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Comparative Evaluation of Plating versus K-Wire Fixation for Displaced Metacarpal Fractures: Functional and Radiological Outcomes

Dr. Malay K Roy
Associate Professor, Department of Orthopaedics Surgery Mymensingh Medical College, Mymensingh, Bangladesh

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Corresponding Author
Dr. Malay K Roy
Associate Professor, Department of Orthopaedics Surgery Mymensingh Medical College, Mymensingh, Bangladesh

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ABS TRAC T

Background: Metacarpal fractures are common hand injuries and may lead to persistent functional limitation when alignment, stability, or rehabilitation is inadequate. K-wire fixation is economical and minimally invasive, whereas plate fixation can provide stable internal fixation. This study compares the clinical and radiological outcomes of the two methods.

Materials and Methods: A prospective comparative study included 40 adults with closed displaced metacarpal fractures. Twenty patients were treated with K-wire fixation and 20 with open reduction and plating. Follow-up was performed through 6 months, with assessment of radiological union, range of motion, grip strength, DASH score, and complications.

Results: Mean radiological healing time was 7.2 weeks in the plating group and 9.8 weeks in the K-wire group. At 3 months, mean range of motion was 89.00° versus 77.77°. Mean DASH score at 6 months was 5.35 versus 15.82, and grip strength was 110.45 versus 96.3 lb in the plating and K-wire groups, respectively. Excellent-to-good functional outcome was reported in 95% of plating cases compared with 70% of K-wire cases. Infection occurred in 1 plating case and 4 K-wire cases.

Conclusion: In this prospective cohort, plating was associated with faster radiological healing and better functional measures at follow-up than K-wire fixation, although operative time and hospital stay were longer with plating.

Keywords: *Metacarpal fracture; plating; K-wire; DASH; grip strength; range of motion.*

INTRODUCTION

Metacarpal fractures constitute an important proportion of traumatic hand injuries. The clinical importance of these fractures extends beyond radiographic alignment because the hand requires coordinated motion, strength, sensation, and flexibility for normal function. Malalignment, rotational deformity, stiffness, and delayed healing can adversely affect activities of daily living and occupational performance.

Road traffic accidents, falls, assaults, and machine-related injuries are described as common mechanisms of hand trauma. The choice of treatment depends on fracture stability, displacement, location, associated injury, and functional requirements. Stable and undisplaced fractures may be treated conservatively, whereas unstable or displaced fractures may require operative stabilization.

K-wire fixation has long been used for metacarpal fractures. Its advantages include low cost, availability, and relatively limited surgical exposure. Nevertheless, the source article notes disadvantages including potentially less reliable fixation and complications such as pin-tract infection, malunion, and non-union.

Plate fixation provides rigid internal stabilization and can facilitate early movement. However, plating requires open exposure and may be associated with implant irritation, skin problems, tendon-related issues, or implant failure. Thus, comparison between the two techniques remains clinically relevant.

The supplied study was designed to compare K-wire fixation and open reduction with plating in adults with closed displaced metacarpal fractures. The study followed patients for six months and assessed radiological union, range of motion, grip strength,

functional outcome by DASH, and postoperative complications.

AIM

To compare the functional and radiological outcomes of displaced metacarpal fractures treated with K-wire fixation and open reduction internal fixation using plating.

OBJECTIVES

- To compare time to radiological fracture union between the two groups.
- To compare postoperative range of motion.
- To compare grip strength during follow-up.
- To assess functional outcome using the DASH questionnaire at six months.
- To compare postoperative complications.
- To describe operative time and hospital stay.

MATERIALS AND METHODS

Study Design

A prospective comparative study was conducted in the Department of Orthopaedics at a tertiary care hospital over two consecutive years, from December 2020 to November 2022. Patients with metacarpal fractures requiring surgical treatment were enrolled after written informed consent. Institutional Ethics Committee approval was obtained.

Study Groups

Forty patients were included and divided into two groups of 20. Group 1 underwent K-wire fixation and Group 2 underwent open reduction and internal fixation with plating. Patients were offered the two surgical options after explanation of the advantages and disadvantages of each technique.

Eligibility Criteria

Inclusion criteria were closed displaced metacarpal fractures, age above 18 years, and fracture duration of less than 3 weeks. Intra-articular fractures, comminuted fractures involving more than three parts, pathological fractures, and compound fractures were excluded.

Operative Techniques

For plating, a dorsal incision was used for a single metacarpal and an incision between adjacent metacarpals when multiple metacarpals were involved. The dorsal sensory branches were protected, the extensor tendon was retracted, and subperiosteal exposure was performed. The fracture was reduced and provisionally fixed, followed by application of a 2.4-mm locking compression plate, T plate, or condylar plate. Fluoroscopy was used to confirm screw size.

For K-wire fixation, 18 of 20 patients were managed by closed reduction and K-wire fixation and two required open reduction. Closed reduction of metacarpal neck fractures used the Jahss manoeuvre, while shaft fractures were reduced with digital manipulation and traction under fluoroscopic guidance. Bouquet and retrograde K-wire techniques were used according to fracture location.

Postoperative Care and Follow-up

Postoperative anteroposterior and oblique radiographs were obtained. Gentle finger mobilisation was started after the second postoperative day. Dressings were performed on day 2 and sutures were removed on day 14. K-wires were removed after 4 weeks. Follow-up assessments occurred at 2 weeks, 4 weeks, 6 weeks, 3 months, and 6 months. Range of motion, grip strength, radiological union, and DASH score were evaluated.

Statistical Analysis

Qualitative variables were presented as frequencies and percentages. Chi-square testing with continuity correction and Fisher's exact test were used for appropriate 2×2 comparisons. Quantitative variables were expressed as mean ± standard deviation. Unpaired t-test or Mann–Whitney testing was used depending on normality. A p-value below 0.05 was considered significant. The source article reports use of SPSS version 21.0 and Microsoft Excel 2010.

RESULTS

The study included 20 patients in each treatment group. The mean age was 36.95 years in the plating group and 38.85 years in the K-wire group, with no significant age difference reported (p=0.54). There were 4 females and 16 males in the plating group and 5 females and 15 males in the K-wire group.

Table 1. Baseline characteristics

Characteristic	Plating (n=20)	K-wire (n=20)
Mean age (years)	36.95	38.85
Female/Male	4/16	5/15
Mean BMI	23.16	23.55
Dominant injured hand	18	16

Road traffic accident was the most frequent mechanism in both groups. The source reports vehicle accidents in 14 plating cases and 10 K-wire cases, with falls and assaults accounting for the remaining injuries. The difference in injury mechanism was not statistically significant (p=0.59).

Table 2. Fracture distribution

Location	Plating	K-wire
Shaft	17 (85%)	15 (75%)
Neck	2 (10%)	3 (15%)
Base	1 (5%)	2 (10%)

The little and ring fingers were the most commonly involved digits in both groups. The source article reports that the fracture was located in the shaft in 80% of plating cases and 75% of K-wire cases, with no significant difference between groups.

Table 3. Operative and functional outcomes

Outcome	Plating	K-wire
Operative time (min)	73.57	29.45
Hospital stay (days)	4.72	2.89
ROM at 3 months (°)	89.00 ± 7.12	77.77 ± 9.86
DASH at 6 months	5.35	15.82
Grip strength at 6 months (lb)	110.45	96.3
Radiological healing (weeks)	7.2	9.8

The mean time from injury to treatment was 3.23 days and did not differ significantly between groups (p=0.279). The mean operative time and hospital stay were longer in the plating group. However, mean fracture union occurred significantly earlier with plating, at 7.2 weeks compared with 9.8 weeks with K-wire fixation.

Range of motion improved in both groups. At the metacarpophalangeal joint, the plating group showed mean values of 46.64°, 57.06°, and 81.05° at 2 weeks, 6 weeks, and 3 months, respectively. Corresponding K-wire values were 42.65°, 51.30°, and 73.61°. The source reports significantly greater improvement with plating at 6 weeks and 3 months ($p<0.01$).
Grip strength also improved over time in both groups. At 2 weeks, 6 weeks, and 3 months, the reported mean values were 17.38, 24.60, and 52.55 lb for plating and 15.15, 20.24, and 39.61 lb for K-wire fixation. The source reports significantly greater improvement in the plating group at 6 weeks and 3 months.

Table 4. DASH functional outcome at 6 months

Outcome category	Plating (n=20)	K-wire (n=20)
Excellent	14	6
Good	5	8
Fair/Satisfactory	1	4
Poor	0	2

The source text also describes the plating group as having excellent, good, fair, and poor outcomes in 14, 5, 1, and 0 cases, while the K-wire group had 6, 8, 4, and 2 cases, respectively. It reports excellent-to-good outcomes in 95% of plating cases versus 70% of K-wire cases and fair-to-poor outcomes in 5% versus 30%.

Table 5. Postoperative complications

Complication	Plating	K-wire
Infection	1	4
Delayed union	0	2
Implant loosening	1	0*
MCP stiffness	2	6

*The source table lists implant loosening as 0 in the K-wire group, while the surrounding narrative states 2 cases. This internal discrepancy should be checked against the original study records before publication.

DISCUSSION

The main finding of the study was better radiological and functional recovery in the plating group. The mean union time was 7.2 weeks with plating compared with 9.8 weeks with K-wire fixation, and the source describes this difference as statistically significant.

Functional recovery also favored plating. At three months, mean MCP range of motion was higher with plating, and the improvement was reported to be significant at six weeks and three months. Grip strength followed a similar pattern, with greater recovery in the plating group.

The six-month DASH results further support the functional advantage reported in the study. A lower DASH score indicates less disability, and the mean score of 5.35 in the plating group was lower than 15.82 in the K-wire group.

The source findings are discussed in relation to previous studies. Ahmed et al. was cited as showing longer operative time for plating, whereas Lv et al. reported longer operating time with K-wire in their comparison. The supplied article also cites Ozer et al., whose clinical results were reported as similar between techniques in that study.

K-wire fixation remains attractive because of its economy, availability, and minimally invasive nature. The current study nevertheless suggests that, in the selected population of displaced closed metacarpal fractures, plating may provide more stable fixation and facilitate earlier functional recovery.

These findings should be interpreted in the context of the study design. The study was not randomized, involved only 40 patients, and included different metacarpal fracture locations. Therefore, treatment selection and fracture heterogeneity may influence observed differences.

Clinical Implications

- Plating may be considered when stable fixation and early functional recovery are important.
- K-wire fixation remains a practical option, particularly when minimally invasive and economical stabilization is desirable.
- Treatment should be individualized according to fracture stability, location, displacement, soft-tissue status, and patient factors.
- Pin-tract infection and stiffness require careful monitoring after K-wire fixation.
- Implant-related problems should also be considered after plating.

Limitations

The study was single-centered, involved a small sample

of 40 patients, was not randomized, and included different anatomical locations of metacarpal fractures. The source authors recommend multicentric studies with longer follow-up and randomized controlled comparisons. In addition, the complication table contains an internal discrepancy regarding implant loosening in the K-wire group, which should be verified.

CONCLUSION

In this prospective comparative study, open reduction and plating was associated with faster fracture healing, greater range of motion and grip strength, lower DASH disability scores, and fewer reported infections than K-wire fixation. Plating required longer operative time and hospital stay. The findings support plating as an effective option for selected displaced metacarpal fractures, while recognizing that larger randomized studies are required for definitive treatment recommendations.

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Conflict of Interest

The supplied article reports no conflict of interest.

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