



A Study of ORIF With Plate & Screws and ESSEX LOPRESTI Technique For Intra-Articular Fracture of Calcaneus

KEYWORDS

ORIF, Essex Lopresti, Calcaneus, Creighton Nebraska score

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ABSTRACT *Background:* To evaluate outcomes of ORIF and modified Essex Lopresti procedure for intra-articular fractures of calcaneus.

Methods: It was a prospective study conducted in 23 feet of 19 patients. ORIF with reconstruction plate was done in 12 while modified Essex Lopresti close reduction was done in 11 feet. All patients were followed up to 18 months. Outcome of procedure was evaluated with Creighton-Nebraska score of Crosby and Fitzgibbons.

Results: We found that mean correction of Bohler's angle was almost equal in open reduction technique in both types of intra articular fractures while it was better in Essex Lopresti technique in tongue type fracture. Ankle range of motion was achieved in all cases between 40-70 degrees with good to excellent walking.

Conclusion : The use of Essex Lopresti technique avoids the large incision and stripping required for formal ORIF thus decreasing amount of scar formation and possibly residual stiffness. This method proved effective in selected joint depression type intra-articular fractures.

Calcaneus fractures are relatively rare injuries, with reported occurrence of 2% of all fractures. 75% of intraarticular type calcaneal fractures are due to axial force in the axis of crus when processes lateralis tali impacts as a hammer on the area of Gissane's angle vertex and breaks through the posterior articular facet.^{1, 2, 3} Most of the calcaneal fractures occur in the male industrial workers, making the economical importance of this injury substantial. Many authors have reported that patients may be totally incapacitated for as long as three years and partially impaired for at least five years after the injury.⁴

Despite the relative prevalence of these injuries, the definitive management has controversial but due to advent of techniques of radiographic imaging, sophisticated methods of fixation and proper rehabilitation have changed the scenario by remarkable improvements in the results.⁵ Although there has been many advances in imaging and management techniques, opinion for management of complex calcaneal fractures differ. Each modality has at times enjoyed more attention and enthusiasm in the literature. Frustrating factors that perpetuate this disagreement is the subset of calcaneus fractures with poor long term outcome, regardless of the management. Cotton commented in 1916 that "the man who breaks his heel bone is done so far as his industrial future is concerned"^{6, 7, 8, 9}

MATERIALS AND METHODS

Ours was a prospective study including 23 feet of 19 patients conducted between December 08 to February 11. Among them 12 patients underwent ORIF with plate and screws and 11 patients undergone closed reduction and screws fixation. All intra-articular calcaneal fractures with or without comminution i.e. joint depression type and tongue type fracture were included in the study. Patients with pre-existing arthritis of subtalar joint, old calcaneal fracture, extra articular calcaneal fractures and open calcaneal fractures were excluded from the study. Outcome of the study

was evaluated with Creighton-Nebraska score of Crosby and Fitzgibbons.¹⁰

In the 1st technique, under spinal anesthesia, lateral decubitus position on translucent table under intraoperative fluoroscopy control (Lateral and Broden's view) was given. Gentle retraction of the flap is performed by inserting Kirschner wires into the talus or gently retracting the flap with blunt hook after fully exposing the calcaneus. Now the anterior and laterally displaced tuberosity fragment, posterior plantar aspect of tuberosity, middle facet and the medial part of posterior facet are aligned with Kirschner wires. After reducing the central and lateral fragments to the stable medial portion, the posterior facet is reconstructed with reconstruction plate which was provisionally fixed with Kirschner wire. Now the cancellous bone graft harvested from metaphyseal region of upper end of tibia is used in cases where area beneath the posterior facet is vacant and non-supportive or enough bone is missing or impacted where buttress is needed. Now the definitive fixation with reconstruction plate is done and three main components of calcaneus the anterior process, posterior tuberosity and joint are secured to the plate with several screws placed into each component. Kirschner wires which were put from posterior aspect now removed when reconstruction plate is fixed with screws.

In the 2nd technique, the first step in the procedure was to place a Steinman pin or ulna nail from posterior aspect of the calcaneal tuberosity directed towards the inferior aspect of the most distal part of the displaced posterior facet. Thick Kirschner wire drilled from medial side of the posterosuperior calcaneus advanced into the displaced fragment to pass just inferior to the posterior facet and parallel with the lateral border of the calcaneus towards the cuboid. The wire was advanced to a point approximately one centimeter short of the facet. Cortical screw of adequate size fixed after measurement. A scrubbed assis-

tant performed an Essex Lopresti reduction in three steps which was accomplished while holding the dorsum of the foot with palm of one hand and the first pin with the other hand. Both thumbs were placed on the plantar surface of the foot approximately under the middle of the calcaneus.

- First the foot was forced into varus to unlock the primary fracture.
- Second, the midfoot and first pin was forced plantarward using the thumb as fulcrum.
- Finally, the foot was forced into valgus to bring the posterior facet adjacent to sustentaculum.

If the reduction was acceptable, then while maintaining the pressure on the foot and pin, 3.5mm cortical screws passed from posterior aspect of calcaneus caudal to cranial direction one or two in number. Then one or two 3.5mm cortical screws introduced from inferior aspect of calcaneus posteriorly introduced obliquely and vertically just underneath the posterior facet. Now pin used for reduction was removed and after releasing pressure on foot by assistant, long cortical screws 4.8mm introduced parallel to second pin short of anterior process of calcaneus or cuboid.

Essex Lopresti technique in joint depression type fracture

In joint depression type fracture the method of reduction of Essex Lopresti was almost same except the articular reduction was the first to performed and fixed with cortical screws from bottom of heel directed just underneath the posterior facet and later on primary fracture line and other secondary fracture lines to be addressed subsequently.

Patients are initially supplied with posterior below knee splintage not less than 4 to 5 weeks and later on given support stockings as needed to control foot and ankle edema and are encouraged. All patients were followed up at weekly interval for 1 month and then every 2 months till last follow up during study period and data were recorded. Radiographs were taken at end of first month and then every 2 months (figure-1,2,3,4) postoperatively with following criteria.

1. Bohler's angle
2. Gissane's angle
3. Heel width:
4. Subtalar articular step off
5. Tuberosity reduction
6. Subtalar arthritis with joint space reduction
7. Heel height (Calcaneal facet height):

RESULTS

All patients were followed up to minimum period of 6 months. 5 patients were followed up to 24 months. The mean follow up was of 12.38 months. One patient of joint depression fracture operated by ORIF with reconstruction plate was lost to follow up after two months.

Our study included total 19 patients with mean age of 38.6 years. Amongst 19 patients, 4 patients were females & 15 were male patients. Hence calcaneal fractures were most commonly seen in young to middle aged active males. Mode of trauma was due to fall from at home from height in 6 patients, fall from height at occupation sites in 8 patients and fall at sports in 1 patient and 4 patient met with road traffic accident. In 4 patients bilateral affection of calcaneus was noted while in rest of the patients unilateral

injury was observed. Among the patients having unilateral injuries right calcaneus was affected in 7 patients while left calcaneus in 8 patients. So nearly 4/5th of cases had unilateral calcaneus injury.

In 9 feet joint depression type of calcaneus fracture was noticed while tongue type fracture was seen in 14 feet. ORIF with recon plate was used in 5 feet of joint depression type and in 7 feet of tongue type fractures. Essex Lopresti method was used in 4 feet of joint depression type and 7 feet of tongue type of fracture of calcaneus. In 7 patients (36.84%) fractures other than the calcaneus were seen (table 1).

During follow up, in patients having joint depression type of fracture, mean correction in Bohler's angle was 25 degrees who were treated with ORIF with reconstruction plates while it was 19.25 degrees in whom Essex Lopresti procedure was done. However in tongue type fracture, mean correction in Bohler's angle was 23 degrees who were treated with ORIF with reconstruction plates while it was 26.71 degrees in whom Essex Lopresti procedure was done. (Chart 1)

Mean preoperative Gissane's angle in joint depression type and tongue type fracture treated with open technique was 129.20 and 118.30 while postoperative follow up Gissane's angle were 110.80 and 106.71 respectively. Mean preoperative Gissane's angle in joint depression type and tongue type fractures treated with closed technique were 126.50 and 121.70 while postoperative follow up angle were 113 and 100.14 respectively.

During follow up period range of inversion/eversion was 10-20 degrees in 80 % of patients with joint depression fracture treated with ORIF while the same was in 75% of patients with same type of fracture treated with EL procedure. In patients with tongue type fracture, range of inversion/eversion was 10-20 degrees in 85.7% patients treated with ORIF while in 100% patients with EL procedure.

Range of movements at ankle joint was more than 60 degrees in 60% patients in whom joint depression fracture was treated with ORIF while it was in 50% patients in whom the same type of fracture was treated with EL procedure. In patients having tongue type fracture, 57.14% patients operated by ORIF were having more than 60 degrees of ankle range of motion while 71.42% patients operated by EL procedure were having same range of motion.

In 1(4%) patients subtalar arthrosis was noted during follow up periods while sural nerve hypo aesthesia was seen in one (4%) patient. 2(8.6%) patients complained dull aching pain after weight bearing.

Foot score observed was excellent to good in 100% patients having joint depression fracture treated with ORIF, while it was 71.4% in tongue type injury treated with ORIF. Score was 75% in joint depression type injury treated with Essex Lopresti technique while it was 100% in tongue type treated with Essex Lopresti technique (chart 2).

DISCUSSION:

The goal of treatment of major intraarticular calcaneal fracture of weight bearing subtalar joint requires anatomical reduction, internal fixation and early rehabilitation along with careful patient selection and high technical skill to achieve excellent operative results. Age of patient, gener-

al medical status, history of smoking, diabetes, peripheral vascular disease, osteoporosis, presence of polytrauma, local factors like fracture blisters, pathoanatomy of fracture with good roentgenography, timing of surgery will decide the surgical approach and final definite outcome. In our study, 61% of feet were having tongue type of intraarticular fracture while 39% were having joint depression type.

A lateral extensile approach popularized by Benirschke and Sangeorzan¹¹ as similar to Gould was the sole exposure technique for reduction and fixation of intra articular fracture as this incision protects the neurovascular structure, taking care of skin flap as well as tension is avoided at corner of wound and undermining of the skin is not needed when applying a plate. We used reconstruction plates 2.5mm of various designs including reconstruction 'T' plate, single prong recon plate which proved effective fixation along with ease of application with peculiarities like molding, bending and desired length. Frankel and Anderson¹² has described in their case reports regarding comminuted calcaneal fracture that having a defect in cancellous bone of calcaneal body, reconstruction plate will triangulate fixation over the defect and provide better support of posterior facet of subtalar joint. It was observed that ORIF was marginally better than Essex Lopresti technique in joint depression type fracture. However Essex Lopresti technique was seemingly superior in tongue type fracture.

Tornetta¹³ evaluated 88% of Sanders type IIC tongue type fracture fixation with modified Essex Lopresti technique where 12% required conversion to open reduction and plate fixation. In our study neither of the intraarticular fracture treated with Essex Lopresti method required conversion to open reduction.

The modified Essex Lopresti reduction and fixation technique is the treatment of choice for less comminuted posterior facet and tuberosity fragment tongue type and selected joint depression type intra-articular fractures.

Internal fixation with cortical screws after Essex Lopresti type percutaneous reduction technique is enough to maintain reduction in fresh cases of intraarticular fractures rather than ORIF and bone grafting.

The Essex Lopresti method of reduction allows early motion without loss of reduction and popularized in patients with risk factors like smoking, diabetes, peripheral vascular diseases where wound healing complication is potential. The method we used include a slight modification of original technique in that reduction is maintained by either Steinman pin or with ulna nail that pass from posterior tuberosity to anterior calcaneus or cuboid immediately inferior to facet, thus supporting the facet. We then used cortical screws 3.5mm and 4.8mm of various length for propping of posterior facet, fixation of sustentacular anteromedial fragment along with primary fracture line and anterior process up to calcaneocuboid joint to hold posterolateral fragment unlike original technique where either reduction tool(Steinman pin) itself was left or instead single 6.5mm cannulated cancellous screw was fixed. We also used 4mm cannulated cancellous screws as an added support.

We performed autogenous cancellous bone grafting harvested from upper metaphyseal portion of tibia in 3 cases (13%) of comminuted joint depression type fracture in open technique. Palmar¹³¹ stated that the bone graft should be used when the area beneath the posterior facet

is vacant and non-supportive or whenever enough bone is missing or impacted that a buttress is required.

Paley and Hall⁶⁴ stated that Bohler's angle is an indirect reflection of both calcaneal height and the arch angle. In our study, correction of Bohler's angle in both techniques was comparable to Ehrendorfer, Pillai et al¹⁵ and Vaclav, Daniel et al⁵². Prompt osteosynthesis should be considered for intra-articular fractures of the calcaneus in order to restore the shape of the hind foot and Böhler's angle. From our observations, we found that mean correction of Bohler's angle was almost equal in open reduction technique in both types of intra articular fractures while it was better in Essex Lopresti technique in tongue type fracture.

Gissane's angle was corrected in both the techniques in both joint depression as well as tongue type intraarticular fractures as evident on follow up lateral radiographs compared with opposite normal foot except in 4 cases of bilateral injury. Most of the cases had no angulation of the subtalar joint between posterior facet of calcaneus and talus. Tuberosity reduction was achieved in all cases.

In our study 66% of patients showed 40-60% of improvement of range of eversion and inversion while 34% of patients showed 60-80% of improvement. Mohammed, Gamal et al⁵⁷ had evaluated outcome with 72% patients showed an average range of motion while 16% showed near normal range of motion fixed with plate with small lateral approach. Most studies describe an approximate 50% decrease in subtalar range of motion in all operatively treated calcaneal fracture^{13,41}. Ankle range of motion was achieved in all cases between 40-70 degrees with good to excellent walking and tip toe and heel to toe spring gait.

Tornetta³⁹ had 3% of cases had mild loss of reduction during healing, 15% of patients had drainage from Steinman pin site which forced to early removal, 15% of cases had stinging at shoe wear which resolved over time. In our study two cases had postoperative pain while walking which was mild in nature. The causes of pain are related to deformity, articular damage to posterior facet, widening of heel causing impingement on lateral malleolus and disruption of heel pad. Postoperative follow up radiograph suggestive of early subtalar arthrosis developed in one case of tongue type fracture treated with plating. Patient was treated with subtalar arthrodesis later on. Another patient in whom tongue type fracture treated with plating developed pain which needs analgesics off and on and change of shoe wear and was subsided on its own. No pain developed related to peroneal tendon irritation and no cases of subluxation of peroneal tendon detected on follow up. No hardware related complication was detected in any of the cases. None of the cases required hardware removal. Sural nerve related symptoms were noted in one case of joint depression type injury treated with plating but recovered after 8 months.

The period of incapacity in patients ranged from 6-8 months in both the intraarticular fractures treated with either of the techniques. All patients had no change of the job after treatment except one patient with pain and subtalar arthritis changed the job of heavy labourer. The calcaneal posterior facet height as described by Leung, Yuen et al¹⁴, was measured on lateral radiograph on follow up as well as calcaneal width as described by Bohler¹⁵ on axial follow up radiographs was measured. Height was restored to normal in 95% of cases except one where height was less than 0.5cm in comminuted joint depression fracture

treated with plating. Four cases were bilateral so it was not comparable.

There was no prominent residual widening of heel noted except in two cases, one foot in bilateral tongue type fracture treated with Essex Lopresti and one foot of joint depression type treated with plating where widening was resolved after weight bearing. In our study, 4.34% of feet had residual swelling observed in tongue type fracture treated with open technique with satisfactory functional results. In a study by Mohammed, Gamal et al¹⁶ residual widening was seen in 9% in both satisfactory and unsatisfactory functional results as well as residual swelling was seen in 7.2% of cases.

We used scoring system of Creighton-Nebraska assessment of Crosby and Fitzgibbons^{16,17} where good to excellent score 100% was achieved in joint depression type treated by open technique and tongue type treated with Essex Lopresti technique, while it was 71.4% good to excellent in tongue type treated with open technique and 75% in joint depression type treated with Essex Lopresti method which was comparable to study of Leung, Yuen et al,¹⁴ and better than Mohammed, Gamal et al¹⁷.

Earliest enthusiastic rehabilitation and mobilization is the key to excellent to good functional outcome following formal ORIF with reconstruction plate as well as modified Essex Lopresti technique of both the types of intra-articular fractures.

Figure 1 : Joint depression treated with plating



Figure 2: Joint depression treated with screws



Figure 3: Tongue type treated with plating



Figure 4: Tongue type treated with screws



Table 1: Type of fracture & treatment technique

Treatment technique	Type of fracture		
	Joint depression	Tongue type	
ORIF with recon plate	5(41.67%)	7(58.33%)	12(52.17%)
EL procedure	4(36.36%)	7(63.64%)	11(47.83%)
	9	14	Total – 23 feet

Chart 1: Post operative change in Bohler's angle

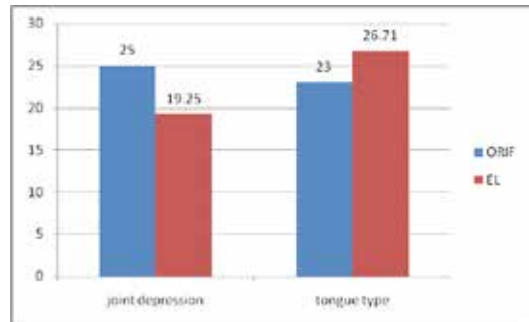
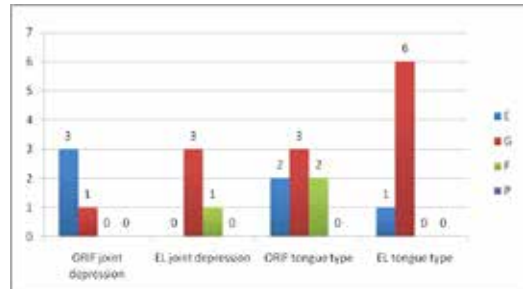


Chart 2: Foot score



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