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Our Experience with Operative Treatment of intra-articular calcaneal fractures with calcaneal plates

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Abstract

Background: Surgical treatment using open reduction and stable osteosynthesis of displaced calcaneal fractures has become a standard method of treatment in recent times. The purpose of this study was to determine whether open reduction and internal fixation of displaced intra-articular fractures results in better general and disease specific outcomes at 1 year after injury.

Materials and Methods: Between February 2012 and December 2015, 28 Patients with intra-articular calcaneal fractures were treated with calcaneal plates (locking and non-locking) using standard extended lateral approach to calcaneum. Patients were evaluated by history, physical examination and radiography. Fractures were assessed by preoperative CT Scans in selected complex fracture patterns. Bone grafts were not added when a locking plate was used. Treatment results were evaluated by AOFAS Ankle-Hindfoot Scale at different follow-up periods ranging from 6months to 3years.

Results: Wound healing complications were noted in 4 patients (~14%), which was the most frequent complication. Implants were removed in a total of 4 patients, in one case because of severe swelling, where the patient had early implant removal after 3months of surgery. All fractures united eventually and no patient had deep osseous infection or foot compartment syndrome. Overall results according to the AOFAS Ankle-Hindfoot Scale were Good to Excellent in 23(~83%) Cases.

Conclusion: Open reduction and internal plate fixation of intra-articular fractures is associated with low complication rates and gives better quality of life after the surgery. The method has been improved by implanting locking compression plates, osteosynthesis is more stable, enables early weight bearing, and bone-grafting is rarely necessary. Outcome scores in this study tend to support ORIF for calcaneal fractures when there is a clear indication.

Keywords: intra-articular calcaneal fracture, calcaneal plate, AOFAS Ankle-Hindfoot Scale

Introduction

Calcaneal fractures are relatively rare injuries, with reported occurrence of 2% of all fractures. The intra-articular types constitute to 75% of calcaneal fractures and historically have been associated with poor functional outcome.

These fractures mostly occur due to an axial load such as a fall from a height or a motor vehicle accident or sometimes by fall of a heavy object over the heel. These fractures occur as an axial load force is applied to the posterior facet of the calcaneus through the talus, shear forces are directed through the posterior facet toward the medial wall of the calcaneus. These injuries may be associated with other axial load injuries such as lumbar spinal, pelvic and tibial plateau injuries and these injuries are more common in higher-energy injuries. Approximately 10% of injuries are bilateral and less than 5% are open injuries. Many calcaneal fractures are work related, as they result from a fall from height, especially in males age 35-45 years. These fractures frequently result in long-term disability with potentially severe economic impact on the patients and their family.

Historically, treatment of displaced intra-articular fractures has varied from non-operative management with or without closed reduction, to open reduction with internal fixation by various surgical approaches, to primary arthrodesis. The non-surgical treatment was popular might be related to the potential for wound complications in many and possibly osteomyelitis in some of the surgically treated patients. However, over the past two decades the interest has swung back towards surgical management due to improved surgical techniques and less soft tissue stripping.

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Although many pioneers in the field introduced screw or plate fixation of the broken calcaneus, surgical treatment using open anatomical reduction and stable internal osteosynthesis is only commenced at the start of the 1980s. The treatment was made possible by the introduction of new imaging methods such as CT which allowed better detection of the fracture pathology and provided the basis for new surgical strategies. The Foot and Ankle Expert group of the AO Foundation together with Synthes USA developed an anatomically an shaped interlocking calcaneal plate, which has been available since 2002.

Plate osteosynthesis of the intra-articular fractures is a standard treatment method, but it has potential complications such as poor wound healing and infection. The complications of wound healing may occur because of not enough precisely performed incisions. Calcaneal shape restoration by means of open reduction internal fixation (ORIF) or primary subtalar arthrodesis if needed helps in prevention of late complications such as malposition, flattening of the longitudinal arch, anterior ankle impingement syndrome, lateral impingement syndrome, and axial malalignment of the hind foot. The locking compression plate (LCP) has improved the functional results, limited the indications for bone grafting, and shortened the treatment.

The purpose of this study was to determine whether open reduction and internal fixation of displaced intra-articular fractures using calcaneal plates results in better general and disease specific outcomes at 1 year after injury.

Materials and Methods

28 intra-articular calcaneal fractures in 28 patients were treated by means of open reduction and internal plate fixation from February 2012 to December 2015.

The most frequent mechanism of injury was fall from a height. Other mechanisms of injuries were motor vehicle accidents or fall of a heavy object on the heel. There were 23 males and 5 females patients in our study with an average age of 41 years (range 14 -63 years). One patient had an open fracture (Type 2, Gustilo and Anderson Classification) with the wound over the medial side of calcaneal area.

Table 1: Characteristics of Studied groups (Calcaneal fracture study, 28 fractures in 28 patients)

Age Group	No. of Patients
<25 Years	01
25-35 years	06
35-45 years	13
> 45 years	08

Patients were evaluated by a detailed history, physical examination and radiography. X rays taken included axial calcaneal views along with routine antero-posterior and lateral views. Other associated injuries were looked for and noted. Computed Tomography with Sanders CT Scan Classification was used in selected patients with complex fracture patterns. Displaced calcaneal fractures (posterior articular facet step off more than 2mm, significant shortening, loss of height, and widening of the calcaneus, i.e., Böhler's and Gissane's angle variations) were included in the operative treatment. In all these cases, we performed primary osteosynthesis with restoration of the calcaneal shortening, loss of height, broadening and intra-articular joint restoration of subtalar joint.

We operated usually from the 3 to 10 days after injury (earlier if the soft tissue conditions are good), when the soft tissue

edema decreased and there were positive wrinkles on hind foot soft tissues. The surgery was performed under tourniquet, with the patient placed in lateral decubitus position, under intraoperative fluoroscopy control (Broden's views). The standard extended lateral approach with L-shaped incision (Seattle Type) were used. Posterior and calcaneal facet reconstruction including the Gissane's angle, Böhler's angle with calcaneal height, width, length restoration, and no varus-valgus deviation were main goals of open reduction. Calcaneal plates (both locking and non-locking) were used to stabilise the fractures. Bone Grafting was not performed in any Cases.

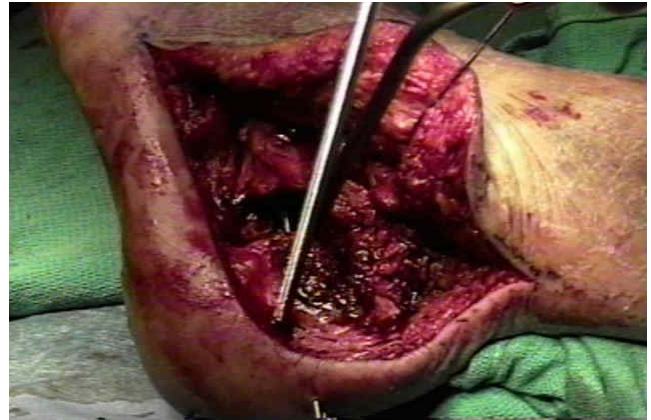


Fig 1: Intra Operative Photograph (above) showing the extended lateral approach used, and opening of Lateral calcaneal wall is gently pried laterally to expose intra articular fragments and a model of locking calcaneal plate used (below) After the surgery, A sterile compressive elastic dressing was given. Range of motion exercises began immediately on the first postoperative day. The progressive weight-bearing was started after 8 weeks, initially with 30% of their weight. Patients were allowed full weight-bearing after 12 weeks, provided that reduced and stabilized fracture position stayed unchanged and signs of bone healing were present. When LCP had been applied, we started up progressive weight-bearing two weeks earlier, because of better stability of locked screws in plate. Hardware removal was considered unnecessary unless there were complications. Post Operative X-ray imaging including Axial calcaneal views, were obtained on the 4th, 8th, and 12th week, and then 6th, 12th, and 24th month after the surgery.

The Patients were followed up for a minimum 12 months after surgery (maximum follow up 3 years). The Radiographs and in selected cases CT Scans were analysed one year after the operations. The late complications and functional outcomes including patients' satisfaction were evaluated at regular outpatient examinations. On the radiographs and CT scans, Böhler's, Gissane's, talocalcaneal angle (TCA), talus first

metatarsal angle (TFMA), and calcaneal inclination angle (CIA) were measured and evaluated.



Fig 2: Preoperative, Postoperative and follow-up (at 3 months) Xrays of a patient showing intra-articular fracture of calcaneum, treated with ORIF using a locking calcaneal plate and showing signs of bony union at follow up.

Overall Treatment results were evaluated by AOFAS Ankle-Hindfoot Scale at different follow-up periods ranging from 6months to 3years.

Results

Twenty four of all 28 wounds (~86%) healed with primary intention. Superficial healing defects (wound edge necrosis, skin edema blisters, superficial wound infections) occurred in 4 (~14%) cases. Most of the wounds eventually healed with no patient having deep osseous infection. In one patient the plate had to be removed for subsequent successful healing process. Implants were removed in a total of 4 patients, in one case because of severe swelling, where the patient had early implant removal after 3months of surgery. Time of hardware removal varied from 3 months to 2 years after the surgery.



Fig 3: Post Op Heel Rise with Ankle Plantar flexion in a Patient, One year after injury.

The AOFAS Ankle-Hindfoot Scale we achieved excellent to good results in 23(~83%) cases

Table 2: Overall Results According to A OFAS Ankle-Hindfoot Scale

	No. of Patients (%)
Excellent	06 (~21%)
Good	18 (65%)
Fair	03 (~10%)
Poor	01 (~4%)

Conclusion

Open reduction and internal plate fixation of intra-articular fractures is associated with low complication rates and gives better quality of life after the surgery. The method has been improved by implanting locking compression plates, osteosynthesis is more stable, enables early weight bearing, and bone-grafting is rarely necessary. Outcome scores in this study tend to support ORIF for calcaneal fractures when there is a clear indication.

In the Last Decade, Open reduction and internal plate fixation of displaced intra-articular fractures has become a standard surgical method with low complication rate and better quality of life after the surgery.

Rates of wound complications that achieved~14% in our study is comparable with the results published in literature of the last decade. Many of the wound complications may be avoided by proper planned incisions and taking extreme care of soft tissues during exposure and closing the flaps. We may finally conclude that, properly timed open reduction and internal

fixation with calcaneal plates in indicated cases, taking care of soft tissue envelope and early controlled rehabilitation leads to therapeutic success in displaced calcaneal fractures.

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