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## TECHNICAL NOTES

## Locking Plate Fixation for Intra-Articular Fractures of Calcaneum

Abhijeet A Salunke<sup>1</sup>, Danakrishna Vachalam<sup>1</sup>, Prem H Menon<sup>1</sup>, S Saseendar<sup>2</sup>, Tan Junhao<sup>3</sup>, Gurpal Singh<sup>1</sup>

<sup>1</sup>University Orthopedics, Hand and Reconstructive Microsurgery cluster, University Hospital, Singapore

<sup>2</sup>Dept of Shoulder and Elbow Surgery, National University Hospital, Singapore

<sup>3</sup>Yong Lin Loo School of Medicine, National University, Singapore

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**\* Corresponding author:**

Dr. Abhijeet A Salunke  
Clinical Fellow, University Orthopedics, Hand and Reconstructive Microsurgery cluster, University Hospital, Singapore  
[drabhijeetsalunke@gmail.com](mailto:drabhijeetsalunke@gmail.com)

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## ABSTRACT

Surgical management of calcaneum fracture consists of open reduction with proper reduction of intra-articular fragments and fixation with plating. Locking plate systems have been used for fixation of intra-articular fractures. The locking plate fixation provides a simple and adequate fixation for management of displaced intra-articular calcaneal fractures. The open reduction and internal fixation method with locking plates can be a rewarding technique for early mobilization and better fracture reduction in calcaneal fractures.

## INTRODUCTION

Calcaneum is the most common tarsal bone to be fractured following road traffic accidents and fall from height. Majority of fractures are intra-articular with an incidence of approximately 60-75 % [1]. The clinical and functional outcomes after management of calcaneum fracture have improved in recent period [2-5]. The role of nonsurgical treatment with help of immobilization and braces has been described in literature. The key to success in the surgical management of intra-articular calcaneum fractures is proper reduction of the fracture fragments. Surgical management of calcaneum fracture consists of open reduction with proper reduction of intra-articular

fragments and fixation with plating. Locking plate systems have been used for fixation of intra-articular fractures. This method of fracture fixation has helped for early fracture union and mobilization and rehabilitation.

**Calcaneum fracture classification:**

Sanders classification system is used to assess intra-articular calcaneal fractures [6]. This classification is based on the number of intraarticular fracture lines and their location on CT images. There are four types of fractures according to Saunders classification; types 1 to type 4 injuries, the expected outcomes are progressively worse.

### Surgical technique of fracture fixation with locking plate system:

The patient is on a radiolucent table in lateral position. The lateral skin incision extends from calcaneal tuberosity to calcanea-cuboid joint. Thick skin flap are made to avoid skin necrosis and wound breakdown. Kirschner wires are placed and are bent at an 90 degrees angle in the proximal part of surgical incision to avoid repeated handling of the skin flaps. Fracture reduction is achieved with help of osteotome and kirschner wires. Lateral wall is subperiosteally cleaned of soft tissue and articular fracture fragments are exposed. The first step of fracture fixation consist of restoration of height, width, and valgus position. The depressed fracture fragments are elevated in following sequence; lateral wall, sustentaculum tali, anterior process, calcaneal tuberosity followed by posterior facet. The fracture reduction is assessed with help of image intensifier imaging. Lateral and axial view is useful to evaluate the fracture reduction. Locking plate fixation method is used for fracture fixation. Template is used to evaluate proper dimensions of plate. The locking plate is placed over lateral aspect of the calcaneum and screws of appropriate size are used for securing the plate (Figure 1). Bone graft or bone graft substitutes can be used for filling the bone defects.

### Rehabilitation and follow-up:

During postoperative period foot is elevated with the ankle in the neutral position with a plaster slab to reduce postoperative swelling. Range-of-motion exercises of the ankle with dorsi-flexion and plantar flexion are started on first postoperative day. Patients are ambulated with non weight bearing on first postoperative day followed by full weight bearing after fracture union. Full weight bearing is delayed for up to 12-18 weeks, depending on the amount of fracture comminution and the subsequent rigidity of the fracture fixation and healing. Serial radiographs are performed at one month interval to evaluate fracture union (Figure 2, 3).

### DISCUSSION:

The calcaneum is the most commonly fractured tarsal bone. It accounts for approximately 2% of all fractures and 60-65 % of all tarsal fracture [1-6]. Calcaneus fractures results in a varus deformity with heel widening, loss of calcaneal height, and subtalar joint incongruity [7,8]. Open reduction of the fracture fragments with anatomic reduction and rigid internal fixation plays important role in management of calcaneum fracture.

Lateral, axial, and oblique radiographs are useful for the evaluation of the fracture fragments and subtalar joint [1,7]. Oblique radiographs of foot are used for assessment of the extension of fracture into the calcaneocuboid joint.



Figure 1: Intra-operative photograph showing a calcaneum locking plate



Figure 2: Lateral radiograph of calcaneum with locking plate fixation



Figure 3: Axial radiograph of calcaneum with locking plate fixation

CT scan helps for the evaluation of the fracture pattern and surgical planning [1,7-9]. CT scans of the calcaneus are useful in determining the amount of comminution. Sanders classification is based on com-

puted tomography and helps for proper planning for the treatment of calcaneum fracture.

The timing of the surgical management depends on the medical condition of the patient, edema and swelling around the foot and ankle joint [2,4,5]. There is no consensus for ideal timing of surgical intervention in calcaneum fracture. The amount of swelling is an indicator of the degree of soft-tissue injury. As the swelling decreases, the skin begins to wrinkle so the wrinkling of the skin is an important clinical finding for deciding the appropriate timing of surgical fixation. According to Mostafa et al surgery was performed after an average of duration of 4.83 days from admission [7]. Fracture fixation should be performed within fourteen days from the injury as fracture reduction is difficult after this period due to callus formation.

There is no consensus of the surgical approach for fixation in calcaneum fractures [8-14]. Stephenson et al has used a combined medial and lateral approach [15]. McReynolds et al has recommended the lateral approach for tongue type fracture and joint depression fractures [16]. Proper surgical incision helps to provide a complete visualization of the subtalar and calcaneocuboid joint [8-16].

Bone grafts may provide mechanical stability and help for prevention of reduction of the joint height [17, 18]. But the use of bone graft depends on the amount of joint collapse and availability of bone grafts and bone graft substitutes.

The inappropriate surgical scar healing may lead to wound breakdown in calcaneum fractures [19-22]. The key step which may prevent scar healing problems is proper thickness of skin flap and minimal handling of the flap. In post operative period patient should be encouraged for minimal walking, limb elevation and protection with plaster with windows around surgical incision.

The use of locked plate fixation in the calcaneum fracture has been believed to provide greater stability than that of nonlocking plates. Hyer et al showed that early weight bearing of calcaneal fractures is allowed after fracture fixation with locked plating [4]. The radiological evaluation of the patients showed that, there was no significant loss of calcaneal height, joint reduction and fixation stability. The results of this study are suggestive of strong inherent stability of the locked plate construct for calcaneum fractures. Leung et al compared patients treated by surgical methods and patients treated conservatively management [12]. This study showed that the results of the surgically group treated was significantly better. Longino et al had compared results of locking plate fixation with and without bone grafting and did not find any significant difference [18]. Zwipp et al presented a study on calcaneal fracture treatment with 496 patients treated with surgical method [20]. In this study the use of locking plate fixation versus non-locking plate fixation resulted in reduction of use of bone grafting from 53% to 3.8% respectively.

Rak et al concluded that there were less complications and better results related to treatment with locking compression plates [22]. Their results showed that locking plates can be used for fixation in all types of intra-articular calcaneal fractures.

## CONCLUSION

Locking plates provides a simple and adequate fixation for management of displaced intra-articular calcaneal fractures. The open reduction and internal fixation method with locking plates can be a rewarding technique for early mobilization and better fracture reduction in calcaneal fractures.

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