

## Open Reduction and Internal Fixation of Depressed Intra-Articular Calcaneal Fractures with Locking Calcaneal Plate

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### Abstract

**Background:** Management of intra-articular calcaneal fractures has always been a matter of debate among orthopaedic surgeons. We prospectively analyzed radiological and functional results of depressed intra-articular calcaneal fractures fixed by locking calcaneal plates. **Materials and Methods:** We operated 28 intra-articular joint depression type calcaneal fractures (as per Essex-Lopresti classification system) using the standard extended lateral approach and fixed them with locking plate during the period, October 2011 to September 2014. Patients were followed up clinically and radiologically for at least 1 year. Radiological assessment was done by Bohler's angle and Gissane's angle along with measurement of calcaneal height and width. Functional outcome was assessed using the American Orthopedics Foot and Ankle Society (AOFAS) scale. **Results:** Wound healing complications were 7/28. Four patients had flap necrosis, two had superficial and one had deep infection. Preoperative size of Böhrer's angle corrected to normal range in all cases. The overall results according to the AOFAS Ankle Hindfoot Scale were good or excellent in 84%. None of the patients had compartment syndrome, heel pad problems, peroneal tendinitis, reflex sympathetic dystrophy or implant failure. **Conclusion:** Open reduction and internal fixation of intra-articular calcaneal fractures has become a standard surgical method. Fewer complications and better results related to treatment with locking compression plates have been observed for all Sanders types of intra-articular calcaneal fractures.

**Keywords:** Calcaneal Locking Plate; Intra-Articular Calcaneal Fracture; Lateral Extensile Approach.

### Introduction

Management of fractures of the calcaneus is one of the most challenging problem among the orthopaedic surgeons. Calcaneal fractures account for approximately 2% of all fractures and 75% of fractures of foot. Of these 10% are bilateral, 10% have associated injuries, and 60% to 75% are displaced intra-articular fractures. These fractures are uniformly caused by an axial load mechanism, such as a fall or a motor vehicle accident, and may be associated with other axial load injuries, such as lumbar, pelvic, and tibial plateau fractures [1-5]. Debate continues regarding the management of

calcaneal fractures, between open reduction and internal fixation and closed treatment. The conservative treatment invariably leads to long-term consequences. Calcaneal shape restoration by means of open reduction - internal fixation is a necessary prevention of late complications seen with conservative treatment such as malposition, flattening of the longitudinal arch, anterior ankle impingement syndrome, lateral impingement syndrome, and axial malalignment of the hind foot [[7-10].

The locking compression plate (LCP) has improved the functional results, limited the indications for bone grafting, and shortened the treatment. The purpose of our study is to assess the functional results and complications of calcaneal

fractures treated with calcaneal locking compression plates.

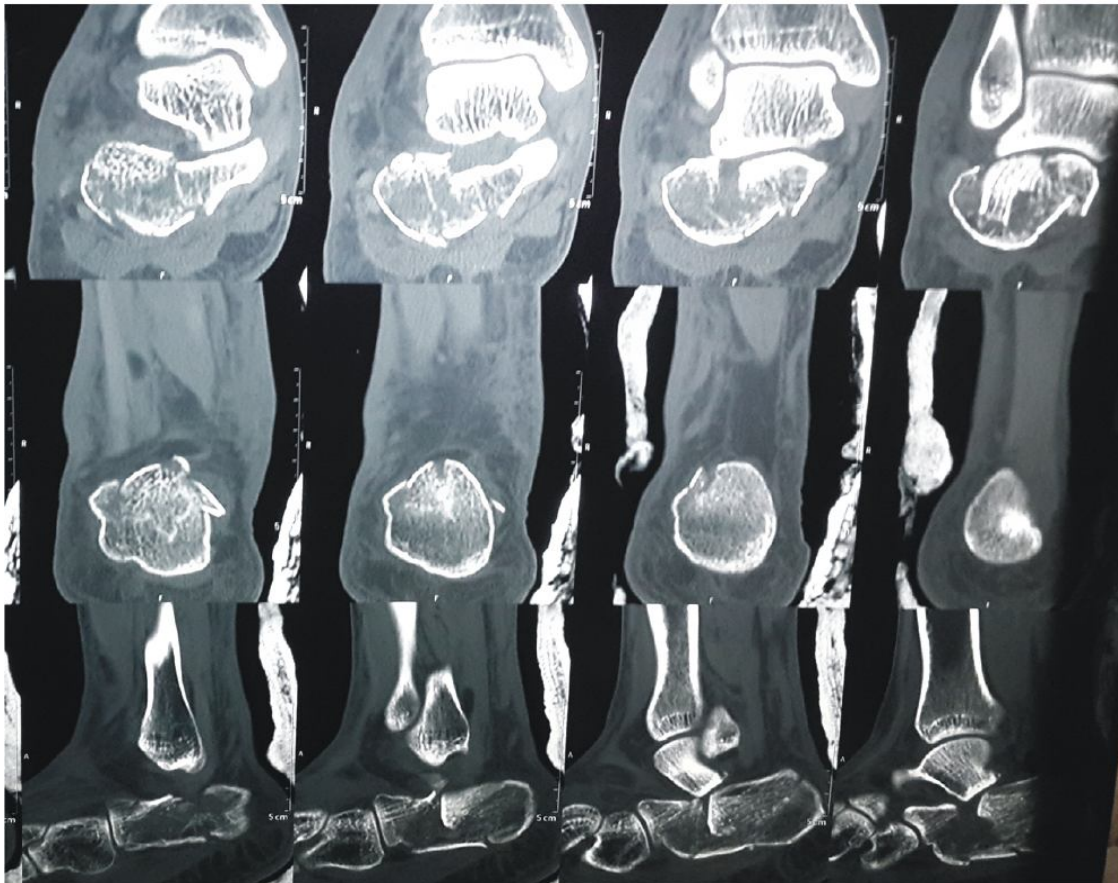
### Materials and Methods

30 intra-articular joint depression type calcaneal fractures (as per Essex-Lopresti classification system [11]) in 28 patients (2 simultaneous bilateral fractures) were treated by means of open reduction and internal plate fixation with locking compression plate, from October 2011 to September 2014. The most frequent mechanism of injury was fall from height. There were 22 males and 6 females with an average age of 44 years (range 23–73 years). Patients with extra-articular undisplaced or tongue type intra-articular calcaneal fracture or compound calcaneal fracture were excluded from the study. Patients operated on after 3 weeks were also excluded from the study. Ethical clearance was obtained from the ethical committee. Patients were evaluated for associated injuries and X-rays of anteroposterior, lateral and axial views of calcaneum were done (Fig-1a). CT scan was done to assess the amount of comminution and articular depression whenever

Fig. 1a:



Fig. 1b:





possible (Fig-1b). Initially below knee slab in neutral, limb elevation and ice pack fomentation were used to decrease swelling.

### Operative Procedure

Surgical treatment of the fractures took place once soft tissue conditions allowed (usually between 10 to 21 days), when the soft tissue edema decreased and there were positive wrinkles. The surgery was started with the patient placed in lateral decubitus position, antibiotics administered and tourniquet applied. Exposure was done with standard lateral approach with L-shaped incision type and no-touch technique was used. The approach was developed as a full-thickness flap. The lateral cortical fragment (bulge fragment) was then hinged away. Subsequently, a good view into the subtalar joint was obtained. The soft tissue flap was held back by K-wires, which had been inserted into the talus and bent. Use of the joy-stick technique with a Schanz-screw placed through the tuber calcanei achieves reduction and in particular the length and axis is regained (Fig-2a & b). Depending on fracture type and size of the defect, we filled up the defect with autogenous cancellous bone and locking compression plate was applied. Plate was fixed with fully threaded locking screws and confirmed in lateral and axial fluoroscopic views. Closed suction drainage was done for 24 to 48 hours until drainage was less than 25 ml per 8 hours. Removal of the short

leg splint was done at 3 to 5 days postoperatively. If the flap showed uncomplicated healing, and the wound was sealed, early active range of motion was begun at that time. At the second postoperative week, active range of motion of the ankle and subtalar joint was instituted. Patients learned to draw the alphabet

Fig. 2a:



Fig. 2b:

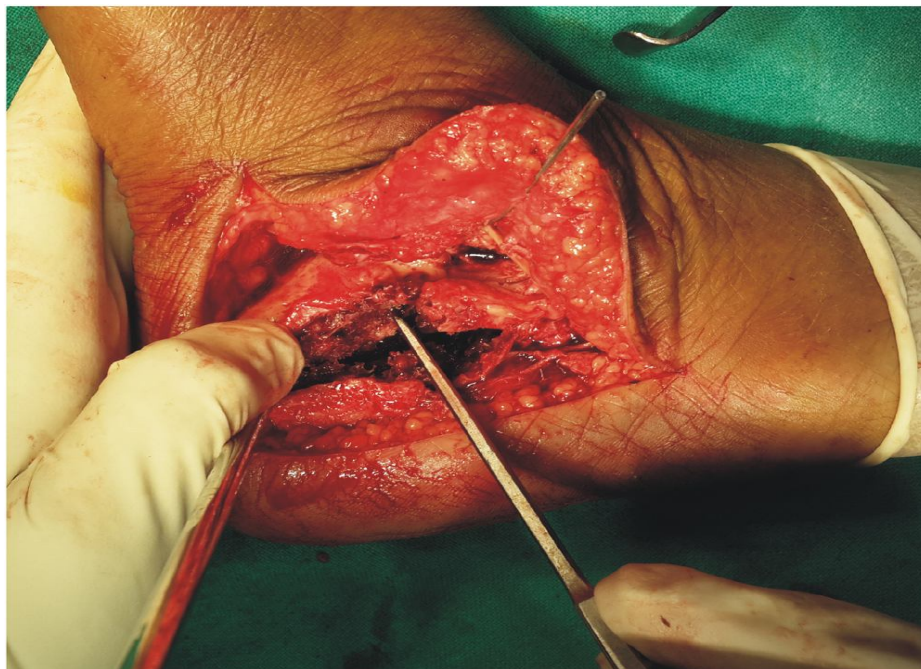




Fig. 3 a b:

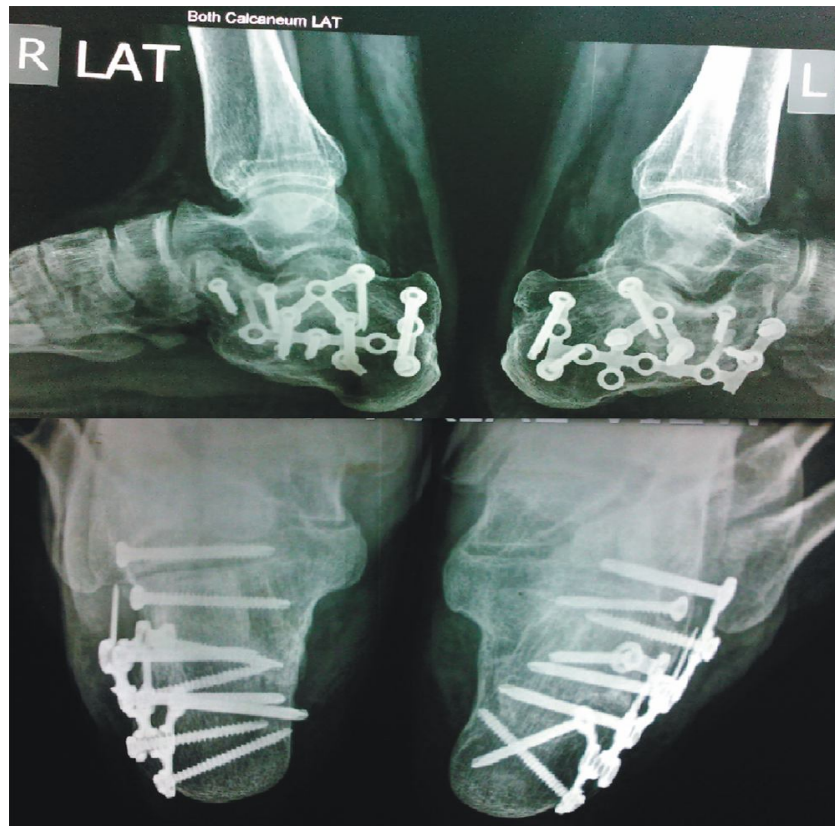


Fig. 4 a b c d:



with the hallux of their injured limb or make progressively larger circles with their feet. No weight bearing was allowed for 12 weeks. Patients were followed up clinically (Fig.-4a, b, c, d) and radiologically (Fig.-3a & b) at least for 1 year. Radiological assessment was done by Bohler's angle<sup>12</sup> and Gissane's angle [13] along with measurement of calcaneal height and width. Functional outcome was assessed using the American Orthopaedics Foot and Ankle Society (AOFAS) scale [14].

## Results

28 patients with 30 joint depression types of calcaneal fractures (2 bilateral calcaneal fractures) were operated, of which 2 patients were lost in follow-up. Hence only 26 patients with 28 calcaneus fractures were included in the study.

### *Wound healing*

During postoperative treatment we detected 4 cases with superficial wound edge necrosis, of which all healed completely with dressing and antibiotics. Three cases had wound infection, of which one case recovered and two cases developed persistent implant infection where implant was removed about 6 months after surgery. No fragment redislocations occurred after forced plate removal. No patient developed deep osseous infection.

Until follow-up upto an average period of 8.6 months, no case required an arthrodesis. At the final follow up examination only 20 patients were able to return to work. 6 patients had to change their vocation because they were all manual labourers. More than 85% of the patients had no or only mild occasional pain with no limitation of daily activity and no gait abnormality and were able to walk at least more than 200 mts. with only some difficulty on uneven surface. All patients had stable ankle joint with all having dorsiflexion and plantar flexion more than 30°. The average subtalar range of motion was 17°, with only 3 cases having near normal restriction (75%-100%), and 6 having severe restriction (<25%).

Average AOFAS score at final follow-up was 85 (range 66 to 97), with 84% having excellent to good results and 2 (8%) and 1 (4%) had fair and poor results respectively. The mean Bohler's angle improved from preoperative 5.5° (range -15° to 18°) to immediate postoperative 28° (range 17° to 31°), which was decreased to 25.3° (range 13° to 29°) at final follow-up. It was maintained in normal range

(20° to 40°) in all the patients except three who had highly comminuted fractures.

The mean Gissane's angle improved from preoperative 153° (range 131° to 169°) to immediate postoperative 119° (range 112° to 142°), which fell to 122° (range 116° to 146°) at final follow-up.

The mean calcaneal height improved from preoperative 3.1 cm (range 3.4 to 4.1 cm) to immediate postoperative 4.5 cm (range 4.3 to 4.8 cm) and decreased to mean 4.32 cm at final follow-up.

The mean calcaneal width improved from preoperative 4.2cm (range 3.9 to 4.2 cm) to immediate postoperative 3.7 cm (range 3.5 to 3.9 cm) and lost to mean 3.8 cm (range 3.7 to 4.0 cm) at final follow-up.

## Discussion

Open reduction and internal plate fixation of displaced intra-articular calcaneal fractures has become a standard surgical protocol with low complication rates and better quality of life after the surgery. Use of locking compression plate makes the fixation more stable even without bone grafting and enables earlier weight-bearing[15-17]. Brauers anglicised the cost-effectiveness of surgery versus conservative treatment for intra-articular calcaneal fractures and showed economical advantage of ORIF[15]. Most of the conservatively treated patients later underwent arthrodesis procedure. Poorer prognosis is related to males, heavy workers, bilateral fractures, and Sanders type IV fractures [18]. Canadian Orthopaedic Trauma Society performed a prospective, randomized, multicenter trial and compared operative with nonoperative treatment of displaced intra-articular calcaneal fractures in 424 patients with 471 fractures. There was no difference in overall outcome between the operative and non-operative groups; however, those having non-operative treatment of their fracture were 5.5 times more likely to require a subtalar arthrodesis for post-traumatic arthritis than those undergoing operative treatment[19]. Radnay et al [20] studied the outcome of patients with a displaced intra-articular calcaneal fracture that eventually required arthrodesis; patients who had initially been treated operatively had superior results compared with those who had initially been treated nonoperatively. This might have been due to the comparatively better preservation of the calcaneal geometry after operative treatment. We also believe that arthrodesis surgical technique is less

demanding when the arthrodesis follows operative treatment of such a fracture compared with non-operative treatment. Wound related complications leading to implant removal have also been reported after operative treatment in many studies [21]. Wound related problems in the present study was slightly high compared with those in other studies. This may perhaps be due to increased prevalence of nosocomial and antibiotic-resistant infections such as MRSA in our clinical scenario. In our series average AOFAS score was 85, with 84% having excellent to good results, whereas two (8%) and one (4%) had fair and poor results respectively which is similar to previous studies [22-30]. All patients except one were able to walk at least more than 200 m with only some difficulty on uneven surface. The better functional outcome assessment as seen in our study is considered due to use of the locking plate, which provides better stability and fixation as compared to conventional plates. In our study, the immediate postoperative mean Bohler's angle, mean Gissane's angle, calcaneal height and width were 28°, 119°, 4.5 cm and 3.7 cm respectively, which was decreased to 25.3°, 122°, 4.3 cm and 3.8 cm respectively at final follow-up. Restoration of Bohler's angle is associated with a better outcome, which can only be attained by open reduction and maintained with locked plating. In our series, Bohler's angle was maintained in normal range (20° to 40°) in all the patients except three patients who had highly comminuted fractures.

It is concluded that open reduction and internal fixation with locking plate is a good treatment option for joint depression type intra-articular fracture of calcaneum, resulting in restoration of calcaneal height, width, Bohler's and Gissane's angles, and allowing early mobilization, provided adequate care and importance is given to local conditions and meticulous soft tissue dissection because of a chance of slightly higher incidence of infection.

#### Footnotes

Source of Support: Nil

Conflict of Interest: None.

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