



A minimally invasive fixation technique for selected patients with fifth metacarpal neck fracture



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ABSTRACT

Objective: The objective of this study was to compare the short-term results of treatment of fifth metacarpal neck fractures using a minimally invasive surgical fixation technique and the gold standard splinting method in a selected patient group of office workers with high expectations.

Patients and methods: Twenty-four male patients (mean age: 28 years, range: 18–46 years) satisfying the inclusion criteria were enrolled in the study in two groups: surgical treatment and splinting (U-shaped ulnar gutter) groups. Hygienic interactions during daily activities and the use of keyboard and pens were allowed in the posttreatment period. The Short Form-Disabilities of the Arm, Shoulder and Hand Score (DASH) questionnaire was used to assess patient satisfaction and functionality of the extremity on the 30th and 45th days. Joint ranges of motion were measured on the 45th day. Functional and radiological evaluation data were analyzed statistically.

Results: In the conservative treatment group, initial palmar angulation was measured to be 42.6°, whereas a mean of 13.5° was noted and metacarpal shortening of 5.6 mm decreased to 2 mm after treatment, respectively. In terms of total joint range of motion (ROM), flexion of the treated side was at 91.25% and extension at 92.5% when measured versus the healthy-side values at the final follow-up. The mean time for return to work in this group was 33.6 days. The mean Quick-DASH score on the 30th-day follow-up was 69.5, whereas it was 39.3 at the 45th-day follow-up. The radiological findings showed a correction of the mean palmar angulation from 43° to 8° at follow-up in the surgically treated group. The initial metacarpal shortening of 9.3 mm improved to 0.5 mm at final examination. In terms of total joint ROM, flexion of the treated side was at 94% and extension at 95.5% when measured versus the healthy-side values on the 45th-day follow-ups. The mean time for return to work was 3.9 days. The mean Quick-DASH score on the 30th-day follow-up was 2.96, whereas it was noted as 0.69 at the 45th-day follow-up.

Conclusions: We recommend antegrade intramedullary K-wire fixation as a reliable method, which minimizes the functional loss and allows for early return to daily activities in office workers who sustained a fracture of the fifth metacarpal neck.

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Introduction

Fractures of the fourth and fifth metacarpal neck, also known as Boxer's fracture, comprises one-third of all fractures of the hand [1–5]. Fracture of the fifth metacarpal neck is commonly seen after the second decade in men and subsequent to a trauma caused by a fall or hitting a hard object [2]. The mechanism of Boxer's fractures is

reported to develop following break in the relatively weak metacarpal neck due to axial loading on the metacarpophalangeal joint [3]. Based on the severity of the trauma, the metacarpal head displaces in the direction of flexion and shows poor healing due to the destruction of the volar cortex and deforming force of intrinsic muscles [2,3,5,6]. Cosmetic and functional losses may occur in cases where appropriate reduction and fixation are not achieved [5–7].

The treatment of Boxer's fractures is usually by nonsurgical means [2,6–9]. However, surgical intervention may be necessary in the presence of a rotational deformity, significant angulation, or in the case where a cast fails to hold the reduced fracture. The commonly held criteria for instability are as follows: a shortening of >3 mm, angulation of the metacarpal neck by $\geq 45^\circ$, and an

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apposition of >50% [9]. Antegrade and retrograde intramedullary fixation with a K-wire and fixation with plates are among the major surgical methods. However, as these fractures are of benign nature and cause no functional deformities, and patients have varying expectations from treatment, none of these methods present with a significant advantage over another. Yet, it is evident that 4–6 weeks of cast application has a significantly negative impact on the daily lives of the patients, in addition to the challenges involved in their follow-up and satisfaction.

Hence, a minimally invasive technique is required for secure fracture reduction and fixation and for allowing the hand to perform daily activities during the recovery period. By comparing the results of our technique applied on the selected patient group with the gold standard splinting method, we wanted to test our hypothesis that a significant difference can be achieved in the early-term functionality using our method.

The objective of this study was to compare the short-term results of treatment of fifth metacarpal neck fractures using a minimally invasive surgical fixation technique and splinting after closed reduction in the selected patient group of office workers with high expectations.

Patients and methods

Patients who received an intervention on the diagnosis of Boxer's fracture between 2014 and 2015 were included in the study, with their consents obtained. For good results, 70° (standard deviation, SD: 5) of angulation, as reported by Garcia-Elias et al., was accepted as the radiological threshold [10]. Accordingly, the power of the study was 80%, with an alpha value of 0.05 and each group comprised 12 subjects.

Inclusion criteria were presence of an acute (0–15 days), closed, and simple fracture of the fifth metacarpal neck, absence of an ipsilateral injury or deformity, presence of an angulation of >40° in oblique plane imaging, age ≥18 years, having acquired a master's degree or still being a student, and being an employee in a social-professional environment with mild physical activities.

Rotational deformity was clinically assessed based on the extension of the axis of the fifth finger towards the scaphoid tubercle during flexion and orientation of the nail of the finger during extension. Angulation of the fracture was evaluated by measuring the angulation in the continuity of the dorsal cortical line of the fifth metacarpal in a 30° oblique X-ray image.

Twenty-four male patients (mean age: 28 years, range: 18–46 years) satisfying the above criteria were included in the study. Fractures were on the right side in 19 patients (77%) and on the left in five (23%). Regardless of the affected side, all fractures involved dominant side. The mode of trauma was punching a hard surface in anger.

Twelve of these patients were enrolled in the surgical treatment group and the other 12 in the conservative treatment group via block randomization. After the patients were provided with sufficient information about the fracture and its treatment, closed reduction without any general or regional anaesthesia was performed in the emergency room on patients who chose to undergo conservative treatment. No sedative or haematoma block anaesthetics were administered during gentle closed reduction with the Jahss manoeuvre. These patients were immobilized in a U-shaped ulnar gutter splint that was applied to fix the fourth and fifth metacarpophalangeal, proximal, and interphalangeal joints in semiflexion (Fig. 1). The reduction was repeated in the presence of an angulation of >40° in the oblique plane in the follow-up radiographs. Patients were called for control visits on the second and seventh days after closed reduction. Splints were removed on the fourth week. Along with patient satisfaction levels, functionality of the hand and its

impact on daily activities were questioned on the 30th and 45th days. The absence of pain upon pressuring on the fracture line was considered a union.

In patients willing to undergo a surgical treatment, surgical procedure was performed with block anaesthesia under operating room conditions. The patient was laid in the supine position. Closed reduction was applied employing the Jahss manoeuvre under fluoroscopic guidance. Then, a simple incision of 2 cm was made right to the distal of the carpometacarpal joint, proximal to the fifth metacarpal. A cortical window was created with the sharp end of a 1.6-mm K-wire and widened cautiously. Fixation was performed with an intramedullary insertion of two pre-contoured K-wires of 1.6 mm in an antegrade fashion. Distal angulation of the first K-wire was advanced towards the palmar region and then rotated towards the dorsal upon reaching the metacarpal head in order to correct the palmar angulation (Fig. 2). Stability of the reduction was improved with an insertion of the second K-wire. Distal ends of the K-wires were advanced to the cancellous part of the metacarpal head for adequate fixation. Proximal ends of the wires were cut off at the cortex level and left under the skin. The surgical incision site was closed with 4/0 absorbable sutures. The mean duration of surgery was 34 (20–45) min. K-wires of all patients were removed on the 30th postoperative day under local anaesthesia without any re-displacement cases. Splints applied after wound dressings were removed on the seventh day. Hygienic interactions during daily activities and use of keyboard and pens were allowed.

Total joint (metacarpophalangeal + proximal interphalangeal + distal interphalangeal) range of motion (ROM) in all cases was measured with a goniometer. Functional capacities of the joints were compared with those of the healthy side. The Short Form-Disabilities of the Arm, Shoulder and Hand Score (DASH) questionnaire was used to assess patient satisfaction and functionality of the extremity on the 30th- and 45th-day follow-ups. In addition, shortening, rotation, and angulation values were measured on the 30th-day follow-up for both groups.

Statistical analysis was performed using the SPSS 20.0 software. The Mann-Whitney test was used as the two groups were independent and did not have a normal distribution. The level of significance was set at $p < 0.05$.

Results

In the conservative treatment group, the mean duration from the time of fracture to treatment was 3 (range: 0–13) days. The mean palmar angulation was measured from 42.6° (range: 27°–55°) before treatment to 13.5° (range: 10°–28°) at the last follow-up. In addition, the initial metacarpal shortening of 5.6 (range: 5.3–6.1) mm decreased to 2 (range: 0–4) mm at the last follow-up. In terms of total joint ROM, flexion of the treated side was at 91.25% (range: 75–100%) and extension at 92.5% (range: 80–100%) when measured versus the healthy-side values at the final measurement. The mean time for return to work in this group was 33.6 (range: 26–41) days. The mean Quick-DASH score on the 30th-day follow-up was 69.5 (range: 59.1–79.5), whereas it was 39.3 (range: 22.7–61.4) at the final follow-up. Two patients experienced a failure of reduction during the first week, who underwent re-reduction and splinting under local anaesthesia in our outpatient clinic.

In the surgical treatment group, the mean duration from the time of fracture to treatment was 2 (range: 0–4) days. Preoperative palmar angulation was 43° (range: 40°–55°), whereas a mean of 8° (range: 0°–17°) was measured after 45th postoperative day. Preoperative metacarpal shortening of 9.3 (range: 6–15) mm improved to 0.5 (range: 0–3) mm 45th postoperative day. In terms of total joint ROM, flexion of the treated side was at 94% (range: 75–100%) and extension at 95.5% (range: 90–100%) when measured versus the healthy-side values on the 45th-day

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