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ORIGINAL ARTICLE

Outcomes and complications of exposed Kirschner wire fixation for metacarpal fractures: a retrospective study

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ABSTRACT

Aim Metacarpal fractures are common hand injuries, frequently treated with closed reduction and internal fixation (CRIF) using Kirschner wires (K-wires). While exposed K-wires allow for simple hardware removal and early mobilization, their use is traditionally associated with a higher risk of pin tract infections. There is a lack of studies focusing exclusively on exposed K-wires in metacarpal fractures.

Methods A total of 134 patients who underwent CRIF with exposed K-wires for metacarpal fractures between January 2023 and March 2024 were retrospectively reviewed. After applying inclusion and exclusion criteria, 118 patients were analysed. Demographics, fracture characteristics, complications, and follow-up data were collected. Functional outcomes were assessed using the QuickDASH and the Michigan Hand Outcomes Questionnaire (MHQ) before hardware removal.

Results Most patients were male, 88 (75%), with a mean age of 39.3 years. The little finger was the most frequently injured, 71 (60%). In 102 (86%) cases, a single metacarpal fracture was observed. The average number of wires used was 1.7, and hardware was removed after a mean of 40.1 days. The rate of pin tract infection was <4%, all classified as superficial and managed conservatively. Only one case required reoperation due to secondary displacement. The mean QuickDASH score was 25, and the average MHQ score was 70.15, indicating overall good functional and patient-reported outcomes.

Conclusion Exposed K-wire fixation for metacarpal fractures appears safe and reliable, with low complication rates and favourable patient-reported outcomes, supporting its use in outpatient pathways without compromising safety.

Keywords: device-related infections, hand bones, retrospective studies, treatment outcome

INTRODUCTION

Fractures of the metacarpal bones account for approximately 10% of all fractures, constituting more than one-third of all hand fractures (1). Most hand fractures can be treated conservatively, provided they are stable and show minimal shortening or malrotation (2-4). Unstable, closed, and reducible metacarpal fractures can be effectively treated with Kirschner wire (K-wire) fixation (5-6).

Closed reduction and internal fixation (CRIF) with K-wires provide functional outcomes and complication rates comparable to those of open reduction and internal fixation (ORIF) using mini-plates (7). Both techniques are reliable and should be chosen according to the fracture pattern and patients' characteristics (8).

K-wire fixation offers minimal soft-tissue damage and has the advantage of leaving the patient hardware-free after approximately 4 weeks (7). When used in fracture fixation, K-wires may be left buried under the skin or left exposed outside the skin surface. Buried wires reduce the risk of external contamination and allow earlier dressing removal; however, their removal typically requires an additional operating room procedure. In contrast, exposed wires allow for simple outpatient removal and obviate a secondary surgery, potentially facilitating early mobilization. The main concern traditionally raised against exposed wires has been pin tract infection, yet emerging data indicate that the practical advantages of exposed K-wires may outweigh this risk, especially in routine clinical settings (9–12).

Pin site infection is reported as the most common complication, with a prevalence ranging from 4% to 20% (13-14). K-wire site infections are typically managed with antibiotics and early pin removal, though in some cases surgical debridement may be required (11). Several studies have attempted to determine whether this complication is more likely to occur when K-wires are left exposed, but the debate remains open (9–11).

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A recent prospective study found no statistically significant difference in infection rates between exposed and buried K-wires for hand fractures, highlighting the practicality of exposed wires for outpatient management without compromising safety (23). Available studies are not conclusive, either due to the limited number of patients included (16,19) or, in comparative studies (buried vs exposed), because of unbalanced group sizes (10–11, 13). In other cases, the analysis was not confined to a single anatomical region, thereby reducing the specificity and applicability of the findings (11,13,17).
The aim of our study was to focus exclusively on metacarpal fractures, analysing both the post-operative complication rate and patient-reported satisfaction in cases treated with exposed K-wires.

MATERIALS AND METHODS

Patients and study design

A total of 134 patients with metacarpal fractures treated with closed reduction and internal fixation (CRIF) were retrospectively identified at the Department of Orthopaedics and Hand Surgery of the Policlinico Gemelli in Rome between 1 January 2023 and 1 March 2024.
Inclusion criteria were: patients of any age with one or more metacarpal fractures, treated with CRIF using K-wires, minimum follow-up available until hardware removal (at least 30 days), and availability of a Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score (21). Exclusion criteria were: fractures of other bones, hardware removal performed at another institution, neurological impairments or any other neuromuscular conditions.
Patient age, gender, comorbidities, and date of primary surgery were recorded. Surgical indication, fracture location, K-wire placement, number of K-wires, and date of removal were collected through chart review, together with postoperative complications such as pin tract infection, secondary displacement, and the need for reoperation, which were systematically assessed at scheduled follow-up visits.
Patients completed the QuickDASH score (21) and the Michigan Hand Outcomes Questionnaire (MHQ) (18-22) either in clinic or by phone, referring to the period prior to hardware removal. Both instruments were selected because they are validated outcome measures for upper limb musculoskeletal conditions, providing reliable and reproducible data on function and patient-reported satisfaction.
The study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments. Informed consent for data collection and analysis was obtained from all patients involved.

Methods

Surgical procedure. Surgery was performed by experienced orthopaedic surgeons from the same team. All patients received a single dose of intravenous cefazolin (2 g) 30 minutes prior to surgery. The surgical field was prepared and draped under sterile conditions.
The standard procedure consisted of closed reduction. In cases where closed reduction was not feasible or extremely difficult, a small incision cantered over the fracture site was made to perform a mini-open reduction. Internal fixation was achieved using K-wires of various diameters (ranging from 1.2 mm to 1.8 mm), under fluoroscopic guidance.
For fractures involving the head, diaphysis, and distal metaphysis, K-wires were inserted in a proximal-to-distal direction. For fractures of the base, with few exceptions, wires were inserted retrograde.
The wires were left exposed in all cases and bent at right angles near the skin surface to prevent migration and to create a tension-free interface between the skin and the K-wire. The exposed segment of wire was covered with diluted povidone-soaked ribbon gauze, and a light dressing was applied, leaving the metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints free to move (Figure 1, 2).

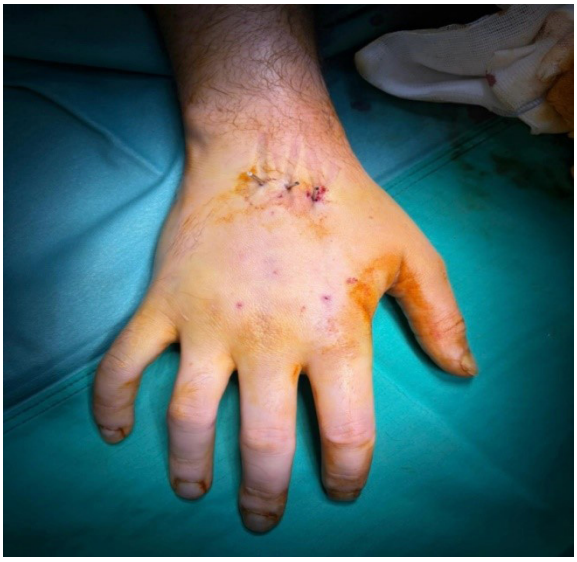

Figure 1. Intraoperative image demonstrating exposed Kirschner wire fixation for metacarpal fracture (Department of Orthopaedics and Hand Surgery, Fondazione Policlinico Universitario A. Gemelli IRCCS, 2023)

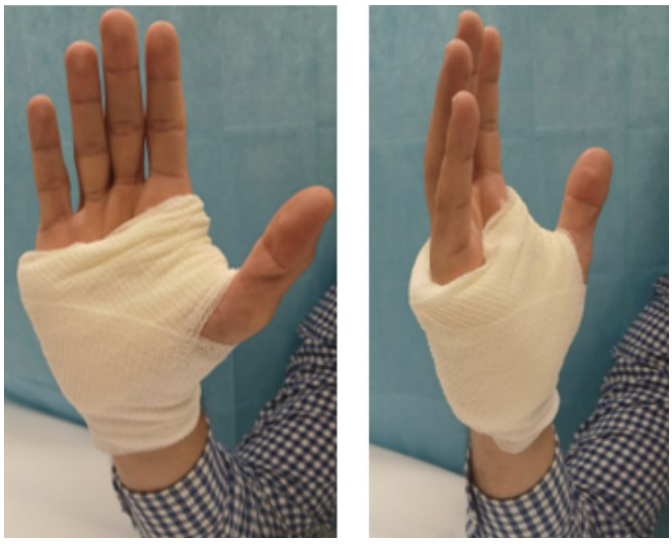

Figure 2. Postoperative view of the hand dressing (Department of Orthopaedics and Hand Surgery, Fondazione Policlinico Universitario A. Gemelli IRCCS, 2023)

Postoperative care. No antibiotics were administered during the standard postoperative period. Patients were instructed to maintain the dressing clean and dry, and were advised against changing it at home. No sutures were placed, except in cases where open reduction was required. All patients were evaluated in the clinic at 7 and 30 days postoperatively with X-ray imaging. An additional (intermediate) X-ray was requested for patients at risk of secondary fracture displacement.

The dressing was not changed until the day of hardware removal, unless clinical signs of infection were present or the dressing became soiled. Infection was defined clinically as erythema, tenderness of the surrounding soft tissues, or purulent discharge at the pin site. K-wire removal was performed between four and six weeks postoperatively.

The QuickDASH (21) is a shortened version of the original DASH Outcome Measure, consisting of 11 items (instead of 30 originally). It is designed to assess physical function and symptoms in individuals with upper limb musculoskeletal disorders. We used the Italian version of the MHQ (18, 22). The MHQ is a self-administered questionnaire composed of six subscales: overall hand function, activities of daily living, work performance, pain, aesthetics, and patient satisfaction. Items are rated on a 5-point scale, ranging from 1 (very good) to 5 (very poor). The scores are then converted to a 0–100 scale, where higher values indicate better hand function and greater patient satisfaction.

Statistical analysis

Data were analysed using descriptive statistics. Continuous variables were reported as means with standard deviations, while categorical variables were expressed as percentages. These methods were chosen to provide reliable and transparent reporting of clinical outcomes and to ensure comparability with previous studies on hand fractures.

RESULTS

A total of 118 patients (out of 134) with surgically treated metacarpal fractures were ultimately included. Five patients were excluded due to loss to follow-up or incomplete documentation. Two patients presented with neurological impairments, while three could not be reached by phone, preventing collection of the QuickDASH and MHQ scores. Six patients reported concurrent major trauma and were therefore excluded.

Eighty-eight (75%) patients were male. The mean age at the time of injury was 39.26 years (range: 14–82).

The right-to-left ratio of injured hands was 7:3; however, data on hand dominance were not collected.

The most frequently injured finger was the little finger, involved in 71 (60%) cases. Ring finger injuries accounted for 20 (17%), index finger for 15 (13%), and middle finger for 14 (12%). The remaining 11 (9%) cases involved the thumb.

In 102 (86%) patients, a single metacarpal bone was fractured; in the remaining cases, two or more digits were affected.

The mean number of K-wires used was 1.7. Hardware removal was performed at a mean of 40.1 days postoperatively (Table 1). Infection was observed in fewer than 4% of cases (4/118), all of which were characterized by soft tissue redness at the pin site with serous or purulent discharge. In one case, the fracture was open, while another patient presented with an extremely deteriorated and dirty dressing. One patient was 78 years old; the others were under 60. None of them had comorbidities known to increase infection risk, such as diabetes.

In all cases, the infection resolved with empiric antibiotic therapy (amoxicillin/clavulanic acid at standard dosage) and early hardware removal, followed by immobilization until complete healing was achieved. In all cases of infection, microbiological cultures were obtained from the pin tract. *Staphylococcus aureus* was identified as the causative pathogen in each case.

Loss of reduction occurred in only one patient (<1% of the cohort), requiring reoperation and new reduction.

Table 1. Characteristics of 118 patients with surgically treated metacarpal fractures

Variable	
Mean age (range±SD) (years)	39.26 (14-82±14.5)
	No (%) of patients
Gender	
Male	88 (74.6)
Female	30 (25.4)
Number of metacarpal fractures	
Single	102 (86.4)
Multiple	16 (13.6)
Distribution by digit	
I° MC	11 (9.3)
II° MC	15 (12.7)
III° MC	14 (11.9)
IV° MC	20 (16.9)
V° MC	71 (60.2)
Mean days before wire removal	40.1
Mean MHQ score	70.15
Mean QuickDASH score	25

In five patients, hardware removal was delayed due to slow fracture healing.

No cases of malrotation or unacceptable shortening were reported.

The mean QuickDASH score was 25, which corresponds to mild residual disability, indicating that patients were able to resume most daily-life activities with only minor limitations. The mean MHQ score was 70.15, reflecting good perceived function and high patient satisfaction. It should be noted that some questionnaire items were not entirely applicable to our patient population. Specifically, questions related to heavy activities (such as opening jars, carrying bags over 10 pounds) or washing could not be properly answered, as patients had been instructed to avoid such tasks during recovery. Conversely, patients engaged in office-based work reported being able to attend their workplace or work remotely (Table 2).

Table 2. Postoperative complications in 118 patients

Complication	**No (%) of patients**
Superficial infections	4 (3.4)
Deep infections	0 (0)
Reintervention	1 (0.85)
Loss of reduction	1 (0.85)
Hardware removal after expected period	5 (4.2)

DISCUSSION

This retrospective study was designed to confirm the reliability and safety of exposed Kirschner wires in the treatment of metacarpal bone fractures. The main focus was to debunk the idea that associates exposition of wires and higher pin-related infection (19). Most studies supporting high infection risks analyse distal radius fractures with longer hardware removal time (14,16,19) and do not take into account data regarding exclusively metacarpal bone fractures (13, 17, 19). Many studies compare the complications and infection rates between bur-

ied and exposed K-wires but most of the time there is unbalance between the two groups in favour of exposed K-wires (10,11,13). Some authors pointed out that despite the widespread use of K-wires for their ease and low cost, the risk of pin site infection remains a relevant issue, particularly when wires are left exposed, and current evidence does not clearly favour one technique over the other (15).

Our study aimed to provide a focused analysis of metacarpal bone fractures trying to give a clear overview on the complications of the treatment with exposed K-wires. Compared to previous reports in the literature, the demographic data we collected are overlapping. The first difference we noticed is the average hardware removal time. We recorded an average time of 40.05 days, which is higher than what is reported in literature (16, 19-20). These findings are favourable, as we observed a lower infection rate despite an extended hardware retention period. As regards infection, we recorded a rate of <4% of infection of the pin tract and all of them were superficial infections caused by the isolated pathogen *Staphylococcus aureus*. These data recall the lower end indicated in literature; the highest reported infection rate for exposed K-wires is 20% (14,19). However, this figure is not specific to metacarpal fractures and may therefore be biased. In other studies, focusing more specifically on the use of exposed K-wires in phalangeal and metacarpal fractures, the reported infection rate was 6.5% (13,17), which is more consistent with our findings.

One of the biggest advantages of K-wires is the possibility to perform hardware removal quickly. K-wires are usually removed in outpatient consultations. Reasons for reintervention could be unacceptable or loss of reduction, infection or difficult removal outside the operating room. While the first two complications are less likely in phalangeal and metacarpal fractures, the removal of buried K-wires can be challenging in an outpatient setting. According to Hargreaves et al. (19), up to 18% of buried K-wires require removal in the operating room, compared to exposed wires which are typically removed in clinic. In our series, only one patient required reintervention due to secondary loss of reduction.

One of the advantages of buried K-wires is the possibility to leave the hand free of dressing. Our personal preference when using exposed K-wires is to leave a soft dressing with the wrist and the metacarpal-phalangeal joints free until removal. In this way the patient is free to move immediately.

However, micromotion between the wire and the soft tissue interface may lead to excessive soft tissue injury, potentially resulting in deep-seated infections around the buried metacarpal wires, so it is important to properly bend the wires and cover them with abundant dressing. Patients are educated to perform finger exercises, so that mobility will be almost at full ROM after hardware removal, and to use the hand for basic daily life activities. We decided to administer our patients both QuickDASH and MHOQ to prove that even with K-wires they could manage basic daily life activities. As expected, all items related to strength and work-related activities received lower scores, given the activity restrictions imposed during the recovery period.

This study has some limitations, including the relatively small sample size, the retrospective design, and the absence of a control group treated with buried K-wires.

In conclusion, our results provide clinically relevant data, since no previous study has focused exclusively on metacarpal fractures treated with exposed K-wires. For surgeons, these findings highlight that exposed K-wire fixation can be considered a safe and effective option, especially in cases where outpatient management and simple hardware removal are desirable, without increasing the risk of severe complications. Future prospective and multicentre studies, ideally randomized and comparing exposed and buried techniques under uniform conditions, are needed to confirm these observations and to establish standardized treatment protocols.

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TRANSPARENCY DECLARATION

Conflicts of interest: None to declare.

REFERENCES

1. Bloom JM, Hammert WC. Evidence based medicine: metacarpal fractures. Plast Reconstr Surg 2014;133:1252–60.
2. McNemar TB, Howell JW, Chang E. Management of metacarpal fractures. J Hand Ther 2003; 16:143–51.
3. Dean BJF, Little C. Fractures of the metacarpals and phalanges. Orthop Trauma 2011; 25:43–56.
4. Meunier MJ, Hentzen E, Ryan M, Shin AY, Lieber RL. Predicted effects of metacarpal shortening on interosseous muscle function. J Hand Surg Am 2004; 29:689–93.
5. Freeland AE, Geissler WB, Weiss APC. Surgical treatment of common displaced and unstable fractures of the hand. Instr Course Lect 2002; 51:185–201.
6. Gregory S, Lalonde DH, Fung Leung LT. Minimally invasive finger fracture management: wide-awake closed reduction, K-wire fixation, and early protected movement. Hand Clin 2014; 30:7–15.
7. Wong TC, Ip FK, Yeung SH. Comparison between percutaneous transverse fixation and intramedullary K-wires in treating closed fractures of the metacarpal neck of the little finger. J Hand Surg 2006; 31:61–5.
8. DelPrete CR, Chao J, Varghese BB, Greenberg P, Iyer H, Shah A. Comparison of intramedullary screw fixation, plating, and K-wires for metacarpal fracture fixation: a meta-analysis. Hand (N Y) 2025; 20(5):691-700. Epub 2024 Feb 27. doi:10.1177/15589447241232094
9. Chen L, Wang Y, Li S, Luo R, Zhou W, Li Y , et al. Effect of buried vs exposed Kirschner wire osteosynthesis on phalangeal, metacarpal and distal radial fractures: a systematic review and meta-analysis. Arthroplasty 2020; 2(1):4.
10. Terndrup M, Jensen T, Kring S, Lindberg-Larsen M. Should we bury K-wires after metacarpal and phalangeal fracture osteosynthesis? Injury 2018; 49:1189–93.
11. Abdullah S, Soh EZF, Ngiam CJ, Sapuan J. A prospective study comparing the infection rate between buried vs exposed Kirschner wires in hand and wrist fixations. Cureus 2023; 15:e36462.
12. Waheed K, Mulhall K, Mwaura B, Kaar K. Percutaneous wire fixation of distal radial fractures: is it preferable to bury the wires? Injury 2010; 41:592–5.

13. Ridley TJ, Freking W, Erickson LO, Ward CM. Incidence of treatment for infection of buried versus exposed Kirschner wires in phalangeal, metacarpal, and distal radial fractures. J Hand Surg Am 2017; 42:525–31.
14. Hsu LP, Schwartz EG, Kalainov DM, Chen F, Makowiec RL. Complications of K-wire fixation in procedures involving the hand and wrist. J Hand Surg Am 2011; 36:610–6.
15. Reissis D, Charalambous CP. Buried versus exposed Kirschner wires for fixation of hand and wrist fractures: a meta-analysis. J Hand Surg Eur Vol 2021; 46:509–15.
16. McQuail PM, Awan N. A comparison of pin site infection rates between percutaneous buried and exposed K-wires in treating distal radius fractures. Bone Joint J 2018; 100-B:41.
17. Rafique A, Ghani S, Sadiq M, Siddiqui IA. Kirschner wire pin tract infection rates between percutaneous and buried wires in treating metacarpal and phalangeal fractures. J Coll Physicians Surg Pak 2015; 25:744–7.
18. Passiatore M, De Vitis R, Cilli V, Gigante A, Padua L, Cilli L. The Italian version of the Michigan Hand Outcomes Questionnaire (MHQ): translation, cross-cultural adaptation and validation. J Hand Surg Asian Pac Vol 2021; 26:666–83.
19. Hargreaves DG, Drew SJ, Eckersley R. Kirschner wire pin tract infection rates: a randomized controlled trial between percutaneous and buried wires. J Hand Surg Br 2004; 29:374–6.
20. Gillis JA, Lalonde J, Alagar D, Azzi A, Lalonde DH. K-wire fixation of closed hand fractures outside the main operating room does not increase infections. Plast Reconstr Surg Glob Open 2022; 10:e4679.
21. Beaton DE, Wright JG, Katz JN; Upper Extremity Collaborative Group. Development of the quickdash: comparison of three item-reduction approaches. J Bone Joint Surg Am 2005; 87:1038–46.
22. Chung KC, Pillsbury MS, Walters MR, Hayward RA. Reliability and validity testing of the michigan hand outcomes questionnaire. J Hand Surg Am 1998; 23:575–87.
23. Khan H, Iqbal MJ, Yousaf A, Shah I, Anwar MI, Ahmad I. Outcome of buried versus exposed Kirschner wires in terms of infection in fractures of phalanges and metacarpal bones of the hand. Cureus 2022; 14:e85499.