

HOSTED BY



Contents lists available at ScienceDirect

Journal of Acute Disease

journal homepage: www.jadweb.org



Document heading doi: 10.1016/S2221-6189(14)60049-4

Functional results of osteosynthesis with mini-plate and screws in metacarpal fractures

Hakan Başar^{1*}, Betül Başar², Abdullah Kırbız¹¹Department of Orthopaedics and Traumatology, Sakarya Training and Research Hospital, Sakarya, Turkey²Department of Physical Medicine and Rehabilitation, Akyazı State Hospital, Sakarya, Turkey

ARTICLE INFO

Article history:

Received 29 Dec 2014

Received in revised form 30 Dec 2014

Accepted 31 Dec 2014

Available online 2014

Keywords:

Metacarpal fracture

Mini-plate and screw fixation

Early mobilization

ABSTRACT

Objectives: To evaluate the radiological and functional results of osteosynthesis with mini-plate and screws in metacarpal fractures.

Methods: In our study 43 patients who were operated between 2009 and 2012 were included. The patients were followed-up for (19.76±5.61) months. The mean age of patients was (31.11±7.81) years (7 females, 36 males). The fracture types were oblique for 19 patients, spiral for 15 patients and transverse for 9 patients. The patients were operated after a mean of 3.4 d (range 3 h–6 d) after the fracture had occurred. Patients were immobilized for 2 weeks with a splint after surgery. Passive joint movements were started on the third days, and active joint movements were started in the second week. Rehabilitation of all patients was done in the same center with supervision of the same physiotherapist. The patients were assessed by total joint range of movement of the finger, grasping strength and Quick-DASH scores.

Results: No significant differences were detected between fingers of the operated hand with same finger of the healthy hand according to total joint range of movement. Total joint range of movement values were measured perfect for 38 patients, good for 4 patients and medium for 1 patient. There were no significant differences with the corresponding finger on the opposite healthy side according to grasping strength. Soiling in the wound dressing was observed in 1 patient but there was no active drainage. Soiling of the wound dressing disappeared after 3–5 d of treatment with antimicrobial agent. Bone union was observed in all patients in a mean of 6 weeks (range 5–7 weeks). The time to return to work was (31.6±8.9) d after the surgical treatment of the fracture.

Conclusions: Mini-plate and screws fixation of unstable metacarpal fractures produces anatomical reduction of fractures with stabilization that is rigid enough to allow early mobilization, thereby preventing stiffness and hence good functional results.

1. Introduction

Metacarpal fractures are a common presenting problem to the hand surgeon. During surgical treatment, anatomic

reduction is very important. A biomechanical cadaveric study shows that as much as 8% loss of grip power may result from every 2 mm of metacarpal shortening[1]. A few degrees of malrotation may lead to digital overlap when a fist is made[2].

Metacarpal fractures of hand are generally treated conservatively. Outcome of conservative treatment in displaced, irreducible, unstable and rotational fractures is poor. Surgical treatment is preferred in this type of

*Corresponding author: Hakan Başar, Department of Orthopaedics and Traumatology, Sakarya Training and Research Hospital, Sakarya, Turkey.

Tel: 90 505 441 86 08

E-mail: hbasar80@hotmail.com

fractures[3].

There are various surgical treatment techniques; however mini-plate and screws provide a rigid fixation. These implants neutralize rotational, torsion and shearing forces at the fracture area, thus enabling earlier, and stronger rehabilitation[4–6]. A rigid fixation enabling bone healing and early active finger motions is important in surgical treatment[7–9].

In the present study, we evaluated the outcomes of early mobilization of mini-plate and screws osteosynthesis of unstable extra-articular metacarpal fractures.

2. Materials and methods

A total of 43 patients who were operated with a diagnosis of displaced, irreducible, unstable metacarpal fractures between 2009 and 2012 were included in this study. Mini-plate and screws were used for internal fixation of these fractures. The patients were followed-up for (19.76 ± 5.61) months. The mean age of patients was (31.11 ± 7.81) years (7 females, 36 males). All fractures were closed extra-articular fractures, and intra-articular fractures and multiple metacarpal fractures were excluded from the study.

Thirty-one of the patients had a fracture in their dominant hands, while 12 had fractures in the non-dominant hands. The fracture types were oblique for 19 patients, spiral for 15 patients and transverse for 9 patients.

The patients were operated after a mean of 3.4 d (range 3 h–6 d) after the fracture had occurred. The surgical intervention in all patients was done with tourniquet homeostasis, with dorsal surgical approach. The fracture line was reached by displacing the extensor tendons to the radial and ulnar sides. The fracture ends were exposed by periosteal elevator, and then internal fixation was done with standard AO foundation techniques with mini-plate following surgical reduction (Figure 1). Patients treated with mini-plate were immobilized for 2 weeks with a splint after surgery. Passive joint movements were started on the third days, and active joint movements were started in the second week. Rehabilitation of all patients was done in the same center with supervision of the same physiotherapist.

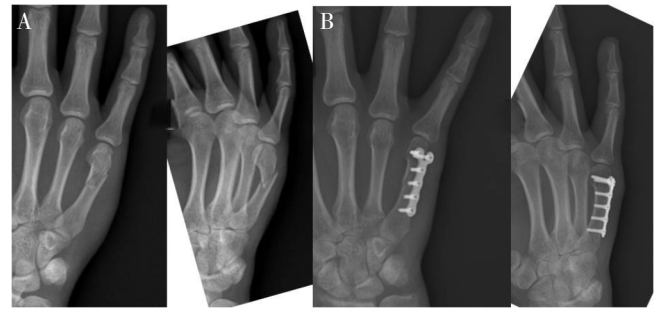


Figure 1. A: Preoperative radiographies; B: Postoperative radiographies of 5th metacarpal fracture at 33 years old patient.

The patients were assessed by total joint range of movement of the finger, grasping strength and Quick-DASH (disabilities of arm, shoulder and hand) scores. The total of range of movement of the metacarpophalangeal joint (normal: 0° – 85°), proximal interphalangeal joint (0° – 110°), and distal interphalangeal joint (0° – 65°) were added, in order to calculate total joint range of movement. 260° – 220° was considered perfect, 219° – 180° good, 179° – 130° medium, $<130^{\circ}$ was considered as a poor result[9]. The grasping strength of the finger was measured by a hand dynamometer (Jamari Preston, USA). The measurement was done 3 times for each finger, and the average of the measurements was used and this was compared with the corresponding finger on the opposite side for assessment of loss of strength.

In the statistical assessment, student's *t*-test was used in comparison of total joint range of motion and grasping strength.

3. Results

No complications of displacement in the fracture line, implant failure, distal loss of sense due to nerve damage, malunion and rupture of the extensor tendon, osteonecrosis and sudeck atrophies were observed in the postoperative follow-up of the patients. Soiling in the wound dressing was observed in only one patient but there was no active drainage. Soiling of the wound dressing disappeared after 3–5 d of treatment with antimicrobial agent. Bone union was observed in all patients in a mean of 6 weeks (range 5–7 weeks). The time to return to work was (31.6 ± 8.9) d after the surgical treatment of the fracture.

In the assessment of total joint range of movement values of patients at the last control examination, no

significant differences were detected between finger of the operated hand with same finger of the healthy hand ($P>0.05$). Total joint range of movement values were measured perfect for 38 patients, good for 4 patients and medium for 1 patient.

In the comparison of these two treatments in terms of grasping strength, there were no significant differences with the corresponding finger on the opposite healthy side ($P>0.05$).

4. Discussion

Most of metacarpal fractures are stable either before or after closed reduction and can be successfully treated by protective splintage and mobilization^[3]. On the other hand, results of protective splintage and mobilization of unstable metacarpal fractures are usually unsatisfactory.

Inappropriate treatment of metacarpal fractures may cause important problems in terms of patient satisfaction and functioning. Quality of life is negatively affected as a consequence of unsuccessful treatment^[9,10].

Internal fixation with Kirschner wire, tension band technique and isolated screws produces weaker fixation than mini-plate and screws. Mini-plate and screws fixation of unstable metacarpal fractures produces anatomical reduction of fractures with stabilization that is rigid enough to allow early mobilization, thereby preventing stiffness^[11,12].

During surgical dissection we should avoid soft tissue trauma and excessive periosteal stripping. Further, drilling and tapping should be carefully to avoid loosening of screw holes. Because repositioning of the plate or replacement with a longer plate may not be possible because of the limited bone length.

In the literature, several studies have reported satisfactory results with internal fixation of unstable metacarpal and phalangeal fractures using mini-plate and screws^[11]. The overall results in our study were similar to those above with good results achieved.

The stable fixation with mini-plate and screws provides good functional results. Active mobilization can be started immediately after surgery; edema, fibrosis and scar formation can be reduced; and tendon gliding can be preserved.

Conflict of interest statement

The authors report no conflict of interest.

References

- [1] Meunier MJ, Hentzen E, Ryan M, Shin AY, Lieber RL. Predicted effects of metacarpal shortening on interosseous muscle function. *J Hand Surg Am* 2004; **29**(4): 689–693.
- [2] Royle SG. Rotational deformity following metacarpal fracture. *J Hand Surg Br* 1990; **15**(1): 124–125.
- [3] Stern PJ. Fractures of the metacarpals and phalanges. In: Green DP, Hotchkiss RN, Pederson WC, Wolfe SW, editors. *Green's operative hand surgery. Vol 1*. 5th ed. Philadelphia: Elsevier Churchill Livingstone; 2005, p. 286–294.
- [4] Agarwal AK, Pickford MA. Experience with a new ultralow-profile osteosynthesis system for fractures of the metacarpal and phalanges. *Ann Plast Surg* 2006; **57**: 206–212.
- [5] Kawamura K, Chung KC. Fixation choices for closed simple unstable oblique phalangeal and metacarpal fractures. *Hand Clin* 2006; **22**: 287–295.
- [6] Nalbantoğlu U, Gereli A, Kocaoğlu B, Aktaş S, Seyhan M. [Surgical treatment of unstable fracture–dislocations of the proximal interphalangeal joint]. *Acta Orthop Traumatol Turc* 2007; **41**: 373–379. Turkish.
- [7] Adams JE, Miller T, Rizzo M. The biomechanics of fixation techniques for hand fractures. *Hand Clin* 2013; **29**: 493–500.
- [8] Carpenter S, Rohde RS. Treatment of phalangeal fractures. *Hand Clin* 2013; **29**: 519–534.
- [9] Freeland AE, Geissler WB, Weiss AP. Operative treatment of common displaced and unstable fractures of the hand. *J Bone Joint Surg Am* 2001; **83**: 928–945.
- [10] Bannasch H, Heermann AK, Iblher N, Momeni A, Schulte-Mönting J, Stark GB. Ten years stable internal fixation of metacarpal and phalangeal hand fractures–risk factor and outcome analysis show no increase of complications in the treatment of open compared with closed fractures. *J Trauma* 2010; **68**: 624–628.
- [11] Gupta R, Singh R, Siwach RC, Sangwan SS, Magu NK, Diwan R. Evaluation of surgical stabilization of metacarpal and phalangeal fractures of hand. *Indian J Orthop* 2007; **41**: 224–229.
- [12] Trevisan C, Morganti A, Casiraghi A, Marinoni EC. Low severity metacarpal and phalangeal fractures treated with miniature plates and screws. *Arch Orthop Trauma Surg* 2004; **124**: 675–680.