

Original article:

Comparative study of k-wire fixation with fluoroscopy and hypodermic needle fixation without fluoroscopy for distal phalangeal fractures

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ABSTRACT

Background: Distal Phalanx (DP) fractures are the most common hand injuries. Different types of fixation have been proposed for displaced fractures. The aim of the present study is to compare functional and radiological outcomes of DP fractures surgically treated with needles vs Kirschner-wires (k-wire).

Methods: A prospective hospital based study was performed on two fixation types. 22 distal phalanx fractures were treated with k-wire fixation with fluoroscopic control in a main operating room setting. 23 distal phalanx fractures were treated with hypodermic needle fixation without fluoroscopic control in an emergency treatment room setting. Data were collected on fracture type, fracture healing and complications.

Results: No significant difference in healing time, union, delayed union and non-union was found between the two groups. Loosening was significantly more frequent in the hypodermic needle group, without affecting clinical or radiographic outcome.

Conclusion: Treatment of displaced distal phalanx fractures with hypodermic needle fixation yields good results. Performing this procedure in a treatment room is safe and might reduce operative time and radiation exposure for both surgeon and patients.

Keywords: Distal phalangeal fracture, Hypodermic needle, K wire.

Introduction

Hand fractures are among the most frequent skeletal injuries. In particular, the most commonly fractured bone in the hand is the distal phalanx (DP).¹ They are often caused by crush injuries and account for up to 50% of hand fractures after work injuries.² These fractures are classified based on their location as tuft fractures, shaft fractures or intra-articular fractures.³ Fracture treatment usually depends on type of fracture displaced or non displaced, Nonoperative treatment is the norm for nondisplaced fractures whereas for displaced fractures, Al-Qattan reported both conservative and surgical treatment.⁴

DaCruz et al.⁵ approximately 30 years ago, had reported drawbacks in conservative treatment with high rates of residual disability such as dysesthesia, onychodystrophy, loss of Range of Motion (ROM), pain as well as fracture instability hence, a need for stable bone fixation to avoid undesired adverse effects. In literature, different techniques of internal fixation have been described: some authors recommended a 20-gauge hypodermic needle drilled across the fractures,⁶ others proposed Kirschner-wires (k-wire) fixation⁷ and the cortical screw of 1.3–1.5 mm⁸ drilled

across the fracture was considered a promising technique. The k-wire fixation is the most frequently used technique, but complications are reported in literature such as stiffness, pin site infection and fracture instability.⁹

An alternative to k-wire fixation for distal phalangeal fractures is the use of sterile hypodermic needles. Chen and Schneider described fixation using a 20 gauge hypodermic needle for unstable fractures with soft tissue disruption.⁶ Fixation with hypodermic needles has the advantage of not requiring any power operated instruments and can be done simply in any emergency department under digital block, where sterile needles are readily available. The purpose of this study is to determine whether a hypodermic needle fixation performed in a minor treatment room without fluoroscopic control affects fracture healing when compared to k-wire fixation performed in an operating room with fluoroscopy control.

Material and methods

A prospective hospital based study was conducted for the duration of 6 months (sept. 2020 – feb. 2021), in Dept of Orthopedics, Medical College, Churu on 45 patients with distal phalanx fractures selected by consecutive sampling. 22 distal phalanx fractures were treated with k-wire fixation with fluoroscopic control in a main operating room setting. 23 distal phalanx fractures were treated with hypodermic needle fixation without fluoroscopic control in an emergency treatment room setting. Informed written consent was taken. Patients aged 18 years or older with an unstable distal phalanx fracture requiring hardware stabilization were included in study. Pediatric age group patients (<18 years), delayed presentation (after 1 week of injury), revision surgeries, treated with other methods were excluded from study. Detailed history and thorough clinical examination conducted and information on fracture type, associated injuries, time to fracture union, complications, and follow-up duration was collected. Patients were separated into two groups based on the method of fixation (k-wire vs hypodermic needle). Results were compared using an independent *t*-test for quantitative data, and chi-squared test for categorical data. Statistical significance was defined as $p < 0.05$.

Surgical technique: k-wire group

All patients were treated in the operation room under regional nerve block. Patients were positioned in a supine position and were prepped and draped in a sterile fashion. A tourniquet was applied if deemed necessary. The nail was removed if there was an associated nail bed injury, and thorough irrigation was performed. K-wires were used to reduce and stabilize the fracture. The k-wire was inserted in a distal to proximal fashion, crossing the fracture line. After radiographic confirmation of fracture reduction, the DIP joint was extended 10° and the needle advanced through the DIP joint. If deemed necessary, a second or a third k-wire could be added. The k-wires were inserted using a power tool. Final reduction and fixation were verified using fluoroscopy. A J-shaped aluminum splint was applied dorsally to the DIP joint with the PIP joint free.

Surgical technique: hypodermic needle group

All patients were treated under digital block. Patients were positioned in a supine position and were prepped and draped in a field sterility fashion. A finger tourniquet was applied if deemed necessary. The nail was removed if there was an associated nail bed injury, and thorough irrigation was performed. Depending on the finger size, an 18-gauge or 20-gauge hypodermic needle was used to reduce and stabilize the fracture. The needle is inserted in a distal to proximal fashion, crossing the fracture line. The DIP joint was then extended 10°, and the needle was advanced

through the DIP joint. A smaller needle can be used to pre drill the distal fragment from proximal to distal. If deemed necessary, a second needle could be added. Needles were inserted manually without the use of power tools. Final reduction and fixation were verified clinically without the use of fluoroscopy. A J-shaped aluminum splint was applied dorsally to the DIP joint with the PIP joint free.

Results

During the 6 months period (sept 2020- feb 2021), total 45 patients were treated surgically for DP fractures out of them 22 with k-wire fixation in the operating room and 23 patients were treated with hypodermic needle fixation in the treatment room. Mean age in both groups was comparable that is in k-wire group it was 44 ± 6.02 years and in needle group it was 42 ± 9.81 years (range 18–75). Male were more prone to the DP fractures. Main complication was loosening of fixation in both groups and superficial and pin tract infection was more in hypodermic needle fixation group.

Table1. socio-demographic profile and fracture data

Characteristics	K wire group (N = 22)	Hypodermic needle group (N = 23)	P value
Age (years)	44 ± 6.02	42 ± 9.81	0.417
Sex			
Male	18 (81.81%)	17 (73.91%)	0.780
Female	4 (18.19%)	6 (26.09%)	
Side of fracture			
Right	13 (59.1%)	10 (43.47%)	0.454
Left	9 (40.9%)	13 (56.53%)	
Type of Fracture			
Open	16 (72.73%)	19 (82.60%)	0.661
Closed	6 (27.27%)	4 (17.4%)	
Site of Fracture			
Tuft	11 (50%)	12 (52.17%)	0.773
Shaft	10 (45.46%)	11 (47.82%)	
Articular	1 (4.54%)	0	
Fracture pattern			
Transverse	14 (63.63%)	16 (69.57%)	0.916
Oblique	8 (36.36%)	7 (30.43%)	
Fracture fragments			
Two part	16 (72.73%)	17 (73.90%)	0.839
Three part	4 (18.18%)	3 (13.05%)	
Comminuted	2 (9.09%)	3 (13.05%)	

There was no significant difference between two groups in terms of type, side, site, pattern, and fragments of the fracture.

Table2. After treatment complications

Characteristics	K wire group (N = 22)	Hypodermic needle group (N = 23)	P value
Healing time (wk)	7.8 ± 3.2	6.5 ± 2.7	0.147
Union (n)	20	19	0.704
Delayed union (n)	2	4	
Migration of fixation	0	1	
Superficial and pin tract infection	1	2	
Loosening of fixation	2	4	

Mean healing time was 7.8 ± 3.2 weeks in the k-wire group and 6.5 ± 2.7 weeks in the needle group. No significant difference was found between the two groups ($p > 0.05$).

Discussion

This study compares clinical and radiological fracture healing after reduction and fixation with or without fluoroscopic control. We did not find any significant difference in fracture healing, confirming our hypothesis. The healing time in the needle group was even less compared to the k-wire group. One explanation could be that the needle is inserted by hand, generating less heat and causing less bone necrosis compared to the k-wire group and protect soft tissue sleeve and blood supply for early healing. Loosening was encountered more in the needle group compared to the k-wire group, but it did not seem to affect clinical or radiographic outcome. Migration of the fixation device was encountered in one patient in the needle group, requiring revision surgery in the operating room with transformation to k-wire fixation.

Delayed union was seen in 2/22 fractures in the k-wire group and in 4/23 fractures in the needle group. The high number of delayed unions and nonunions may possibly be explained by the high incidence of open fractures, leading to a loss of fracture hematoma and prolonging the healing time and the high incidence of crush injuries. No postoperative infections were encountered in one group or another. These findings concur with other data on the safety of relative sterility in hand surgery. LeBlanc et al. found a superficial infection rate of 0.4% in carpal tunnel surgery performed under field sterility.¹⁰ Similar results were described for k-wire fixation performed in the emergency room and treatment room.^{11,12}

However, k-wire fixation requires the main operating room, which necessitates an anesthetic and OT technician. Since we have shown similar clinical outcomes, there is a significant cost saving if the hypodermic needle technique is performed in the emergency department.

One could argue that some of the fractures in this study would have healed anyway due to the soft tissue envelope and concomitant nailed repair. Others might have evolved to a fibrous non-union with or without symptoms.

CONCLUSION

Distal phalanx fracture fixation with a hypodermic needle in a treatment room is safe, cost effective, minimum man power uses and might reduce operative time and radiation exposure for both surgeon and patients.

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