Dr. D. Y. Patil School of Medicine, Nerul, Navi Mumbai, India

## Abstract

**Objectives:** The objective of this study was to evaluate the functional outcome of intramedullary Kirschner wire (K-wire) nailing technique in proximal phalanx fractures. **Methods:** We conducted a prospective, randomized clinical study to evaluate the functional outcome. 30 patients of isolated proximal phalangeal fracture were treated with intramedullary nailing using K-wire technique. Outcomes were assessed radiologically as well as clinically based on range of movement according to the American Society for Surgery of Hand (ASSH) and QuickDASH Scoring system. **Results:** Radiologically, all patients showed fracture union at 6-8 weeks. No complications were reported except in one patient who developed bursitis. **Conclusion:** Treating an unstable proximal phalangeal fracture with intramedullary nailing using K-wire shows outstanding results with minimal to negligible complications.

**Keywords:** Bouquet technique, Hand fracture, Intramedullary nailing, Phalangeal fractures

## Introduction

Fractures of the phalanges and metacarpals are some of the most encountered orthopaedic hand injuries constituting 10% of all fractures<sup>1</sup>. In the United States, metacarpal fractures account for 18% and phalangeal fractures account for 23% of all fractures below the elbow<sup>2</sup>. In a survey of patients attending the Accident Department of a District General Hospital, amongst sports injuries, 48% were to the little finger out of which 25% fractures were of the metacarpal and 75% were dislocations of the phalanges<sup>3</sup>. The lifetime incidence of metacarpal fractures is 2.5%<sup>4</sup>.

These fractures are too often considered as minor injuries and may result into deformities, if not properly addressed in the early stage<sup>5</sup>. The phalangeal fractures with impermissible rotations and angulations in any plane need operative fixation<sup>5</sup>. Operative interference aims to restore articular congruity, length, and correction of rotations<sup>5</sup>. This leads to mobilization and improved functional outcome. However, there are certain complications after operation. The most frequent post-operative complication includes stiff painful joints due to prolonged immobilization at fracture sites. The advantage of using intramedullary wires for the treatment of fractures of the hand and small bones is a well-known fact<sup>6</sup>. The intramedullary wire enables 3-point fixation and allows early mobilization to prevent stiffness. Unstable phalangeal fractures, that is, fractures with displacement, rotational deformities, shortening and

angulation have been associated with significant morbidity and such fractures need surgical fixation<sup>7</sup>.

Amongst the various techniques used, K-wires are versatile, cost-effective and surgeon friendly that can be used percutaneously or by open methods<sup>4</sup>. K-wire can be used in different directions like radioulnar, ulnoradial, or central depending on the anatomy of the fracture<sup>4</sup>. Percutaneous trans-metacarpal intramedullary Kirschner wire (K-wire) fixation of proximal phalangeal fractures has been described as a useful technique, but prospective studies with K-wire fixation are few. Hence, this study was undertaken to evaluate outcome on a day-care basis.

## Materials and Methods

This study was performed in single tertiary care teaching hospital in Navi-Mumbai (India) and was a prospective and

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**Corresponding author:** Dr. Shivam Mehra, Junior Resident, Department of Orthopaedics, Padmashree Dr. D. Y. Patil School of Medicine, Nerul, Navi Mumbai, India

**E-mail:** drshivammehra@gmail.com

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**Figure 1.** Pre-operative X-ray of patient having post-traumatic left sided second proximal phalanx mid shaft fracture closed with no DNVD.

	Mean	SD
Age (yrs.)	31.2	8.18
	No.	%
<b>Gender</b>		
• Male	20	66.7%
• Female	10	33.3%
<b>Type of fracture</b>		
• Extra articular transverse fracture	23	76.6%
• Extra articular oblique fracture	7	23.4%

**Table 1.** Demography and profile of patients.

randomized study conducted between December 2018 till March 2021. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013. Informed consent was obtained from all individual participants included in the study.

A total of 30 patients were a part of this study out of which 20 were men and remaining women. Table 1 shows the demographic features of the patients which also includes the mean age of patients i.e. 31.2 years. All patients were given regional anaesthesia. Under anaesthesia, closed reduction of fracture was achieved and confirmed. Entry was made at the base of the proximal phalanx with a 2 mm K-wire. Movements were checked on table. Post-operative strapping was given, and plaster was applied. Wound inspection and

dressing were done on second, fifth, and tenth day. Patients were allowed activity after 8 weeks when radiological signs of union were evident on X-rays.

Patients both men and women with short oblique fracture (n=7), transverse fracture (n=23) of shaft of proximal phalanx, having extra articular fracture, aged eighteen to seventy years, undergoing primary index surgery, and having different modes of injury, that is, fall from height, slippage and road traffic accidents were included in the study. All the phalanx fracture are classified into extraarticular fractures, intraarticular fractures according to the extent of the fracture into the joint whereas anatomically it is classified into Base fracture, Shaft fracture(transversus, oblique, comminuted) and Head fracture.

Patients with age less than eighteen years were excluded from this study. Also patients with open fracture, intra articular fracture, comminuted fracture, pathological fractures, with previous surgery on same phalanx, and having old non-unions or malunions were also excluded from the study.

Pre-operatively, radiological confirmation of the diagnosis was carried out by taking anterior posterior, oblique X-rays of hand (Figure 1). Intra-operatively, phalanx fracture reduction was done, and intramedullary K-wire fixation was achieved (Figure 2).

The detailed procedure was as follows. Patient was taken on OT table with hand rest under regional anaesthesia. Standard procedure included draping and achieving fracture reduction reduction by traction and manipulation which was confirmed under image intensifier. Stab incision was taken just distal to the base of proximal phalanx and entry was made with 2 mm Kirschner wire (K-wire) on dorsolateral and dorsomedial safe corridor, using the entry point. 1 mm pre-



**Figure 2.** Post-operative X-ray of patient having post-traumatic left sided second proximal phalanx mid shaft fracture closed with no DNVD.

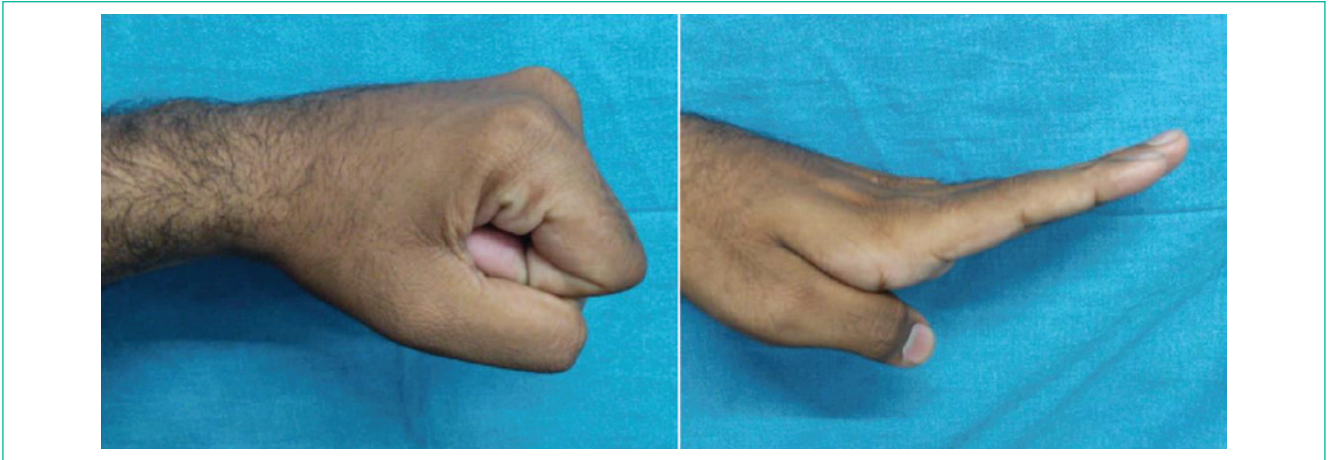


**Figure 3.** Follow up X-rays after 10 weeks of fixation of patient having post-traumatic left sided second proximal phalanx mid shaft fracture closed with no DNVD.

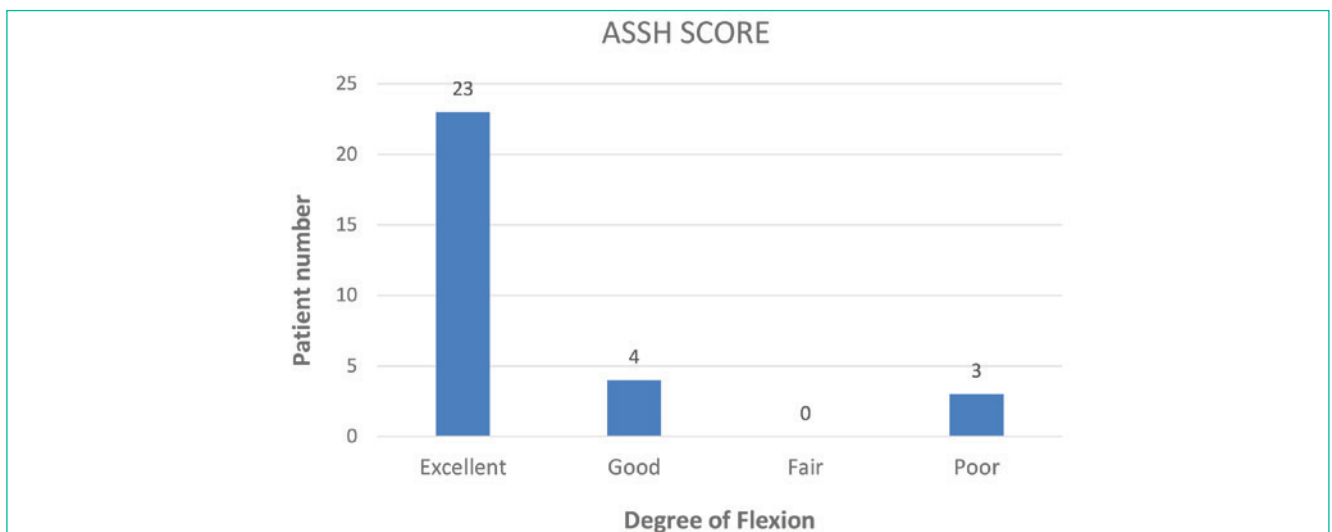
bent K-wire was passed into the medullary canal up to the distal subchondral region to achieve three-point fixation and medullary canal was stacked with two or three K-wires to achieve reduction and stability. After confirming the fracture reduction and position of K-wire under image intensifier, wires were cut short and buried, through which wash was given in wound and tag suture was taken. Sterile dressing and buddy strapping was done following which fingers were supported with slab.

Post-operatively, patient was kept on oral analgesics

and single antibiotic for five days. Check dressing was done on second and fifth day. Slab removal was done on fifth day following which mobilization with buddy strapping was started & suture was removed on tenth day. Independent mobilization was started after two weeks. Wound inspection and dressing were done on second, fifth and tenth days. Suture removal was done on tenth day. The involved fingers were mobilized from seventh day of the surgery with strapping of the adjoining finger giving support. Strap removal was done along with suture removal and independent mobilization of



**Figure 4.** Clinical photographs after 10 weeks with complete movement of finger.



**Figure 5.** ASSH Score showing the degree of flexion of 30 patients post K-wire nailing.

fingers was started. Patient was told to avoid all activity with the operated hand for six weeks. Patient was discharged on third day with regular follow up done on OPD basis. Patient was allowed activities after eight weeks when radiological union of fracture was confirmed using X-rays.

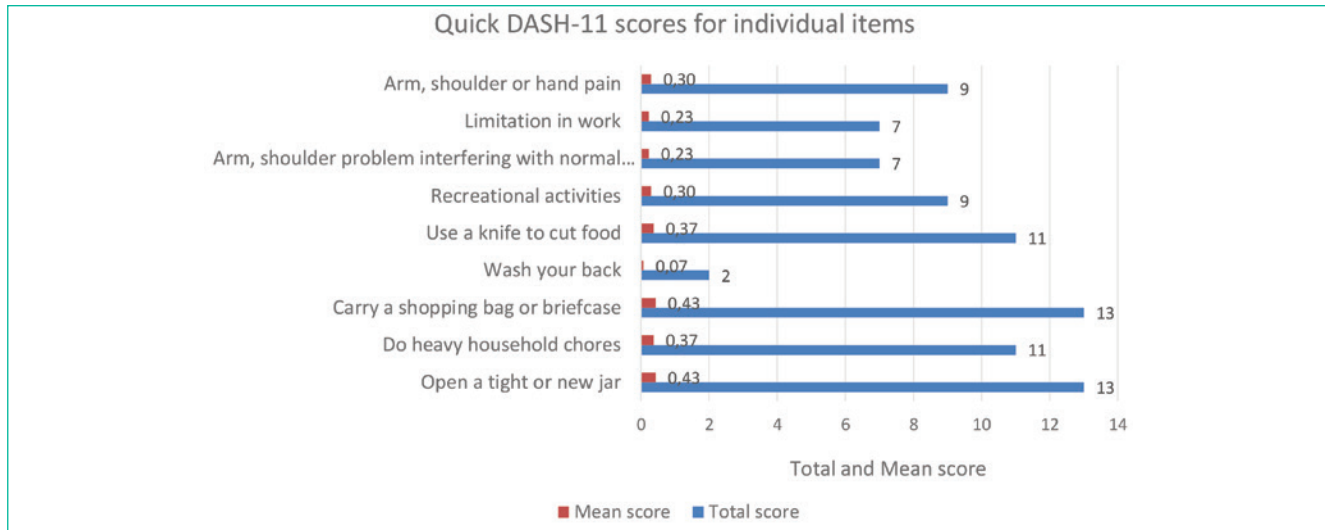
## Results

The patients were regularly followed up for six months and assessment was done clinically and radiologically. The average stay in hospital was 5-7 days. The average time taken for surgery was 40 minutes. Plaster was kept for a week.

Average time for steady mobilization with buddy strap

was 7 days. No patient had infection, or finger lag, one patient had bursitis. All patients returned to normal work by 12 weeks. Radiological union was seen at 7-8 weeks (Figure 3 and Figure 4). There was no collapse, angulation or non-union. Also, we did not have any complications in our study as we cut the wire short and buried it under the cortex. There was no non-union, mal-union, angulation, collapse, or adhesions of the extensor aponeurosis resulting in the stiffness of the adjacent joints as seen in other techniques of fixation.

ASSH and Quick DASH scores were used to assess the clinical outcome. Out of 30 patients, 27 patients



**Figure 6.** Total and Mean Quick DASH-11 scores of 30 patients post K-wire nailing.

demonstrated excellent or good degree of flexion in the ASSH score (Figure 5). The Quick DASH score was calculated based on various parameters that included the ease of doing routine chores, engaging in physical activities and pain. 24 patients out of 30 had a Quick DASH score of 0 which shows the success of the K-wire nailing technique (Figure 6). Also, in the remaining 6 patients, the results were good or satisfactory. Measuring the clinical outcome of the K-wire technique by ASSH and Quick DASH scores thus, showed that this nailing technique can be used in proximal phalanx fractures.

## Discussion

There are multiple methods for treatment of the fracture of proximal phalanx. Non-operative measures like strapping are used for the treatment of nondisplaced fractures. Displaced unstable fractures can be treated with operative fixation and stabilization. The extensor hood on the dorsum of the proximal phalanx sometimes becomes adherent to the underlying fracture site during healing and may result in stiffness of the joint and poor functional outcome. The main goal of any operative treatment of the fracture of proximal phalanx is to achieve anatomical reduction, stable fixation and early mobilization following fixation and minimal soft tissue dissection (AO). Of the various methods used, plates and screws provide rigid fixation, but it requires extensive dissection and periosteal stripping leading to adhesions and stiffness<sup>8-10</sup>.

Closed reduction and cross K-wire fixation is the standard method. However, it fails to provide compression at fracture site resulting in non-union or delayed union<sup>11</sup>. Also, K-wire must be kept outside skin which may cause infection.

Additionally, patients cannot be mobilized early and hence purpose of the fixation is lost.

As fractures of long bones have been successfully treated with intramedullary nailing, phalanges can be considered as long bones of the hand and treated by intramedullary fixation. This can be done similar to Ender's nail technique as K-wires are introduced through small stab incisions since, adhesions are nil. Also, this technique is safe, cost-effective (compared to mini plate), spares the joint and provides stable three-point fixation and anatomical reduction<sup>6,12</sup>. Though it is not a rigid fixation, it provides fracture stability for early mobilization of the finger. It can also be used in non-compliant patients<sup>13</sup>. All this leads to patient having excellent to good results following intramedullary K-wire fixation. Our results are similar to a study conducted by Gonzalez et al, 1996<sup>8,14</sup>.

## Conclusion

Closed intramedullary K-wire fixation of the unstable proximal phalanx fracture is a safe, low-cost, and effective treatment. It facilitates early mobilization and restoration of function with no complication rates. It can be used for transverse, short oblique fractures of the proximal phalanx with good to excellent results.

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