



A Study on Functional Outcome of Various Modalities of Internal Fixation of Metacarpal and Phalangeal Fractures of Hand - 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 40 patients with unstable metacarpal and phalangeal fractures which were internally fixed by various modalities 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%. 8 persons developed complications of which 4 had infection and the other 4 had joint stiffness.

Conclusion: Various modalities of internal fixation is a good option for treating unstable metacarpal and phalangeal 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.

BACKGROUND

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.

Too often these metacarpal and phalangeal fractures are neglected or treated as minor injuries and results in major disability and deformity with permanent disability and handicap.

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 and phalangeal fractures using various modalities of internal fixation compared to the conservative treatment. This study involves evaluating functional outcome of metacarpal and phalangeal fractures treated by various modalities of internal fixation.

OBJECTIVES OF THE STUDY

1. To study the various mechanism and pattern of metacarpal and phalangeal fractures and their surgical management by various modalities.
2. To study the functional outcome of metacarpal and phalangeal fractures treated by various modalities of internal fixation.
3. To study the technical difficulties and complications of metacarpal and phalangeal fractures treated surgically.

Inclusion Criteria

1. Age more than 13 to 70 years.
2. Physical fitness for surgery.
3. Sex : Both male and female.
4. All cases of fractures of metacarpals and phalanges of hand.

Exclusion Criteria

1. Age less than 13 years.
2. Patient not willing or medically unfit for surgery.
3. Undisplaced hairline fractures.

Indications

Indications for various modalities of internal fixation of the metacarpals and phalanges of hand are

1. Acute/Late, Unilateral/Bilateral, Metacarpal/ Phalangeal fractures of hand.
2. Patients who are younger and active groups.
3. Patients who wants quick return to work.
4. Patients having unstable, irreducible metacarpal and phalangeal fractures of hand with displacement >5mm, angulation >30° and rotational instability >10°.
5. Long oblique spiral fractures of metacarpals and phalanges.
6. Fractures with intraarticular extension.

AIM

Metacarpal and phalangeal 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 and phalangeal fractures like K-wire fixation, interosseous wiring, cerclage wiring and plate osteosynthesis.

In this study we assess Functional outcome of metacarpal and phalangeal fractures treated by various modalities of internal fixation using the American Society for Surgery of the Hand (ASSH) and Total Active Flexion (TAF) score-a prospective study

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: non compression

Screws composition – stainless steel

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

Screw pitch: 0.5mm

Screw length: 8-16mm

K-Wires :1.2mm to 2.5mm

SS Wires

Instruments Used:

Drill bit

- composition: stainless steel
- diameter: 1mm

Drill used: power drill with RPM: 20,000-30,000

Coolant: external saline irrigation

Tap: stainless steel, 2mm diameter

Plating kit:

- Reduction clamps
- Plate holding forceps
- Screw holder
- Screw driver
- Bone spike
- Periosteal elevator
- Mini retractors

MATERIAL AND METHODS

Source of Data:

Patients with metacarpal and phalangeal fractures admitted to RAJAH MUTHIAH MEDICAL COLLEGE & HOSPITAL, ANNAMALAI UNIVERSITY, CHIDAMBARAM will be taken up for study after obtaining the consent.

Period of study: From JUNE 2015 to SEP 2016.

DESIGN OF THE STUDY: Prospective

METHOD OF COLLECTION OF DATA

Patients with metacarpal and phalangeal fractures are selected after clinical and radiological analysis during the period of study from June 2015 to Sep 2016.

All the patients selected for study will be 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 will be taken for surgery. Patient will be followed till Union is achieved Clinically as well as Radiologically.

Time required for union, range of motion of surrounding joints and complications occurred before / during / after surgery will be studied in detail.

Minimum of 40 cases will be studied without any sampling procedure

RESULTS

40 patients were included in this study. 12 patients had multiple metacarpal and phalangeal fractures (30% cases). Right hand was involved in 22 of the patients (55%). 4 out of 40 were female patients (10%). All the 40 patients who underwent various modalities of internal fixation for unstable metacarpal and phalangeal 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 32 patients (80%), good in 4 patients (10%), fair in 2 patients (5%), poor in 2 patients (5%). The overall results are satisfactory.

4 patients developed superficial wound infection, both were the case of multiple metacarpal and phalangeal fractures. Both these cases with superficial infection settled with daily dressing and antibiotics. 4 patients had stiffness of metacarpo phalangeal and interphalangeal joints and all were cases of multiple metacarpal and phalangeal fractures for whom physiotherapy was continued and patients showed improved range of motion, and the results in these patients are fair & poor.

DISCUSSION

Most of the metacarpal and phalangeal fractures are stable before or after closed reduction are managed successfully by conservative method of protective splinting followed by early mobilization. Only a small percentage of metacarpal and phalangeal fractures are unstable and in these patients the functional results following conservative treatment are unsatisfactory. These are the cases indicated for various modalities of internal fixation which are usually less than 5 % of hand fractures. James et al reported that conservative method used in treatment of unstable fractures had loss of function in 77 % of fingers.

Closed reduction / Open reduction and internal fixation with K wire is one of the treatment modalities in these unstable fractures. 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. Report by Shehadi et al 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. They provide comparable functional outcome with plate and screw fixation. But there is incidence of loss of reduction, penetration of metacarpo phalangeal 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 various modalities of internal fixation of metacarpal and

phalangeal fractures. A study by Souer et al 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 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 DabeziesSchutte 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 40 patients, 4 patients developed superficial wound infection. In all 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. Four Patients with multiple metacarpal and phalangeal fractures developed finger stiffness. Eventually all patients had improved ROM following physiotherapy.

In unstable metacarpal and phalangeal fractures, various modalities of internal fixation is a better option for several reasons:

They provide stable fixation in all unstable metacarpal and phalangeal fractures thus allowing early mobilization of fingers

Shortening seen in multiple metacarpal and phalangeal fractures which are corrected by various modalities of internal fixation restores the power of interossei muscle thereby retaining the grip strength of hand.

Multiple metacarpal and phalangeal fractures are usually associated with severe soft tissue injury. In these unstable metacarpal and phalangeal fractures, treatment by various modalities of internal fixation 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 and phalangeal fractures treated by various modalities of internal fixation, all the cases showed bone union (100%). The functional result assessed by

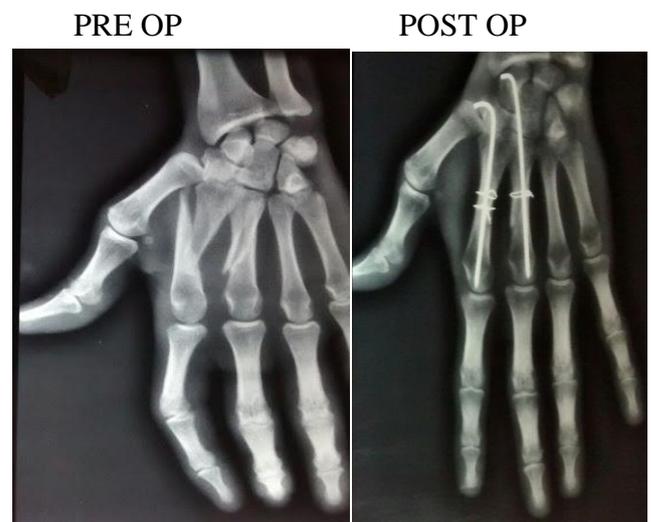
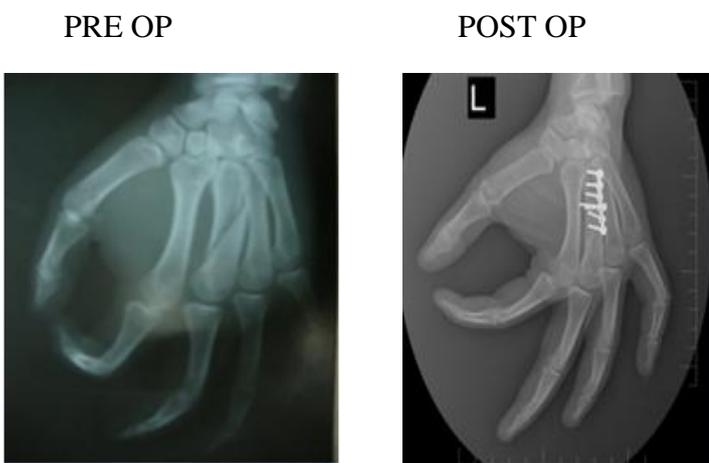
American Society For Surgery Of The Hand (ASSH) Total Active Flexion score showed excellent results in 80% of the patients (32 of 40 cases), good in 10% of cases (4 of 40 cases). Stable and rigid fixation provided by various modalities of internal fixation allowed early mobilization of fingers thereby preventing stiffness and achieve overall good functional results. Although there were 10% (4 cases) of superficial infection, all settled with regular dressing and antibiotics without affecting final functional outcome.

CONCLUSION

Internal fixation by various modalities is a good option for treating unstable metacarpal and phalangeal fractures, where conservative measures are less effective, the rigid stable fixation provided by various modalities of internal fixation 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 and choosing the correct implant are critical in achieving good results and minimising the complication.

CLINICAL PICTURES



REFERENCES

1. Gupta R, Singh R, Siwach RC, Sangwan SS. Evaluation of surgical stabilization of metacarpal and phalangeal fractures of hand. *Indian J Orthop* 2007;41(3);224-29
2. deJonge JJ, Kingma j, van der Lei B. Fractures of the metacarpals. A retrospective analysis of incidence and etiology and a review of the English-language literature. *Injury* 1994;25:365-9
3. Kamath JB, Harshvardhan, Naik DM, Bansal A. Current concepts in managing fractures of metacarpal and phalanges. *Indian J PlastSurg* 2011; 44: 203-11.

4. Barton NJ. Fractures and joint injuries of hand. In : Wilson JN editor. Watson – Jones fractures and joints injuries. 6thedn Vo. II Churchill Livingstone Pvt. Ltd, New Delhi 1996:p.739-88.
5. Brenwald J (1987) Bone healing in the hand. *ClinOrthopRelat Res* 214:7-10
6. Stern PJ (1999) Fractures of the metacarpals and phalanges. In: Green DP (ed) *Operative hand surgery*, vol 1. Churchill Livingstone, New York, pp 711–77
7. Stern PJ: Management of fractures of the hand over the last 25 years. *J Hand Surg [Am]* 2000; 25:817-823.
8. AswiniSoni, AnmolGulati, J.L Basi: outcome of closed ipsilateral metacarpal fractures treated with minifragment plates and screws: a prospective study: *J orthopaedTraumatol* (2012) 13: 29-33
9. Barton N (1989) Conservative treatment of articular fractures in the hand. *J Hand Surg Am* 14:386–390
10. Wright TA (1968) Early mobilization in fractures of the metacarpals and phalanges. *Can J Surg* 11:491–498
11. Amadio PC (1991) Fractures of the hand and the wrist. In: Jupiter JB (ed) *Flynn’s hand surgery*. Williams & Wilkins, Baltimore, pp 122–185
12. James JIP (1962) Fractures of the proximal and middle phalanges of the fingers. *ActaOrthopScand* 32:401–412
13. Parsons SW, Fitzgerald JA, Shearer JR (1992) External fixation of unstable metacarpal and phalangeal fractures. *J Hand Surg Br* 17(2):151–155
14. Shehadi SI (1991) External fixation of metacarpal and phalangeal fractures. *J Hand Surg Am* 16(3):544–550
15. Schuind F, Donkerwolcke M, Burny F (1991) External minifixation for treatment of closed fractures of the metacarpal bones. *JOrthop Trauma* 5(2):146–152
16. Pritsch M, Engel J, Farin I (1981) Manipulation and external fixation of metacarpal fractures. *J Bone Joint Surg Am* 63(8):1289–1291
17. Buchler U (1994) The small AO external fixator in hand surgery. *Injury* 25 (Suppl 4):S-D55-63
18. Gonzalez MH, Igram CM, Hall RF (1995) Flexible intramedullary nailing for metacarpal fractures. *J Hand Surg* 20:382-387
19. Orbay JL, Indriago I, Gonzalez E et al (2002) Percutaneous fixation of metacarpal fractures. *Op Tech Plast Reconstruct Surg* 9:138–142
20. Gonzalez MH, Hall RF Jr (1996) Intramedullary fixation of metacarpal and proximal phalangeal fractures of the hand. *ClinOrthopRelat Res* 327:47–54
21. Itadera E, Hiwatari R, Moriya H et al (2008) Closed intramedullary fixation for metacarpal fractures using J-shaped nail. *Hand Surg* 13(3):139–145
22. Chen SH, Wei FC, Chen HC et al (1994) Miniature plates and screws in acute complex hand injury. *J Trauma* 37:237–242
23. Ford DJ, el-Hadidi S, Lunn PG et al (1987) Fractures of the metacarpals: treatment by A. O. screw and plate fixation. *J Hand Surg Br* 12:34–37
24. Dabezies EJ, Schutte JP (1986) Fixation of metacarpal and phalangeal fractures with miniature plates and screws. *J Hand Surg Am* 11:283–288
25. Bu‘chler U, Fischer T (1987) Use of a minicondylar plate for metacarpal and phalangeal periarticular injuries. *ClinOrthopRelat Res* 214:53–58
26. Diwaker HN, Stothard J (1986) The role of internal fixation in closed fractures of the proximal phalanges and metacarpals in adults. *J Hand Surg Br* 11:103–108
27. Hastings H 2nd, Carroll C 4th (1988) Treatment of closed articular fractures of the metacarpophalangeal and proximal interphalangeal joints. *Hand Clin* 4:503–527

28. Melone CP Jr (1986) Rigid fixation of phalangeal and metacarpal fractures. OrthopClin North Am 17:421–435
29. Stern PJ, Wieser MJ, Reilly DG (1987) Complications of plate fixation in the hand skeleton. ClinOrthopRelat Res 214:59–65
30. Thakore HK (1986) Osteosynthesis for the unstable fracture of the hand. J Hand Surg Br 11:417–421
31. Trevisan C, Morganti A, Casiraghi A et al (2004) Low severity metacarpal and phalangeal fractures treated with miniature plates and screws. Arch Orthop Trauma Surg 124:675–680
32. Souer JS, Mudgal CS (2008) Plate fixation in closed ipsilateral multiple metacarpal fractures. J Hand SurgEur 33(6):740–744