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Outcome of Metacarpal Shaft Fractures treated with mini plates: A prospective study

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Abstract

Introduction: Metacarpal fractures are among the most common fractures encountered in the Emergency Department. They can be treated by Conservative methods as well as operative methods. Operative methods usually lead to better clinical results. This study aimed to evaluate the clinical results using the Total Active Flexion score by the American Society of Hand Surgeons (ASSH)

Aim of study: To evaluate the functional outcome of Metacarpal shaft fractures treated with Mini Plates
Materials and Methods: This prospective study was conducted in a tertiary health care Centre from January 2020 to June 2021. Inclusion criteria were patients with closed, displaced metacarpal fractures of fingers 2 to 5. 50 patients were included in the study. Age was between 20- 50 years

Results: 50 patients were included in the study. Half (25) were males and half (25) were females. 80 percent of the patients (40) had fractures in the dominant hand. Total active flexion measured was excellent in 35 patients, good in 10 patients, and fair in 5 patients

Conclusion: Use of Mini plates leads to early post-operative rehabilitation and good clinical outcome as measured by the Total active Flexion score given by ASSH.

Keywords: Metacarpal fractures, Mini plates, Total active Flexion

1. Introduction

Metacarpal Fractures are one of the most common fractures encountered in the emergency department. They account for 30% of hand fractures. Axial loading, direct trauma or twisting injury represent the main causes^[1].

Treatment is aimed at restoring length, reduction of the fracture, stable fixation, correcting of rotational deformity and early postoperative rehabilitation^[2].

They can be treated by Conservative methods as well as operative methods. Operative methods usually lead to better clinical results. Current Recommendation Operative treatment^[3].

Different surgical methods are documented in the literature, Mini plate fixation is one of them. It leads to rigid fixation, early postoperative rehabilitation and better clinical outcomes^[4].

Aim of study

To evaluate the functional outcome of Metacarpal shaft fractures treated with Mini Plates

Material and Methods

Our study included 50 patients with closed, displaced, unstable fractures. They presented to our hospital between January 2020 to June 2021. They were properly counselled and explained about the operative procedure. A written consent was taken from each patient before operating the patient. The patients were aged between 20-50 years. Exclusion criteria followed was those with open fractures, undisplaced fractures, and a patient who do not wanted an operative intervention.

Surgical technique: Supine position was selected for operative intervention with the arm of the patient supported on the side table. After Painting and draping, Tourniquet was inflated, and the incision was given dorsally through the skin. Tendons and dorsal interossei muscles were identified. Retraction of extensor tendons was done, and the metacarpal shaft was exposed by a periosteal elevator.

Fracture hematoma was irrigated and any tissue lying between the bony fragments were removed and fracture reduction was done by longitudinal traction and Blunt reduction forceps. The fracture fragment's reduction was held by a Reduction towel. A mini plate was applied after confirming reduction under C-ARM. After the Screws were inserted, the Final reduction was evaluated under C-ARM. Wound irrigation was done with special emphasis on Hemostasis. Wound closure was done with plate coverage with soft tissue to protect tendons from irritation.

Patients were kept in dorsal below elbow slab for a period of 2 weeks with the hand kept in a position of safety. At 2 weeks, Early postoperative Rehabilitation was started with Active ROM of the fingers. Clinical and radiological evaluation was done at 4 weeks, 8 weeks, 10 weeks, 12 and 16 weeks.

The outcome was evaluated using Total active flexion at the Final foldup (Table 1). Total Active Flexion is calculated by adding the degrees of flexion at MCP (Metacarpo-Phalangeal Joint), PIP (Proximal Interphalangeal Joint), DIP (Dorsal Interphalangeal Joint) and subtracting the sum of extension deficits at these joints. These values are then compared with the contralateral hand to evaluate how much function has recovered [5].

Results

Ours was a prospective study to evaluate the outcome of mini plates in metacarpal shaft fractures which were closed, displaced and unstable. 50 patients were included in the study. 25 (50%) were males and 25 (50%) were females. Follow up period was 4 months. Patients were aged between 20-50 years and the mean age was 35 years.

According to the morphology of fractures, 20 fractures were transverse, spiral in 10 patients and oblique in 20 patients. The patients were evaluated clinically and radiologically regularly. All the patients active fracture union between 8- 12 weeks with a mean seen at 10 weeks.

Dominant hand was involved in 35 (70 percent) of the patients. One metacarpal fracture was seen in 30 (60 percent) of the patients. 20 (40 percent) of the patients had 2 metacarpal fractures.

Total active flexion was used to evaluate the outcome. The score was seen to be 260 degrees in 5 patients, 250 degrees in 25 patients, 240 degrees in 5 patients, 220 degrees in the 5 patients, 200 in 5 patients and less than 170 but greater than 150 in 5 patients. After the final follow-up, we found results to be excellent in 80 percent (40) of the patients, good in 10 percent (5) of the patients and Fair in 10 percent (5) of the patients.

Three patients had superficial infections, which were treated by oral antibiotics.

The patients were motivated regularly for physiotherapy, and it was made sure that they followed a proper regimen as advised by the physiotherapist. Two patients had the formation of Keloid, but it did not lead to any functional impairment. There was no incidence of any tendon irritation, fracture displacement after fixation or any angular deformity.

Discussion

Metacarpal fractures are usually treated by conservative methods. But the displaced, unstable usually necessitate surgical treatment as the conservative methods may lead to unsatisfactory outcomes [6]. Various treatment techniques such as antegrade k wire, Retrograde K wire and transverse K wire fixation. Mini plates are documented in surgical

treatment methods for metacarpal fractures. Out of these the mini plate fixation is a relatively new technique as compared to all other techniques.

Our study aimed to evaluate the outcome of mini plate fixation in the metacarpal fractures. We did so by assessing the Total Active Flexion Given by ASSH (American Society of Hand Surgeons).

Our Study included 50 patients, which is well above the accepted limits. Studies have been conducted by many Authors, but our patient number is by far more than all of these. Souer *et al.* [7] included 18 patients, Gupta *et al.* [8] evaluated 31 patients, Trevisan *et al.* [9] included 42 patients in their studies, and Ashwani *et al.* [10] evaluated and reported the results of 21 patients.

Patients in our study ranged from 20-50 years with an average age seen to be 35 years. This was similar to that seen by Souer *et al.* [7] who hasd mean age of 34 years (18-50). This was higher than that seen in studies done by Trevisan C *et al.* [9] who found the mean age to be 39.4 years (17-77 years) and Ashwani *et al.* [10] who found the mean age to be 49.5 years(16-75).

Dominant hand was involved in 35 (70 percent) of the patients. One metacarpal fracture was seen in 30 (60 percent) of the patients. 20 (40 percent) of the patients had 2 metacarpal fractures. In a study done by Trevisan C *et al.* [9] he found dominant hand fracture to be in 31 patients with 34 patients having one metacarpal, 6 patients having two metacarpal and 2 patients having three metacarpal fractures. Ashwani *et al.* [10] in his study found that 11 patients with 2 metacarpal, 7 patients with 3 metacarpal and 3 patients with four metacarpal fractures.

We operated on all cases using the dorsal approach and it was made sure to protect the soft tissues as well as neuro-vascular structures. This little but important precaution during the intraoperative period led to good functional recovery. This approach also provides a good view of the metacarpals, which can greatly help reduce and later in plate application.

All of Our patients achieved bone union at 8-12 weeks. In a study done by Souer *et al.* [7] they encountered 1 delayed union. In a study done by Page and Stern [12] they found non union in 1 out of 36 patients and Stern *et al.* [13] found nonunion in 3 out of 17 patients.

Total active flexion was used to evaluate the outcome. The score was seen to be 260 degrees in 5 patients, 250 degrees in 25 patients, 240 degrees in 5 patients, 220 degrees in the 5 patients, 200 degrees in 5 patients and less than 170 degrees but greater than 150 degrees in 5 patients. Our study showed TAF to be excellent in 80 percent (40) of the patients, good in 10 percent (5) of the patients and Fair in 10 percent (5) of the patients. This points out to satisfactory results in most of the patients. Trevisan C *et al.* [9] found the average TAF to be 256 degrees (range 175°-260°). Bosscha K *et al.* [11] in his study found TAF score to be excellent in 31 out of 34 patients (92%) and poor in the rest of them. Similarly, Ashwani *et al.* [10] in his study evaluated patients using TAF and DASH (Disabilities of hand, Shoulder and Arm) scores found poor results in 1 patient and excellent in the rest of the patients with mean DASH score of 8.47 (Range 1-26).

Three patients had a superficial infection which was treated by Oral antibiotics. Two patients developed Keloid over the suture line, but this does not lead to any functional disability. We had a low complication rate in our study. This was similar to as seen by the Dabezies and Schutte [14] who in their study of 27 patients treated with mini plates, found low complication rates. It is reported in the literature that open

hand fractures and those with massive soft tissue injury have high complication rates as compared to those with closed fractures^[15].

In literature, many studies have been published comparing the various treatment methods. But the, most of them had been focused on closed reduction and percutaneous pinning. James *et al.*^[16] in his study found out that using closed methods led to a reduction in 77% of the fractures. Another treatment modality is Open Reduction and K wire fixation, but it can lead to infection and other problems such as protruding K wires^[17]. The external fixator can be used especially in Open fractures, but they can lead to complications such as pin tract infection, implant failure and loss of fixation^[18].

Very few studies have been solely focused on the mini plate fixation of the metacarpal fractures, but we did it here in our study. We have found various advantages of plate fixation in our study, such as stable anatomical fixation, early postoperative rehabilitation, and early return to work. This early rehabilitation regime had also led to no cases of stiffness in our study. There was no complication regarding angular deformity as well as shortening in our study. Overall, our patients achieved the satisfactory functional outcome.

The limitation of our study was a smaller number of patients and less time of follow-up.

Conclusion

We conclude that the Fixation of Metacarpal fractures with Mini plate is one of the viable options which can be used in displaced and unstable metacarpal shaft fractures.

Table 1: TAF Score System from MCPJ to DIPJ (digits 2-5)

Degree of Flexion	Results
220-260 Degrees	Excellent
180-219 Degrees	Good
130-179 Degrees	Fair
Less than 130 Degrees	Poor

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