ORIGINAL RESEARCH PAPER

Volume-8 | Issue-7 | July - 2019 | PRINT ISSN No. 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

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

Orthopaedics

Dr. J. Maheswaran* MS Ortho, Assisstant professor of Orthopaedics , Madurai Medical College , Madurai *Corresponding Author

Dr. V. Mohanakrishnan Junior Resident , Department of Orthopaedics, Madurai Medical College , Madurai

ABSTRACT

Nowhere in the body are form and function more closely related than in the hand. Often these metacarpal fractures are treated as minor injuries causing major functional disability. In order to maintain hand function man's most important tool, the treatment of choice in recent years has shifted from predominantly conservative measures to more surgical procedures. Unstable metacarpal fractures require internal fixation. Long term follow up depends upon fracture angulation & rotation .Rotation of the digit impairs- functional grip and can be a source of chronic pain. Metacarpal shortening affects interosseous function with a 10mm loss of length corresponding up to 55% muscle power loss.Hand function – affected by 1) Angulation of the fracture greater than 30 degrees , 2) Rotational deformity greater than 10 degrees , 3) Gross shortening of the metacarpal >5mm Many factors such as delicate handling of tissues, preservation of gliding planes for tendons, prevention of infection, early and appropriate physiotherapy other than accurate reduction and fixation affect recovery of good mobility.This study includes 20 cases all of whom were adults. Closed unstable metacarpal fractures were selected. The outcome was analysed with special emphasis on active movement of fingers at metacarpophalangeal and interphalangeal joints. 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 .

KEYWORDS

Fracture , metacarpal fractures, mini fragment plates and screws

1. INTRODUCTION

Fractures of 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[1].Too often these metacarpal fractures are neglected or treated as minor injuries and results in major disability and deformity with permanent disability and handicap [2, 3].Hand fractures can be complicated by deformity from no treatment, stiffness from over treatment and both deformity and stiffness from poor treatment [4]. Fracture healing in the hand is not an isolated goal rather the functional result is of paramount importance [5].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 [6].

2.AIM OF THE STUDY

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, plateosteo synthesis, etc.In this study we assess 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 - a prospective 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

3.MATERIAL AND METHODS

SOURCE OF DATA : Adult patients with metacarpal fractures admitted to GOVT RAJAJI HOSPITAL, MADURAI will be taken up for study after obtaining the consent.

DESIGN OF THE STUDY: Prospective

METHOD OF COLLECTION OF DATA: Patients with metacarpal fractures are selected after clinical and radiological analysis during the period of study from Sep 2012 to Sep 2014All 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 20 cases will be studied without any sampling procedure

PRE OPERATIVE PREPARATION:

Base line blood investigations, x-rays –pre op,post op

A minimum of two views – anteroposterior and oblique – are mandatory for assessing:

1. Degree of angulation
2. Amount of shortening
3. Presence of comminution

PROCEDURE AND POSTOPERATIVE PROTOCOL

All patients were admitted in casualty department and were resuscitated. If there were any major associated injuries they were treated accordingly at first. After the general condition of the patient improved, radiographs – anteroposterior and oblique views were taken. Fracture reduced in closed manner at first under sedation and volar below elbow slab was applied. Unstable fractures were taken up for surgery – open reduction and internal fixation with plate osteosynthesis. Most of the cases were taken up for surgery on the 1st or 2nd day of admission. Patient who were associated with major injuries were taken up for surgery between 5 to 7 days after admission.

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. Then extensor

tendons were retracted and anatomical reduction of the fracture fragments are carried out. Reduction is held using point reduction forceps or a stabilizing K wire. Interfragmentary lag screws were used in long spiral and oblique fractures. Plate configuration were chosen according to the fracture pattern (straight plate for shaft fractures, T or L configured plates were used for periarticular fractures) 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 wound closed without drain. Splinting of the hand was done with a volar below elbow slab.

POST OPERATIVE PROTOCOL

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 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.

4.RESULTS

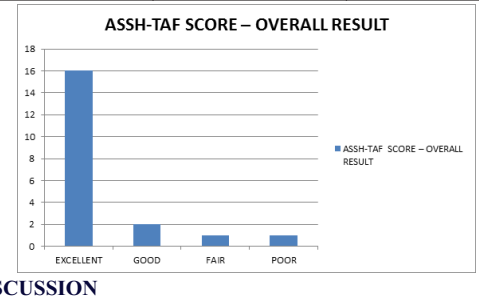
20 patients were included in this study. 6 patients had multiple metacarpal fractures (30% cases). Right hand was involved in 11 of the patients (55%). 2 out of 20 were female patients (20%). All the 20 patients who underwent open reduction and internal fixation with plate osteosynthesis for unstable 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 are 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.

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



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 [7, 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 [12]. 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 [48-57]. 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 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 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. 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

6. 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. de Jonge 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 Plast Surg 2011; 44: 203-11.
4. Barton NJ. Fractures and joint injuries of hand. In : Wilson JN editor. Watson – Jones fractures and joints injures. 6th edn Vo. II Churchill Livingstone Pvt. Ltd, New Delhi 1996:p.739-88.
5. Brenwald J (1987) Bone healing in the hand. Clin Orthop Relat Res 214:7-10
6. Ozer K, Gillani S, Williams A et al (2008) Comparison ofintramedullary nailing versus plate-screw fixation of extra-articular metacarpal fractures. J Hand Surg Am 33(10):1724–1731
7. 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
8. Linschied RL Kinematic consideration of the wrist. Clin Orthop Relat Res 1986:202:27-39
9. McMurtry RY, Youm Y Flatt AE et al Kinematics of wrist II: Clinical application s Journal of Bone and Joint Surgery 1978; 60-A 955-61
10. McQueen MM Gelbke MK Wakefield A et al, Percutaneous oufixation versus conservative treatment for the fractures of the waist of scaphoid. A prospective randomised study: Journal of Bone and Joint Surgery Br 2008; 90: 60-71
11. Swanson AB: Fractures involving the digits of the hand. Orthop Clin North Am 1970; 1:261-274.
12. Stern PJ: Management of fractures of the hand over the last 25 years. J Hand Surg [Am] 2000; 25:817-823.
13. McElfresh EC, Dobyns JH: Intra-articular metacarpal head fractures. J Hand Surg [Am] 1983; 8:383-393.
14. Jahss SA: Fractures of the metacarpals: a new method of reduction and immobilization. J Bone Joint Surg Am 1938; 20:178-186.
15. Foucher G: "Bouquet" osteosynthesis in metacarpal neck fractures: a series of 66 patients. J Hand Surg [Am] 1995; 20(3 pt 2):S86-S90.
16. Ouellette EA, Freeland AE: Use of the minicondylar plate in metacarpal and phalangeal fractures. Clin Orthop Relat Res 1996; 327:38-46
17. Burkhalter WE, Reyes FA: Closed treatment of fractures of the hand. Bull Hosp Jt Dis Orthop Inst 1984; 44:145-162.
18. Wilson RL, Carter MS: Management of hand fractures. In: Hunter JM, Schneider LH, Mackin EJ, et al ed. Rehabilitation of the Hand, St. Louis: CV Mosby; 1978:180-194
19. Melone Jr CP: Rigid fixation of phalangeal and metacarpal fractures. Orthop Clin North Am 1986; 17:421-435.
20. Gropper PT, Bowen V: Cerclage wiring of metacarpal fractures. Clin Orthop Relat Res 1984; 188:203-207.
21. Hastings 2nd H, Cohen MS: Screw fixation of the diaphysis of the metacarpals. In: Blair WF, ed. Techniques in Hand Surgery, Baltimore: Williams & Wilkins; 1996:246-254
22. Dumont C, Fuchs M, Burchhardt H, et al: Clinical results of absorbable plates for displaced metacarpal fractures. J Hand Surg [Am] 2007; 32:491-496.
23. Freeland AE: External fixation for skeletal stabilization of severe open fractures of the hand. Clin Orthop Relat Res 1987; 214:93-100.
24. Lutz M, Sailer R, Zimmermann R, et al: Closed reduction transarticular Kirschner wire fixation versus open reduction internal fixation in the treatment of Bennett's fracture dislocation. J Hand Surg [Br] 2003; 28:142-147.
25. Wagner CJ: Method of treatment of Bennett's fracture dislocation. Am J Surg 1950; 80:230-231.
26. Gelberman RH, Vance RM, Zakaib GS: Fractures at the base of the thumb: treatment with oblique traction. J Bone Joint Surg Am 1979; 61:260-262.
27. Buchler U, McCollam SM, Oppikofer C: Comminuted fractures of the basilar joint of the thumb: combined treatment by external fixation, limited internal fixation, and bone grafting. J Hand Surg [Am] 1991; 16:556-560.
28. Green DP: Complications of phalangeal and metacarpal fractures. Hand Clin 1986; 2:307-328.
29. Weckesser EC: Rotational osteotomy of the metacarpal for overlapping fingers. J Bone Joint Surg Am 1965; 47:751-756
30. Jupiter JB, Koniuch MP, Smith RJ: The management of delayed union and nonunion of the metacarpals and phalanges. J Hand Surg [Am] 1985; 10:457-466.
31. Mohammad Umar Mumtaz, Muneer Ahmad Farooq, Altaf Ahmad RASOOL: Unstable metacarpal and phalangeal fractures: Treatment by internal fixation by using AO minifragment plates and screws: Turkish journal of trauma and emergency surgery: 2010:16(4):334-338
32. Aswini Soni, Anmol Gulati, J.L Basi: outcome of closed ipsilateral metacarpal fractures treated with minifragment plates and screws: a prospective study: J orthopaed Traumatol (2012) 13: 29-33
33. Barton N (1989) Conservative treatment of articular fractures in the hand. J Hand Surg Am 14:386–390
34. Wright TA (1968) Early mobilization in fractures of the metacarpals and phalanges. Can J Surg 11:491–498
35. Amadio PC (1991) Fractures of the hand and the wrist. In: Jupiter JB (ed) Flynn's hand surgery. Williams & Wilkins, Baltimore, pp 122–185
36. James JIP (1962) Fractures of the proximal and middle phalanges of the fingers. Acta Orthop Scand 32:401–412
37. Parsons SW, Fitzgerald JA, Shearer JR (1992) External fixation of unstable metacarpal and phalangeal fractures. J Hand Surg Br 17(2):151–155
38. Shehadi SI (1991) External fixation of metacarpal and phalangeal fractures. J Hand Surg Am 16(3):544–550
39. Schuind F, Donkerwolcke M, Burny F (1991) External minifixation for treatment of closed fractures of the metacarpal bones.J Orthop Trauma 5(2):146–152
40. Pritsch M, Engel J, Farin I (1981) Manipulation and external fixation of metacarpal fractures. J Bone Joint Surg Am 63(8):1289–1291
41. Buchler U (1994) The small AO external fixator in hand surgery.Injury 25 (Suppl 4):S-D55-63
42. Gonzalez MH, Igram CM, Hall RF (1995) Flexible intramedullary nailing for metacarpal fractures. J Hand Surg 20:382-387
43. Orbay JL, Indriago I, Gonzalez E et al (2002) Percutaneous fixation of metacarpal fractures. Op Tech Plast Reconstruct Surg 9:138–142
44. Gonzalez MH, Hall RF Jr (1996) Intramedullary fixation of metacarpal and proximal phalangeal fractures of the hand.Clin Orthop Relat Res 327:47–54
45. 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
46. Agarwal AK, Pickford MA (2006) Experience with a new ultralow-profile osteosynthesis system for fractures of the metacarpals and phalanges. Ann Plast Surg 57:206–212
47. Bosscha K, Snellen JP (1993) Internal fixation of metacarpal and phalangeal fractures with AO minifragment screws and plates: a prospective study. Injury 24:166–16
48. Chen SH, Wei FC, Chen HC et al (1994) Miniature plates and screws in acute complex hand injury. J Trauma 37:237–242
49. 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
50. Dabezies EJ, Schutte JP (1986) Fixation of metacarpal and phalangeal fractures with miniature plates and screws. J Hand Surg Am 11:283–288
51. Bu¨chler U, Fischer T (1987) Use of a minicondylar plate for metacarpal and phalangeal periarticular injuries. Clin Orthop Relat Res 214:53–58
52. 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
53. Hastings H 2nd, Carroll C 4th (1988) Treatment of closed articular fractures of the metacarpophalangeal and proximal interphalangeal joints. Hand Clin 4:503–527
54. Melone CP Jr (1986) Rigid fixation of phalangeal and metacarpal fractures. Orthop Clin North Am 17:421–435
55. Stern PJ, Wieser MJ, Reilly DG (1987) Complications of plate fixation in the hand skeleton. Clin Orthop Relat Res 214:59–65
56. Thakore HK (1986) Osteosynthesis for the unstable fracture of the hand. J Hand Surg Br 11:417–421
57. Trevisan C, Morganti A, Casiraghi A et al (2004) Low severity metacarpal and phalangeal fractures treated with miniature platesand screws. Arch Orthop Trauma Surg 124:675–680
58. Souer JS, Mudgal CS (2008) Plate fixation in closed ipsilateral multiple metacarpal fractures. J Hand Surg Eur 33(6):740–744