

# Comparison of Conservative and Closed Reduction Percutaneous Pinning Methods for the Treatment of 5<sup>th</sup> Metacarpal Neck Fractures

✉ Mesut Karıksız<sup>1</sup>, ✉ Mehmet Fatih Erol<sup>2</sup>

<sup>1</sup>University of Health Sciences Turkey, Başakşehir Çam and Sakura Training and Research Hospital, Clinic of Orthopedic and Traumatology, İstanbul, Turkey

<sup>2</sup>Private Vega Hospital, Clinic of Orthopedic and Traumatology, Tekirdağ, Turkey

## ABSTRACT

**Introduction:** This study aimed to evaluate the clinical and radiological outcomes of conservative treatment and closed reduction with antero-gradual pinning for the treatment of 5<sup>th</sup> metacarpal (MC) neck fractures.

**Methods:** Data of patients who underwent surgery for 5<sup>th</sup> MC neck fractures between January 2017 and December 2020 were retrospectively analyzed. Two groups were formed: those treated with closed reduction and antero-gradual intramedullary Kirschner wire fixation and those treated with closed reduction and casting. The groups were statistically compared in terms of pre- and post-treatment radiological angulation, functional outcomes, and return to work times. Quick-Disability of Arm, Shoulder and Hand Outcome Measure and visual analog scale (VAS) were used for functional scoring.

**Results:** The study included 33 patients (6 male, 27 female) treated conservatively and 32 patients (4 male, 28 female) treated with closed reduction and antero-gradual percutaneous pinning. In the closed reduction and casting group, the post-treatment angulation was measured as 19 degrees (10-30). In the antero-gradual pinning group, the post-treatment angulation was 15 degrees (9-20). At the end of the first year, 5<sup>th</sup> MC joint flexion was measured as 75 degrees (30-100) in group 1 and 75 degrees (50-100) in group 2. The DASH score was 0 (0-25) in group 1 and 0 (0-40) in group 2. The VAS score was 96 (18-100) in group 1 and 100 (30-100) in group 2.

**Conclusion:** The results of this study suggest that intramedullary Kirschner wire fixation is a safe option for treating 5<sup>th</sup> MC neck fractures. In addition, an increase in angulation was observed after closed reduction even in cases where acceptable limits of angulation were maintained. While emphasizing the need for more comprehensive research, this study also suggests that surgical treatment could be effective in different angulations.

**Keywords:** 5<sup>th</sup> metacarpal neck fracture, percutaneous pinning, conservative treatment, closed reduction

## Introduction

Fractures of the hand can lead to significant issues affecting daily life activities, making the treatment of such fractures of paramount importance. In particular, the 5<sup>th</sup> metacarpal (MC) bone fracture is a commonly encountered type of hand fracture in adults, often affecting males and displaying a tendency to occur in the dominant hand (1). The incidence of such fractures generally peaks within the age group of 10 to 29 years (2). Conservative and surgical approaches are used to treat MC fractures. Treatment options maintain hand mobility and restore grip strength. The decision to perform surgical intervention is based on factors such as the presence of clinical abnormalities or radiological evaluations. Specifically, factors such as clinical abnormalities in the frontal or horizontal axis (malrotation) or radiological palmar tilt

determine surgical indications. The palmar tilt limit varies between 30° and 45° in adults (3). Studies indicate that with a palmar tilt of 30° at the distal end of the MC, there is an 8% loss of grip strength in the 5<sup>th</sup> digit and a 22% loss of MCP joint mobility (4,5). Additionally, due to displacement during flexion, a 2-10 mm shortening of the MC can result in an 8% to 55% reduction in interosseous muscle strength (6). Surgical treatment options include external fixation, percutaneous K-wire fixation, and internal fixation with a plate. Among minimally invasive percutaneous methods, antero-gradual intramedullary pinning and cross-pinning between the fourth and 5<sup>th</sup> rays are also employed (7-10). We preferred the antero-gradual intramedullary pinning technique because it provides less soft tissue damage and a more stable fixation than the cross-pinning technique. This study aimed to evaluate the clinical and



**Address for Correspondence:** Mesut Karıksız MD, University of Health Sciences Turkey, Başakşehir Çam and Sakura Training and Research Hospital, Clinic of Orthopedic and Traumatology, İstanbul, Turkey

**Phone:** +90 506 291 80 49 **E-mail:** mesutkariksiz@gmail.com **ORCID ID:** orcid.org/0000-0002-9632-7694

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radiological outcomes of conservative treatment and closed reduction with anterograde pinning in treating neck fractures of the 5<sup>th</sup> MC bone. This study was conducted to understand which method is more effective for treating 5<sup>th</sup> MC fractures and to shed light on clinical practices.

## Methods

This study was based on a retrospective analysis of data from patients who underwent surgery for fractures of the 5<sup>th</sup> MC neck between January 2017 and December 2020. In accordance with the ethical considerations of our study, necessary permissions were obtained from the University of Health Sciences Turkey, Gazi Yaşargil Training and Research Hospital Local Ethics Committee (approval number: 490, date: 12.06.2020). Patients 18 years of age, those with open or comminuted fractures, or those treated with a different method were excluded from the study.

The patients included in the study were divided into two treatment method groups: patients treated with closed reduction and anterograde intramedullary Kirschner wire fixation method and patients treated with closed reduction and casting method. Written informed consent forms were obtained from all patients planned to be included in the study.

These two groups were extensively evaluated regarding radiological angulation values, functional outcomes, and return-to-work durations during pre- and post-treatment periods. Quick-Disability of Arm, Shoulder and Hand Outcome Measure score and visual analog scale (VAS) were used to measure functional outcomes (11).

The main objective of this study was to compare the effects of different treatment methods on the clinical outcomes of patients with fractures of the 5<sup>th</sup> MC neck. The collected data were statistically analyzed, and the results were reported in detail.

### Closed Reduction and Cast Fixation Method

#### Application of the Method

The patients were placed in a supine position in the outpatient clinic. Traction was applied to the fracture area, and reduction was performed closed using the Jahss maneuver. In this method, the metacarpophalangeal (MP) joint and proximal interphalangeal joints were flexed to 90 degrees, and reduction was completed by pushing the MC distal fragment of the proximal phalanx dorsally (12). Subsequently,

an ulnar gutter splint was applied with the wrist in 30 degrees of extension and the MP joint in 70 degrees of flexion (13) (Figure 1). The splint was shaped by applying slight pressure to the distal volar and proximal dorsal sides to prevent malalignment in the fracture area. The following splint application, confirmation of proper alignment was obtained using control plain radiographs.

### Post-Treatment Period

All patients were invited for weekly follow-up appointments. For patients with confirmed alignment during the first two weeks of follow-up, removal of the cast was planned for the 5<sup>th</sup> week of treatment. The cast was removed, and wrist and hand exercises were recommended after detecting sufficient signs of bone union in direct radiographs taken at the end of the 5<sup>th</sup> week. When adequate joint range of motion and muscle strength were restored at follow-up appointments two weeks later, patients were granted permission to return to work. Cases with insufficient rehabilitation progress were included in a physical therapy and rehabilitation program.

### Closed Reduction and Antegrade Intramedullary Kirschner Wire Fixation Method

#### Surgical Technique

In cases with an angulation of 30 degrees or more at the fracture site, a surgical treatment approach was chosen. All surgeries were performed under regional block anesthesia applied to the dorsal and volar branches of the ulnar nerve at the proximal level of the 5<sup>th</sup> MC. Suitable diameter Kirschner wires were selected and shaped for operation (Figure 2). A percutaneous entry site was prepared under fluoroscopic control, twice the width of the chosen Kirschner wire from the ulnar side, at the proximal dorsal aspect of the 5<sup>th</sup> MC. The wires were placed with rotational manipulations into the MC medulla under fluoroscopic guidance. Once the fracture line was reached, appropriate alignment was achieved using the Jahss technique. Subsequently, after confirming that the tip of the first wire was within the distal fragment, it was rotated dorsally to secure the fracture alignment. The second wire was advanced into the distal fragment through similar manipulations under fluoroscopic control to achieve compression. The procedure was concluded by dressing the wire tips.



**Figure 1.** (a) Two-way X-ray (5<sup>th</sup> metacarp neck fracture), (b) two X-rays (after conservative treatment), (c) two X-rays (after bone healing)



**Figure 2.** (a) Two-way X-ray (5<sup>th</sup> metacarp neck fracture), (b) Two X-rays (after surgical operation), (c) Two X-rays (after bone healing)

### Post-Treatment Period

All patients were discharged on the day of surgery. Starting from the first day after the operation, wrist and hand exercises were recommended to the patients. Patients engaged in jobs that did not require heavy lifting were granted immediate permission to return to work. Patients were evaluated on the 10th day after the operation to assess joint range of motion. A physical therapy and rehabilitation program was planned for patients who did not reach the rehabilitation level. Radiographic assessment of bone union was performed during the 5<sup>th</sup> week of follow-up. When sufficient signs of bone union were observed, the wires were extracted under outpatient conditions. The following wire removal, no rehabilitation program was implemented.

### Statistical Analysis

SPSS 16.0 software (SPSS, Chicago, IL, USA) was used for statistical analysis. Measurement values are expressed as mean and standard deviation.

### Results

In the first group, 6 patients were female and 27 were male. In the second group, there were 4 female and 28 male patients. The mean ages of the groups were determined as 29 (18-65) and 25 (18-67), respectively. The average time to intervention was 2 (1-7) days in the first group and 4 (1-10) days in the second group. The pre-intervention palmar angulation value was measured as an average of 41 (30-60) degrees in the first group and 43 (30-62) degrees in the second group (Table 1). In the group treated with closed reduction and casting, the post-treatment angulation values were measured as an average of 19 (10-30) degrees. The angulation values in patients treated with percutaneous pinning were an average of 15 (9-20) degrees. In evaluations based on the date of fracture occurrence, the average time to return to work was 63 days in the first group and 35 days in the second group. At the end of the first year, MP joint flexions were measured at an average of 75 (30-100) degrees in the first group and 75 (50-100) degrees in the second group. The DASH score used for functional scoring was an average of 0 (0-25) in the first group and 0 (0-40) in the second group. The VAS score was measured as an average of 96 (18-100) in the first group and 100 (30-100) in the second group (Table 2). In the first group, 6 patients experienced displacement at the fracture site during follow-up and received reapplication of a cast. In the second group, no displacement at

**Table 1. Main values**

	Group 1	Group 2
Sex		
Female	6	4
Male	27	28
Age (year)	29 (18-65)	25 (18-67)
Time elapsed between trauma and intervention (days)	2 (1-7)	4 (1-10)
Palmar angulation value (degrees)	41 (30-60)	43 (30-62)

The data are presented as mean and total values

**Table 2. Control values at the end of the first year**

	Group 1	Group 2
Palmar angulation value (degrees)	19 (10-30)	15 (9-20)
Active flexion of the MP joint (degrees)	75 (30-100)	75 (50-100)
Average return to work (days)	63	35
QuickDASH (0-100, 0 being best)	0 (0-25)	0 (0-40)
VAS (0-100, 100 being best)	96 (18-100)	15 (9-20)

Data are presented as mean and total values. MP: Metacarpophalangeal. QuickDASH: Quick-Disability of Arm, Shoulder, and Hand Outcome Measure, VAS: Visual analogue scale

the fracture site was observed during follow-up. Complications such as damage to the dorsal branch of the ulnar nerve, extensor tendon injury, and avascular necrosis of the MC head did not occur in the first group. Surgical cases did not experience pin tract infection. Three patients experienced pin tract pain; however, no treatment other than anti-inflammatory therapy was required. The average duration of surgery in these patients was recorded as 15 (10-25) minutes. The mean frequency of fluoroscopy usage was 18 (12-30).

### Discussion

Boxer's fractures, also known as 5<sup>th</sup> MC neck fractures, constitute a significant portion of hand injuries and are the most common type of MC bone fractures (1,14,15). Especially in cases where displacement is within acceptable limits at the fracture site, casting remains a preferred method (3). In cases where the amount of displacement exceeds acceptable limits, closed reduction and casting may be preferred. The fact that this treatment can be easily applied in outpatient clinics

without the need for any anesthesia method is a major reason for its preference. Additionally, the wide acceptable range of functional alignment limits for 5<sup>th</sup> MC neck fractures makes this option stand out in terms of preference, as it allows achieving acceptable functional outcomes without the risks of surgery.

However, even in cases where the initial alignment is appropriate, poor consolidation can occur because of the inadequacy of casting during treatment, leading to malalignment during the treatment process (2). In our series, closed reduction and recasting were performed in 6 patients because of displacement observed during follow-up. In the group treated with closed reduction and antegrade pinning, there were displacement cases requiring re-operation. Although functional losses seen in cases where consolidation is completed without proper alignment might be tolerated within acceptable limits, these losses can be problematic, especially for individuals engaged in tasks requiring delicate hand skills. In cases treated with casting, patients may not be able to return to work until consolidation is achieved, particularly in injuries affecting the dominant hand. Moreover, after casting is removed, a period of exercise is necessary to compensate for limited joint mobility and muscle strength in the wrist and hand joints. In some cases, the recommended exercise programs may not be sufficient, and physical therapy and rehabilitation sessions may be required. All these processes can significantly prolong the time from fracture occurrence to return to work.

Several surgical treatment options have been developed to preserve bone alignment in boxer's fractures. Among these options, antegrade intramedullary Kirschner wire fixation is the preferred method because of its less invasive nature, adequate stability, and shorter application time (7). The most significant advantage of this method is its ability to achieve proper fracture alignment under fluoroscopy and provide stable fixation with minimal damage. The literature show that these practices are often performed under general anesthesia or axillary block anesthesia (7-9). This implies that this method includes all the risks of general anesthesia or axillary block anesthesia applications as well as the associated time losses. In addition, routine follow-up casting performed at intervals of 2 to 3 weeks after this procedure poses a risk of causing functional losses. Evaluating this entire process, it can theoretically be anticipated that this method will be more successful than casting in terms of preserving alignment, but it might not offer a significant advantage in terms of anesthesia method, rehabilitation, and return to work periods compared with casting treatment.

Regarding the functional outcomes, the DASH score was 0 (0-25) in group 1 and 0 (0-40) in group 2 at the end of the first year. The VAS score was 96 (18-100) in group 1 and 100 (30-100) in group 2. No significant difference was found between the two groups.

When comparing the plaster casting and antegrade pinning techniques that form the basis of our study, it can be observed that the antegrade pinning method is statistically significantly superior to the plaster casting method in terms of post-treatment angulation values and return to work periods.

Treatment of a displaced 5<sup>th</sup> MC neck fracture by antegrade intramedullary pinning yielded a better improvement in active ROM and

QuickDASH in the first 3 months than percutaneous retrograde crossed-pinning, and both groups had similar DASH scores in the final follow-up (16). We preferred the anterior intramedullary pinning technique to start early movement of the joint and ensure an early return to work.

In today's world, the economic importance of the return to work period is increasing. In our study, to utilize the advantages of the intramedullary fixation method, mitigate its risks, and minimize the return to work period, we found it appropriate to make some modifications to this method. We aimed to eliminate the risks associated with general anesthesia by performing operations using regional anesthesia at the proximal region of the 5<sup>th</sup> MC. Subsequently, by preparing the percutaneous entry site and applying previously shaped Kirschner wires percutaneously, we avoided the risks associated with incisions. Leaving the proximal ends of the wires outside the skin, although it brings the risk of pin tract infection, allowed us to remove the pins without anesthesia in outpatient conditions after consolidation was completed. Not applying additional casting treatment in any of the patients and starting exercise programs on the first day following surgery aimed to minimize problems such as joint movement limitation or muscle strength loss in the wrist and hand region. This also helped us achieve the intended shortening of the return to work period.

#### Study Limitations

There is no doubt that our study has several limitations. One of the most significant limitations is the number of cases. Studies with larger sample sizes and multicenter designs can provide higher-quality evidence. Another limitation of our study is that we included only two treatment options for MC bone fractures. Comparative studies that encompass other treatment methods mentioned in the literature could provide clinicians with more enlightening data. Another limitation is that a single surgeon performed the surgical interventions in our study. Investigating operations performed by different surgeons could be more valuable for evaluating the reproducibility of the study method.

#### Conclusion

At the end of our study, we can infer that treating intramedullary Kirschner wires may be a safe option for managing of 5<sup>th</sup> MC neck fractures. The observation of increased angulation even in cases where fracture displacement is within acceptable limits at the end of casting treatment suggests that surgical treatment can be considered not only for cases with angulation greater than 30 degrees but also for cases with lower angulation. However, it should be noted that more comprehensive studies are needed to obtain more reliable results.

**Ethics Committee Approval:** In accordance with the ethical considerations of our study, necessary permissions were obtained from the University of Health Sciences Turkey, Gazi Yaşargil Training and Research Hospital Local Ethics Committee (approval number: 490, date: 12.06.2020).

**Informed Consent:** Written informed consent forms were obtained from all patients planned to be included in the study.

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