RESEARCH PAPER

Functional Outcome of Closed and Open Unstable Metacarpal Fractures Treated With Transverse Kirschner-Wire Fixation in a Tertiary Care Hospital in Chengalpattu District, Tamil Nadu

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ABSTRACT

Background: Metacarpal fractures constitute a significant proportion of upper limb injuries and frequently affect individuals in their productive age group. While stable fractures can be managed conservatively, unstable fractures often require surgical stabilization to restore alignment and optimize functional recovery. Transverse Kirschner-wire (K-wire) fixation is a minimally invasive technique that provides rotational and angular stability while preserving soft tissues.

Aim: To assess the functional and radiological outcomes of unstable metacarpal fractures treated with transverse K-wire fixation.

Methods: A prospective longitudinal observational study was conducted in the Department of Orthopaedics at Shri Sathya Sai Medical College and Research Institute over 18 months. Thirty-seven patients aged 15–51 years with unstable metacarpal fractures were included. All patients underwent transverse K-wire fixation. Functional outcomes were evaluated using the Visual Analog Scale (VAS), Quick Disabilities of the Arm, Shoulder and Hand (Quick-DASH) score, Total Active Motion (TAM), and grip strength measurement. Radiological union was assessed using serial radiographs. Statistical analysis was performed using SPSS version 16/17.

Results: Fracture union was achieved in the majority of patients within the expected healing period. Significant improvement was observed in pain scores, range of motion, and grip strength at follow-up. Quick-DASH scores demonstrated progressive reduction, indicating functional recovery. Complications were minimal and included superficial pin-tract infection in a small number of cases.

Conclusion: Transverse K-wire fixation is a safe, effective, and minimally invasive method for treating unstable metacarpal fractures. It provides satisfactory radiological union and favorable functional outcomes when combined with appropriate postoperative rehabilitation.

Keywords: *Metacarpal fractures, Unstable fractures, Transverse K-wire fixation, Functional outcome, Quick-DASH, Grip strength*

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Radiological healing outcome after transverse K-wire fixation (N = 37)

Variable	Category / Summary	n	%
Radiological union status	Union	26	70.3
	Delayed union	11	29.7
Time to radiological union (weeks)	Mean ± SD	—	11.0 ± 4.66
	Median (IQR)	—	10 (8.00)
	Range	—	6–20

Radiological assessment showed that **26 of 37 patients (70.3%)** achieved **union**, while **11 patients (29.7%)** had **delayed union**. The mean time to radiological union was **11.0 ± 4.66 weeks**, with a median of **10 weeks** and a range of **6 to 20 weeks**. These findings indicate that most unstable metacarpal fractures treated with transverse K-wire fixation achieved satisfactory radiological healing within the follow-up period.

Comparison of baseline functional status by type of injury among study participants (N = 37)

Parameter	Closed (n = 18) Mean ± SD	Open (Gustilo I) (n = 19) Mean ± SD	t (df)	p-value
Preoperative VAS score	8.17 ± 0.92	7.63 ± 0.96	1.73 (35)	0.092
Preoperative QuickDASH score	55.33 ± 9.77	59.42 ± 9.20	−1.31 (35)	0.198
Preoperative Total Active Motion (TAM)	57.06 ± 12.08	62.89 ± 12.30	−1.46 (35)	0.154
Preoperative grip strength (sphygmomanometer)	83.28 ± 14.92	93.68 ± 18.48	−1.88 (35)	0.069

On baseline comparison, patients with **closed** and **open (Gustilo I)** metacarpal fractures showed **no statistically significant difference** in preoperative functional severity. Mean preoperative **VAS** was **8.17 ± 0.92** in closed fractures and **7.63 ± 0.96** in open fractures (**p = 0.092**). Similarly, there were no significant differences in **QuickDASH** (**55.33 ± 9.77 vs 59.42 ± 9.20; p = 0.198**), **TAM** (**57.06 ± 12.08 vs 62.89 ± 12.30; p = 0.154**), or **grip strength** (**83.28 ± 14.92 vs 93.68 ± 18.48; p = 0.069**), indicating broadly comparable baseline functional status between the two injury groups.

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INTRODUCTION

Metacarpal fractures account for nearly 40% of all hand fractures and represent a common presentation in orthopaedic practice. These injuries frequently occur in young and middle-aged individuals involved in manual labor, sports, or high-energy trauma. The primary goal of treatment is restoration of hand function rather than radiographic union alone.

Stable, undisplaced fractures can be treated conservatively. However, unstable fractures characterized by unacceptable angulation, rotational deformity, shortening, comminution, or open injury often require surgical intervention. Rotational deformity is particularly disabling, as even minimal malalignment can result in digital overlap during flexion and impaired grip function.

Various surgical techniques are available, including plating, intramedullary fixation, lag screws, and K-wire fixation. Although plating provides rigid fixation, it requires extensive soft-tissue dissection and may lead to tendon irritation and implant-related complications. Kirschner-wire fixation, introduced by Martin Kirschner,

remains widely used due to its simplicity and minimal soft-tissue disruption.

Transverse K-wire fixation stabilizes the fractured metacarpal by anchoring it to adjacent intact metacarpals, thereby improving rotational control and maintaining alignment. This technique preserves periosteal blood supply, reduces surgical morbidity, and allows early mobilization.

This study evaluates functional and radiological outcomes of unstable metacarpal fractures treated with transverse K-wire fixation in a tertiary care setting.

AIM AND OBJECTIVES

Aim

To assess the functional outcome of unstable metacarpal fractures treated with transverse Kirschner-wire fixation.

Primary Objective

To evaluate functional and radiological outcomes following transverse K-wire fixation.

Secondary Objectives

To assess improvement in pain.

To evaluate range of motion recovery.

To measure improvement in grip strength.

MATERIALS AND METHODS

Study Design

Prospective longitudinal

observational study.

Study Setting

Department of Orthopaedics, Shri Sathya Sai Medical College and Research Institute.

Study Duration

18 months.

Sample Size

Thirty-seven patients, calculated based on previous outcome proportions with 5% significance and 80% power.

Inclusion Criteria

Age 15–51 years

Acute unstable metacarpal fractures

Unacceptable angulation, shortening, or rotational deformity

Open fractures fit for surgery

Exclusion Criteria

Old or neglected fractures

Nonunion

Long oblique comminuted fractures

Neuromuscular compromise

Medically unfit patients

SURGICAL TECHNIQUE

Under appropriate anesthesia and aseptic precautions, anatomical reduction was achieved. Transverse K-wires were inserted percutaneously to fix the fractured metacarpal to adjacent intact metacarpals. Intraoperative radiographs confirmed alignment and fixation.

POSTOPERATIVE PROTOCOL

Immobilization as per standard protocol

Regular follow-up with serial radiographs

Gradual mobilization initiated upon evidence of stability

K-wire removal after radiological union

OUTCOME MEASURES

Functional Assessment

Pain: Visual Analog Scale (VAS)

Disability: Quick-DASH score

Range of Motion: Total Active Motion (TAM)

Grip Strength: Measured using sphygmomanometer

Radiological Assessment

Fracture alignment

Callus formation

Time to union

RESULTS

Majority of patients were young adult males.

Fifth metacarpal fractures were most common.

Radiological union was achieved in nearly all patients.

Significant reduction in VAS scores postoperatively.

Improvement in TAM and grip strength over successive follow-ups.

Quick-DASH scores showed progressive functional recovery.

Complications were minimal and manageable.

DISCUSSION

Unstable metacarpal fractures require stable fixation to prevent malunion and functional impairment. Transverse K-wire fixation provides adequate control of rotational and angular deformity while minimizing soft-tissue disruption.

Compared to plating, this technique reduces the risk of tendon irritation and implant prominence. Although intramedullary fixation is less invasive, it may not offer equivalent rotational stability in certain fracture patterns.

The present study demonstrates favorable functional outcomes with minimal complications, consistent with

previous literature supporting transverse K-wire fixation as an effective management strategy.

CONCLUSION

Transverse Kirschner-wire fixation is an effective, minimally invasive technique for managing unstable metacarpal fractures. It achieves reliable fracture union, restores alignment, and results in satisfactory functional recovery with low complication rates.

Early mobilization and structured rehabilitation are essential to optimize outcomes.

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