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Unstable Metacarpal Fractures: A comparative study between Mini-plates and percutaneus K-wire fixation at Emergency Hospital, Mansoura University, Egypt

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Abstract

Introduction: Management of metacarpal shaft fracture is dictated by the stability and personality of the fracture. It may be conservative or surgical. Surgical management of Metacarpal fractures has different techniques and different instruments.

Methods: The study included 40 patients presented at Emergency Hospital, Faculty of Medicine, Mansoura University, with 48 fractured metacarpals in 30 hands. 20 patients were fixed by open reduction and internal fixation using mini-plates, the other 20 patients were fixed by percutanous K wires.

Results: In this study, it was found that after 6 weeks of follow up, group A showed 93.3 % satisfactory results, while group B showed 86.7 % satisfactory results, while after 3 months of follow up both groups showed satisfactory and good results in 93.3 % of cases.

Conclusion: Mini-plates fixation in oblique and spiral fractures provide stable and rigid internal fixation that allows early active range of motion and early excellent results. Percutaneous K-wire fixation has the advantages of preserving the soft tissue.

Introduction

Metacarpal fractures comprise between 18–44 % of all hand fractures [1-3]. Most metacarpal fractures occur in the active and working population, particularly adolescents and young adults. Trauma to the hand is exceedingly common, frequently resulting in metacarpal, fractures and dislocations [3,4]. Appropriate treatment includes a thorough assessment, physical examination, and directed imaging. Such an approach should lead to a rational treatment plan that focuses on the rehabilitation of all damaged components, including osseous, articular, and soft tissue structures [5,6]. Management of metacarpal shaft fracture is dictated by the stability and personality of the fracture. Undisplaced fracture with any fracture configuration can be managed by conservative method with a slab or a splint immobilising the wrist in Extension and MP joint in flexion greater than 70° (Clam digger slab/cast), allowing early IP mobilisation. [7-11].

No absolute contraindications exist for treatment of metacarpal injuries. Almost all injuries are amenable to either immobilization, closed or open reduction, with or without fixation [12-14]. Disability from hand injury may result in loss of sensation, loss of strength and loss of flexibility, which are the chief functions of the hand. Prevention of disability from hand injuries is the primary goal of treatment. Maintenance of function rather than cosmesis is of paramount concern in the management of hand injuries. The most commonly reported complication is stiffness [15,16]. Extensor lag, infection, tendon rupture, malunion and non-union also are common [17] Infection rates in metacarpal fractures are low. Poor outcomes are directly correlated to the higher degrees of soft tissue injury and contamination [18-20].

Aim of the Work

Assessment of management of unstable oblique and spiral metacarpal fractures by open reduction and internal fixation using mini-plates compared to percutaneous Kirschner wire fixation.

Patients

The study included 40 patients presented at Emergency Hospital, Faculty of Medicine, Mansoura University, with 48 fractured metacarpals in 30 hands. 20 patients were fixed by open reduction and internal fixation using mini-plates (group A), the other 20 patients were fixed by percutanous K wires (group B).

Inclusion Criteria

i. Unstable spiral and oblique shaft fractures of all metacarpals

ii. Age >18 years old

iii. Recent metacarpal fractures

iv. Closed fractures

Exclusion Criteria

i. Comminuted shaft and condylar fractures

ii. Metacarpal fractures in children <18 years old

iii. Old Metacarpal fractures

iv. Open fractures

Type of Anaesthesia

General anaesthesia was used in 80% of patients in group A compared to 60% of patients in group B. on the other hand, regional anaesthesia was used in 20% of patients in group A compared to 40% of patients in group B.

Duration of the Surgery

Duration of the surgery ranged between 40 to 90 minutes in group A with a mean of 65 minutes, while in group B ranged between 10 to 45 minutes with a mean of 27.5 minutes.

Methods

Initial Assessment

40 Patients with unstable spiral and oblique fractures were seen at emergency room and thorough examination and assessment was conducted including:

History taking

The range of age of the patients was from 16 to 50 years old, 27 patients were males and 13 patients were females, 22 patients had hard manual or industrial work, while 18 patients had office jobs or domestic work.

Non-patients involved in the current study were diabetic, hypertensive nor having other debilitating diseases. 23 patients were injured by direct blow by a hard object and 3 others were injured during heavy duty exercises, while the remaining 14 patients were injured during road traffic accidents. 18 patients were assaulted by others, while the other 22 patients were accidentally injured.

Thorough clinical Examination

a. Local neurovascular assessment.

All patients in the current study had intact distal vascularity with average digital pulp capillary refill time (2-6 seconds) and neurologically free.

b. Assessment of the tendon and soft tissues integrity. All the patients in the current study had intact tendons of the hand flexor and extensor groups and intact soft tissue coverage.

Radiological Assessment

Two different pictures are usually taken of the hand: one from the back with the palm facing down (posteroanterior, or PA, view), one from the side (lateral view, or lat).

Management

i. First aid Treatment

All patients had temporarily splint for the affected part, using thumb spica for fractures of the first metacarpal and volar slab for fractures of the other metacarpals. Limb elevation with analgesics, anti-edematous measures were given until the time of operation.

Routine laboratory investigations were done before operation.

ii. Operative Treatment

a. The operation was done under general or local intravenous anaesthesia.

b. The patient was positioned supine.

c. Tourniquet was used in cases fixed by mini-plates.

d. Preparation and Draping.

e. Fluoroscopic guidance was used in all cases fixed by percutanous K-wires.

iii. Fixation by Mini-plates

Surgical Approach

a. Fracture of the shaft of the first Metacarpal

A dorsolateral incision was made to expose the fracture.

b. Fractures of the Second and Fifth Metacarpals

A dorsoradial and dorsoulnar longitudinal incisions respectively were made with a curve at the distal or proximal end (Figure 1).

c. Fractures of the third and fourth metacarpals

Figure 1: Surgical approaches for metacarpal fractures.

A longitudinal incision was made for these two bones, and also for internal fixation of combination of metacarpals when several bones were involved. They were placed between the metacarpal rays and were extended distally or proximally by a Y-shaped prolongation (Figure 1).

The superficial nerves and veins were identified and preserved. The extensor tendons with the paratendons were

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retracted. The periosteum was incised over the fracture in the longitudinal direction leaving as much as possible and preserving origins of the interosseous muscles. After surgical exposure, the fracture was opened, and the fracture line was inspected to determine the optimal position of the plates and the number of screws. Tourniquet was deflated with proper haemostasis for bleeding points. Closure of the skin. Postoperatively, a removable dorsal short arm splint was applied, and full wrist and finger motion exercises were encouraged. Sutures were removed within 14-16 days (Figures 2-4).

Figure 2: 2nd metacarpal fracture managed by mini-plate.

Figure 3: 1st metacarpal fracture managed by mini-plate.

Figure 4: 3rd and 4th metacarpal fracture managed by mini-plate.

iv. Fixation by Percutanous K-wires

Surgery was performed under fluoroscopic guidance. The fracture was reduced using the closed method, in which the metacarpophalangeal and proximal intrphalangeal joints are flexed to an angle of 90 degrees, and upward pressure with traction was applied on the flexed finger to correct dorsal angulation and rotational deformity. Once the fracture was reduced, a K-wire was inserted through the metacarpal head in the retrograde direction, while reduction is maintained. After insertion of the first K-wire, another K-wire was inserted in the same manner for angular and rotational fracture stability. Then, the wrist was maintained into a fully flexed position, and the wires were sequentially advanced farther through the dorsal subchondral bone of the metacarpal bone, soft tissue overlying the carpal bone, and dorsal skin. The distal end of the wires was just within the subchondral bone of the metacarpal head, clear of the articular surface. The wires were bent back distally the point of bending being where the wires emerged from the metacarpal. This bend takes the wires clear of the wrist joint.

Figure 5: 4th and 5th metacarpal fractures managed by k wire fixation.

Figure 6: 2nd metacarpal fracture managed by K wire fixation.

Postoperatively, a well-molded short arm slap, ulnar gutter or radial gutter in the intrinsic-plus position was applied for all the patients. Patients were encouraged to start full finger motion active and passive exercises within the splint the following day. Five weeks after surgery or when there were radiographic signs of bone healing, the wires were removed and patients were encouraged to perform wrist and finger motion exercises more vigorously without a splint (Figures 5 & 6).

Results

DASH Score

DASH score at final follow up (after 3 months) in group A was excellent in 13 patients (65%), good in 4 patients (20%),

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fair in 1 patient (5%) and poor in 2 patients (10%), while in group B, results were excellent in 16 patients (80%), good in 2 patients(10%), fair in 1 patient (5 %)and poor in 1 patient (5%) (Table 1) (Figure 7).

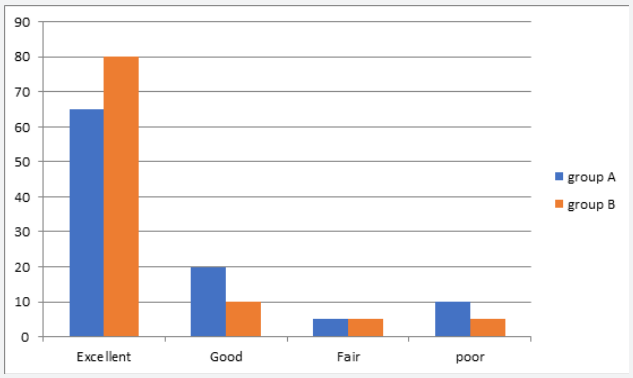

Figure 7: DASH score.

Table 1: Comparison between the two studied groups according to DASH score.

Dash score	Group A (n = 20)		Group B (n = 20)	
	N	%	N	%
Excellent	13	65	16	80
Good	4	20	2	10
Fair	1	5	1	5
Poor	2	10	1	5
Total	20	100	20	100

Union

In group A, time of union ranged between 4 and 5 weeks, however one patient did not achieve union. While in group B, time of union ranged between 6 and 7 weeks. Although the mean time of union was better in group A, the results were statistically insignificant (Table 2).

Table 2: Comparison between the two studied groups according to time of union.

Time of union	Group A (n = 20)		Group A (n = 20)	
	N	%	N	%
Non-united	1	5	2	10
4 weeks	2	10	1	5
5 weeks	13	65	4	20
6 weeks	3	15	9	45
7 weeks	1	5	4	20
Total	20	100	20	100

Hand grip

In group A, 14 patients had strong hand grip (70%), 5 patients had average hand grip (25%), one patient had weak hand grip (5%). While in group B, 13 patients had strong hand grip (65%), 5 patients had average hand grip (25%), 2 patients had weak hand grip (10%). Although the hand grip was better in group A, the results were statistically insignificant (Table 3) (Figure 8).

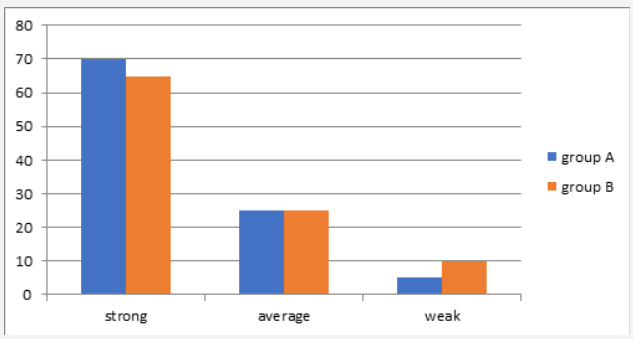

Figure 8: Hand grip.

Table 3: Comparison between the two studied groups according to hand grip.

Hand Grip	Group A (n = 20)		Group B (n = 20)	
	N	%	N	%
Strong	14	70	13	65
Average	5	25	5	25
Weak	1	5	2	10
Total	15	100	15	100

Final Results

In the present study, it was found that after 6 weeks of follow up, group A showed 93.3 % satisfactory results, while group B showed 86.7 % satisfactory results, while after 3 months of follow up both groups yielded satisfactory results in 93.3 % of cases. These results were comparable to the results of other studies:

As regard closed reduction and percutaneous intramedullary K-wire fixation, satisfactory results were reported by Elmaraghy and co-workers in 76 % of cases [21], while Eaton et al reported satisfactory results in 90 % of cases [22]. Segmuller et al. [23] in 1971, used open reduction and plate fixation and showed excellent results in 84.9% and poor in 15.1%.

Conclusion

There is no significant difference of the outcomes between mini-plates and percutaneous K-wires in management of unstable spiral and oblique metacarpal fractures. Mini-plates fixation in oblique and spiral fractures provide stable and rigid internal fixation that allows early active range of motion and early excellent results. Percutaneous K-wire fixation has the advantages of preserving the soft tissue.

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