

## Original Research Article

# Outcome of internal fixation procedure: miniplate vs cross K wires for displaced metacarpal metaphyseal fracture

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**Received:** 16 September 2020

**Accepted:** 14 October 2020

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## ABSTRACT

**Background:** Metacarpal fractures are considered a frequent orthopedic injury seen commonly in emergency units. Objective of the study was to compare the outcome of internal fixation procedure of miniplate versus cross kirschner wires (k-wires) for displaced metacarpal metaphyseal fractures.

**Methods:** In this experimental prospective study, 100 patients with metacarpal metaphyseal fracture were considered. Internal fixation was done by miniplate in one group and cross k wires in other group. Outcomes in terms of radiological union were compared between both groups. The data was analyzed by using SPSS for windows (version 26.0).

**Results:** Mean age of the patients was 38.70±13.61 years. Male to female ratio of the patients was 1.2:1. The radiological success was noted in 76 (76.0%) patients. Statistically insignificant difference was found between the study groups in terms of radiological success of the patients (p=0.6396). K wire fixation was recorded to have significantly shorter duration of operation time in comparison to miniplate fixation (p=0.0001).

**Conclusions:** The internal fixation procedure of both miniplate and k wire are equally effective in terms of radiological success for management displaced metacarpal metaphysis fractures. As compared to miniplate fixation, K wire fixation was found to have significantly shorter duration of operation time.

**Keywords:** Kirschner wire, Metacarpal fractures, Metaphysis, Miniplate

## INTRODUCTION

Metacarpal are prone to injury in daily work and routine of life.<sup>1</sup> Metacarpal fractures are considered a frequent orthopedic injury seen commonly in emergency units. Their incidence is 13.6 fractures per 100,000 persons per year and comprise about 36% of all fractures of hand.<sup>2,3</sup> They contribute up to 40% visits of hospital emergencies.<sup>4</sup> Considered as being trivial injuries, metacarpal fractures are neglected most of the times.<sup>5</sup>

Major causes of metacarpal fractures include machine injuries and road traffic accidents.<sup>6</sup> Majority of these fractures may be simple, closed and stable.<sup>7</sup> Soft tissue injuries, dislocation of adjacent joints and other injuries associated with metacarpal fractures can result in loss of proper function of hand, which may not be easy to regain afterwards.<sup>8</sup>

Consensus for optimal treatment of metacarpal fractures is still lacking. Some studies have compared the

effectiveness of miniplate and K-wire in terms of different aspects yet relatively shorter sample size of these studies do not allow us to draw clear conclusions about the efficacy of both these approaches.<sup>9,10</sup> Depending upon fracture type, location and stability, both conservative and operative techniques are employed. Kirschner wire (K-wire) has the advantage of easy availability, cost effective, minimal dissection and technical ease.

But wire fixation may lead to prolong immobilization and post-operative stiffness. Mini-plate can acquire low profile fixation with great rigidity and finger length maintenance but it is invasive and may cause infection, adhesions and may need to be removed in future.<sup>11</sup> This study was conducted to compare the results of both miniplate fixation and K wiring in our population.

**METHODS**

This experimental prospective study was performed at the Department of Orthopedic surgery and traumatology, Services Hospital, Lahore, following approval from institutional review board from 01<sup>st</sup> January 2017 to 28<sup>th</sup> March 2019. Sample size of 100 (50 in each group) was calculated based on an anticipated success rate in terms of radiological union of 79.54% in Kirschner wire internal fixation group versus 56.2% in miniplate internal fixation group with 80% power of test divided in two groups A and B.<sup>5,12</sup>

Patients of both gender, aged 18 to 60 years presenting with transverse metacarpal metaphyseal fracture were enrolled. All patients with open fractures (on clinical examination), polytrauma patients, having neurovascular injury (on history and clinical examination showing inability to move), past injury to same hand (on history and clinical examination) or those who did not give consent to participate in the study, were excluded. A total of 100 patients with transverse metacarpal fracture who fulfilled the inclusion and exclusion criteria were included in the study from emergency and outdoor department after taking informed consent. They were assigned 2 groups, A and B. Miniplate internal fixation was done in group A and cross K fixation in group B, based on a table of randomly assorted digits.

All procedures were performed under Bier`s block. During procedure straight longitudinal skin incision was made on dorsal surface of hand in the interval between adjacent metacarpal bones but not directly over extensor tendons. Extensor tendons were retracted to expose the bone. Fracture was reduced and fixed with 2mm miniplate on dorsal surface of bone.

Wound was closed in layers and aseptic dressing was applied. In second group with displaced metacarpal fractures close reduction was done and fixed with 2 cross percutaneous K-wires and volar slab was applied for 4 weeks and range of motion of fingers was assessed after the procedure. Evaluation of patients after surgery was done on weekly basis till 6 weeks then at 3,6 and 9 months. X rays were obtained to ensure proper reduction and bone healing. The record was entered in a predesigned proforma.

Data was analyzed using statistical package for social sciences (SPSS) version 16. Qualitative data like gender, age groups, radiological union and complications were presented as frequencies and percentages. Quantitative data like age, pain score, duration of operation (minutes) and time of union (weeks) were presented as means and standard deviations. Comparison of two groups in terms of qualitative data was done employing chi-square test whereas quantitative data was compared using independent sample t-test. P value less than or equal to 0.05 was considered significant.

**RESULTS**

**Table 1: Distribution of gender and age between both study groups.**

Study variables		Miniplate fixation (n=50)	K wire fixation (n=50)	P value
		N (%)	N (%)	
Sex	Male	26 (52.0)	29 (58.0)	0.5465
	Female	24 (48.0)	21 (42.0)	
Age groups (years)	≤45	37 (74.0)	41 (92.0)	0.3342
	>45	13 (26.0)	9 (8.0)	

**Table 2: Radiological outcome, duration of operation, pain score and time to union among patients of both study groups.**

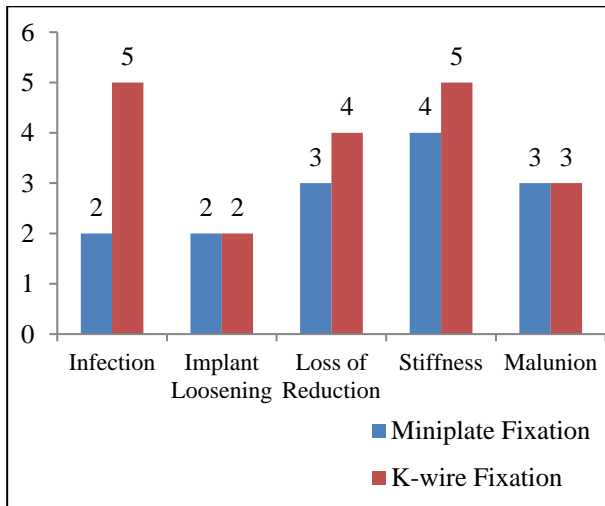
Study variables	Miniplate fixation (n=50)	K wire fixation (n=50)	P value
Radiological outcome	Success	39	0.6396
	Failure	11	
Duration of operation in minutes (mean±SD)	54.18±3.51	37.64±2.84	0.0001
Pain score by vas (mean±SD)	5.31±1.48	4.81±1.22	0.0683
Time of union in weeks (mean±SD)	11.77±2.46	12.62±2.59	0.0956

Mean age among study participants was 38.70±13.61 years with an age range of 18-60 years. There were 55 (55%) male and 45 (45%) female with a ratio of 1.2:1. Distribution of gender and age between both study groups is given in table number 1 and there was no statistical difference (p>0.05).

Overall, union was successful in 76 (76.0%) patients. When both groups were compared for radiological outcome (union), no statistical difference was observed (p=0.6396). K-wire fixation was recorded to have significantly shorter duration of operation time in comparison to miniplate fixation (p=0.0001).

Comparison of pain noted by VAS among both study groups was not statistically different (p=0.0683). No statistically significant difference was found among both groups in terms of mean time of union (weeks) as shown in Table 2.

Figure 1 is elaborating comparison of Complication between both study groups. No significant difference was observed between participants of both study groups (p=0.9384).



**Figure 1: Complications among patients of both study groups.**

P-value=0.9384.

**DISCUSSION**

There are many treatment methods for fixation of metacarpal fractures. These include K-wiring, tension band wiring, lag screw fixation and plating. For achieving stable and rigid fixation to get union of metacarpal fractures and prevent mal alignment that allows early mobilization, plating is the treatment of choice.<sup>13</sup> Some studies show that K wire fixation for metacarpal fractures is preferable technique due to less soft tissue dissection, short operation time and less chances of complications like scarring and infection.<sup>14</sup>

In our study both the miniplate and K wires were found to have statistically insignificant difference in comparison of radiological success rate. In our study the radiological success achieved in 76% of the cases. Manipulation after K wire fixation is simple. It causes less damage on fracture blood supply. However, the control of fingers motion is difficult after this procedure.<sup>15</sup> In terms of operation time, we noted significantly less operation time was required for K-wire fixation patients. Operation time with K wires has already been noted to be significantly short (p<0.01) as compared to miniplate fixation, however, no difference of total active range of motion, healing time, post-operative pain and rate of union among groups.<sup>16</sup> We also noted that there was no difference of VAS pain score in between patients of both study groups.

In contrast to our findings, mini plate fixation of metacarpal or phalangeal fractures in Han population of China was found superior than K wires.<sup>17</sup> While a study by Aski B and Bhatnagar A, concluded that fixation with K wires in unstable shaft fractures has good results with added advantage of bone fixation without opening up the fracture site. This could not be achieved when mini plate was employed.<sup>18</sup>

One more study by Luo HB demonstrated that the clinical effect of mini-plate fixation for complicated metacarpal fracture was apparently better than that of K wire, so mini-plate fixation can be used as an effective repair method for complicated metacarpal fracture. Statistical analysis showed that significant differences in total action flexion score were detectable between the two groups at 3 months of follow-up (p<0.05).<sup>19</sup> Khatri et al found K-wire internal fixation to have excellent results in 75% of the patients with proximal phalanges and metacarpal fractures while miniplates were found to have an efficacy of 85% but the no statistical significance was noted among the both study groups (p=0.737).<sup>20</sup>

One of the limitations of this study was that we had comparatively small sample size in both study groups. We also couldn't record the duration of hospitalization among participants of both study groups.

**CONCLUSION**

The internal fixation procedure of both miniplate and k wire are equally effective in terms of radiological success for management displaced metacarpal metaphysis fractures. As compared to miniplate fixation, K-wire fixation was found to have significantly shorter duration of operation time. Further studies with larger group of patients involving multiple centers and settings will further verify the findings of this study.

**ACKNOWLEDGEMENTS**

The authors would like to thank Muhammad Aamir (Research Consultant, Bahawalpur) for his volunteer support in statistical analysis of this research.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Shair NA, Tariq A, Shakeel M, Kashif M, Ahmad E, Abubakar M. Outcome of internal fixation procedure: miniplate vs cross k wires for displaced metacarpal metaphyseal fracture. *Int J Res Med Sci* 2020;8:3866-9.