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### Outcome after open reduction and internal fixation of intraarticular fractures of the calcaneum without the use of bone grafts

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### Abstract

**Background:** Intraarticular fractures of calcaneum are commonest type of calcaneal fractures. Lots of controversies exist about the ideal management for them. The focus is now shifting on operative management by open reduction and internal fixation for these fractures with or without the use of bone grafts.

**Method:** Thirty intraarticular fractures classified by Essex Lopresti radiological classification, were treated by open reduction and fixation. The patients were followed over a mean period of 30 months (25-40 months).

**Results:** All the fractures united at a mean duration of 14 weeks. 86% patients had excellent functional outcome with one patient having fair and one having poor functional outcome.

**Conclusion:** Open reduction and internal fixation with plate is a good method for treatment of intraarticular fractures of calcaneum to achieve anatomical restoration of articular surface under vision, stable fixation, early mobilization and an option for primary subtalar arthrodesis if deemed necessary.

**Keywords:** Intraarticular fracture calcaneum, Essex Lopresti classification, Open reduction internal fixation with plate without bone grafts.

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Fig. 1. (a) Pre-operative calc...

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Calcaneum is the most commonly fractured tarsal bone. Majority of all calcaneal fractures are intraarticular and 30% are extraarticular [1],[2],[3]. The incidence of fracture calcaneum has remained relatively constant [4]. The mechanism of injury is axial loading in a majority of patients but others like brake pedal injuries and high-velocity trauma leading to open fractures are also common. The fracture line usually moves medially forming an antero-medial and postero-lateral fragment. The sustentacular fragment usually stays associated with talus because of strong ligaments. The postero-lateral fragment is important as it contains the posterior facet and can be rotated by as much as  $180^{\circ}$  in extreme cases. The postero lateral part of talus forces a free lateral piece of posterior facets into tuberosity fragment [1],[2],[5].

Conservative treatment of intraarticular fractures very often leads to increased morbidity due to incongruity of articular surface [1],[2],[5],[6], widening of heel, talar dorsiflexion, loss of talo-calcaneal lever arm [5] and peroneal tendon impingement [7],[8],[9],[10],[11]. Hence focus has shifted to operative management with better outcome [6],[7],[8],[9],[10]. History of treatment suggests diverse treatment options; hence we have carried out a study to know the outcome of intraarticular fracture of calcaneum after operative treatment by open reduction and plating, without the use of bone graft.

## Materials and Methods

Thirty intraarticular fractures of calcaneum were operated upon from December 2001 to April 2003 with one case of bilateral fracture calcaneum. Twenty five patients were male and 4 female. Sixteen fractures were on right side and 14 on left side. The mechanism of injury was fall from height in 26 patients and road traffic accidents in 3 patients. Two patients had associated spinal injury, one patient had pelvic fracture and three patients had associated ipsilateral lower limb trauma. One patient had open grade 1 injury with wound on medial aspect of the foot. Twenty eight patients were operated within one week of trauma and one patient was operated 12 days post injury because of adverse local condition. We have used the fracture classification system by Essex Lopresti based on X-rays [1],[2]. But the fracture pattern was assessed by using lateral, as also axial and Broden's view [2]. Accordingly 21 fracture had joint depression variety and 9 fracture had tongue type fracture configuration. Though we understand that CT scan classification is much better [1],[2], we were unable to apply it for all the patients due to financial constraint.

After admission the patients were placed in a bulky Jones dressing and assessed for operability by AP, lateral and axial views of both affected and normal foot (for comparison). CT scans were obtained whenever it was possible to do so. Pre-operatively Gissane's angle and Bohler's angle were measured.

All the patients were operated in a lateral position by a lateral approach under tourniquet control and fixed calcaneal plate which best suited fracture configuration and 4mm simple cancellous screws with meticulous assessment of screw size to prevent injury to medial neurovascular bundle.

Primary subtalar fusion was not done in any of the cases inspite of extensive comminution of posterior facet in three fractures and acceptable alignment was achieved by buttress plating and interfragmentary screw fixation.

*Surgical Technique:* All the patients were operated by basic approach, advocated by Sanders [1] using Benirsche and Sangeorzan incision. [13] Accordingly right angled skin incision was made on the lateral

aspect of the limb. The horizontal limb was kept at the junction of thick plantar and thin dorsal skin. The vertical limb extended midway between lower border of fibula and tendoachilles. The angle was curved and not sharp. At the distal end, the horizontal incision was turned upwards at the calcaneo-cuboid joint. The incision was carried down to the lateral wall cutting the inferior peroneal retinacula and calcaneofibular ligament thus elevating a flap of tissue, but carefully protecting the peroneal tendon sheath, which was not opened. Peroneal tendons were mobilized over the fibula and self retaining retraction was obtained by passing K-wires in lateral malleolus, talus, cuboid which were bent away from the operative site to obtain excellent exposure of the subtalar joint and the posterior facet.

Primary fracture line in the lateral wall was exposed and opened, the depressed posterior facet was dug out and elevated with the help of an elevator. After lifting out the posterior facet; with the help of a schanz screw drilled in the posterior tuberosity fragment varus angulation, impaction, increased heel width and loss of a calcaneal height were corrected by giving a valgus corrective force in the opposite direction. Achievement of congruous posterior facet was the prime aim of surgery although congruous reduction of anterior, middle facet & calcaneocuboid joint was also attempted. This reduction was appreciated under direct vision and provisionally fixed with 2.5 mm K-wires passed axially. On table a radiographic assessment was made for restoration of Bohlers and Gissane's angle. On achieving acceptable reduction, especially of posterior facet, final fixation was done either with an anterior cervical spine fusion plate, reconstruction plates, Sanders or modified Sander's plate and 4mm simple cancellous screws. After the lateral wall had been repositioned into anatomical position to obtain the height of calcaneum. The medial sustentacular fragment was fixed with a screw passed under IITV control through the plate from lateral to medial side, into sustentaculum tali.

In 5 patients there was a sagittal split in posterior facet which was successfully compressed using interfragmentary screw passed through the plate. The reduction of the posterior facet was successfully maintained by a screw passed through the subchondral bone just below the posterior facet. The flap was apposed using Vicryl 1-0 in subcutaneous plane and skin by silk.

*Post Operative:* Post operative elevation was maintained for 48 hours. Number 10 drain was used in all cases and removed at 48 hours and a below knee splint was given over a bulky compressive dressing. Active ankle and subtalar motion was encouraged from 2<sup>nd</sup> or 3<sup>rd</sup> day post operative as pain permitted and was assessed by the 'circle draw test'. Sutures were removed at an average of 18 days. The patients were kept non weight bearing for 8 weeks. Gradual weight bearing progressed from 8 to 14 weeks and patients were full weight bearing by the end of 14 weeks. Regular check X-rays obtained at 6 to 8 weeks and then at 14 weeks. Podograms were taken at final follow up and compared with the opposite side in unilateral cases. The results at an average 2 years of follow up were analyzed using Creighton and Nebraska score <sup>7</sup> and radiological assessment was done with Gissane's angle and Bohler's angle [Figure - 1],[Figure - 2].

## Results ▲

Post operative restoration of Bohler and Gissanes angle was possible in all the patients. In all the patients Bohlers angle (Normal 25 to 40 degree) was decreased to average of 10 degree pre-operatively indicating depressed posterior facets. Post operatively we were able to achieve a Bohler's angle of average 30 degrees. Gissane's angle (Normal 90-110 degree) was disturbed in all the patients and post operative we were able to restore it in a normal range. Post operative average Gissane's angle was 100<sup>0</sup>.

Patient distribution as per various criterias of CreightonNebraska scoring has been shown in [Table - 1]. Post operative infection requiring implant extraction at 12 weeks was seen in one patient contributing to fair result and superficial infection which responded to antibiotics was seen in one patient.

Intraarticular fractures are common as compared to extraarticular fractures, hence the importance of anatomical reduction to decrease the possibility of joint incongruity and subtalar arthritis. Open reduction and internal fixation is now more aggressively advocated for management of intraarticular fractures of calcaneum. Intraarticular fractures are commoner and hence importance of anatomical reduction to decrease the complication of subtalar arthritis, joint incongruity and late ankle arthritis.

In the present series, joint depression variety was commoner as compared to tongue type. This observation matches with that cited by other authors also. [7],[12] Associated injuries were common, especially involving spine and lower limb, as was also noted by other. [12],[14] In our study, it was possible to restore the Gissane's angle and Bohler's angle post-operatively. The average pre-operative Bohler's angle was  $10^{\circ}$  and it was  $30^{\circ}$  post operatively. Scalmberg et al [12] reported average pre operative Bohler's angle of  $6^{\circ}$  and average post operative angle of  $26^{\circ}$ .

In our series 25 patients had no pain on activity. This is in contrast to the other reports [15],[16],[17], which claim that pain was not improved by surgery. Only in four patients the range of inversion and eversion was restricted to 40% to 60% of normal, this is similar to that reported by other authors [18]. No patient had to change jobs and only 5 patients had to work with some restrictions as was also observed by Leung et al [7]. No patient underwent change in shoe size though 6 patients had changes in size of podogram at 2 yrs. follow up. Thus asymptomatic heel widening occurred in a significant number of patients. At 2 yrs. follow up only 3 patients had moderate swelling. Of this only one patient had it because of causalgia contributing to poor result. Operated patients had very good outcome with less time off work as has been suggested by others [1],[18].

Surgical technique, soft tissue dissection and local conditions are most important in determining the success of surgery and rate of infections. Though CT scanning is better we found accurate radiological evaluation is adequate in planning operative management. In no patient we opted for primary subtalar arthrodesis. In no patient did we damage the neurovascular bundle because of long screws.

Tendoachilles shortening and heel broadening can be adequately prevented by open reduction and internal fixation, though asymptomatic heel broadening occurred in 6 patients. In our series in spite of gross comminution seen in 3 cases, good functional results were obtained in two cases by achieving acceptable alignment of posterior facet and in these cases need for primary subtalar arthrodesis did not arise. This is contrary to some reports [19],[20]. However one patient developed causalgia with moderate swelling and subtalar stiffness contributing to poor result. This observation matched with views of Sanders et al [22] and Buch et al [23].

With strict post operative protocol of non weight bearing crutch walking no patient developed secondary collapse. Post operative achievement of Gissane's angle and Bohlers angle correlated well with activity and range of inversion and eversion, this is in concordance with Leung et al. [7] Postoperative arthritic changes were seen in three cases but till date two of them have good functional range of motion and minimal symptoms. As contrary to some authors [8],[21] we didn't find bone grafting as essential to prevent collapse and maintain the height of calcaneum.

It is concluded that open reduction and internal fixation with plate is an excellent method for treatment of intraarticular fracture calcaneum even if not supplemented by bone graft, provided adequate importance is given to local condition and meticulous soft tissue dissection because of a slight high rate of infection.

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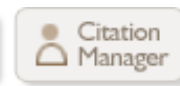
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## Figures

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## Tables

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