Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

Original research article

Functional Outcome Of Metacarpal Fractures Treated With Locking Mini-Plates And Screws At A Tertiary Care Hospital

[1]Dr. Rohith CS, [2]Dr. Viresh, [3]Dr. Manoj Bhagirathi Mallikarjunaswamy, [4]Dr.Siddharam biradar, [5]Dr. Pratyush K Sarangi

[1] Senior Resident, Department of Orthopaedics, Chamarajanagar Institute of Medical Sciences, Yadapura, Karnataka, India

[2, 4, 5] Post Graduate, Department of Orthopaedics, Chamarajanagar Institute of Medical Sciences, Yadapura, Karnataka, India

[3]Assistant Professor, Department of Orthopedics, CIMS, Chamarajanagar, Karnataka, India

Corresponding Author:
Dr. Manoj Bhagirathi Mallikarjunaswamy

Abstract

The outcome of hand fractures correlates closely with the severity of initial injury. The risk factors include injuries of the tendons and tendon sheaths, damage of the articular cartilage, comminution of fractures, severely crushed soft tissues, bone loss, aggressive surgical dissection, delay of treatment, and the implant itself. On admission, demographic data was recorded and a thorough history was taken to assess mode of injury and associated co-morbidities. General systematic and local examination were done to assess other associated injuries and open wounds followed by radiological evaluation in AP and oblique views. Functional outcome assessed by ASSH (American Society for Surgery of the Hand) TAF (Total Active Flexion) score was excellent in 22 patients (73%), good in 6 patients (20%), fair in 2 patient (6%). The overall results are satisfactory.

Keywords: Functional outcome, metacarpal fractures, locking mini-plates and screws

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].

The outcome of hand fractures correlates closely with the severity of initial injury. The risk factors include injuries of the tendons and tendon sheaths, damage of the articular cartilage, communition of fractures, severely crushed soft tissues, bone loss, aggressive surgical dissection, delay of treatment, and the implant itself. With better and stable implants, instrumentations, operative techniques, and rehabilitation therapy, fracture healing and better functional recovery have ensued.

A stable bony construct that allows early tendon gliding and joint movement encourages good bone union and minimises joint and tendon complications. In some biomechanical studies, plating for comminuted fractures provided superior rigidity when compared with other fixation methods [6].

Recent studies have shown good functional results with surgical treatment of metacarpal fractures using

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

locking mini-plates and screws as compared to the conservative treatment or K-wire fixation.
This study involves evaluating functional outcome of metacarpal fractures treated with locking mini-plates and screws.

Methodology

Total number of patients studied were 30

Inclusion criteria

- Metacarpal and phalangeal fractures of either hand.
- Age more than 18 years.
- Physical fitness for surgery.
- Sex: Both male and female.
- Patients willing to participate in the study.

Exclusion criteria

- Age less than 18 years.
- Type 3 compound wounds.
- Patient not willing or medically unfit for surgery.
- Patients presenting with fractures after 2 weeks of the trauma

On admission, demographic data was recorded and a thorough history was taken to assess mode of injury and associated co-morbidities.
General systematic and local examination were done to assess other associated injuries and open wounds followed by radiological evaluation in AP and oblique views.
Once the diagnosis is confirmed and patient notified about the fracture and need for surgery. His consent is taken and pre op planning done.

Pre-op planning

- Blood investigations (Complete blood count, ECG, RFT, Serum electrolytes, FBS, HBA1C, HIV, HCV and HBSAG profiles).
- ECG, Where necessary, 2D-ECHO were taken.
- Selection of appropriate sizes of LCP plates and screws and their corresponding instruments.
- Appropriate antibiotics and pre-anaesthetic medications were given.

Implant details

- 1.5 mm Locking Compression Plate.
- **Composition:** Titanium.
- **Length:** Range from 28mm to 50mm.
- **Breadth:** 5mm.
- **Thickness:** 1.5 mm.
- **Holes:** 4-8 holed.
- **Configuration:** Straight plate (for shaft fractures), L-plate & T-plate (for peri-articular fractures).
- **Type:** Compression.
- Screws composition-Titanium.
- **Screw type:** Self-tapping type, round headed with single slot.
- **Screw pitch:** 1 mm.
- **Screw length:** 8-16mm.

Instruments used: Drill bit

- **Composition:** Stainless steel.
- **Diameter:** 1.5 mm.

Follow-up

- Was done at 4th, 6th, 8th and 12th 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.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

- Hand function was assessed on every visit as per ASSH-TAF score.

Results

Table 1: Time interval between injury and surgery

Time interval (days)	No. of cases
<2	23
2-5	6
>5	1

Associated injuries

- 7 Cases has associated bony injuries.
- 3 cases-Clavicle fracture.
- 2 cases-Ipsilateral both bone forearm fracture.
- 1 case-Ipsilateral tibia and fibula shaft fracture.
- 1 case-Ipsilateral proximal phalanx fracture of the same finger.

Superficial skin infection was seen in 3 cases (10%), stiffness of MCP joints in 6 cases (20%) tendon irritation in 3 cases (10%) due to implant prominence.

Table 2: Complications

Complications	No. of cases
Superficial infection	3
Stiffness	6
Tendon irritation	3
Mal-union	0
Non-union	0
Implant breakage	0

In most of the cases bony union was achieved in 6-7 weeks accounting for 77%.

Table 3: Union time

Union time (weeks)	No. of cases
6-7	22
8-9	5
>9	3

Out of 30 cases 22 cases showed excellent results (73%) in terms of ASSH- TAF score, 6 cases having good cases (20%), 2 cases had poor outcome (6%) of which 1 case was due to tendon irritation and 1 case due to stiffness due to lack of adequate physiotherapy due to pain.

Table 4: Functional outcome as per ASSH-TAF score

Score	3 months follow-up
Excellent	22
Good	6
Fair	2
Poor	0

30 patients were included in this study. 7 patients had multiple metacarpal fractures (23% cases). Right hand was involved in 19 of the patients (63%). 23 out of 30 patients were males (77%). All the 30 patients who underwent open reduction and internal fixation with locking compression plate for unstable metacarpal fractures achieved bone union (100%). In most of the cases bony union was seen between 6-7 weeks, average period being 7.03 weeks (range 6-12 weeks). Spiral and oblique fractures united at 7 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 22 patients (73%), good in 6 patients (20%), fair in 2 patient (6%). The

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

overall results are satisfactory.
3 patients developed superficial wound infection. Both these cases with superficial infection settled with daily dressing and antibiotics. 3 patients had stiffness of Metacarpo-phalangeal and Inter-phalangeal 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.
3 patients in our study developed tendon irritation, this is due to inadequate coverage of the 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.

Discussion

Metacarpal fractures can be fixed with external fixator. Report by Shehadi *et al*. [7] 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 pre-bent 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 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. A study by Souer *et al* [8] 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 [9] 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 30 patients, 3 patients developed superficial wound infection. In all 3 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. 6 Patients with multiple metacarpal fractures developed finger stiffness and 1 case had fractures in all the four metacarpals, 3 cases had comminuted fractures and 2 cases had involvement of 2 metacarpals. Eventually all patients had improved ROM following physiotherapy.
In unstable metacarpal fractures, plate fixation is a better option for several reasons: [5]

- They provide stable fixation in all unstable metacarpal fractures thus allowing early mobilization of fingers
- Shortening seen in multiple metacarpal fractures which are corrected by plating restores the power of interossei muscle thereby retaining the grip strength of hand.
- Multiple metacarpal fractures are usually associated with severe soft tissue injury.

In these unstable metacarpal fractures, treatment with locking compression plates 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 with locking compression plates 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 in 22 patients (73%), good in 6 patients (20%), fair in 2 patient (6%).The average union time was 7.03 weeks for spiral and oblique fractures and 8 weeks for transverse and communited fractures. Stable and rigid fixation provided by locking compression plate allowed early mobilization of fingers thereby preventing stiffness and achieved overall good functional result [10].

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

Conclusion

Locking compression plates are a good option for treating comminuted, unstable and osteoporotic metacarpal and phalangeal 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 compared to other modalities of treatment of metacarpal and phalangeal fractures.

Detailed clinical and radiological assessment of fracture, careful preoperative planning, meticulous dissection, precision in surgical technique (coverage of plate with periosteum) and choosing the correct implant (locking compression plates) are critical in achieving good results and minimising the complication.

References

1. Gupta R, Singh R, Siwach RC, Sangwan SS, Magu NK, Diwan R. Evaluation of surgical stabilization of metacarpal and phalangeal fractures of hand. Indian Journal of Orthopaedics. 2007 Jul;41(3):224.
2. De Jonge JJ, Kingma J, Van der Lei B, Klasen HJ. Fractures of the metacarpals. A retrospective analysis of incidence and aetiology and a review of the English- language literature. Injury. 1994 Aug;25(6):365-9.
3. Kamath JB, Harshvardhan DM, Bansal A. Current concepts in managing fractures of metacarpal and phalangess. Indian journal of plastic surgery: official publication of the Association of Plastic Surgeons of India. 2011 May;44(2):203.
4. Barton NJ. Fractures and joint injuries of hand. In: Wilson JN editor. Watson-Jones fractures and joints injures. 6th edn. Churchill Livingstone Pvt. Ltd, New Delhi. 1996;2:739-88. (pg 1)
5. Brennwald J. Bone healing in the hand. Clinical Orthopaedics and related research. 1987 Jan;214:7-10.
6. Cheong WH, Keung WH, Yiu WK. Stainless steel 2.0-mm Locking compression plate osteosynthesis system for the fixation of comminuted hand fractures in Asian adults. Journal of Orthopaedics, Trauma and Rehabilitation. 2011;15:57-61.
7. Gonzalez MH, Igram CM, Hall Jr RF. Flexible intramedullary nailing for metacarpal fractures. The Journal of hand surgery. 1995 May;20(3):382-7.
8. Souer JS, Mudgal CS. Plate fixation in closed ipsilateral multiple metacarpal fractures. Journal of Hand Surgery (European Volume). 2008 Dec;33(6):740-4.
9. Dabezies EJ, Schutte JP. Fixation of metacarpal and phalangeal fractures with miniature plates and screws. Journal of Hand Surgery. 1986 Mar;11(2):283-8.
10. Büchler U, Fischer T. Use of a minicondylar plate for metacarpal and phalangeal periarticular injuries. Clinical Orthopaedics and Related Research®. 1987 Jan;214:53-8.