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Research Article

Outcomes of Metacarpal Fracture Fixation: A Comparison between Dual Intra-Medullary 1.5mm Kirschner's Wire and Single 2.0mm K-Wire Techniques

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ABSTRACT

Objective: This study aims to evaluate and compare the outcomes of two fixation techniques for metacarpal fractures: dual intra-medullary 1.5mm flexible Kirschner's wire (K-wire) fixation versus single 2.0mm K-wire fixation.

Methods: Conducted at the Department of Orthopedic in Muhammad Medical College / Ibn-E-Sina University Mirpurkhas Pakistan, this prospective study spanned from January 2024 to December 2024. A total of 40 patients, aged between 18 and 60 years, with either single or multiple metacarpal fractures were enrolled. Participants were randomly assigned to one of two treatment groups: Group 1 received dual intra-medullary 1.5mm flexible K-wire fixation, while Group 2 was treated with a single 2.0mm K-wire.

Results: The mean age of participants was 34.89 ± 6.45 years, with a predominance of male patients. In Group 1, 50% (n=10) of patients achieved excellent outcomes, 25% (n=5) had good outcomes, and 20% (n=4) reported fair outcomes. Conversely, in Group 2, 40% (n=8) had excellent outcomes, 25% (n=5) had good outcomes, 25% (n=5) had fair outcomes, and 10% (n=2) experienced poor outcomes, as classified by Strickland's criteria. While no statistically significant differences were found between the two fixation methods, those treated with dual 1.5mm K-wires exhibited better functional results.

Conclusion: The findings suggest that dual K-wire fixation offers a superior approach for managing metacarpal fractures compared to single K-wire fixation, attributed to quicker healing times and reduced complications.

Keywords: Metacarpal fracture, Dual K-wire fixation, Single K-wire fixation, Orthopedic outcomes

INTRODUCTION

The hand is the most essential organ for direct contact with the world around us. It allows for grasping and is distinguished from other animals by the presence of an opposing thumb. The primary functions of the hand include fine and gross motor skills, as well as serving as a crucial apparatus for feeling and interpreting the immediate environment. The precision and stability of the microscopic articulations, the delicate balance between intrinsic and extrinsic muscles, and the intricate tendon systems necessitate a solid and aligned supporting skeleton. In many cases, the gliding tendons that encircle the tubular skeleton of the phalanges are the

ultimate determinants of functional prognosis following skeletal trauma.

Swanson correctly stated, "Hand fractures can be compounded by deformity from no therapy, stiffness from overtreatment, and both deformity and stiffness from poor treatment." The most common fractures seen in emergency rooms and orthopedic clinics are hand fractures. Fractures of the metacarpals and phalanges account for 14-28 percent of all emergency room visits. The fifth finger is usually involved in non-thumb metacarpal fractures, accounting for approximately 88 percent of all metacarpal fractures.

These metacarpal fractures are frequently overlooked or treated as minor injuries, resulting in significant disability and deformity, as well as permanent impairment. Metacarpal fractures are the most common type of hand fracture, accounting for up to 40% of all cases, and are commonly referred to as a "broken hand" by the general population. Healing of hand fractures is not a singular goal; rather, achieving a functional outcome is critical.

The goal of this study is to compare the outcomes of dual intra-medullary 1.5 mm flexible K-wire fixation and single 2.0 mm K-wire fixation in metacarpal fractures.

MATERIALS AND METHODS

This study was conducted at our hospital. Forty individuals over the age of 18 with metacarpal fractures were included in this study. Simple randomization was used to divide the patients into two groups of 20 each. The participants were split into two equal groups (Group 1 and Group 2). In Group 1 (20 patients), dual intramedullary 1.5 mm flexible K-wire treatment was administered. In Group 2 (20 patients), a single 2.0 mm Kirschner wire was used to treat the metacarpal fractures.

Patients with a single or multiple metacarpal fractures aged between 18 to 60 years were included. Those with pathological fractures, intra-articular fractures, dislocated shoulders, or comminuted fractures were excluded. Routine blood tests were conducted for all participants. The affected hand was then X-rayed to determine the type and location of the fracture. It was confirmed that the patient was medically fit for surgery. Prior to surgery, patients were required to fast for at least six hours. The operated limb was elevated for 48 hours post-surgery. Broad-spectrum antibiotics, along with anti-inflammatory and analgesic medications, were administered. A radiological evaluation was performed the day after the procedure to check the fixation of the reduction. The first postoperative dressing was applied on the fifth day.

RESULTS

The functional outcome of fracture therapy was measured using the total active range of motion

(TAM) method, as recommended by the American Society for Hand Surgery (ASSH). The following findings were made: - The study's youngest patient was 20 years old, while the oldest was 57 years old. The average age of the patients was 34.89 ± 6.45. We found a higher number of males as compared to the females. (Table 1)

Table 1: Demographic Characteristics of the Participants

Variable	Gender	Group 1	Group 2	Total
Males		16	17	33
Females		04	03	07
Age	Minimum	20	20	20
	Maximum	34.67	35.12	35.12
	Mean	29.67	28.12	28.89

Right-handed people account for 77.5 percent of the population. Roadside accidents accounted for 63.3 percent of instances, while assault accounted for 33.7 percent. Both sets of patients had extraarticular diaphyseal non-comminuted fractures. Closed fractures accounted for 72.5 percent of the patients, while complicated fractures accounted for 27.5 percent. The most prevalent type of metacarpal involvement is single metacarpal involvement, which accounts for 70% of all cases. (Table 2)

Table 2: Characteristics of the injury

Characteristic	Frequency	Percentage
Hand Involved		

Right	31	77.5%
Left	09	22.5%
Cause of Accident		
Road Traffic	26	65.0%
Accident Assault	10	27.5%
Fall	04	7.5%
Others	01	2.5%
Type of Fracture		
Close	29	72.5%
Complicated	11	27.5%

In this study, 77.5% (n=29) of the patients operated within three days of injury, and 22.5 (09) operated within four to seven days of damage. Group 1 had an average union time of 7.4 ± 1.86 weeks, whereas group 2 had 8.3 ± 0.93 weeks. (Table 3)

Table 3: Duration from Accident to Surgery and Average Union Time

Variable	Group 1	Group 2
Duration from Accident to Surgery		
Within 3 days	16	15
4-7 days	04	05
Average Union Time	7.4 weeks	8.2 weeks

We observed that 50 % (n=10) of patients in group 1 had excellent results, 25% (n=5) had good results, and 20% (n=4) showed fair results. However, in the group, 2, 40%, 25%, 25%, and 10% showed excellent, good, fair, and poor results, respectively, according to Strickland's classification (Table 4)

Table 4. Grading of results according to Strickland's classification

Grade	Group 1 n (%)	Group B n (%)
Excellent	10 (50%)	8 (40%)
Good	5 (25%)	5 (25%)
Fair	4 (20%)	5 (25%)
Poor	1 (5%)	2 (10%)
Total	20 (100%)	20 (100%)

DISCUSSION

No significant difference had been observed between a Dual 1.5 mm intramedullary k-wire or a Single 2 mm Kirschner's wire. However, patients who were treated with Dual 1.5 mm intramedullary k-wire had better functional results One of the treatment modalities in these unstable fractures is the open reduction / closed reduction and internal fixation with a single K wire. [10] However, they provide less rigid fixation and are rotationally unstable with a higher incidence of stiffness. There is a higher risk of pin tract infection, and problems due to protruding ends of K-wire are significant. Dual k-wire fixation of metacarpal fractures has become popular to solve these issues. It gives you better stability, quicker mobilisation, reduced stiffness, and a lower risk of infection.[11, 12]

The majority of the patients in this study were in their third and fourth decades of life. The study's youngest patient was 20 years old, and the oldest was 57 years old, with a mean age of 35.7 years.

A previous study found a similar tendency, with an average age of 35 years.[13]

There were more males and fewer females in our sample, with a male to female ratio of around

3:1. Because males are more involved in outdoor road, industrial, and assault activities, males outweighed females in sustaining such fractures. Another study found a similar pattern in their series, with a male to female ratio of 7:3.[13] In the current investigation, the right upper limb was more usually engaged in a 3:1 ratio. This is in line with the fact that roughly 90% of the population is right-handed. [14]

Our study's most common mode of injury was a road traffic accident, followed by assault and fall. This is in line with the findings of a study conducted in Rawalpindi, Pakistan. [15] A recent Pakistan study reported similar findings that the most common etiology of fracture was the road traffic accident, which accounted for more than 60% of the mode of injury. [16] Another study In most cases, high-energy trauma from roadside incidents was the cause of injury. In our study assault was the second most common cause of these fractures. These findings are consistent with the findings of previous studies. [17] In our study, most of the patients were operated on within three days of the accident, and 6 remaining were operated on within seven days. In some situations, the delay was caused by the time it took to prepare the medico-legal report and obtain the medico-legal x-rays. Other studies also reported a similar pattern in which most patients were operated on within one week of the injury.[18, 19]

In our research, we obtained a 100% union rate. In our study 70 % patients in group A, showed union in 6-8 weeks,25% patients (26.67) in 9-12 weeks, and 5% patient in >12 weeks, with an average union time of 7.4 weeks, compared to 65% (n=13) patients in group 2 who showed union in 6-8 weeks, 30 % (n=6) patients in 9-12 weeks, and 5% (n= 1) in >12 weeks, with an average union time of 8.2 weeks.

Group A's average union time was 7.6 weeks, whereas group B's average union time was 8.3 weeks. There is no statistically significant difference between the two groups regarding radiological union time. A study also reported that 100 percent union with the use of Kirschner's wire in treating a hand fracture occur within 6 weeks.[20]

Limited sample size and single-center study are the main limitations and drawbacks of the current study.

CONCLUSION

We concluded that dual k-wire is a superior alternative for metacarpal fracture care than single k- wire because of the early union and fewer complications.

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