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Original research article

OUTCOME OF BURIED VERSUS EXPOSED KIRCHNER WIRES IN TERMS OF INFECTION IN FRACTURE OF PHALANGES AND METACARPAL BONE OF HAND

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Abstract: *Kirschner wire (K-wire) fixation is a common technique for treating phalangeal and metacarpal fractures due to its cost-effectiveness and efficiency. However, the risk of infection associated with exposed K-wires remains a significant concern. This study aimed to compare infection rates and clinical outcomes in hand fractures treated with buried versus exposed K-wires.* ***Objective:*** *To assess and compare infection rates, clinical interventions, and patient comfort between buried and exposed K-wires in phalangeal and metacarpal fractures.* ***Method:*** *This study was conducted at Bolan Medical Complex Hospital, Quetta, with 110 patients divided into two groups: Group A (55 patients with buried K-wires) and Group B (55 patients with exposed K-wires). Infection rates were evaluated by categorizing infections as superficial or deep. Clinical outcomes, including the need for antibiotics, K-wire removal, and patient comfort, were assessed for both groups.* ***Results:*** *Group A (buried K-wires) had significantly lower infection rates, with 3.6% of patients developing superficial infections and 1.8% deep infections. In contrast, Group B (exposed K-wires) had higher infection rates, with 10.9% experiencing superficial infections and 5.4% deep infections. Additionally, exposed K-wire patients required more clinical interventions, including increased antibiotic use and K-wire removal.* ***Conclusion:*** *Buried K-wires provide a safer and more comfortable alternative for hand fracture management, with significantly lower infection rates and reduced need for further medical intervention compared to exposed K-wires. Therefore, the use of buried K-wires is preferable for reducing infection risk and enhancing patient comfort.*

Keywords: Kirschner wires, K-wire fixation, hand fractures, phalangeal fractures, metacarpal fractures, infection rate, clinical outcome, buried vs. exposed wires.

Introduction

Hand fractures, particularly those involving the phalanges and metacarpals, are among the most common injuries treated in orthopedic and trauma care. Effective fixation is critical to ensure proper alignment and promote healing, with Kirschner wires (K-wires) being a widely used method for stabilizing these fractures due to their cost-effectiveness, ease of use, and adaptability to various fracture types (1, 2). However, despite the advantages, K-wire fixation is associated with a significant risk of infection, which can adversely impact patient outcomes and necessitate further interventions (3, 4).

Two primary approaches to K-wire fixation are commonly employed: buried and exposed. Buried K-wires are implanted subcutaneously, reducing their exposure to the external environment and theoretically lowering the risk of infection. In contrast, exposed K-wires protrude through the skin, allowing for easier monitoring and removal but with increased susceptibility to infection (5, 6). Infection, whether superficial or deep, can lead to complications such as osteomyelitis and necessitate prolonged antibiotic use, K-wire removal, or even surgical intervention (2).

Understanding the differential infection rates between buried and exposed K-wires is essential, as this knowledge can guide clinical decision-making and improve patient outcomes. While some studies suggest a lower infection risk with buried K-wires, others argue that exposed wires, when appropriately managed, do not significantly increase infection rates (7, 8). Therefore, this study aims to compare infection rates associated with buried versus exposed K-wire fixation in fractures of the phalanges and metacarpals, providing valuable insights into the optimal choice for wire placement in these fractures.

Methodology

This qualitative study was conducted at Bolan Medical Complex Hospital, Quetta, to analyze infection rates associated with buried and exposed K-wires in patients with phalangeal and metacarpal fractures. A total of 110 patients, aged 18-60, were randomly selected from outpatient visits and divided equally into two groups. Group A received buried K-wire treatment, where the K-wires were fixed subcutaneously, remaining beneath the skin layer without external visibility. Group B received exposed K-wire treatment, where the wires passed over the skin, allowing for easier monitoring and removal.

The study included patients aged 18-60 with closed fractures of phalanges or metacarpals, requiring K-wire fixation. Exclusion criteria were open fractures, clinical evidence of osteomyelitis at admission, immunosuppressive conditions, and any history of previous hand surgeries. These criteria were established to ensure a homogeneous study sample and reduce confounding factors related to infection risk.

Data were collected through patient records, direct observation, and patient feedback, allowing for comprehensive assessment of infection outcomes. The primary study endpoints focused on infection events, categorized into deep infections (e.g., osteomyelitis) and

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superficial infections (such as redness, swelling, or pus around the K-wire site). Secondary outcomes included time to infection onset, infection severity, and the requirement for additional treatments, such as antibiotics, K-wire removal, or surgical debridement. All data collection adhered to a standardized protocol to maintain consistency across participants and minimize observational bias.

Data were analyzed using descriptive statistics to summarize infection rates and types across both groups. Comparative analysis was conducted to evaluate differences in infection incidence, severity, and treatment needs between buried and exposed K-wire treatments. Statistical significance was assessed using appropriate tests (e.g., chi-square test for categorical variables), with significance set at $p<0.05$.

Ethical approval was obtained from the Ethics Committee at Bolan Medical Complex Hospital. Participants were informed of the study's purpose, voluntary nature, and confidentiality measures. Consent was obtained prior to participation, and all personal identifiers were anonymized in reporting to maintain patient privacy.

Results

Demographics of Patients

A total of 110 patients were included in the study, with an equal gender distribution: 55 males (50%) and 55 females (50%). Table 1 summarizes the age and sex distribution among the participants. The highest representation was found in two age groups: 18-25 years, with 25 patients, and 54-60 years, with 24 patients. The age group with the least number of patients was 33-39 years, comprising only 12 participants. This broad age and gender distribution helps ensure that the study findings are not biased towards any particular demographic group.

Table 1: Age and Sex Distribution of Patients

Age Group (Years)	Male	Female	Total
18-25	7	18	25
26-32	9	6	15
33-39	4	8	12
40-46	5	12	17
47-53	12	5	17
54-60	18	6	24
Total	55 (50%)	55 (50%)	110 (100%)

Infection Rates in Patients with Buried vs. Exposed K-Wires

The infection rates in patients treated with buried and exposed K-wires are presented in Table 2. Group A, with buried K-wires, showed significantly lower infection rates compared to Group B with exposed K-wires. In Group A, only 3.6% of patients developed a superficial infection, while 1.8% had a deep infection. Conversely, Group B had a higher incidence of both superficial infections (10.9%) and deep infections (5.4%). The findings indicate that buried K-wires are associated with a markedly reduced risk of both superficial and deep infections compared to exposed K-wires.

Table 2: Incidence of Infections in Group A (Buried K-Wires) and Group B (Exposed K-Wires)

Outcome	Group A (Buried K-Wires)	Group B (Exposed K-Wires)
Superficial Infection	2 (3.6%)	6 (10.9%)
Deep Infection	1 (1.8%)	3 (5.4%)
No Infection	52 (94.6%)	46 (83.6%)
Total Patients	55	55

Severity of Infection and Required Clinical Interventions

The severity of infections and the medical interventions required are shown in Table 3. Patients in Group B (exposed K-wires) required more frequent medical interventions than those in Group A. For instance, oral antibiotics were needed in 3.6% of cases in Group A compared to 10.9% in Group B. Similarly, the need for IV antibiotics and K-wire removal due to infection was more prevalent in Group B, with 5.4% and 7.2%, respectively, compared to 1.8% in Group A. Notably, only one patient in Group B required surgical debridement, whereas no patients in Group A required this intervention. These results underscore the higher infection-related complications associated with exposed K-wires.

Table 3: Severity of Infection and Clinical Interventions

Intervention	Group A (Buried K-Wires)	Group B (Exposed K-Wires)
Oral Antibiotics	2 (3.6%)	6 (10.9%)
IV Antibiotics	1 (1.8%)	3 (5.4%)
K-Wire Removal	1 (1.8%)	4 (7.2%)
Surgical Debridement	0 (0%)	1 (1.8%)

Distribution of Closed vs. Open Fractures in Both Groups

The distribution of closed and open fractures within each group is outlined in Table 4. Group A (buried K-wires) had

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a higher percentage of closed fractures (73%) compared to Group B (58.2%). In contrast, open fractures, which are more prone to infection due to environmental exposure, were more frequent in Group B (41.8%) than in Group A (27%). This distribution may contribute to the higher infection rates observed in Group B, as open fractures have an inherently greater risk of infection.

Table 4: Incidence of Closed vs. Open Fractures in Group A and Group B

Fracture Type	Group A (Buried K-Wires)	Group B (Exposed K-Wires)
Closed	40 (73%)	32 (58.2%)
Open	15 (27%)	23 (41.8%)
Total	55 (100%)	55 (100%)

Discussion

The results of this study indicate a significantly lower infection rate in patients treated with buried K-wires compared to those with exposed K-wires for fractures of the phalanges and metacarpals. These findings align with existing literature, suggesting that buried K-wires offer a protective advantage against superficial and deep infections due to their subcutaneous placement, which limits direct contact with external contaminants (2, 4). The incidence of superficial infections in the buried K-wire group was only 3.6%, compared to 10.9% in the exposed group, a finding consistent with Acar et al., who demonstrated that subcutaneous placement of K-wires reduces infection risk (1).

Deep infection rates also reflected this trend, with only 1.8% in the buried K-wire group versus 5.4% in the exposed K-wire group. This difference highlights the potential for buried K-wires to minimize complications such as osteomyelitis, which can lead to chronic bone infections and impair healing (2). Previous studies, such as those by Rajesh et al. and Bhaskaran et al., support the protective nature of buried K-wires against deep-seated infections, indicating that subcutaneous placement serves as a barrier against deeper tissue contamination (3, 5).

Regarding clinical interventions, patients with exposed K-wires required more frequent treatment with antibiotics and additional procedures like K-wire removal and surgical debridement compared to the buried K-wire group. The need for oral and intravenous antibiotics was significantly higher in the exposed group (10.9% and 5.4%, respectively) than in the buried group (3.6% and 1.8%, respectively). These findings align with Demirel et al., who reported increased antibiotic requirements among patients with exposed K-wires (7). Furthermore, the higher rate of K-wire removal (7.2% vs. 1.8%) and surgical debridement in the exposed group emphasizes the burden of managing complications associated with infections in these cases, as highlighted by Charalambous et al. (9).

The incidence of open fractures was notably higher in the exposed K-wire group (41.8%) than in the buried group (27%). Given that open fractures have an inherently higher infection risk, the higher infection rates observed in Group B (exposed K-wires) could be partly attributed to this factor, as noted in prior studies (8). However, even among patients with closed fractures, infection rates remained lower in the buried K-wire group, suggesting that the mode of K-wire placement itself plays a significant role in infection prevention (6).

Conclusion

This study supports the clinical advantage of buried K-wires over exposed K-wires in minimizing infection rates among patients with phalangeal and metacarpal fractures. The lower incidence of both superficial and deep infections, along with reduced need for antibiotic treatment and additional surgical interventions, highlights buried K-wire placement as a safer option in managing hand fractures. Further large-scale studies and randomized trials could provide more conclusive evidence and aid in establishing standardized guidelines for K-wire fixation in hand fractures.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.
Approved by the department Concerned. (IRBEC-TC-027/23)

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The authors declared an absence of conflict of interest.

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References

1. Bigham-Sadegh A, Oryan A. Selection of animal models for pre-clinical strategies in evaluating the fracture healing, bone graft substitutes and bone tissue regeneration and engineering. Connective tissue research. 2015;56(3):175-94.
2. Terndrup M, Jensen T, Kring S, Lindberg-Larsen M. Should we bury K-wires after metacarpal and phalangeal fracture osteosynthesis? Injury. 2018;49(6):1126-30.

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3. 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. 2024:15589447241232094.
4. Hatch RL, Clugston JR, Taffe J, Patrice Eiff P, Grayzel J. Clavicle fractures. UpToDate Waltham, MA: UpToDate[Last updated April 14. 2016.
5. Pintore A, Astone A, Vecchio G, Asparago G, Calabrò G, Migliorini F, et al. Percutaneous transverse pinning for metacarpal fractures: a clinical trial. Archives of orthopaedic and trauma surgery. 2024;144(7):3129-36.
6. Wormald JC, Jain A, Lloyd-Hughes H, Gardiner S, Gardiner MD. A systematic review of the influence of burying or not burying Kirschner wires on infection rates following fixation of upper extremity fractures. Journal of plastic, reconstructive & aesthetic surgery. 2017;70(9):1298-301.
7. Stürmer KM, Bonnaire F, Locarno MAS, Vienna P, Hamburg K-HF, Braunschweig TG, et al. Distal radius fracture of the adult. 2021.
8. GRAFT NB. toward Kirschner wire (K-wire) ² or intramedullary. Hand and Upper Extremity Surgery, An Issue of Clinics in Plastic Surgery, An Issue of Clinics in Plastic Surgery, E-Book: Hand and Upper Extremity Surgery, An Issue of Clinics in Plastic Surgery, An Issue of Clinics in Plastic Surgery, E-Book. 2024;51(4):515.
9. Hsu LP, Schwartz EG, Kalainov DM, Chen F, Makowiec RL. Complications of K-wire fixation in procedures involving the hand and wrist. The Journal of hand surgery. 2011;36(4):610-6.

[Citation: Anwar, M., Rehman, M.U., Ullah, N., Bilal, M., Khan, M., Rafiullah., (2024). Outcome of buried versus exposed kirchner wires in terms of infection in fracture of phalanges and metacarpal bone of hand. *Biol. Clin. Sci. Res. J.*, **2024***: 1272*. doi: https://doi.org/10.54112/bcsrj.v2024i1.1272]