

FUNCTIONAL OUTCOME OF CLOSED METACARPAL FRACTURES TREATED WITH MINI PLATES AND SCREWS – A PROSPECTIVE STUDY

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ABSTRACT

Background: Fractures of the bones of the hand are among the commonest fractures in humans but their management varies widely in different regions of the world. The variability is due to many reasons including availability of resources, social factors, geographic constraints, surgeon's preference and experience and local practice patterns. Hand fractures constitute 14 to 28% of all visits to hospital following trauma by various means. These fractures are often neglected or treated as minor injury and results in major disability. **Methods:** This study included 20 patients with closed unstable metacarpal fractures which were openly reduced and fixed with mini plating and screws at Rajah Muthiah Medical College. The outcome was analysed with special emphasis on active movement of fingers at metacarpophalangeal and interphalangeal joints. **Results:** We assessed the functional outcome with American Society for Surgery of the Hand (ASSH) score and Total Active Flexion (TAF) score. 100% union achieved in all cases with average period of union as 7.2 weeks, functional outcome was excellent in 80%, good in 10%, fair in 5% and poor in 5%. 2 persons developed complications of which one had infection and the other had joint stiffness. **Conclusion:** Plate and screw fixation is a good option for treating closed unstable metacarpal fractures as it allows early mobilisation and good functional results provided detailed clinical and radiological assessment of the fracture, careful pre operative planning, meticulous dissection, precision in surgical technique and choosing the correct implant are strictly followed.

Keywords: Metacarpal Fractures, Mini Plates, Screws

1. INTRODUCTION

Fractures of the bones of the hand are among the commonest fractures in humans, but their management varies widely in the different regions of the world. This variability is due to many reasons, including availability of resources, social factors, geographic constraints, surgeon preference and experience, and local practice patterns. Developing countries are more likely to apply less expensive methods of managing hand fractures.

Fractures of the metacarpal bones of the hand constitutes between 14-28% of all visits to the hospital following trauma by various means like assault, road traffic accidents, industrial accidents, agricultural accidents etc (Gupta et al., 2007).

Too often these metacarpal fractures are neglected or treated as minor injuries and results in major disability and deformity with permanent disability and handicap (Dejonge et al., 1994; Kamath et al., 2011).

Hand fractures can be complicated by deformity from no treatment, stiffness from over treatment and both deformity and stiffness from poor treatment (Barton, 1996). Fracture healing in the hand is not an isolated goal; rather the functional result is of paramount importance (Brenwald, 1987).

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. This study involves evaluating functional outcome of metacarpal fractures treated with miniplates and screws (Ozer et al., 2008).

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OBJECTIVES OF THE STUDY

1. To study the various mechanism and pattern of metacarpal fractures and their surgical management with plates & screws
2. To study the functional outcome of metacarpal fractures treated surgically.
3. To study the technical difficulties and complications of metacarpal fractures treated surgically.

Inclusion criteria:

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

Exclusion criteria:

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

Indications:

Indications for plate fixation of the metacarpals are

1. Multiple fractures with gross displacement
2. Displaced diaphyseal transverse, short oblique, or short spiral fractures
3. Comminuted intraarticular and periarticular fractures - displaced
4. Comminuted fractures with shortening or malrotation or both

2. MATERIALS AND METHODOLOGY

Adult patients with metacarpal fractures admitted to RAJAH MUTHIAH MEDICAL COLLEGE AND HOSPITAL, CHIDAMBARAM was taken up for study after obtaining the consent. Period of study: From June 2015 to Aug 2016.

All the patients selected for study was examined according to protocol, associated injuries noted and clinical and lab investigations carried out in order to get fitness for surgery

Consent of the patient was taken for surgery. Patient was followed till Union was achieved Clinically as well as Radiologically.

Time required for union, range of motion of surrounding joints and complications occurred before / during / after surgery was studied in detail. 20 cases were studied without any sampling procedure.

Metacarpal fractures are common in adolescents and young active individuals. functional outcome of these fractures depend upon severity of injury and the achievement of treatment. mostly these are treated by conservative methods, unstable fractures where closed reduction and final outcome are unsatisfactory are treated by operative measures. there are multiple surgical options for treating metacarpal fractures like K-wire fixation, interosseous wiring, plate osteosynthesis.

In this study we assessed Functional outcome of closed metacarpal fractures treated with plates and screws using the

American Society for Surgery of the Hand (ASSH) Total Active Flexion (TAF) score.

IMPLANT PROFILE

1 mm AO mini plate

Composition: stainless steel. AO stainless steel implants are produced from implant quality 316L stainless steel which typically contains iron (62.5%), chromium (14.5%), nickel 2.8%), molybdenum and minor alloy elements

Length: range from 28mm to 50mm

Breadth: 5mm

Thickness: 1mm

Holes: 4-8 holed

Configuration: straight plate (for shaft fractures), L – plate & T – plate (for periarticular fractures)

Type: noncompression

Screws composition – stainless steel

Screw type: non self tapping type, round headed with single slot

Screw pitch: 0.5mm

Screw length: 8-16mm

3. RESULTS

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 were fair & poor.

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.

PRE OP CLINICAL PICTURES POST OP



Extension of MCP and IP joints

Flexion of MCP and IP joints



Grip Strength

Pinch Strength



4. 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 (Barton, 1989; Wright, 1968). 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 (Stern, 1999; Amadio, 1991). James et al (1962) 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 (Gupta et al., 2007) 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 (Parsons et al., 1992; Shehadi, 1991; Schuind et al., 1991; Pritsch, et al., 1981; Buchler, 1994). Report by Shehadi et al⁽¹³⁾ 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 (Stern, 2000).

Intramedullary fixation with prebent K-wires was used for transverse and short oblique fractures (Gonzalez, 1995; Orbay et al., 2002; Gonzalez and Hall, 1996; Itadera et al., 2008). 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 (Chen et al., 1994; Ford et al., 1987; Dabezies and Schutte, 1986; Buchler and Fischer, 1987; Diwaker and Stothard, 1986; Hastings and Carroll, 1988; Melone, 1986; Stern et al., 1987; Thakore, 1986; Trevisan et al., 2004). A study by Souer and Mudgal (2008) 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 (2007) 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 and Schutte, (1986) 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 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 (Soni et al., 2012).

- 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 screws allowed early mobilization of fingers thereby preventing stiffness and achieve 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.

5. 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 and careful preoperative planning, meticulous dissection and 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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