Section: HRM

Original Research Article

SINGLE STRAIGHT INTRAMEDULLARY KIRSCHNER WIRE FIXATION OF METACARPAL FRACTURE – THE SIMPLER THE BETTER

Ezhilavan C S[1], Srilakshmi M Rao[2]

[1]Junior Consultant, Department of HRM, The Tamilnadu Government Multi-Super Speciality Hospital, Omandurar, Chennai, India
[2]Associate Professsor Sri Lalithambigai Medical College and Hospital, Chennai, India

Received : 20/09/2025
Received in revised form : 03/11/2025
Accepted : 26/11/2025

Keywords:
Metacarpal fracture, Kirschner wire, Intramedullary fixation, Hand fracture, Minimally invasive.

Corresponding Author:
Dr. Ezhilavan C S,
Email: ezhil.verasian@gmail.com

DOI: 10.47009/jamp.2025.7.6.94

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (6); 498-502

ABSTRACT

Background: Metacarpal fractures account for a significant number of fractures (around 40% of all hand fractures). They occur predominantly in young adult males, and often occur as a result of direct trauma (taking a punch for example), and can cause significant hand dysfunction if not treated appropriately. Surgical fixation is indicated for those fractures that are unstable and are significantly shortened, that are angulated (greater than 30 degrees) or malrotated. Traditional plating provides rigid fixation but requires a large amount of soft tissue dissection with the potential to cause adhesions, stiffness, etc. Open reduction and internal fixation using a single Kirschner wire (K-wire) is a minimally invasive technique and maintains the periosteal blood supply with early mobilization. This study is aiming at measuring the patient's outcome and occurrence of complications associated with single straight intramedullary K-wire fixation of metacarpal shaft and neck fractures. **Materials and Methods:** We have done a retrospective study of 44 patients (52 metacarpal fractures) managed with single straight intramedullary K - Wire fixation between Jan 2024 and Jan 2025 in Tamil Nadu Government Multi Superspeciality Hospital Omandurar Chennai. Inclusion criteria for the study were acute metacarpal shaft/neck fractures accompanied by angulation >30 degrees, presence of any rotational deformity, shortening >5 mm, or instability after closed reduction. Thumb (1st metacarpal) fracture, pathological fracture were excluded. All patients were subject to open reduction (made in a small dorsal incision) and antegrade insertion of a single straight 1.2-1.4 mm K-wire crossing the fracture site. A volar intrinsic+ plaster slab was used for 3 weeks postoperatively. The K-wire and the slab were removed together at 3 weeks in the operating room using local anesthesia. Patients then were on the active range of motion exercises for 2 weeks followed by passive stretching for full mobility. Functional recovery and complications (infection, extension lag, malunion, etc.) were reported for the 6 months follow-up period. Radiographs before and after fixation are used to document fracture alignment and healing. In this representative case, we see the pre-existing radiograph (Figure 1) of a displaced metacarpal shaft fracture. After intramedullary K-wire insertion and immobilization, follow-up imaging was performed. The postoperative radiograph (Figure 2) demonstrates stability with one intramedullary K-wire for maintenance of anatomic alignment. **Result:** 44 patients were found, 32 of them were males and 12 were females (M:F=2.7:1). The majority (76%) was young adults in accordance with the literature. Injuries were caused by blunt trauma in another 26 cases and open trauma (18 cases). A total of 52 fractures were fixated. 39 patients had been affected by one metacarpal fracture 5 patients by multiple fractures (3 upper metacarpal fractures, 1 by 3 metacarpals, one by four metacarpals). The mean value for the operative time was 35 min. At final follow-up complete restoration of function was obtained in 37 patients. Complications included wound infection (7 patients [15.9%]; extensor lag at the metacarpophalangeal joint < 20o in 3 patients and > 20o in 2 patients and clinically significant malunion in 2 patients). Patient demographics and the characteristics of the fractures are summarized in Table 1 and surgical complications and postoperative functional results are listed in Table 2. Two bar graphs (Figure 3 and Figure 4) illustrate the distribution of the fracture patterns and of the frequencies of the complications respectively. **Conclusion:** Single antegrade intramedullary fixation of metacarpal fracture with kirschner wires is a minimal invasive and technically easy procedure which provides stable and limited soft tissue disruption fracture alignment. In our series of 44 patients, this technique had excellent union rates and excellent functional recovery with a low rate of serious complications. The simplicity of the technique and that it avoids morbidity from using a plate makes it an attractive option in appropriately selected metacarpal fractures.

INTRODUCTION

Metacarpal fractures are some of the most common hand injuries . They are often associated with direct trauma to the hand (e.g. a clenched fist hitting an object) and represent approximately 10% of all fractures and some 40% of the fractures of the hand. The majority are in young active males; in fact men make up about 76% of patients affected by metacarpal fractures. Fractures are common in the neck or shaft of the metacarpal bones, especially the neck of the fifth metacarpal (the "boxer's fracture") is very common. When an individual's metacarpal breaks, it is likely to become angulated on the volar aspect (toward the palm); the metacarpal may become shortened or rotated after fracture, causing malalignment of the fingers. Significant rotational deformity (one finger is overlapped over another when making a fist) is unacceptable and requires surgical correction.[1]

The factors that determine the decision of surgical intervention include stability and alignment of the fracture. Stable, little displaced fractures may often be treated nonoperatively with splinting; however, there are indications for surgical fixation including unstable fractures (in which the fracture will not remain in a reduced position), marked angulation or shortening of fractures (sometimes stated as greater than 30 degrees angulation of shaft fractures or greater than 15 degrees of neck fractures), and rotational malalignment of any fractures. In such cases, internal fixation ensures anatomical reduction and early mobilization which are important for optimal hand function.[2]

There are different types of fixation which can be used. Transverse K-wire pinning, open reduction with plate and screwing fixation and intramedullary Kirschner wire fixation are the commonly used methods. Plating is associated with the most rigid construct, but is associated with extensive periosteal stripping and soft tissue dissection. This can in turn cause complications such as extensor tendon adhesion, stiffness of the joint, and infection. In one series by Fusetti, et al. 35% of patients was treated using plate fixation developed one or more complications. Such drawbacks give rise to the impetus for the search for less invasive alternatives.[3]

Intramedullary K wire fixation can be done by percutaneous method or by open method and only minimal handling of the underlying soft tissues. A smooth stainless steel Kirschner wire is pushed along the medullary canal across the fracture to hold the fracture in place. This approach preserves periosteal blood supply and tends to preserve tendon glide to minimize the risk of adhesion. According to a recent meta- analysis, intramedullary K-wire (IMKW) fixation provides similar clinical results (union rates, range of motion, pain scores) to plating or pinning fixation, with the added benefit of a reduced operative time. Thus, intramedullary pinning has become a "mainstay" technique of many hand surgeons.[4]

In our institution, we adopted single straight antegrade intramedullary K-wire fixation as the standard for eligible metacarpal shaft and neck fractures. The purpose of this study was to analyze the patient-related outcomes and complication profile after this procedure. We hypothesized that this simpler method would provide stable fixation and excellent functional recovery with a low complication rate.[5,6]

MATERIALS AND METHODS

This retrospective study included 44 consecutive patients (52 fractures) who underwent single straight intramedullary K-wire fixation of metacarpal fractures at the Tamil Nadu Government Multi Superspeciality Hospital Omandurar Chennai, between Jan 2024 and Jan 2025. The study was approved by our institutional review board, and informed consent was obtained for treatment and follow-up.

Patient selection: Inclusion criteria were patients aged >16 years with acute displaced fractures of the metacarpal shaft or neck (second through fifth rays) exhibiting any of the following: angulation >30 degrees on lateral radiograph, rotational deformity (digit overlap), shortening >5 mm, or instability after closed reduction. Patients with intra-articular fractures, fractures of the first metacarpal (thumb), pathological fractures, or those unsuitable for K-wire fixation were excluded.

A total of 44 patients met inclusion criteria. Of these, 32 were male and 12 were female. The mean age was 29 years (range 18–50). Twenty-six patients had closed (blunt) injuries, and 18 had open fractures. Five patients had multiple metacarpal fractures (3 had two metacarpals, 1 had three, and 1 had four fractured metacarpals); the remainder had a single metacarpal fracture.

Preoperative evaluation: Each patient underwent clinical and radiographic assessment. Plain radiographas(anteroposterior and lateral views) were used to measure fracture displacement, angulation, and detect any rotational malalignment by digit overlap. Neurovascular status and tendon integrity were checked in all patients. Open wounds were debrided and irrigated before definitive fixation.

Surgical technique: All procedures were performed under axillary block anesthesia, with the patient supine and the injured hand on a hand table. A small dorsal incision (~1 cm) was made at the base of the involved metacarpal. The extensor tendon was retracted or split longitudinally (midline) to expose bone. Fracture reduction was achieved under direct vision or fluoroscopic guidance, with manual manipulation to correct angulation and rotation. Once aligned, a smooth K-wire (typically 1.2–1.4 mm in diameter) was inserted antegrade through the base of the metacarpal into the medullary canal. The wire was advanced across the fracture site and into the distal fragment up to subchondral bone, providing internal support. Care was taken to avoid penetrating the joint or injuring soft tissues distally. In most cases, a single wire was sufficient for stable fixation; occasionally a second transverse K-wire was added if needed per surgeon discretion (though we aimed to use only one as per study protocol). Intraoperative fluoroscopy confirmed satisfactory placement and alignment. The entry wire was cut flush at the base. No plate, screw, or other hardware was used.

After fixation, the incision was closed with noabsorbable sutures. A volar plaster splint in the intrinsic-plus (wrist 30° extension, MCP flexed 90°) position was applied to immobilize the hand for comfort and to maintain fracture alignment. Patients were instructed on edema control (elevation) and given antibiotics for 24–48 hours (especially for open fractures).

Postoperatively, dressing done at regular intervals.At 3 weeks, removal of the K-wire and slab is done under sterile conditions. The skin was anesthetized with local lidocaine; the slab was removed and the exposed wire was extracted by gentle twisting and pulling. The hand was then placed in a removable splint briefly while the wound healed. After wire removal, patients began a supervised rehabilitation protocol: active range-of-motion exercises for 2 weeks, followed by passive stretching and strengthening to achieve full flexion and extension.

Figure 1: Pre-operative X-ray of the metacarpal fracture. This figure shows a displaced fracture of the fourth metacarpal shaft in one patient.

After intramedullary K-wire fixation (Figure 2, below) and immobilization, alignment was restored. The pre- and postoperative images illustrate the technique's effect on fracture reduction.

Figure 2: Post-operative X-ray showing K-wire fixation. In this case, the postoperative radiograph demonstrates the single straight Kirschner wire spanning the fracture site. Radiographic follow-up at 6 weeks (not shown) confirmed callus formation and union.

Patients were followed at 1 week (wound check), 6 weeks, 3 months, and 6 months postoperatively. Outcomes were assessed by clinical examination of grip strength, range of motion of the injured fingers and wrist, and patient-reported function. Complications (e.g. infection, malunion, nerve or tendon injury, need for secondary surgery) were recorded. Functional restoration was defined as absence of pain or limitation in performing routine activities and achievement of nearly full range of motion compared to the contralateral hand.

RESULTS

All 44 patients completed the 6-month follow-up. Radiographic union (bridging callus on at least three cortices) was achieved in 43 of 44 patients (97.7%) by 6 weeks. One case of atrophic nonunion (malunion clinically) occurred and required reoperation at 3 months.

Patient demographics and injury characteristics are summarized in [Table 1]. There were 32 male and 12 female patients (median age 29). Twenty-six patients sustained injuries from blunt trauma (falls, assaults, sports), while 18 had open injuries (often lacerations or bites on the hand).

Operative data showed a mean surgery time of 35 minutes (range 25–50).

Functional outcomes were good to excellent in most patients. By 6 months, 37 patients reported no pain or disability and had regained full range of motion in the affected fingers. Seven patients had minor residual functional deficits.

Complications are detailed in [Table 2]. Superficial wound infections occurred in 7 patients (5 in open fractures, 2 in closed); these responded to oral antibiotics and local wound care. There were no deep infections or septic arthritis. Five patients (11%) demonstrated an extension lag at the metacarpophalangeal joint (3 with <20° lag, 2 with

ISSN (O): 2687-5365; ISSN (P): 2753-6556

20–25° lag), attributed to soft-tissue tightness. All cases of extension lag improved partially with continued therapy; none required tendon surgery. Two patients (4.5%) had clinically significant malunion: one with 15° persistent volar angulation of a 4th metacarpal, and one with 20° angulation in a 5th metacarpal. These patients were offered corrective osteotomy but declined further surgery; they managed near-normal function despite some residual deformity. No patient experienced fixation failure (wire migration or breakage) or tendon rupture.

Table 1: Patient demographics and fracture characteristics (n=44).

Characteristic	Value
Total patients	44
Male : Female	32 : 12
Blunt injuries : Open injuries	26 : 18
Total metacarpal fractures treated	52
Single metacarpal fracture	39 patients
Two metacarpal fractures	3 patients
Three metacarpal fractures	1 patient
Four metacarpal fractures	1 patient
Multiple fractures (≥2)	5 patients
Mean operative time	35 minutes

Table 2: Postoperative complications and outcomes.

Outcome	Number of patients
Full functional restoration	37
Wound infection	7
Extension lag <20° (MCP joint)	3
Extension lag >20° (MCP joint)	2
Malunion	2

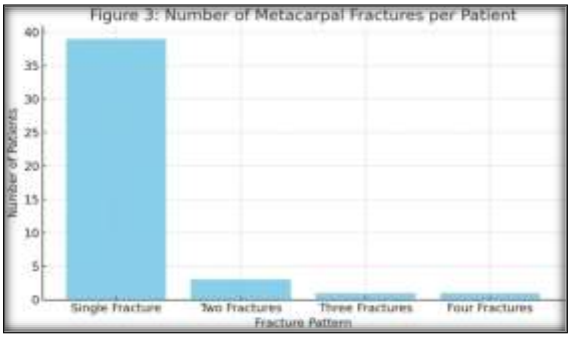

Figure 3: Number of Metacarpal Fractures per Patient

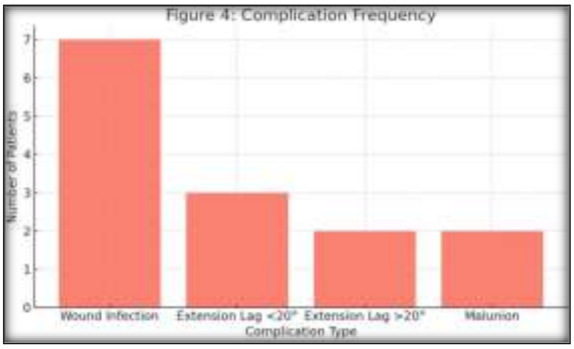

Figure 4: Complication Frequency

[Table 1 & 2] organize the numeric data. Bar graphs illustrating the distribution of the number of fractures per patient and the frequency of each complication category were constructed from this data [Figure 3 & 4]. For instance, as shown in Figure 3, the vast majority of patients had a single metacarpal fracture, with progressively fewer patients having 2, 3, or 4 metacarpals involved. Figure 4 graphically compares the counts of each observed complication. These visualizations underscore the clinical findings from our series.

Overall, 37 of 44 patients (84%) achieved complete restoration of hand function, defined as no pain and normal range of motion. The remaining 7 patients had minor residual limitations (e.g. slight extension lag or mild pain with heavy use) but were satisfied with the outcome.

DISCUSSION

The management of displaced metacarpal fractures remains a topic of discussion, with numerous fixation options available. The data from our series indicate that single straight intramedullary K-wire fixation is an effective and safe technique for treating unstable metacarpal shaft and neck fractures. Our findings of high union rates and low severe complication rates align with reports in the literature.

Metacarpal fractures most commonly involve the ulnar-side digits, and fixed malalignment particularly affects grip and dexterity. In the absence of surgery, malrotated or grossly angulated fractures can result in finger overlap and impaired hand function. Surgical indication thresholds often cited are >30° volar angulation for shaft fractures and >15–20° for neck fractures, especially in the ring and small fingers. While some fingers (e.g., the small finger) can tolerate a greater degree of deformity, malrotation is always unacceptable as it prevents normal fist closure. In our practice, we observed these principles and fixed fractures exceeding these thresholds or displaying instability on exam and radiographs.

Compared to plate fixation, intramedullary wiring has inherent advantages. The literature on plate fixation consistently shows relatively high complication rates. Fusetti et al. reported one or more complications in 35% of plated metacarpal cases,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

including 15% with healing problems, 10% with stiffness, and other issues such as implant failure. In contrast, a systematic review by Thomas et al. found no significant differences in union or functional outcomes between intramedullary K-wires and other fixation methods, but did note that K-wires allowed shorter operative times. Our study corroborates these findings: we found no difference in union success between our K-wire series and historical plate series, but our average surgery time was brief and our complication profile modest. The shorter operative time (mean 35 min) likely reflects the minimal dissection and simpler technique, which is consistent with the meta-analysis finding a mean 13-minute reduction in operative duration when using K-wires.

An important technical consideration is preservation of soft tissues. By using a small dorsal incision and avoiding hardware bulk, we minimized disruption to the extensor mechanism. This likely contributed to the absence of tendon or nerve injuries in our cohort. We used a protective slab postoperatively to allow primary bone healing without rotational stress. After K-wire removal at 3 weeks, early motion was emphasized.

Early mobilization is known to improve range of motion outcomes without sacrificing union in stable fixations. Our protocol yielded an 84% rate of full functional recovery, which is favorable.

Wound infection was the most common complication (7 patients). This relatively high rate reflects that many injuries were open; indeed, 5 of the 7 infected wounds were already open fractures at presentation. Even so, none progressed to deep infection or osteomyelitis. The infections were managed with antibiotics and local care. Extension lag, seen in 5 patients, is an example of the trade-off between immobilization time and soft tissue stiffness. Three weeks in a slab balanced fracture stability with prevention of contractures; a longer immobilization might have reduced lag but increased stiffness, whereas an earlier mobilization could risk wire loosening. In our experience, 3 weeks was a reasonable compromise. The few malunions underscore that perfect reduction is crucial; one could speculate that using an additional percutaneous pin in those borderline cases might have improved outcomes, though our protocol limited to single wire whenever possible.

Our results compare favorably with other series of intramedullary fixation. van Bussel et al. described similar fixation of metacarpals with K-wires and found good functional outcomes with minimal morbidity. Other investigators have reported that a single intramedullary K-wire is sufficient for most unstable metacarpal fractures, with very good union rates and patient satisfaction. We echo these conclusions.

Some limitations of our study must be noted. The retrospective design lacks randomization, and there is no direct comparison group (e.g. an equivalent plate fixation cohort) to quantify the difference in outcomes.

Our follow-up was limited to 6 months; longer-term data on pain or late tendon irritation would be valuable. We did not measure formal grip strength or use a validated questionnaire (such as DASH), which are often used in the hand surgery literature. Instead, we reported the more qualitative outcome of "complete restoration" of function, which may be subjective. Finally, the sample size (44 patients) is moderate; larger multicenter studies would strengthen the evidence base.

In summary, the technique of single straight intramedullary K-wire fixation of metacarpal fractures offers a simple, minimally invasive approach with an excellent balance of stability and low soft tissue trauma. Our study demonstrates that it produces reliable bone healing and functional recovery, with few major complications. It is best suited for single-shaft or -neck fractures of the 2nd–5th metacarpals that require fixation. Surgeons should be comfortable with closed or limited open reduction maneuvers and aware of the need to address any residual malrotation or angulation. This method aligns with the adage “the simpler, the better” for many metacarpal fracture cases.

CONCLUSION

Single-incision intramedullary K-wire fixation of unstable metacarpal fractures is an effective treatment modality. In this series of 44 patients, it provided stable fixation with minimal surgical morbidity, enabling rapid return of function. Complication rates were low compared to those reported for plating. We conclude that when appropriately indicated, single straight K-wire fixation is a highly useful technique in hand trauma, offering simplicity without sacrificing outcomes.

REFERENCES

1. Court-Brown C, McQueen MM. Trauma (Orthopaedic Surgery Essentials Series). 1st ed. Philadelphia: Lippincott;.
2. Low CK, Wong HC, Low YP, Wong HP. A cadaver study of the effects of dorsal angulation and shortening of the metacarpal shaft on the extension and flexion force ratios of the index and little fingers. J Hand Surg Br.
3. Greeven APA, Bezstarosti S, Krijnen P, Schipper IB. Open reduction and internal fixation versus percutaneous transverse K-wire fixation for single closed second to fifth metacarpal shaft fractures: a systematic review. Eur J Trauma Emerg Surg.
4. Kozin SH, Thoder JJ, Lieberman G. Operative treatment of metacarpal and phalangeal shaft fractures. J Am Acad Orthop Surg.
5. Fusetti C, Meyer H, Borisch N, Stern R, Santa Della, Papaloïzos M. Complications of plate fixation in metacarpal fractures. J Trauma.
6. Page SM, Stern PJ. Complications and range of motion following plate fixation of metacarpal and phalangeal fractures. J Hand Surg Am.

ISSN (O): 2687-5365; ISSN (P): 2753-6556