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Fifth metacarpal neck fracture fixation: antegrade intramedullary pinning with two K-wires or percutaneous retrograde crossed pinning

Fırat Fidan, Mehmet Ümit Çetin

[1]Istanbul Aydın University, Medicine School, Orthopedic and Traumatology Deparmant, Istanbul, Turkey
[2]Tekirdağ Namik Kemal University, Tekırdağ, Turkey

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ABSTRACT

Objective: The present study aimed to compare clinical and radiological outcomes in patients with displaced fifth metacarpal neck fractures after treatment with antegrade intramedullary pinning with two K-wires or percutaneous retrograde crossed pinning.

Material Method: While seventeen patients were treated with antegrade intramedullary pinning (Group), 14 were treated with percutaneous retrograde crossed pinning (Group 2). Clinical and radiological outcomes included Quick Dash, active range of motion (ROM), VAS, and dorsal angulation loss at weeks four and twelve and in the final follow-up.

Results: The findings revealed that the groups had mean ages of 29.41±8.15 years and 27.78±7.42 years, res-pectively. While ROM was better in Group 2 at weeks four and twelve, we could not find a significant difference between the groups by active ROM in the final follow-up. Moreover, Group 1 had a better Dash score in the fourth week and twelth week , but both groups had similar Dash scores in the final follow-up. Finally, the groups had no preoperative and postoperative differences radiologically.

Conclusion: The present findings uncovered that treatment of a displaced fifth metacarpal neck fracture by anteg-rade intramedullary pinning yielded a better in the first three months improvement in active ROM and Quick Dash than percutaneous retrograde crossed pinning.

Keywords: Fifth metacarpal fracture, percutaneous retrograde crossed pinning, intramedullary anteg-rade pinning

INTRODUCTION

Fifth metacarpal neck fractures are among the most common injuries of the hand and account for about 20% of all hand fractures (1-3). These fractures are more common in males and young adults (4). Such fractures are often managed conservatively using an ulnar gutter splint or strapping; howev-er, shortening of the metacarpus by more than 3 mm, angulation by more than 30 degrees, and rota-tional deformities are indications for surgical fixation (1-5). Several techniques are currently available for the surgical treatment of the fifth metacarpal neck fracture, including crossed pinning with Kirschner (K)-wire, antegrade intramedullary K-wire, retrograde intramedullary K-wire, retrograde crossed pinning with K-wire, transverse pinning with K-wire, external fixation, and plate fixation (1-7). Nevertheless, a gold standard surgical technique has not been established yet. The decision of which surgical method to use all depends on the surgeon's preference, considering both the pros and cons of each method and the pathoanatomy of each case (1-5).

The goal of operative management is to ensure alignment and stability and initiate early mobilization (5-9). Antegrade intramedullary fixation methods are commonly used, and the application of ante-grade intramedullary pinning seems relatively uncomplicated and minimally invasive (6-10). Retro-grade crossed pinning can also result in good stability; however, it may cause more restrictions on met-acarpophalangeal joint motion due to scarred adhesions of the extensor structures (6).

Corresponding Author: Fırat Fidan, drfiratfidan@gmail.com
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Ultimately, we hypothesize that the antegrade intramedullary Kirschner -wire technique does not involve joint penetration, thus leading to superior finger movements and clinical results in the early peri-od. Therefore, our study aimed to compare clinical and radiographic outcomes of antegrade intrame-dullary pinning with two Kirschner -wires and percutaneous retrograde crossed pinning in patients with fifth metacarpal neck fractures.

MATERIAL AND METHOD

The study was carried out with the permission of the Tekirdağ Namık Kemal University Noninvasive Clinical Researches Ethics Committee (Date: 28.09.2021, Decision No: 2021.223.09.09). All procedures were carried out by the ethical rules and the principles of the Declaration of Helsinki. Because the study was designed retrospectively, no written informed consent form was obtained from patients. We retrospectively collected data between January 2020 and January 2022 on 68 patients with metacarpal neck fractures. We set the inclusion criteria as 1) preoperative angulation of more than 40 degrees on initial presentation before manual reduction and 2) treatment with closed reduction via antegrade intramedullary two Kirschner-wires or retrograde crossed pinning 3) follow-up period of at least six months. However, we excluded 1) patients with open fractures, 2) patients undergoing a conservative treatment, 3) those undergoing an open reduction, 4) patients using plates and screws for fixation, and 5) those with accompanying hand and upper extremity injuries. Thirty-three patients satisfying the above-specified criteria were included in the study. Then, we divided the patients into two groups by surgical treatment performed. While Group 1 consisted of those with antegrade intramedullary fixation, Group 2 comprised the patients with retrograde cross-pinning fixation. We also recorded the demographic characteristics of both groups, including age, sex, injury side, and operation time.

Surgical treatments and postoperative management

Two orthopedic surgeons performed surgery under general or regional anesthesia for all patients. For Group 1, a short longitudinal incision was made on the dorsal-ulnar base of the fifth metacarpal. The metacarpal cortex was reached by blunt dissection. The proximal dorsoulnar cortex was opened with a 2.5 mm drill. The drill was tilted approximately 60 degrees to enter the intramedullary canal at as wide an angle as possible. After adjusting the entry point, 1.4 mm two K-wires were prepared by bending. The distal end was bent upwards by about 20 degrees with pliers. About 2 cm distal, the wire was bent again by no more than 10 degrees in the same direction. The K-wires to be applied were bent 90 deg-rees proximally so that they were longer than the metacarpal and in the same plane with the distal slo-pe from the proximal part for ease of insertion. These bent wires were manually inserted into the me-dullary canal and advanced into the diaphysis before reaching the fracture site. Following closed re-duction, the wires were advanced from the fracture site to the metacarpal head. The position was checked using fluoroscopy. The K-wires were then rotated so that the bent ends were dorsal. Finally, the ends of the K-wires were cut and bent to be outside the skin.

For group 2, a closed fracture reduction was achieved, and reduction was confirmed using fluoros-copy. Then, 1.4 mm two K-wires were pinned on the fifth metacarpal, radial, and ulnar sides, using a crossed-pin configuration. The fixation and position of the wires were confirmed by fluoroscopy. Fi-nally, the K-wires were cut and bent so that they were outside the skin.

Ulnar gutter splints were applied to all patients postoperatively along the ulnar side of the wrist with the wrist extension of 10-20 degrees, metacarpophalangeal (MCP) joints of the fourth and fifth finger at 70 to 90° flexion, and the proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints in slight flexion.

The same standard protocol was applied postoperatively to both groups. After using a splint for four weeks, the movement was initiated in the fourth week. After 4-6 weeks, the K-wires were removed.

Radiographic Evaluation

For both groups, radiologic evaluation was evaluated by one orthopedic surgeon on PA, lateral, and oblique X-rays on the preoperative-postoperative first day, in the fourth and twelfth weeks, and the final follow-up (**Figure 1 and 2**). The degree of angulation is assessed on the lateral radiograph, with lines drawn through the medullary canal.

Figure 1. 52 years male patient treated with antegrad intramedullary pinning. Preoperative oblique view radiograph (A). Preoperative AP view radiograph (B). Postoperative radiographs showing a good reduction of the fracture on the lateral view (C) and oblique view (D). Radiograph in the 8th week after the surgery showing the union of the fracture on the anteroposterior view (E) and oblique view (F). ROM of the MCP in flexion (G) and extension (H) in the final follow-up.

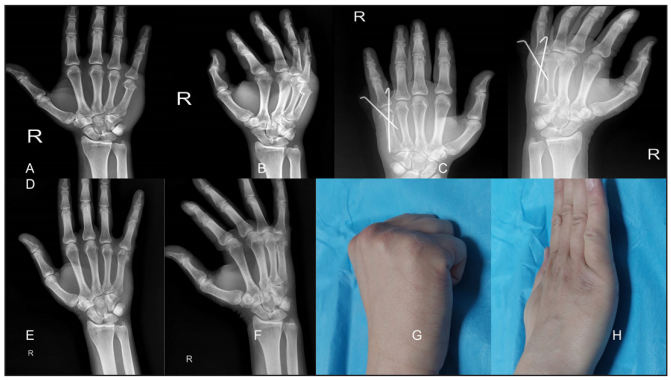

Figure 2. 35 years male patient treated with retrograde crossed pinning. Preoperative AP view radiograph (A). Preoperative oblique view radiograph (B). Postoperative radiographs showing a good reduction of the fracture on the anteroposterior view (C) and oblique view (D). Radiograph in the 6th month after the removal of the nails on the anteroposterior view (E) and oblique view (F). ROM of the MCP in flexion (G) and extension (H) in the final follow-up.

Functional Evaluation

Clinical evaluation included assessment of the range of movement at the MCP joint, visual analog sca-le (VAS), and Quick DASH scoring in the fourth and twelfth weeks and final follow-up. (11). Moreo-ver, the time of first return to work was recorded for both groups. A goniometer measured a joint's range of motion (ROM). The Quick-DASH scoring includes patients' difficulties in daily activities, working life, and social relationships. It consists of 11 items inquiring about restriction and pain; high scores indicate a poor result (12). Besides, the visual analog scale (VAS) is a valid, subjective measure of pain. The responses are scored on a scale ranging from 0 (no pain) to 10 (worst pain) (11). Finally, any complications were noted, including loss of reduction, pin tract infection, tendon irritation, skin irritation, and injury to the dorsal cutaneous branch of the ulnar nerve.

RESULTS

In this research, we studied 31 patients with displaced metacarpal neck fractures treated with the antegrade intramedullary technique (Group 1; n=17) and retrograde crossed pinning fixation (Group 2; n=14). We found the mean ages to be 29.41±8.15 years and 27.78±7.42 years, respectively. The findings also revealed that the cohort included only two female patients and five patients had fractures in their non-dominant hands. The mean time from injury to surgical intervention was 7.8 days in group 1 and 6.4 in group 2. There was no statistically significant difference between the groups (p=0.739). While the mean follow-up period was 9.8±2.8 months, the mean duration of operations was 32.2±10.3 minutes. The groups did not significantly differ by the parameters above (p=0.228). There were also no significant differences between the groups by pin removal time (M=6.03±0.6 weeks; p=0.769). Without differing significantly (p=0.184), the patients returned to work after an average of 7.6±1.6 weeks (**Table 1**).

Table 1. Participants' demographic characteristics

	Group 1	Group 2	p
Age	29.41±8.15	27.78±7.42	0.575
Sex (n) (female/male)	2/15	0/14	
Side (n) (right/left)	3/14	2/12	
Operation time (minute)	32.64±10.01	31.78±11.02	0.228
Follow-up (month)	9.64±2.95	9.07±2.78	0.584
Pin removal (week)	6.00±.70	6.07±.61	0.769
Time of first return to work (week)	7.29±1.57	8.07±1.59	0.184

Regarding their clinical characteristics in the fourth week, ROM of the fifth metacarpophalangeal joint was significantly greater in Group 1 than in Group 2 (p=0.002). Group 2 had a significantly higher mean Quick Dash score (M=63.47±7.65) than Group 1 (M=55.31±6.70) (p=0.004). Nevertheless, we concluded the mean VAS scores of the groups to be similar (p=0.227). (**Table 2**).

In the 12th week, the mean VAS scores of the groups were similar (p=0.856). Yet, we reached a significant difference between the groups by active ROM (p=0.009). While the mean ROM score was 85.35±3.01 in Group 1, it was 82.21±3.21 in Group 2. There was also a statistically significant difference between the groups by Quick Dash (p=0.016).

In the final follow-up, all clinical outcomes (VAS, Quick Dash, ROM) were similar in both groups (p=0.984, p=0.469, and p=0.944, respectively) (**Table2**).

Table 2. Functional outcomes

VAS			
	Week 4	**Week 12**	**Final follow-up**
Group 1	4.11±1.05	2.52±0.62	1.47±0.94
Group 2	3.64±1.08	2.57±0.66	1.42±0.75
p-value	0.227	0.856	0.984
ROM			
	Week 4	**Week 12**	**Final follow-up**
Group 1	73.82±2.53	85.35±3.01	90.29±3.68
Group 2	70.08±3.45	82.21±3.21	90.21±2.19
p-value	0.002	0.009	0.944
Quick Dash			
	Week 4	**Week 12**	**Final follow-up**
Group 1	55.31±6.70	29.74±6.76	3.07±1.76
Group 2	63.47±7.65	33.76±8.62	2.60±1.73
p-value	0.004	0.016	0.469

We also compared the radiological outcomes of the patients by angulation. Accordingly, we could not find significant differences between the groups by their radiological outcomes in the 4th and 12th weeks and the final follow-up (**Table 3**).

Table 3. Radiologic (angulation) outcomes

	Preoperative	Early Postoperative	Final follow-up
Group 1	42.76±6.85	6.9±2.63	8.2±2.76
Group 2	43.59±7.22	7.0±2.49	8.1±2.58
p	0.869	0.763	0.784

Thus, a union was achieved in all patients at follow-up. Although superficial infection developed in one patient undergoing an antegrade technique, he received antibioteraphy and wound care and needed no revision. Besides, five patients (2 in Group 1 and 3 in Group 2) developed skin irritation, which was healed with wound care follow-up without any additional procedure. No loss of reduction, non-union or malunion, or nerve injury in any patient in this study.

DISCUSSION

This present study demonstrated that the patients undergoing intramedullary K-wire fixation of displaced metacarpal neck fractures with low complication rates showed better functional outcome scores and ROM than those with retrograde crossed pinning in the first three months. However, similar func-tional results were achieved between the groups at final follow-up.

Various surgical techniques were previously described for fifth metacarpal neck fractures (1-9). Int-ramedullary techniques have recently become a commonly used method for such fractures and, fol-lowed by early mobilization, have been reported with good outcomes with low complication rates (3-10). In their study, Facca et al. (13) compared the results of locking plates and intramedullary K-wires. Accordingly, they reported that locking plates with immediate mobilization paradoxically provided poorer mobility at the end of follow-ups than intramedullary K-wires with six weeks' immobilization. Intramedullary nailing fixation can also provide adequate stability, and its success was attributed to the basic principle of three-point fixation (8). Intramedullary pinning can be done with one or more K-wires. A recent study compared clinical and radiological outcomes in patients with displaced metacar-pal neck fractures after treatment with single or dual antegrade elastic intramedullary nails (8). They reported that double fixation provided better MCP extension and radiological outcomes than single fixation (8). Theoretically, fixation with a single K-wire would allow rotational instability (14). In this study, we used two K-wires with the intramedullary fixation and showed that the functional outcomes in these patients were satisfactory and displayed acceptable, low-rate complications.

Retrograde fixation may lead to joint stiffness by causing restriction in the MCP joint and may also cause damage to the extensor structures during pinning (14). Kim et al. (3) concluded that antegrade intramedullary pinning results in better outcomes than retrograde pinning at three months postoperati-vely. In their nonrandomized retrospective study, Schädel-Höpfner et al. (6) compared the outcomes of antegrade intramedullary pinning, and percutaneous retrograde crossed pinning for fifth metacarpal neck fractures. As a result, antegrade splinting yielded a significantly better outcome for ROM restric-tion of the metacarpophalangeal joint. Similarly, we found that antegrade fixation of fifth metacarpal neck fractures, compared with retrograde crossed pinning, provided better ROM and DASH scores in the 4th and 12th weeks. However, we could not reach significant differences between the groups in the final follow-up. This may be explained by the idea that retrogradely applied K-wires may have caused stiffness in the MCP joint or damage to the extensor mechanism.

In the present study, fracture reduction with retrograde crossed pinning was similar to antegrade intra-medullary pinning in the early postoperative period and follow-up. Although radiologically similar results were obtained in both groups, in the retrograde group, K-wires are prone to complications, inc-luding restricted motion and stiffness. In addition, wire ends are left outside the skin, commonly resul-ting in problems such as loss of reduction, infection, and skin irritation (4,5,10). Regarding such complications, five patients experienced superficial infection and skin irritation. Yet, the group comp-lication rate was parallel to previous studies (3,5,15).

The limitations of this study include a small number of patients and a relatively short follow-up time.

CONCLUSION

In conclusion, although it is possible to obtain good results with both the antergard technique and the retrograde technique in displaced fifth metacarpal neck fractures ,our study results show that by antegrade intramedullary pinning produces better functional outcomes at 3 months postoperatively in terms of ROM and DASH score of the fifth metacarpophalangeal joint than percutaneous retrograde crossed pinning.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of the Tekirdağ Namık Kemal University Noninvasive Clinical Researches Ethics Committee (Date: 28.09.2021, Decision No: 2021.223.09.09).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execu-tion, and analysis of the paper and that they have approved the final version

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