

# Orthogonal dual plating for fracture of base of 1<sup>st</sup> metacarpal- original study

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## Abstract

**Background:** Treatment of fractures of the base of 1<sup>st</sup> metacarpal is controversial with multimodality of implant choice available like k wire and miniplates. Secondary displacement rates are higher if fracture is not fixed rigidly. In this study, dual miniplates were used in orthogonal manner to fix the 1<sup>st</sup> metacarpal base fractures. **Method:** all patients were treated using dual miniplates in orthogonal manner by dorso volar approach to evaluate functional outcome. **Results:** On follow up, all the patients reported excellent functional outcome with regard to DASH score, Kapandji score and pinch comparison as compared to opposite side. **Conclusion:** orthogonal dual miniplates used for fixation of base of thumb metacarpal provides excellent method to rigidly fix the inherently unstable fracture and favouring early mobilization.

Key words: First metacarpal, Fracture, miniplates, base of 1<sup>st</sup> metacarpal

## Introduction

Fractures of the thumb metacarpal are unique and require a distinct discussion as it has multidirectional mobility with compensatory motion of the adjacent joints [1]. Thumb metacarpal accounts for around 12% of all metacarpal fractures [2]. Thumb stability is essential for most of the hand functions whether the fracture is intra articular or extra articular at base of thumb metacarpal. Intra articular fractures of base of 1<sup>st</sup> metacarpal are Rolando and Bennet fracture dislocation. Displaced intra-articular fractures or persistent subluxation or dislocation can cause limitation of motion, pain and weakness of pinch and of grip [3]. Secondary metacarpophalangeal joint hyperextension deformities can follow thumb basal joint dorsal displacement and severely weaken hand function.

Accurate reduction and stable fixation with anatomy restoration of 1<sup>st</sup> metacarpal base fractures is essential for good functional outcome after intra-articular or extra articular fracture of base of thumb metacarpal. Conservative treatment of the base of first metacarpal base results into mal-union with gross deformity with functional derangement and later on arthritis. Fixation

of 1<sup>st</sup> metacarpal base by kirschner wire is described in literature. There is still paucity of literature and persistent controversy regarding accurate and stable anatomical fixation. We have used Dorsoradial approach for open reduction of the fractures of base of first metacarpal and fixation Using dual miniplates in orthogonal position to achieve rigid fixation of the 1<sup>st</sup> metacarpal base fractures which is the purpose of this article.

## Materials and Method

In this prospective study, seven patients with closed fracture of base of 1<sup>st</sup> metacarpal either intra articular or extra articular admitted in the hospital at Government Medical College, Vadodara, from March 2017 to April 2018 were included in the study. Inclusion criteria were isolated closed fracture of base of first metacarpal either intra articular or extra articular. Open grade fractures and fractures extending into the shaft of metacarpal were excluded. Fractures of the base of first metacarpal associated with other hand fractures were also excluded to reduce bias in final follow up scores. However, patients with lower limb injuries were included in the study. After preoperative analysis, all patients were operated under regional anesthesia and with tourniquet

Manuscript Received: 26<sup>th</sup> November 2018

Reviewed: 6<sup>th</sup> December 2018

Author Corrected: 14<sup>th</sup> December 2018

Accepted for Publication: 17<sup>th</sup> December 2018

**Original Research Article**

control by corresponding author and assisted by secondary author. Wagner incision was used in all the subjects at the dorsoradial aspect of the wrist curving volarward at the wrist crease. After soft tissue dissection, the fracture is reduced and temporarily held with k- wire. Single miniplate is temporarily fixed using k wire in buttressing mode for intraarticular fractures. For extra articular fractures, the first single miniplate is temporarily fixed with k wires on the surface with convexity of fracture. Plate position is confirmed under IITV and fixations using mini screws were done.

Proximal fragment would accommodate either single or two screws. For rotational stability, another mini plate at orthogonal position is fixed using additional mini screws such that proximal fracture fragment had rotational stability at fracture. Surgical wound is sutured in layers.

Postoperatively on 2<sup>nd</sup> day, intermittent thumb mobilization was allowed immediately as tolerated with thumb splint for rest of the period of the day. Patient is followed every 2 weeks interval for at least 3 months or till union occurs.

At final follow up, assessment was done using pain score, DASH score, Kapandji score and pinch comparison to opposite side. Pain score was assessed using VAS score in which score 0 represents no pain and 8 represents severe pain beyond tolerance [4]. Pain score of 0 to 2 represents mild pain, 3 to 5 represents moderate while 6 to 8 shows severe pain with 8 being pain as bad it could be. DASH score is nomenclature used for Disability Arm, Shoulder and Hand score. DASH score considers 30 items disability questionnaire

**Discussion**

Fracture of base of thumb metacarpal can be either intra articular or extra articular fractures. The intra articular fractures can be further subdivided into Bennett and Rolando fractures. Fractures of base of 1<sup>st</sup> metacarpal occur when the thumb is axially loaded and partially flexed. The fracture pattern of intra articular extension has a typical oblique course creating small triangular fragment on the volar ulnar aspect of the metacarpal base. This fragment remains in its position by anterior oblique ligament and shaft region of metacarpal is displaced proximally by pull of abductor pollicis longus with adduction force exerted by adductor pollicis [7]. This typical pattern is observed in Bennett fracture. The Rolando fracture is intra articular variety without shaft displacement mainly Y shaped configuration of intraarticular fragment.

Extraarticular fractures of 1<sup>st</sup> metacarpal base results in shortening of 1<sup>st</sup> metacarpal effective length due to muscle forces resulting in loss of effectiveness of all thumb muscles' function and may lead to retraction of 1st web space resulting in weakness of pinch. Non operative treatment of undisplaced fractures of base of 1<sup>st</sup> metacarpal are recommended with literature support of good functional outcome. Displaced fracture of 1<sup>st</sup> metacarpal base requires surgical intervention to achieve adequate thumb function. Post traumatic arthritis is another common complication following conservative management of intra articular fracture of base of thumb metacarpal 1 mm in congruency of joint surface results in arthrosis at joint and the reason for continued pain postoperatively [8]. Malunion resulting from extra articular fractures not only results into deformity demonstrated that each 2 mm shortening resulted in 7degrees of secondary extensor lag

with score of 0 (no disability) to 100. The mean change in the disability percentage was reported [5]. Kapandji score is thumb opposition score from 0 (no thumb opposition) to 10 (full thumb opposition score) [6]. Pinch and grip strength was noted as compared to contra lateral side.

**Results**

In our study, out of 7 patients, 5 were males and 2 were female patients. 4 fractures of 1<sup>st</sup> metacarpal base were intra articular and 3 patients were extra articular. Out of four intra articular fractures, 3 were male patients and one was female patient. In extra articular type, one patient was female and rest were male patients. Two patients had associated lower limb injuries. The average ages of patients were 33 years. All patients underwent surgery at an average of 1 days after trauma with Wagner approach with dual plates in orthogonal mode. Patients were allowed mobilization immediately postoperative with average of 2<sup>nd</sup> postoperative day.

All the patients were followed up at 2 weeks interval till the time of union or at least 3 months. Outcome evaluation consisted of pain score, DASH score, kapandji score and pinch comparison to contralateral side. At final follow up, average pain score was 1.8/10. Mean improvement in DASH score was 94% with grip and pinch strength 97% and 94% respectively as compared to opposite side. At final follow up kapandji score noted as 9. There is no statistically significant difference in intraarticular or extra articular fracture patients with regard to final outcome scores which was attributed to anatomical reduction and stable fixation. The range of union time was 10-18 weeks.

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and 8% loss of power generation by muscles. This can be compensated by hyperextension at MCP joint but only up to 20 degrees. So more than 6mm shortening requires revision ORIF to reduce the deformity and to improve grip. 1 cm shortening results in only 55% of muscles optimum power generation [9,10].

Conventionally kirschner wires are used to fix the base of first metacarpal fractures. Mini screws are also modality of treatment. In these technique, the fractures are reduced by the countering the deforming forces with longitudinal traction, thumb pronation, and adduction of the metacarpal base. These modalities of treatment require 4 to 6 weeks of immobilization to maintain reduction and to prevent secondary displacement. Intra articular fractures treated with conventional modalities like k wires or screws resulted in posttraumatic arthritis due to incongruity of joint [1]. In T shaped or Y shaped Rolando fracture, closed reduction and percutaneous pinning is difficult to achieve as all intraarticular fragments needs to be aligned. In such fractures, classic 3 piece fractures requires ORIF using Wagner approach as reported by Diaz Garcia et al [1]. Anatomical reduction and stable fixation is recommended to achieve good functional outcome and to avoid post traumatic arthritis [11].

Single plate with miniscrews is also recommended for fixation of metacarpal fractures. Diaconu M. And colleagues reported secondary displacement in around 20% of operated patients treated with single mini T plate. They reported that locking T plate did not provide sufficient strength for fixation to allow early mobilization [3]. These can be attributed to rotational instability due to less number of screws accommodated in the plate in proximal fragment. This drawback can be overcome by using dual plate at orthogonal position to acquire rotational stability in proximal fragment. Buttressing effect of dual plates placed orthogonally contributes to early mobilization without loss of reduction.

Maximillian et al reported that ORIF with rigid internal fixation with modern hardware expedite return to athletic activity [12]. Dual plating provides more rigid internal fixation as compared to single plate which can lead to secondary displacement in upto 20% of patients as reported by Diaconu et al [3]. Abid H. Et al also reported better thumb apposition and retroposition with ORIF [13]. In our study we applied the dual plating orthogonal principle in all 7 patients to achieve anatomical reduction and stable fixation for early mobilization without secondary displacement risk with excellent functional outcome.



**Figure-1:** includes preoperative, and postoperative xray And IITV images intraoperatively.



**Figure 2:** shows intra operative image with dual plate in orthogonal manner.

Till now in the literature, there is no study reported which shows dual plating method of first metacarpal base. Methods described in the literature till now were associated with different complications. Dual plating of the first metacarpal base fractures is novel technique to give adequate stability for fracture union in anatomical position with excellent functional outcome.

## Conclusion

In conclusion, dual plating of first metacarpal base can be a gold standard technique to rigidly fix the fracture for excellent functional outcome. This requires future study of large number of patients with long term outcome as our study has less number of patients with short term outcome analysis.

**Conflict of interest:** None declared.

**Funding:** Nil, **Permission from IRB:** Yes

All patients in this study were operated by corresponding author and assisted by second author. Manuscript primarily prepared by corresponding author with assistance provided by second author. Data collection was done by both authors.

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## How to cite this article?

Shah H.D, Gupta A. Orthogonal dual plating for fracture of base of 1<sup>st</sup> metacarpal- original study. *Surgical Update: Int J surg Orthopedics.* 2018;4(4):165-168. doi:10.17511/ijoso.2018.i04.06.