

ORIGINAL ARTICLE

Comparison of Frequency of Union with Percutaneous Intramedullary Kirschner Wire versus Interfragmentary Screw Fixation in Displaced Extra-articular Metacarpal Fractures

FARHAN QAZI¹, MAJID ZAHEER², ZUBAIR KHALID³, HAFIZ IFTIKHAR AHMED SADAQAT⁴, MUHAMMAD UMAR HAFEEZ⁵, AMANULLAH⁶

¹Assistant Professor, Department of Orthopedic Surgery, Pak International Medical College / Peshawar Institute of Medical Sciences, Peshawar.

^{2,3,4}Consultant Orthopedic Surgeon, Department of Orthopedic Surgery, Ghurki Trust Teaching Hospital, Lahore, Pakistan.

⁵Consultant Orthopedic Surgeon, Department of Orthopedic Surgery, University of Lahore, Pakistan.

⁶Post-Graduate Resident, Department of Orthopedic Surgery, Ghurki Trust Teaching Hospital, Lahore, Pakistan.

Correspondence to: Zubair Khalid, Email: zubair.khalid262@gmail.com, Cell: +92 332 6125051

ABSTRACT

Objective: To compare the frequency of union in cases treated with percutaneous intramedullary kirschner wire versus interfragmentary screw fixation of displaced extra-articular metacarpal fractures.

Study Design: Randomized controlled trial.

Place and Duration: The Department of Orthopedic surgery, Ghurki Trust Teaching Hospital Lahore, Pakistan from May 2021 to November 2021.

Methodology: A total of 70 cases (35 in each group) of both genders aged 18-60 years with displaced extra-articular metacarpal fracture were included. Surgery was performed with the patient under peripheral anesthesia adopting pneumatic tourniquet and image intensification. Patients were randomly divided into 2 groups, undergoing either percutaneous intramedullary K-wire fixation or interfragmentary Screw Fixation. Patients were followed up till 16th week to see the union.

Results: The mean age of patients in K-wire group was 37.89±9.34 years and in screw fixation group was 40.17±12.82 years. In K-wire group, there were 24 (68.57%) male and 11(31.4%) female cases while in Screw fixation group there were 17 (48.6%) male and 18 (51.4%) female cases. In K-wire group, 20 (57.1%) cases reported union while in Screw fixation group, 33 (94.3%) cases reported union at the final follow up ($p < 0.001$).

Practical Implications: Interfragmentary screw fixation in displaced extra-articular metacarpal fractures yielded better outcomes.

Conclusion: Significantly more cases treated with interfragmentary screw fixation of displaced extra-articular metacarpal fractures reported union in comparison to percutaneous intramedullary kirschner wire.

Keywords: Metacarpal fractures, internal fixation, intramedullary K-wire, screw fixation, union.

INTRODUCTION

The incidence of metacarpal fractures among all types of hand fractures falls between 18 to 44%.^{1,2} Intense knowledge regarding these kinds of fractures, their in-built stability, and existing options for the treatment is needed for the best management of these fractures.¹ Generally, traditional conservative treatment is capable of avoiding the loss of function in treating extra-articular metacarpal fractures presenting little angulation, shortening or malrotation.³⁻⁵ However, surgical interventions are required for the fractures presenting initial displacement.^{3,4} Using Kirschner wires for percutaneous fixation, the occurrence of stiffness or scarring is not as frequent as with open surgery, bringing about motion scores to a higher range, however, by using this procedure, it is necessary to give much time to postoperative splinting.⁶ Replacing conventional elastic pinning methods with intramedullary cannulated screws, intramedullary K-wires or intraosseous wiring, interfragmentary or compression screws and hand plate system³, small incisions with few stitches, and fixation with greater stiffness are possible.^{7,8} Conflicting reports exist regarding best approach for the treatment of displaced extra-articular metacarpal fractures.⁹ A study reported that 74.2% of the cases had union who were managed with percutaneous intramedullary K-wire fixation group and 95.5% of the cases had union managed with interfragmentary screw fixation.⁹ We retrieved data about union as they reported 25.8% and 4.55% malunion in either group, respectively.⁹ Another study found higher frequency of union in cases treated with interfragmentary screw fixation as compared to percutaneous intramedullary kirschner.⁹

As no study on local population is done so far, and international data on such comparison is also not available widely. In our practice we mostly use percutaneous intramedullary kirschner wire, through this randomized controlled trial we want to compare it with interfragmentary screw fixation. Through this study if we find higher union in interfragmentary screw fixation group then in future this technique will be applied. By achieving better results we can reduce the loss of related working hours and gain maximum patient's satisfaction. The current study is designed to

compare union rate in cases treated with percutaneous intramedullary kirschner wire and interfragmentary screw fixation of displaced extra-articular metacarpal fractures in local population.

METHODOLOGY

This randomized controlled trial was done at the department of orthopedic surgery, Ghurki Trust Teaching Hospital, Lahore, Pakistan from May 2021 to November 2021. A sample size of 70 cases (35 cases in each group) was estimated using 80% power of test, 95% level of significance. We used 74.19% union rate who were managed with percutaneous intramedullary K-wire fixation group and 95.45% union managed with interfragmentary screw fixation.⁹

Inclusion criteria were patients of both genders aged 18-60 years having unilateral displaced metacarpal fractures within 2 weeks. Exclusion criteria were multiple fracture associated fractures of shoulder, elbow, or wrist, diabetic cases (fasting blood sugar > 126) or those having history of rheumatoid arthritis or gout, or with pre-existing neurological and functional deficits. Displaced extra-articular metacarpal fracture was defined if the patient has metacarpal fractures (confirmed on digital x-rays) with a dorsal angulation of more than 30° or with a shortening of more than 3 mm within 2 weeks.

Approval was acquired from "Hospital Ethical Committee" and informed/written consents were taken from all cases prior to enrollment. Demographic information like age and gender were obtained. Procedure was explained to patients before surgery. All procedures were done by a single consultant having more than 5 years of experience. Peripheral anesthesia was adopted with a pneumatic tourniquet and image intensification. Cases were randomly divided into 2 groups using lottery method and managed with either percutaneous intramedullary K-wire fixation or interfragmentary screw fixation. Standard surgical procedures were adopted in both treatment groups. Patients were followed up till 16th week to label the union at the last follow up.

All collected data was entered and analyzed using "Statistical Package for Social Sciences (SPSS)", version 26.0.

Mean ± SD was used to present quantitative data like age. For categorical data like gender, union and side involvement frequency and percentage was used. To compare union in both groups, Chi-square test was applied. To address effect modifiers data was stratified for patient's age, gender, side involvement, malnourishment and occupation. Post stratification Chi-square test was applied taking p- value ≤ 0.05 as significant.

RESULTS

The mean age of patients in K-wire group was 37.89 ± 9.34 years and in screw fixation group was 40.17 ± 12.82 years. The minimum and maximum age in K-wire and Screw fixation group was 19-59 years and 18-60 years respectively. In K-wire group, there were 24 (68.6%) male and 11 (31.4%) female cases while in Screw fixation group there were 17 (48.6%) male and 18 (51.4%) female cases.

Table-1: Characteristics of Patients (n=70)

Characteristics		Number (%)
Gender	Male	41 (58.6%)
	Female	29 (41.4%)
Age (years)	18-40	48 (68.6%)
	41-70	22 (31.4%)
Side Involvement	Right	46 (65.7%)
	Left	24 (34.3%)
Malnourishment		23 (32.9%)
Occupation	Manual worker	27 (38.6%)
	Others	43 (61.4%)

Table-2: Comparison of Study Variables in both Study Groups (N=70)

Study Variables		Study Groups		P-Value
		K-Wire (n=35)	Screw Fixation (n=35)	
Gender	Male	24 (68.6%)	17 (48.6%)	0.089
	Female	11 (31.4%)	18 (51.4%)	
Age (years)	18-40	26 (74.3%)	22 (62.9%)	0.303
	41-70	9 (25.7%)	13 (37.1%)	
Side Involvement	Right	24 (68.6%)	22 (62.9%)	0.614
	Left	11 (31.4%)	13 (37.1%)	
Malnourishment		12 (34.3%)	11 (31.4%)	0.799
Occupation	Manual worker	15 (42.9%)	12 (34.3%)	0.461
	Others	20 (57.1%)	23 (65.7%)	

Table-3: Comparison of union in both Study groups with respect to Study Variables (N=70)

Study Variables		Union	Study groups		P-value
			K-wire	Screw fixation	
Age years (years)	18-39	Yes	15 (60.0%)	17 (94.4%)	0.011
		No	10 (40.0%)	1 (5.6%)	
	40-60	Yes	5 (50.0%)	16 (94.1%)	0.008
		No	5 (50.0%)	1 (5.9%)	
Gender	Male	Yes	14 (58.3%)	17 (100%)	0.002
		No	10 (41.7%)	-	
	Female	Yes	6 (54.5%)	16 (88.9%)	0.036
		No	5 (45.5%)	2 (11.1%)	
Side Involvement	Left	Yes	6 (54.5%)	12 (92.3%)	0.033
		No	5 (45.5%)	1 (7.7%)	
	Right	Yes	14 (58.3%)	21 (95.5%)	0.003
		No	10 (41.7%)	1 (4.5%)	
Malnourishment	Yes	Yes	6 (50.0%)	10 (90.9%)	0.033
		No	6 (50.0%)	1 (9.1%)	
	No	Yes	14 (60.9%)	23 (95.8%)	0.003
		No	9 (39.1%)	1 (4.2%)	
Occupation	Manual Worker	Yes	7 (46.7%)	12 (100%)	0.003
		No	8 (53.3%)	0 (0%)	
	Others	Yes	13 (65%)	21 (91.3%)	0.034
		No	7 (35%)	2 (8.7%)	

In K-wire group, there were 11 (31.4%) having left and 24 (68.6%) cases having right side involved while in screw fixation group, there were 13 (37.1%) cases who had left and 22 (62.9%) cases who had right side involved. In K-wire group there were 15 (42.9%) manual workers and 20 (57.1%) had other occupations while in screw fixation group there were 12 (34.3%) were manual worker and 23 (65.7%) had other occupation. Table-1 is showing characteristics of patients while table-2 is representing comparison of study variables in between study groups.

In K-wire group, 20 (57.1%) cases had union while in screw fixation group, 33 (94.3%) cases had union. The frequency of union was statistically higher in screw fixation group when compared with K-wires group (p< 0.001). Table-4 is showing comparison of study variables with respect to union in both study groups.

DISCUSSION

Considering injuries of the upper extremity bones, 10% incidence rate of metacarpal fractures is observed in adult people.¹⁰ A study reported that annual rate of incidence of hand fracture cases for the population of UK, was 280 per 100,000. Among European people, 31.5 years is the mean age to hold up under these injuries.¹¹ As far as hand fractures are concerned, higher incidence rate of 20% for fifth metacarpal fractures is observed, and mostly young and working people are affected.¹²

Some of the fifth metacarpal fractures occur in such a way that there are chances of loss of function, weakening of the grip of 5th finger and reduction of the active motion at the 5th metacarpal joint.¹² As a result, functioning of hand becomes compromised and being off work for days, leads to financial constraints. On the other hand, non-operative management of majority of the 5th metacarpal fractures with marginal intervention is possible, which results in outstanding long-term outcomes. However, for open 5th metacarpal fractures, operative management is needed almost every time, so non-operative intervention is out of consideration.¹³

As far as closed injuries are concerned, usually, operative treatments are specified for the management of intra-articular fractures. Regarding intra-articular 5th metacarpal fractures fixation, restoration of the joint surfaces is detected on visual inspection, joint movement is restored and prevented from further damage and osteoarthritis. Extra-articular 5th metacarpal fractures are related to some indefinite manifestations, generally, on the basis of deformity, instability and/or shortening of the metacarpal, decision for surgical intervention is made.¹³

According to our study findings, for the patients of K-wire group the mean age was 37.89±9.34 years and 40.17±12.82 years in screw fixation group. In K-wire group there were 68.6% male and 31.4% female cases while in Screw fixation group there were 48.6% male and 51.4% female cases. In K-wire group 57.1% cases had union while in Screw fixation group 94.3% cases had union. Statistically observed union frequency of K-wires group was higher than group of Screw fixation patients, p-value came out to be < 0.001. A study reported that 74.2% cases had union who were managed with percutaneous intramedullary K-wire fixation group and 95.5% cases had union managed with interfragmentary screw fixation.⁹ Hence, in case of surgical management, authors recommend antegrade intramedullary K-wire fixation for metacarpal shaft fractures. The study resulted in the inclusion of 27 patients presenting 34 fractures. Reported mean of the follow-up of outpatients was 11 weeks, ranging between 4–24 weeks. A mean interval of 30 months (ranging between 8-62 months) was recorded for their functional assessment.¹⁴ In the contrary, another study showed insignificant differences between the results of k-wire fixation and screw fixation.¹⁵ In a study performed previously, intramedullary nail fixation and plate-screw fixation of metacarpal fractures were compared in terms of their clinical and radiographic outcomes, and it was concluded that either of the technique was effective without any significance.¹⁶

CONCLUSION

Significantly more cases treated with interfragmentary screw fixation of displaced extra-articular metacarpal fractures reported union in comparison to percutaneous intramedullary Kirschner wire.

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