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"Study of functional outcome of metacarpal fractures treated by miniplates and screws"

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ABSTRACT: TITLE: "Study of functional outcome of metacarpal fracturestreated by mini plates and screws"
INTRODUCTION: Metacarpal fractures are very common, accounting for 18% of all fractures distal to the elbow, common causes of hand injuries are crush injuries, blunt injuries, fall, RTA (Road traffic accidents), industrial injuries,sportsinjuries. Metacarpal fractures being this common are less emphasised on surgical correction.
PURPOSE: To achieve proper anatomical reduction by rigid fixation and allow early rehabilitation to get full function range of motion at metacarpophalangeal and inter phalangeal joints.
MATERIALS AND METHODS: Clinically and radiologically confirmed closed metacarpal fractures of 30 patients were operated by dorsal approach with mini plates and screws. Mean follow-up period was 10 weeks. Serial functional ranges of motion at MCP(metacarpophalangeal) joints and IP(interphalangeal) joints are noted and results are graded based on functional outcome scoring systems.
RESULTS: Mean TAF (total active flexion) at MCP and IP joints is degrees. Mean Quick DASH score points are 23.83 and based on American Society For Surgery Of The Hand (ASSH) Total Active Flexion (TAF) scoring system 21(70%) had Excellent outcome, 7(23.3%) patients had good outcome, 1(3.3%) patient had fair outcome and 1 lost to follow up.
CONCLUSION: Following minimal soft tissue dissection, rigid fixation of metacarpal fractures by plates and screws we can attain full functional outcome compared to other treating modalities.
KEYWORDS: Metacarpal - Miniplates - screws - Functional outcome– Hand

I. INTRODUCTION

Metacarpal and phalangeal fractures account for 17.2%–21.3% of all fractures in adults and >30% of all hand injuries[1,2.] Metacarpal fractures can be treated non-operatively; however, some are treated most effectively by surgical stabilization[3,4].

Among the common techniques for fixation of unstable metacarpal fractures that cannot be treated by casting alone includes various forms of Kirschner-wire (K-wire) pinning (anterograde intramedullary K-wire, retrograde intramedullary K-wire, transverse pinning with K-wire, retrograde cross pinning with K-wire)[5–7], Extramedullary fixation with plates and screws[8,9] and External fixation[10].Pinning has been traditionally used in the treatment of unstable metacarpal fractures due to its ease of application and minimal surgical exposure. Nevertheless, there has been an increasing trend towards the use of plate and screws providing direct fracture reduction and permitting early range of motion (ROM).

Surgery has increasingly used to treat unstable metacarpalfractures, being especially indicated when there is shortening of the metacarpals by more than 3 mm or when severe apex dorsal angulation is present [11]. New lower profile and smaller plates allow periosteal closure and potentially reduce adhesions compared to earlier designed plates[12].Despite recent advancements in plating techniques it is unclear if these techniques lead to improved functional outcome or a more rapid recovery.

Our purpose was to determine the functional, radiographic outcome and pain scoring in study group to conclude if plates and screws have improved functionality and recovery period compared to other treatment modalities.

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II. MATERIAL AND METHODS

This prospective study was performed at a teaching hospital in India. The study consisted of 30 cases. A case of either sex ≥ 18 years old with fracture of metacarpal were included into the study. An informed written consent of the patient was obtained before inclusion in the study. The ethical clearance from the ethics committee of the institute was obtained before the start of study. The patients excluded from the study were who had compound injury, severe osteoporosis, Associated fractures including phalanges and carpal bones and severe comorbid conditions. The fractures were classified as per AO/OTA (orthopaedic trauma association). The patients were given regional anaesthesia and all the operative procedures were performed under tourniquet control. Preoperative antibiotics were administered 30 minutes before the operation.

III. SURGICAL PROCEDURE

Patient is held in supine position and after giving the anaesthesia tourniquet is applied over the arm . Hand and forearm are exsanguinated before inflating the tourniquet, hand is held over the arm board and an incision given over dorsal aspect of hand adjacent to the metacarpal fracture involved in inter metacarpal valleys or directly over the metacarpal shaft and extended proximally or distally depending on the fracture site, extensor tendons over the involved metacarpal are retracted to either sides and fracture site is reduced and held with bone clamps, appropriate holed miniplate is held over the dorsal aspect of metacarpal and fixed with screws of required size after drilling with 0.8mm drill bit, care is taken in handling the soft tissue .surgical site is washed and closed in layers, tourniquet is deflated and sterile dressing is applied.

Postoperatively hand is elevated and passive range of motion of fingers is allowed from POD1 and active ROM on decrease of pain.

IV. FOLLOWUP AND EVALUATION

All the patients treated in both the groups are followed serially at 2, 4, 6, 8, 10 weeks, 3 months and 6 months and are evaluated for pain based on VAS[13](visual analogue scale) scoring system on 2nd and 3rd week follow-ups, functional outcome based on TAF(Total active flexion) scoring system on 10 weeks, 3rd month and 6th month follow-ups; Quick DASH[14](Disability of arm shoulder and hand) scoring at subsequent week after attaining the fracture union in AP(Anteroposterior) and Oblique radiographs. Finally grading is done based on the American Society For Surgery Of The Hand (ASSH) Total Active Flexion (TAF) scoring system [15,16] in to 4 grades (I.E) Excellent, good, fair and poor outcomes; **Figure 1** shows preoperative postoperative radiographs and functional ROM at final followup of a patient.

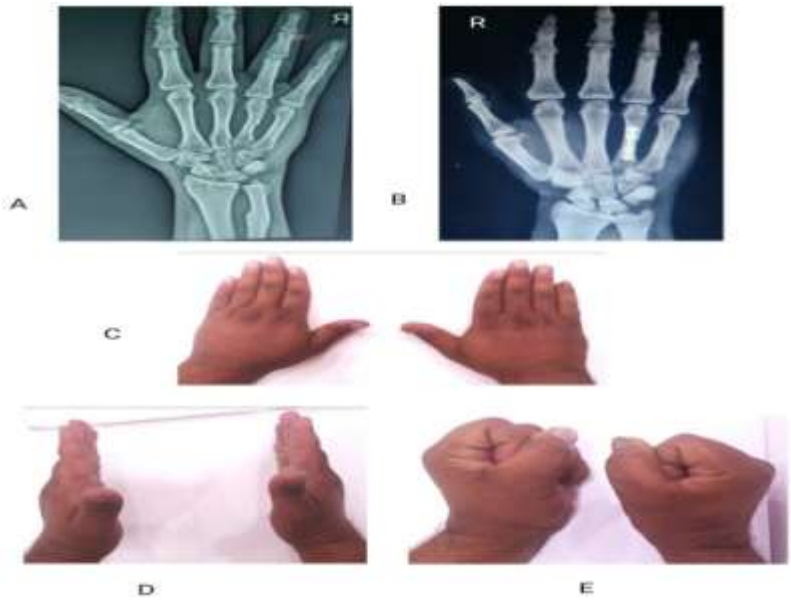

Figure 1: A) Preoperative xray showing 4th metacarpal middle 1/3rd fracture, B) Postoperative xray showing 4th metacarpal fracture treated by Miniplate and screws, C,D,E) Clinical ROM pictures of the patient at final followup.

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TAF= (Active flexion at MCP+PIP+DIP) joints -Extension deficit at MCP, PIP, DIP joints **Tables 1 and 2** depicts the grading of TAF outcomes for 2-4 metacarpals and 1st metacarpal respectively.

Degree of flexion	Grading
220- 260	Excellent
180-220	Good
130-180	Fair
<130	Poor

Table 1: TAF grading by degree of flexion at MCP and IP joints for 2nd to 5th metcarpals

Degree of flexion	Grading
220- 260	Excellent
180-220	Good
130-180	Fair
<130	Poor

Table 2: : TAF Grading by degree of flexion at MCP and IP joints for 5th metacarpal

VAS scoring is a scale of 10cms(centimetres) in which each cm corresponds to response of pain by the patient in ascending order starting from left side of scale which is mildest of pain to maximum limit of pain which is severe pain ending on the right side. This scaling is coupled with a facial expression pain scaling analogue for easy access and understanding to the patient.

For every two centimetres of pain response in VAS scoring there is one picture of face depicting the intensity of pain least starting from left side to utmost pain in the right side end; **Figure 2** shows the VAS scoring system; Mild pain ranging from 0 – 3, Moderate pain ranging from 4 – 6, Severe pain ranging from 7 – 10.

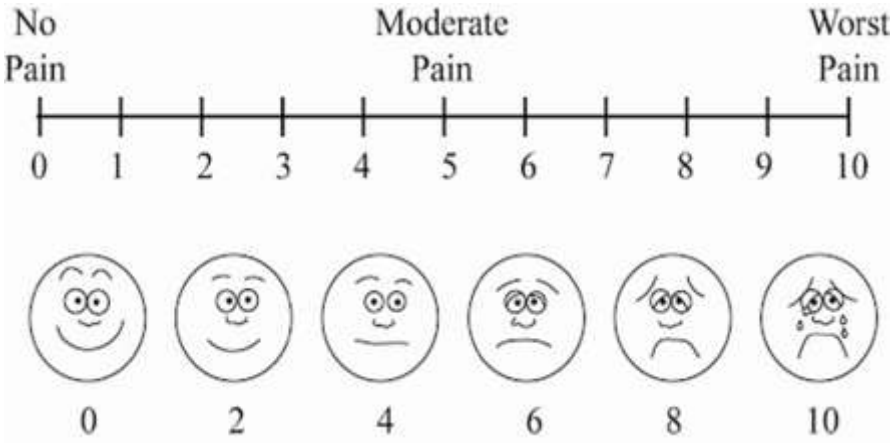

Figure 2 : VAS scoring scale.

Quick DASH scoring system has a set of 11 questionnaires with each question having 5 different responses which have predetermined score ranging from 0 (No disability) to 5 (most severe disability). 10 out of 11 questionnaires are to be attempted by the patient to calculate a Quick DASH score. The questionnaires of Quick DASH are taken from the DASH scoring questionnaire.

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Patient is explained regarding the each questionnaire in their vernacular language and each response is marked , sum of all the responses is calculated Quick DASH Disability/ Symptom score is then calculated by a formula where 'n' is number of questionnaires attempted.

Quick DASH Disability /Symptom score =([sum of 'n' responses ÷ 'n'] – 1)×25

The baseline parameters were assessed using descriptive statistics such as mean and standard deviation. SPSS (statistical package for social sciences) V26.0 software was used to perform these tests.

V. RESULTS

The mean age of the patients was 32.63 years. 50% of the fractures occurred between the age group of 25-35 years. Male to female ratio is approximately 4:1. In 14 (46.66%) cases, mode of injury was road traffic accident, being the commonest cause of injury. 7(23.33%) cases occurred because of assault/sports and in 9(30%) cases, mode of injury was fall.23(76.66%) patients had middle third metacarpal fracture,5(16.66%) patients had distal third and 2(6.66%) cases proximal third metacarpal fracture.Majority of the patients were operated within one week of the surgery with 15(50%) patients having been operated within 3 days of injury and 2(6.66%) cases having been operated after 7 days of injury. Mean VAS score was 4.36 with majority of patients falling into moderate range of pain. Mean Quick DASH score was 23.83, Mean union time of the study group was 10.7 weeks.1 patient landed up into joint stiffness , and 1 lost to follow up, No patient had shown non-union, mal-union, implant failure, tenosynovitis.

Evaluation of the result was done according to the American Society For Surgery Of The Hand (ASSH) Total Active Flexion (TAF) scoring system 21(70%) had Excellent outcome, 7(23.3%) patients had good outcome, 1(3.3%) patient had fair outcome and 1 lost to follow up ; Figure 3 shows the results by TAF scoring system.

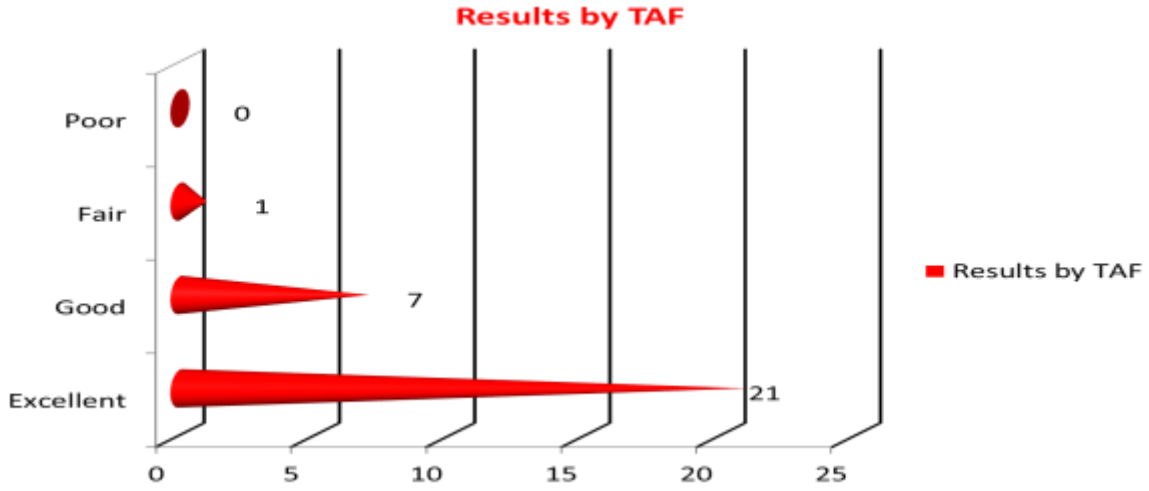

Figure 3: Cone chart depicting Results of the study group by TAF scoring system.

VI. DISCUSSION

Fractures of the hand are increasing due to rapid industrialization and rise in road traffic accidents. They constitute about 10% of the all the fractures[17]. Majority of the fractures can be managed by the non-operative intervention while some require operative intervention. The goal of operative intervention is to provide stable fixation for bony union and allow early range of movements to prevent stiffness. The miniplate has advantage of providing rotational stability and compression at the fracture site in transverse fractures.Nalbtungla et al[18] had reported good to excellent in 86% of the cases treated with miniplates in metacarpal and phalangeal fractures.A 4% incidence of tenosynovitis along with cases of extensor tendon rupture have been reported after plate fixation of metacarpal and phalangeal fractures[19]. withminiplates in metacarpal and phalangeal fractures. Stiffness was the only complication observed. Gupta et al[20] had also reported stiffness as a major complication in their case series.The limitations of the study were 1. Non randomized groups 2. Small study group 3. Short term follow up.

VII. 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 .

VIII. AKNOWLWEDGEMENT

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Declaration Of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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FIGURE CAPTIONS

1.Figure 1 A) AP (Anteroposterior) view of hand Preoperatively showing 4th metacarpal fracture , B) AP view postoperative Xray of hand showing miniplate and screws insitu, C,D,E) FullRange of movements at MCP and IP joints in final followup,

2.Figure 2 VAS scoring scale

3.Figure 3 Cone chart depicting the final outcome by TAF (Total active flexion) scoring system.

TABLES

Table 1 shows the grading by range of motion for 2nd to 5th metacarpals

Degree of flexion	Grading
220- 260	Excellent
180-220	Good
130-180	Fair
<130	Poor

Table 1: TAF grading by degree of flexion at MCP and IP joints for 2nd to 5thmetcarpals

Table 2 shows the grading by range of motion for 1st metacarpal (Thumb)

Degree of flexion	Grading
220- 260	Excellent
180-220	Good
130-180	Fair
<130	Poor

Table 2: TAF Grading by degree of flexion at MCP and IP joints for 5th metacarpal