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Clinical Outcomes of Cross Versus Adjacent Metacarpal Kirschner Wire Fixation for Fifth Metacarpal Neck Fractures: A Retrospective Comparative Study

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Article

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Abstract

Objective

To compare the clinical efficacy of cross Kirschner wire fixation and adjacent metacarpal Kirschner wire fixation in the treatment of fifth metacarpal neck fractures, and to provide evidence to support surgical decision-making.

Methods

A retrospective analysis was conducted on the clinical data of 45 patients with fifth metacarpal neck fractures treated between September 2019 and May 2025. According to the intraoperative fixation method, patients were divided into a control group (cross Kirschner wire fixation, n = 26) and an experimental group (adjacent metacarpal fixation, n = 19). There were no statistically significant differences between the two groups in baseline characteristics, including age, sex, mechanism of injury, and fracture type (P > 0.05). Bone healing time, postoperative volar angulation, DASH score, complication rate and grip strength recovery were compared between the two groups.

Results

All patients were followed up for at least 6 months. The DASH score of the experimental group at 6 months after surgery was significantly lower than that of the control group (12.8 ± 2.2 vs 16.9 ± 4.0, P < 0.01); the average ratio of postoperative grip strength recovery to the healthy side in the experimental group was 84.7 ± 8.3%, which was significantly better than 78.9 ± 8.8% in the control group (P < 0.05). There was no statistically significant difference in bone healing time between the two groups (5.2 ± 0.5 weeks vs 5.5 ± 0.6 weeks, P > 0.05). There was no statistically significant difference in the maintenance effect of the fifth metacarpal neck-shaft angle between the two groups (average postoperative angulation 14.2 ± 4.6° vs 15.7 ± 4.5°, P > 0.05). In the control group, 3 cases of pin tract infection and 5 cases of metacarpophalangeal joint stiffness occurred; 1 case of pin tract infection occurred in the experimental group.

Conclusion

Adjacent metacarpal Kirschner wire fixation may offer advantages in maintaining reduction, promoting functional recovery, and reducing postoperative complications It is especially suitable for stable and mildly comminuted fractures, and can be used as an effective alternative to cross Kirschner wire fixation.

Introduction

Fifth metacarpal neck fracture, also known as a Boxer's fracture, is one of the most common hand injuries, accounting for approximately 20%–25% of all hand fractures [1, 2]. Its main etiology is mostly caused by boxing, falling or blunt force, manifesting as volar angulation, rotational deformity and local swelling and pain. Due to the large mobility of the distal end of the fifth metacarpal and the traction of interosseous muscles and hypothenar muscles, the fracture is prone to volar angulation deformity, which affects the movement of the metacarpophalangeal joint and the function of making a fist [3]. The goal of surgical treatment is to restore the length and axis of the metacarpal and the stability of the metacarpophalangeal joint to avoid functional impairment. Kirschner wire fixation is widely used because of its simple operation, minimal trauma and low cost [4, 5]. The traditional cross Kirschner wire fixation method forms cross support by inserting wires above and below the fracture end, which can provide good anti-rotational stability, but often needs to pass through the metacarpophalangeal joint, with risks of soft tissue injury, pin tract infection and joint stiffness [6]. In 1973, Lamb et al. proposed the adjacent metacarpal fixation method, also known as transverse intermetacarpal Kirschner wire fixation [7]. provides additional stability without crossing the joint by placing Kirschner wires transversely across the fifth and fourth metacarpals for lateral support, reducing postoperative complications [8–10]. At present, there are few comparative studies on the two fixation methods at home and abroad, and the conclusions are inconsistent. To further explore the differences in efficacy and safety, this study retrospectively analyzed the cases of fifth metacarpal neck fractures treated with different Kirschner wire fixation methods in our hospital in the past five years, and compared the functional recovery and complications of the two groups, in order to provide reference for clinical practice.

Materials and Methods

1. General Information

A retrospective analysis was performed on 45 patients with fifth metacarpal neck fractures who were admitted and completed follow-up in The First Affiliated Hospital of Ningbo University and Shenzhen University General Hospital from September 2019 to May 2025. Inclusion criteria: Age 15 to 65 years old; Isolated fifth metacarpal neck fracture; Postoperative follow-up ≥ 6 months; Preoperative volar angulation of the neck-shaft angle > 30° or obvious rotational deformity requiring surgical treatment. Exclusion criteria: Combined with multiple hand fractures or open fractures with severe wound contamination; Combined with nerve and vascular injuries; Combined with uncontrolled severe diabetes; Combined with mental disorders; Poor postoperative compliance or incomplete follow-up data. This study was approved by the Ethics Committee of The First Affiliated Hospital of Ningbo University (Approval No. 2025219RS-01) and was conducted in accordance with the Declaration of Helsinki and its subsequent amendments.

According to the surgical method, they were divided into the control group (cross Kirschner wire fixation group): 26 cases, including 21 males and 5 females, with an average age of 32.3±10.8 years. Experimental group (adjacent metacarpal fixation group): 19 cases, including 16 males and 3 females, with an average age of 35.2±12.5 years. There were no statistically significant differences in gender, age,

injury mechanism, comorbidities and smoking history between the two groups (P > 0.05), which were comparable (detailed data are summarized in Table 1).

Table 1 Comparison of general data between the two groups

Variable	Control group (n=26)	Experimental group (n=19)	P
Age (years)	32.3±10.8	35.2±12.5	0.411
Gender (Male/Female)	21/5	16/3	0.766
Cause of injury (Boxing/Fall/Crush)	13/8/5	12/5/2	0.621
Open injury (Yes/No)	3/23	2/17	0.915
Hypertension (Yes/No)	4/22	2/17	0.636
Diabetes mellitus (Yes/No)	2/24	1/18	0.747
Hyperuricemia (Yes/No)	2/24	2/17	0.741
Smoking history (Yes/No)	5/21	7/12	0.187

2. Surgical Methods

All operations were performed by the same team under general anesthesia or brachial plexus anesthesia. First, closed reduction was performed under C-arm fluoroscopy. Shortening, angulation and rotational displacement were corrected by traction, closed reduction and prizing. If closed reduction could not restore the fifth metacarpal neck-shaft angle to 10-25°, open reduction was selected. After reduction, the assistant temporarily maintained the position of the fracture end. Cross Kirschner wire fixation: Two 1.0 or 1.5 mm Kirschner wires were obliquely inserted across the fracture line from the dorsal side of the fifth metacarpal head, with the needle tip terminating under the proximal cortical bone. The needle end was exposed after operation, and plaster immobilization was performed for 2 weeks. Adjacent metacarpal fixation: 1-2 Kirschner wires were transversely inserted into the distal end of the fifth metacarpal fracture, and 2 Kirschner wires were transversely inserted into the proximal end of the fracture, penetrating both cortices of the fourth metacarpal to serve as an external frame to maintain the stability of the fracture end. The fixation process did not cross the metacarpophalangeal joint, the needle diameter was 1.0 or 1.5 mm, and external fixation was performed for 2 weeks after operation. All patients received routine antibiotics to prevent infection after operation. Active flexion and extension training was gradually started 3 weeks later. Kirschner wires were removed when callus formation and fracture line blurring and disappearance were shown on X-ray. Fist-clenching exercises were resumed within 6 weeks after operation.

3. Observation Indicators

(1) Imaging indicators: The volar angulation of the fifth metacarpal neck-shaft angle was measured at 6 weeks after operation. Two orthopedic surgeons read the films independently and calculated the

average value. (2) Functional assessment: At 6 months after operation, the function of the affected limb was evaluated using the DASH (Disabilities of Arm, Shoulder and Hand) score scale [11]. A lower score indicates better function; at the same time, the grip strength of the healthy side and the affected side, and the range of motion of the fifth MCP were recorded, and the percentage was calculated. (3) Bone healing time: Judged according to callus formation and fracture line blurring and disappearance shown on X-ray. (4) Complications: Including pin tract infection, nonunion, metacarpophalangeal joint stiffness, internal fixation failure.

4. Statistical Methods

SPSS 18.0 software was used for analysis. Measurement data were expressed as mean ± standard deviation, and independent sample t-test was used for comparison between groups; count data were tested with χ^2 test. $P < 0.05$ was considered statistically significant.

Results

1. Operation and Follow-up

All patients underwent surgery successfully and achieved radiographic bony union, with no intraoperative neurovascular injuries. The mean operative time was approximately 1 hour in both groups. All cases were followed up for more than 6 months.

2. Bone Healing and Imaging Results

The average bone healing time of the experimental group was 5.2±0.5 weeks, and that of the control group was 5.5±0.6 weeks, with no statistically significant difference. At 6 weeks after operation, the volar angulation of the fifth metacarpal neck-shaft angle was 14.2°±4.6° in the experimental group and 15.7° ±4.5° in the control group, with no statistically significant difference.

3. Functional Recovery

At 6 months after operation, the average range of motion of the fifth MCP in the experimental group recovered to 93.6±5.3% of the healthy side, and that in the control group was 88.3±7.7% ($P < 0.05$). The DASH score of the experimental group was significantly lower than that of the control group (12.8±2.2 vs 16.9±4.0, $P < 0.01$). In terms of grip strength recovery, the average of the experimental group was 84.7±8.3% of the healthy side, and that of the control group was 78.9±8.8% ($P < 0.05$). All patients in the control group and the experimental group could complete daily life independently without family assistance (detailed data are summarized in Table 2).

Table 2 Comparison of postoperative efficacy indicators between the two groups

Indicators	Control group (n=26)	Experimental group (n=19)	P
Bone healing time (weeks)	5.5±0.6	5.2±0.5	0.124
Neck-shaft angle (°)	15.7±4.5	14.2±4.6	0.227
Loss of neck-shaft angle (>20°, case)	6	1	0.103
MCP range of motion (% of healthy side)	88.3±7.7%	93.6±5.3%	0.013
DASH score (6 months)	16.9±4.0	12.8±2.2	<0.01
Grip strength recovery (% of healthy side)	78.9±8.8%	84.7±8.3%	0.031

4. Complications

In the control group, 3 cases of pin tract infection were cured by dressing change; 5 cases of mild metacarpophalangeal joint stiffness (active flexion < 75°) were improved by rehabilitation training. There was 1 case of pin tract infection in the experimental group, and no metacarpophalangeal joint stiffness occurred. There were no cases of redisplacement or nonunion in both the control group and the experimental group. The overall complication rate was 30.8% in the control group and 5.3% in the experimental group (detailed data are summarized in Table 3).

Table 3 Occurrence of complications

Complications	Control group (n=26)	Experimental group (n=19)	P
Pin tract infection	3 (11.5%)	1 (5.3%)	0.465
Metacarpophalangeal joint stiffness	5 (19.2%)	0 (0%)	0.043
Internal fixation failure	0	0	-
Nonunion	0	0	-

5. Typical Cases

Case 1: A 16-year-old male with fifth metacarpal neck fracture caused by hitting the wall.

Case 2: A 23-year-old male with fifth metacarpal neck fracture caused by falling from a bicycle.

Discussion

The present study compared cross K-wire fixation and intermetacarpal K-wire fixation for fifth metacarpal neck fractures, with particular emphasis on functional recovery rather than radiographic alignment alone. Although both techniques achieved comparable fracture union and maintenance of postoperative volar angulation, intermetacarpal pinning resulted in superior functional outcomes and fewer joint-related complications. These findings suggest that radiographic parameters alone may be insufficient to guide surgical decision-making in boxer's fractures.

Traditionally, postoperative volar angulation has been considered a key determinant of outcome in fifth metacarpal neck fractures. However, several clinical studies have demonstrated that acceptable radiographic alignment does not necessarily correlate with optimal hand function [12, 13]. In the present cohort, postoperative angulation was maintained within the generally accepted range in both groups, yet functional recovery differed significantly. This discrepancy highlights the importance of dynamic functional parameters, such as metacarpophalangeal joint motion and grip strength, which may be more sensitive indicators of treatment success than static radiographic measurements.

Intermetacarpal pinning represents a fixation strategy that prioritizes joint preservation rather than maximal construct rigidity. By avoiding transarticular fixation, this technique minimizes iatrogenic injury to the metacarpophalangeal joint capsule, extensor mechanism, and periarticular soft tissues. In contrast, cross pinning, while providing reliable rotational stability, often necessitates temporary joint immobilization, which may predispose patients to postoperative stiffness [14]. The occurrence of metacarpophalangeal joint stiffness exclusively in the cross-pinning group in our study supports this mechanistic explanation.

Early mobilization is a well-recognized determinant of functional recovery in hand injuries [15, 16]. In our clinical experience, patients treated with intermetacarpal pinning tolerated early active motion more readily following immobilization, likely due to reduced joint irritation and pain, as demonstrated in the Case 2 video, motion of the fifth MCP joint was completely restored at 6 weeks postoperatively. This observation is consistent with previous reports emphasizing the role of joint-sparing fixation techniques in minimizing stiffness and improving patient-reported outcomes [17]. The significantly lower DASH scores and superior grip strength observed in the intermetacarpal pinning group may therefore reflect the cumulative benefit of preserved joint integrity and earlier functional rehabilitation.

Importantly, the absence of a significant difference in fracture healing time between the two groups indicates that intermetacarpal pinning provides sufficient mechanical stability for fracture union. This finding aligns with earlier biomechanical and clinical studies demonstrating that transverse or intermetacarpal K-wire constructs can adequately resist deforming forces in selected metacarpal fractures [18, 19]. Taken together, these results challenge the assumption that greater construct rigidity necessarily translates into superior clinical outcomes and support a more nuanced approach to fixation selection.

The clinical implications of these findings lie in refining the indications for each fixation strategy. Intermetacarpal pinning appears particularly advantageous in stable or mildly comminuted fractures,

where preservation of joint motion and early rehabilitation are paramount. Conversely, in fractures with marked instability, severe comminution, or significant rotational deformity, cross pinning or alternative fixation methods may still be warranted to ensure adequate stability. Thus, fixation strategy should be individualized, balancing the need for stability against the risk of joint-related complications.

Several limitations of this study must be acknowledged. Its retrospective design introduces potential selection bias, as fixation choice may have been influenced by fracture characteristics or surgeon preference. The relatively small sample size, especially in the intermetacarpal pinning group, may have limited the detection of rare complications. Additionally, the follow-up period focused on medium-term outcomes, precluding assessment of long-term degenerative changes. Future prospective studies with larger cohorts and objective motion analysis may further clarify the relationship between fixation strategy, joint preservation, and long-term functional outcomes.

Conclusion

while both cross pinning and intermetacarpal pinning provide reliable fracture stability in fifth metacarpal neck fractures, intermetacarpal pinning offers functional advantages by preserving joint integrity and facilitating early mobilization. These findings support a shift in surgical decision-making from an exclusive emphasis on radiographic alignment toward a more function-oriented fixation philosophy.

Declarations

Data Availability

The raw data supporting the conclusions of this study will be made available by the authors upon reasonable request.

Author Contributions

Conceptualization, Y.W., S.H., P.W. and M.G.; Methodology, M.G.; Validation, J.H. , L.C. and M.G.; Investigation, Y.W., S.H. and M.G.; Resources, Y.W. and M.G.; Data curation, Y.W., S.H., J.H. and L.C.; Writing—original draft, Y.W. and S.H.; Writing—review and editing, Y.W., S.H., J.H., L.C., P.W. and M.G.; Supervision, M.G.; All authors read and approved the final manuscript.

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Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of The First Affiliated Hospital of Ningbo University (protocol code No. 2025219RS-01). Due to the retrospective nature of the study and the use of anonymized clinical data, the requirement for informed consent was waived by the Ethics Committee.

Consent for publication

All authors have thoroughly reviewed the manuscript and consent to its publication.

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Figures

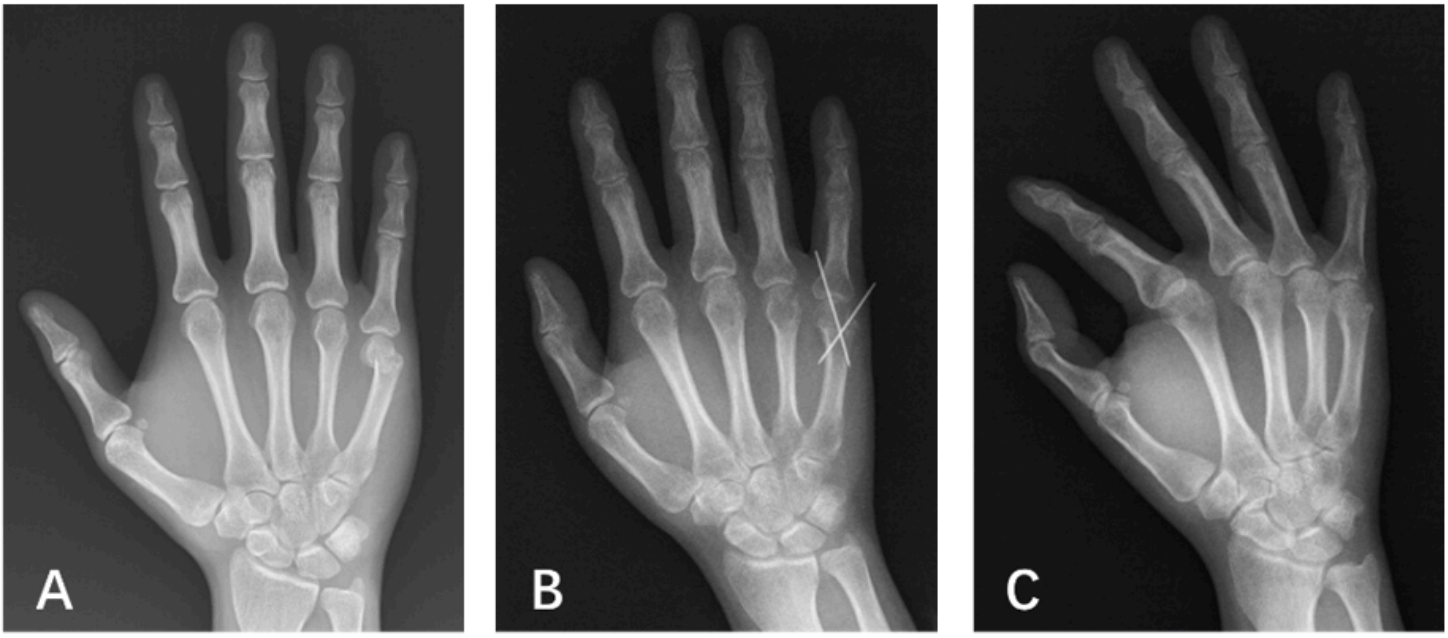


Figure 1

(A) Preoperative X-ray of the patient's right hand, indicating that the fifth metacarpal neck fracture angled about 45°. (B) After surgical reduction of the fracture, cross Kirschner wire fixation was used for the fracture end. (C) X-ray reexamination of the right hand 6 weeks after operation, indicating good healing of the fracture end, and Kirschner wires were removed in the outpatient clinic.

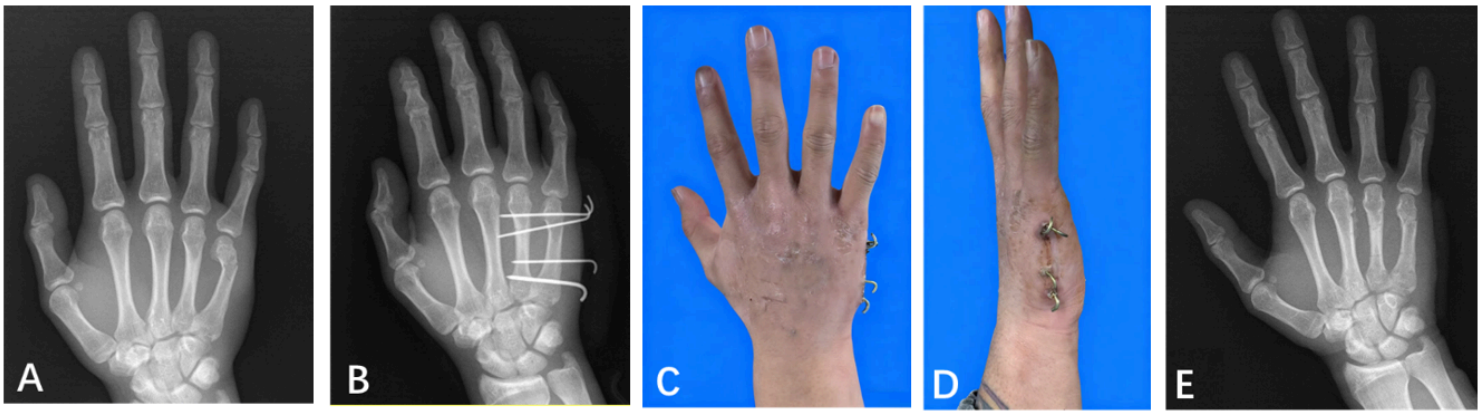


Figure 2

(A) Preoperative X-ray of the patient's right hand, indicating that the fifth metacarpal neck fracture angled about 41°. (B) After surgical reduction of the fracture, adjacent metacarpal Kirschner wire fixation was used for the fracture end. (C) and (D) Appearance photos reexamined 6 weeks after operation, the pin tract was clean and tidy, with no obvious exudate, and the range of motion of the MCP joint recovered to normal (Video 1 attachment). (E) X-ray indicated good healing of the fracture end, and Kirschner wires were removed in the outpatient clinic.

Supplementary Files

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- Videofileforcase2.mp4