

OUTCOME OF INTERMETACARPAL K-WIRE FIXATION IN BASE OF FIRST METACARPAL FRACTURES

Dilip Kuncheria¹, Siju K M², M.S. Padmanabhan³

¹Associate Professor, Department of Orthopedics, Government Medical College, Palakkad, India.

²Assistant Professor, Department of Orthopedics, Government Medical College, Palakkad, India.

³Medical Superintendent, Government Tribal Specialty Hospital, Kottathara, Kerala, India.

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Corresponding Author:

Dr. Siju K M

Email: kmsiju@gmail.com

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ABSTRACT

Background: Fractures at the base of the first metacarpal, including Bennett's and Rolando's fractures, significantly impact thumb function and hand utility. Intermetacarpal K-wire fixation is a minimally invasive technique increasingly used for stabilization following closed reduction. **Objective:** To evaluate the long-term radiological, functional, and pain outcomes of patients undergoing intermetacarpal K-wire fixation for base of first metacarpal fractures. **Materials and Methods:** An ambidirectional cohort study was conducted on 41 patients treated between October 2015 and October 2018, with a minimum follow-up of five years. Functional outcome was assessed using the Quick DASH score, pain was evaluated using the Wong-Baker and Numeric Rating Scales, grip strength was measured by the Jamar dynamometer, and radiological outcomes were graded by the Van Niekerk and Owens modification of the Eaton-Littler classification. **Result:** The majority of patients were young males (90.2%) sustaining injuries mainly due to road traffic accidents. At five years, 85.7% of patients demonstrated no arthritic changes radiologically. Functional outcomes were excellent with a mean Quick DASH score of 4.2143, indicating minimal disability. Grip strength showed a modest improvement postoperatively though not statistically significant. Pain scores were minimal, with no patients reporting significant discomfort. Complications were rare and minor. **Conclusion:** Intermetacarpal K-wire fixation is a safe, effective, and cost-efficient method for treating base of first metacarpal fractures, offering good long-term functional and radiological outcomes with low complication rates.

INTRODUCTION

Fractures at the base of the first metacarpal are relatively common injuries, especially in young adults, due to high-energy trauma such as road traffic accidents or falls.^[1] These fractures are significant because the thumb plays a vital role in hand function, contributing to more than 40% of hand utility.^[2] The stability and integrity of the carpometacarpal (CMC) joint of the thumb are crucial for pinch and grip strength.

Two primary types of fractures are commonly described at the base of the first metacarpal: Bennett's fracture and Rolando's fracture. Bennett's fracture is an intra-articular fracture dislocation, usually involving a single fracture line and dislocation of the metacarpal shaft.^[3] In contrast, Rolando's fracture is a comminuted intra-articular fracture, often Y- or T-shaped, and presents greater challenges in treatment.^[4]

Multiple treatment modalities exist, including closed reduction with casting, percutaneous pinning, open

reduction with internal fixation (ORIF), external fixation, and intermetacarpal K-wire fixation.^[5,6,7,8,9] Closed reduction and intermetacarpal K-wire fixation has gained popularity due to its simplicity, cost-effectiveness, and good functional outcomes without requiring extensive surgical exposure.^[10]

The fixation technique stabilizes the first metacarpal to the second metacarpal, maintaining reduction while allowing early mobilization and avoiding complications like joint stiffness associated with prolonged immobilization.^[10] Studies have shown that closed reduction with intermetacarpal K-wire fixation provides satisfactory anatomical and functional outcomes,

Despite being minimally invasive, complications such as malunion, pin tract infections, or subluxation can occur, emphasizing the need for careful technique and follow-up.^[10] Long-term evaluation is essential to determine the incidence of post-traumatic arthritis, grip strength recovery, pain, and overall function.

This study aims to evaluate the radiological, functional, and pain outcomes in patients who

underwent intermetacarpal K-wire fixation for base of first metacarpal fractures, with a minimum follow-up of five years.

MATERIALS AND METHODS

Study Design

This study is an **ambidirectional cohort study** evaluating the outcomes of **intermetacarpal K-wire fixation in base of first metacarpal fractures**.

Study Setting

The study was conducted at the **Department of Orthopaedics, Government Medical College, Palakkad**.

Participants

All patients presenting to the Department of Orthopaedics with base of first metacarpal fractures, who fulfilled the inclusion criteria and provided informed consent, were included in the study.

Inclusion Criteria

- Fractures of the base of the first metacarpal
- Closed fractures
- Both sex
- Closed reduction possible
- Patients presenting within one week of injury

Exclusion Criteria

- Open fractures
- Closed reduction not possible
- Patients presenting after one week of injury

Duration of Study

The study included cases that underwent **closed reduction and intermetacarpal K-wire fixation** between **October 2015 and October 2018**. The **minimum follow-up period** was **five years**, and the **maximum** was **nine years**.

Sample Size

A total of **41 patients** met the inclusion criteria and were included in the study.

Sampling Method

All eligible and consenting patients during the study period were recruited consecutively.

Procedure

Patients who consented and fulfilled the inclusion criteria were selected. The surgical procedure was performed under **regional anaesthesia** (wrist block or brachial plexus block).

- The hand was positioned **directly over the detector of a C-arm** for intraoperative imaging.
- The **forearm was kept in pronation** throughout the procedure to enhance the accessibility and alignment of the second metacarpal. (Fig 1)
- **Closed reduction** was achieved under fluoroscopy via longitudinal traction, abduction, and extension of the thumb, combined with pronation of the metacarpus.
- After confirming reduction, **two parallel 1.6 mm Kirschner wires** were inserted approximately 2 cm apart through the first metacarpal at a 90° angle into the second metacarpal. (Fig 2,3)

- An inter-articular step-off of ≤ 2 mm was accepted.
- Postoperatively, the limb was dressed, and **regular pin tract care** was provided.

K-wires were **removed at 5 weeks**, followed by **rehabilitation therapy**.

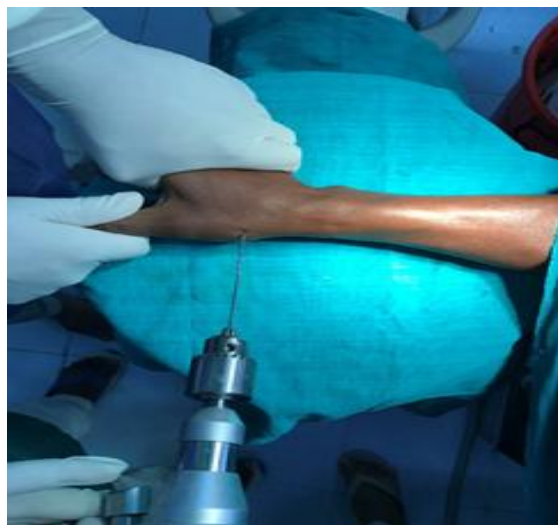


Figure 1: Forearm with hand directly kept over the C arm detector in pronation. Closed reduction was achieved under fluoroscopy via longitudinal traction, abduction, and extension of the thumb, combined with pronation of the metacarpus. Two parallel 1.6 mm Kirschner wires were inserted approximately 2 cm apart through the first metacarpal at a 90° angle into the second metacarpal.



Figure 2: C arm picture showing two parallel K wires fixing first and second metacarpal

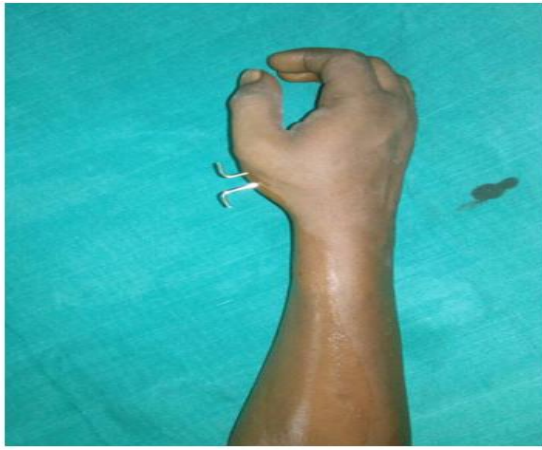


Figure 3: Post-operative clinical picture

Intraoperative Findings:

It was noted that **Green and O'Brien Type IIIA fractures** were the most unstable and challenging for reduction and K-wire fixation.

Radiographic Follow-Up:

- Pre-op X-rays were categorized using the Green and O'Brien classification.
- Post-K-wire removal X-rays revealed occasional malunion.
- Five-year follow-up X-rays showed minimal shortening of the first metacarpal compared to the contralateral side, though functional outcomes were satisfactory.

Variables

1. **Functional Outcome** – Evaluated using the **QuickDASH Score and Kapanji**.
2. **Pain Evaluation** – Assessed using the **Wong-Baker Faces Pain Scale** and **Numeric Rating Scale (NRS)**.
3. **Radiological Outcome** – Determined using the **Van Niekerk and Owens modification of the Eaton-Littler Classification:**
 - **Stage I:** No arthritic changes

- **Stage II:** Osteophytes <2 mm
- **Stage III:** Osteophytes ≥2 mm or joint space narrowing
- **Stage IV:** Complete joint space obliteration

4. Grip Strength – Measured using the **JAMAR Hand Dynamometer**. (fig 4)



Figure 4: Grip strength measured using the JAMAR

Hand Dynamometer

Bias Control

To minimize observer bias, all clinical and radiological evaluations, including scoring and classifications, were performed by an independent assessor not involved in the study or surgical procedures.

Statistical Analysis

Data were analysed using IBM SPSS version 20. Descriptive statistics such as frequencies and percentages were used to summarize categorical data. Group comparisons were performed using the Chi-square test, and a p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Gender Distribution of Patients

Gender	Number (n = 41)	Percentage (%)
Male	37	90.2%
Female	4	9.8%
Total	41	100%

Table 2: Age Distribution of Patients

Age Group (years)	Number (n = 41)	Percentage (%)
20–29	10	24.4%
30–39	16	39.0%
40–49	9	22.0%
≥50	6	14.6%
Total	41	100%

Table 3: Laterality of Injury (Side Involved)

Side Affected	Number (n = 41)	Percentage (%)
Left Hand	24	58.5%
Right Hand	17	41.5%
Total	41	100%

Table 4: Mode of Injury

Mechanism of Injury	Number (n = 41)	Percentage (%)
Road Traffic Accident (RTA)	14	34.1%
Assault	4	9.8%
Fall (Slip/Height/Bed)	6	14.6%
Unspecified/Other	17	41.5%
Total	41	100%

Table 5: Functional Outcome – Quick DASH Score

	N	Minimum	Maximum	Mean	Std. Deviation
Quick Dash Score	21	0	34.0	4.2143	8.02

Table 6: Kapanji Scoring

	N	Minimum	Maximum	Mean	Std. Deviation
Kapanji Score	21	6	10	9.68	0.894

Table 7: Pain Evaluation

Pain Scale	N	Minimum	Maximum	Mean	Std. Deviation
Wong-Baker Scale	21	0	4	0.86	1.167
Numeric Pain Rating Scale	21	0	3	0.68	0.995

Table 8: Radiological Outcome – Eaton–Littler Classification

Eaton–Littler Stage	Number of Patients (n = 21)	Percentage (%)
Stage I	18	85.7%
Stage II	3	14.3%
Stage III	0	0%
Stage IV	0	0%
Total	21	100%

Table 9: Grip Strength (Measured by Jamar Dynamometer)

Grip Strength (kg)	Mean	N	Std Deviation	P value
Affected Hand	31.81	21	7.319	0.137
Non affected hand	30.67	21	8.108	

DISCUSSION

Fractures at the base of the first metacarpal, particularly intra-articular types like Bennett and Rolando fractures, require careful management due to the thumb's pivotal role in hand function.^[11] In this study, intermetacarpal K-wire fixation demonstrated favourable outcomes in terms of radiological alignment, pain relief, grip strength, and functional recovery.

The majority of patients in our study were young males (90.2%), reflecting findings in previous studies where high-energy trauma in young working-age males was the predominant cause.^[10,12,13] Most injuries were attributed to road traffic accidents and falls, which align with other studies.^[10,12,13]

Out of 41 patients, 17 were lost to follow up, two patients expired during follow-up, one developed hemiparesis on operated side & one patient had undergone amputation. They were excluded for post operative evaluation. Remaining 21 patients were evaluated using various criteria.

The radiological outcomes, evaluated using the Eaton–Littler classification at five-year follow-up, showed that 85.7% of patients remained at Stage I, with no signs of arthritic changes. This aligns with previous studies reporting that timely reduction and stable fixation significantly reduce the risk of post-traumatic arthritis.^[10,12]

The functional outcome, assessed using the Quick DASH score, was excellent in our series with a mean score of 4.2143, indicating minimal disability. Similar outcomes have been reported by other studies.^[10,12,13] who demonstrated that patients treated with intermetacarpal K-wire fixation achieved Quick DASH scores under 5. This suggests that despite occasional malunion seen on radiographs, clinical function remains largely uncompromised, a phenomenon supported by earlier works.^[13]

Grip strength, as measured using the Jamar dynamometer, showed a modest postoperative improvement ($+1.143 \pm 3.381$ kg), which was not statistically significant ($p = 0.137$). This result is consistent with other studies with no significant grip strength difference when comparing injured and uninjured hands in the long term.^[10] However, even a modest improvement reflects adequate restoration of thumb stability and function.

Kapanji scoring showed good hand function with a mean score of 9.68 ± 0.894

Pain scores, assessed using both Wong-Baker and Numeric Rating Scales, were remarkably low. The Wong-Baker mean score was 0.86 ± 1.167 at follow-up, and the NRS score averaged only 0.68, indicating mild or no residual pain. These findings reinforce the value of achieving stable anatomical reduction with minimal invasion, which is less likely to result in chronic pain syndromes.^[10,12,13]

Regarding complications, only minimal malunion and no major infections or neurovascular injuries were recorded. This low complication rate can be attributed to careful surgical technique and proper postoperative care, supporting existing literature advocating closed, percutaneous methods over open surgery for selected cases.^[10,12,13]

Another important consideration is the long-term evaluation. With a minimum follow-up of 5 years and a maximum of 9 years, our study is among the few that assess the durability of intermetacarpal K-wire fixation outcomes. This strengthens the case for this technique as a reliable treatment modality for suitable fractures.



Figure 5: Green and O'Brien type I fracture of base of first metacarpal underwent trans metacarpal K wire fixation. Post op X rays show excellent reduction of the fracture. 8 yrs follow-up x rays of the same patient show no arthritic changes

CONCLUSION

Intermetacarpal K-wire fixation for fractures at the base of the first metacarpal provides a reliable, minimally invasive treatment option with favourable long-term outcomes. This technique offers satisfactory anatomical reduction, maintains joint stability, and allows early mobilization, resulting in excellent functional recovery as demonstrated by low Quick DASH scores and minimal residual pain. Grip strength is well preserved, and the risk of complications such as infection or neurovascular injury is low when careful surgical technique and

postoperative care are employed. Radiological assessment at a minimum five-year follow-up shows a low incidence of post-traumatic arthritis, supporting the durability of this fixation method. Therefore, intermetacarpal K-wire fixation represents an effective and cost-efficient approach for managing suitable base of first metacarpal fractures, especially when performed within one week of injury.

REFERENCES

1. Kjaer-Petersen K, Langhoff O, Andersen K: Bennetts fracture. *J Hand Surg [Br]* 1990;15:58-61
2. Kapandji IA. *The Physiology of the Joints*. 6th ed. Volume I. Churchill Livingstone; 2008.
3. Moore A, Varacallo MA. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Aug 4, 2023. Metacarpal Hand Fracture.
4. Tang A, Varacallo MA. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Nov 28, 2022. Anatomy, Shoulder and Upper Limb, Hand Carpal Bones.
5. Black D, Mann RJ, Constine R et al. Comparison of internal fixation techniques in metacarpal fractures. *J Hand Surg Am*. 1985; 10:466-72.
6. Kawamura K, Chung KC. Fixation choices for closed simple unstable oblique phalangeal and metacarpal fractures. *Hand Clin*. 2006; 22:287-95.
7. Dein W., Ansorg P. Treatment possibilities in new and chronic Bennett's fracture. *Beitr. Orthop. Traumatol.*,1989, 36, 217-222.
8. Formander P., Kongsholm J. Simultaneous Bennett's and radius fractures treated with external fixation. A case report. *Acta Orthop. Scand.*, 1990, 61, 84-85.
9. Gedda K. O., Moberg E. Open reduction and osteosynthesis of the so-called Bennett's fracture in the carpometacarpal joint of the thumb. *Acta Orthop. Scand.*, 1953,
10. A.P.A. Greeven a,* , T.D.W. Alta b, R.E.M. Scholtens c, P. de Heer c, F.M. van der Linden .Closed reduction intermetacarpalKirschner wire fixation in the treatment of unstable fractures of the base of the first metacarpal. *Injury* 2012 Volume 43, Issue 2: 246–251
11. Amy L. Ladd, MD, Arnold-Peter C. Weiss, MD, Joseph J. Crisco, PhD, Elisabet Hagert, MD, PhD, Jennifer Moriatis Wolf, MD, Steven Z. Glickel, MD, and Jeffrey Yao, M The Thumb Carpometacarpal Joint: Anatomy, Hormones, and Biomechanics. NIH Public Access Author Manuscript Instr Course Lect. Author manuscript; available in PMC 2014 February 26
12. Closed reduction external fixator fixation versus open reduction internal fixation in the patients with Bennett fracture dislocation Li Zhongzhe, Guo Yang, Tian Wen and Tian Guanglei. *Chin Med J* 2014;127 (22)
13. J Brukse, M. Bednarski , Z Niedzwiedz, A Zyluk, S Grzeszewski. The results of operative treatment of fractures of thumb metacarpal base . *Orthopædica Belgica*, Vol. 67 - 4 – 2001.