

Research Article

Functional outcome of closed metacarpal shaft fractures treated with mini fragment plates

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Abstract: **Introduction:** Fractures of the metacarpal bones of the hand constitutes between 14-28% of all visits. This case series involves evaluating functional outcome of metacarpal fractures treated with miniplates and screws and have shown good functional results as compared to the conservative treatment or K –wire fixation. **Aim:** In this case series we assess Functional outcome of closed metacarpal fractures treated with plates and screws using the American Society for Surgery of the Hand (ASSH) and Total Active Flexion (TAF) score. **Materials and Methods:** Case Series of 10 patients with Metacarpal fractures treated at Navodaya Medical College Hospital and Research Centre. Study included 9 Male and 1 Female with a mean follow up of 12 months. All patients were treated with open reduction with plating technique. **Procedure:** All 10 patients were operated in Navodaya Medical College and hospital and were operated under brachial block. **Conclusion:** Plating technique for metacarpal fracture gives good functional results and should be considered as an effective, advanced surgical option in the treatment of metacarpal fractures. It is a suitable and best method for unstable metacarpal fractures.

Keywords: metacarpal fracture, mini fragment plates, hand fracture, osteosynthesis.

INTRODUCTION

Fractures of the metacarpal bones of the hand constitute between 14-28% of all visits to the hospital following trauma by various means like assault, road traffic accidents, industrial accidents, agricultural accidents etc. Hand fractures can be complicated by deformity from no treatment Stiffness from over treatment and Both deformity and stiffness from poor treatment . Fracture healing in the hand is not an isolated goal rather the functional result is of paramount importance. Recent studies have shown good functional results with surgical treatment of metacarpal fractures using miniplates and screws as compared to the conservative treatment or K wire fixation.

Aim: To evaluate functional outcome Of closed metacarpal shaft fractures treated with mini fragment plates.

MATERIALS AND METHODS

Sample Size: 10 cases

Study Duration: April 2022 to August 2023 Sampling

Procedure: Prospective study.

Method

Patients with metacarpal fractures are selected after clinical and radiological analysis.

- Detailed history and clinical examination was done. Investigations required for surgery was done.
- A pre anaesthetic evaluation was done.
- Pre-operative preparations were performed and informed written consent was taken.
- Follow ups - 6, 12 and 24 weeks were made.

INCLUSION CRITERIA:

- Age more than 18 years.
- Physical fitness for surgery
- Sex : Both male and female

EXCLUSION CRITERIA:

- Age less than 18 years.
- Patient not willing or medically unfit for surgery
- Compound injury

Results (Thumb)	Range of Motion
Excellent	> 120°
Good	100°-120°
Poor	< 100°

Results (2 nd , 3 rd , 4 th & 5 th Fingers)	Range of Motion
Excellent	> 220°
Good	180°-220°
Poor	< 180°

Operative Procedure:

Anaesthesia- General anaesthesia/ Brachial Block

Position: Patient supine with operative hand on arm board.

Surgical Procedure: OPEN REDUCTION INTERNAL FIXATION WITH PLATE OSTEOSYNTHESIS

Tourniquet was used in all the cases before surgery. Metacarpal fractures are approached by dorsal incision made on radial border for the first and second metacarpal, ulnar border for the fifth metacarpal. For the 3rd and 4th metacarpals the approach is made using a dorsal longitudinal incision made between these bones. Extensor tendons were retracted and anatomical reduction of the fracture fragments are carried out and reduction was held using point reduction forceps or a stabilizing K wire.

Plate configuration were chosen according to the fracture and fixed with screws.

Meticulous attention was carried out in soft tissue dissection and adequate soft tissue coverage (periosteum) was made over the plate to avoid irritation to overlying extensor tendon. Thorough wound wash was given and Splinting of the hand was done with a volar below elbow slab.

Intra-op Pictures:

Post-op care: Hand was kept in elevation for 24-48 hours for controlling pain and swelling. Wound was inspected at second post operative day. Thereafter, active mobilization of fingers started and increased progressively within the limits of pain tolerance. Patients were discharged on 5th post operative day and physiotherapy carried out on outpatient basis. Sutures were removed on the 10th postoperative day.

Follow up was done at 4th, 6th and 8th weeks and assessed for clinical progress in terms of range of movements and radiological evaluation done to note fracture union or any loss of reduction.

Clinical pictures:

Case 1:

Pre-Operative Radiograph



Post-Operative Radiograph



Case 2:

Pre-Operative Radiograph



1 year follow-up Radiograph



1 year follow-up scar



Range of motion of same digit



RESULTS

A total of 86 patients undergoing emergency laparotomy were assessed for eligibility. Four patients did not meet the 20 patients were included in this study. 6 patients had multiple metacarpal fractures (30% cases). Right hand was involved in 11 of the patients (55%). 2 out of 20 were female patients (20%). All the 20 patients who underwent open reduction and internal fixation with plate osteosynthesis for unstable metacarpal fractures achieved bone union (100%). In most of the cases bony union was seen between 6-8 weeks, average period being 7.2 weeks (range 6-12 weeks). Spiral and oblique fractures united at 6 weeks, transverse and comminuted fractures united at around 8 weeks.

Functional outcome assessed by ASSH (American Society for Surgery of the Hand) TAF (Total Active Flexion) score was excellent in 16 patients (80%), good in 2 patients (10%), fair in one patient (5%), poor in one patient (5%). The overall results are satisfactory. 2 patients developed superficial wound infection, both were the case of multiple metacarpal fractures (both of these case had involvement of two metacarpal).

Both these cases with superficial infection settled with daily dressing and antibiotics. 2 patients had stiffness of metacarpophalangeal and interphalangeal joints and both were cases of multiple metacarpal fractures for whom physiotherapy was continued and patients showed improved range of motion, and the results in these patients are fair & poor. 103 None of the patients in our study developed tendon irritation, this is due to extra cautious effort taken to cover the plate (low profile plate) with soft tissue (periosteum) for free gliding of overlying extensor tendon. No cases had angular or rotational displacement of fractures. No cases had implant breakage. None of the patients required implant removal.

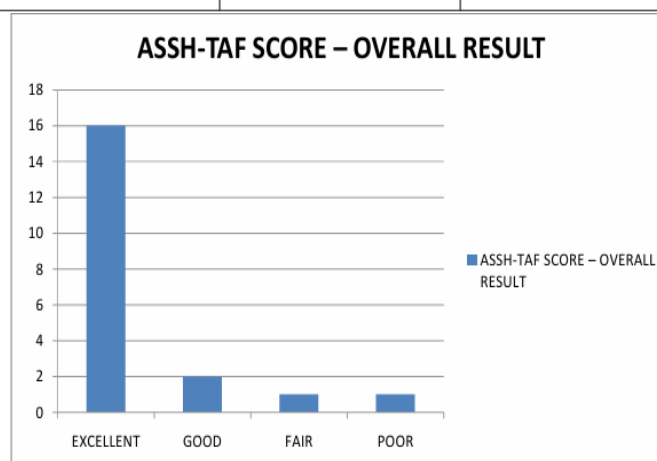
ANALYSIS OF FUNCTIONAL OUTCOME:

The functional outcome was assessed using AMERICAN SOCIETY FOR SURGERY OF THE HAND (ASSH) TOTAL ACTIVE

FLEXION SCORE (TAF) and the following results were obtained.

ASSH-TAF SCORE – OVERALL RESULT:

GRADING	NO OF CASES	PERCENTAGE
EXCELLENT	16	80
GOOD	2	10
FAIR	1	5
POOR	1	5



DISCUSSION

Most of the metacarpal fractures are stable before or after closed reduction and are managed successfully by conservative method of protective splinting followed by early mobilization (33, 34). Only a small percentage of metacarpal fractures are unstable and in these patients the functional results following closed treatment are unsatisfactory. These are the cases indicated for open reduction and internal fixation which are usually less than 5 % of hand fractures (8, 35). James et al (36) reported that closed method used in treatment of unstable fractures had loss of function in 77 % of fingers. Open reduction and internal fixation with K wire(1) is one of the treatment modalities in these unstable fractures but they provide less rigid fixation and are rotationally unstable, there is increased association of pin tract infection and problems due to protruding ends of K-wire are significant. Interosseous wiring with K- wire although provides rigid fixation equivalent to plating are useful only in transverse diaphyseal fractures. Metacarpal fractures can be fixed with external fixator (37-41). Report by Shehadi et al (38) showed full return of total range of motions in up to 100% of metacarpal fractures treated with external fixator. This mode of fixation is useful in compound metacarpal fractures with bone loss. But the routine use of external fixator is discouraged as there is loosening of construct following pin tract infection leading to loss of fixation and there is difficulty in constructing and applying the

fixator. Intramedullary fixation with prebent K- wires were used for transverse and short oblique fractures (42, 43, 44, 45). They provide comparable functional outcome with plate and screw fixation. But there is incidence of loss of reduction, penetration of metacarpophalangeal joint by hardware, thus necessitating a second surgery for hardware removal. There are many literature studies showing satisfactory results of unstable metacarpal and phalangeal fractures treated with AO miniplate and screws (46-57). A study by Souer et al (58) showed good functional outcome by total active motion more than 230 degree in 18 of 19 patients for whom plate fixation was done in closed unstable metacarpal fractures. Another study by Gupta et al (1) showed excellent functional outcome with total active movements more than 230 degree in all of his patients of unstable metacarpal fractures treated with plate fixation. Another study by Dabezies Schutte (50) showed no complication in 27 unstable metacarpal fractures treated with plate fixation. Low complication rate seen in our study was similar to these results. In our study on 20 patients, 2 patients developed superficial wound infection. In both of these cases of superficial infection, there was wound discharge on second post-operative day which settled with daily dressing and antibiotics and this does not affect the final outcome. 2 Patients with multiple 107 metacarpal fractures developed finger stiffness and one case had fractures in all the four metacarpals and the other had fracture involving two metacarpals. Eventually all patients had

improved ROM following physiotherapy. In unstable metacarpal fractures, plate fixation is a better option for several reasons (32): 1) They provide stable fixation in all unstable metacarpal fractures thus allowing early mobilization of fingers 2) Shortening seen in multiple metacarpal fractures which are corrected by plating restores the power of interossei muscle thereby retaining the grip strength of hand. 3) Multiple metacarpal fractures are usually associated with severe soft tissue injury. In these unstable metacarpal fractures, treatment with plate osteosynthesis provides anatomical reduction of fracture with rigid stabilization allowing early mobilization of joints without loss of reduction thus preventing stiffness and yields good functional results. In our study of unstable metacarpal fractures treated with plate osteosynthesis all the cases showed bone union (100%). The functional result assessed by American Society For Surgery Of The Hand (ASSH) Total Active Flexion score showed excellent result in 80% of the patients (16 of 20 cases), good in 10% of cases (2 of 20 cases). Stable and rigid fixation provided by mini plates and 108 screws allowed early mobilization of fingers thereby preventing stiffness and achieved overall good functional results. Although there were 10% (2 cases) of superficial infection, all settled with regular dressing and antibiotics without affecting final functional outcome.

CONCLUSION

Plate and screw fixation is a good option for treating closed unstable metacarpal fractures, where other modalities of fixation are less effective, the rigid stable fixation provided by plating which withstands load without failure allowed early mobilization and achieved good functional results. Detailed clinical and radiological assessment of fracture, careful preoperative planning, meticulous dissection, precision in surgical technique (coverage of plate with soft tissue) and choosing the correct implant (low profile plate) are critical in achieving good results and minimising the complication.

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