

# Functional and Radiological Outcome of Essex Lopresti Procedure in Intraarticular Calcaneal Fractures

Harry Morris<sup>1</sup>, Manoj M. K.<sup>2</sup>

<sup>1</sup>Junior Resident, Department of Orthopaedics, Government Medical College, Trichur, Kerala.

<sup>2</sup>Associate Professor, Department of Orthopaedics, Government Medical College, Trichur, Kerala.

## ABSTRACT

### BACKGROUND

Calcaneum fractures are the most common type of fractures affecting tarsal bone. It accounts for about 60% of all tarsal bone fractures and 2% of adult fractures. 75% of the calcaneal fractures are intra-articular and usually associated with poor outcome. Most common cause of this type of fracture being axial loading i.e., fall from height injuries or in road traffic accidents. The study was done to evaluate the functional and radiological outcome of intra-articular calcaneal fractures treated with Essex-Lopresti technique, as measured by the AOFAS Scoring system, the mean duration of radiological union and the radiological outcome using pre- and post-operative Bohler's angle and associated complications.

### METHODS

From 1st Jan 2017 to 1st June 2018, 36 patients with intra articular calcaneal fractures presented to casualty of which 28 patients were tongue type according to Essex-Lopresti classification and were treated with Essex-Lopresti technique using 4.5 mm Steinman pin. Patients were followed up regularly at 6 weeks, 12 weeks and 6 months. The time taken for radiological union was noted. After satisfactory radiological union, the functional outcome and radiological outcome was studied by the 'American Orthopaedic Foot and Ankle Society (AOFAS)' ankle hind foot scoring system and using pre- and post-operative Bohler's angle measurements.

### RESULTS

The average age of patients in our study was 39.14 years of which all except two were female. Fall from height was the mode of injury in majority of patients except for three which were road traffic accidents. The right calcaneum was involved more commonly than the left. Fracture classification was based on the Sanders and Essex-Lopresti methods. For the study purpose Essex-Lopresti classification was used and all were tongue type fractures according to Essex-Lopresti classification. The functional and radiological outcome was better in tongue type fractures treated with Essex-Lopresti technique. All the patients had signs of radiological union on second follow up at 12 weeks. The average time for union in all the 28 patients was 12.86 weeks. The functional outcome was excellent in 16 patients, good in 8 patients and fair in 4 cases.

### CONCLUSIONS

We are of the opinion that when surgery is opted as a choice of treatment in calcaneal fracture with tongue type variety, Essex-Lopresti technique is good in terms of union of functional outcome in relation to function and range of movements and radiological outcome in relation to pre- and post-op Bohler's angle.

### KEYWORDS

Essex-Lopresti, Intra Articular, Tongue Type, AOFAS Score, Bohler's Angle

*Corresponding Author:*

*Dr. Manoj M. K,  
Murungodiyil (H),  
Nettoor P.O., Maradu,  
Ernakulam-682304, Kerala.  
E-mail: drmanojmk@hotmail.com*

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## BACKGROUND

Calcaneal fractures are caused by a high velocity force to the heel, mostly in vehicle accidents or fall from height. Numerous factors contribute to the fracture pattern: weight, age of the patient, type of fall. Male patients predominated (75%) and younger than 50 years of age, with incapability for the work for the period up to the 2-5 years.<sup>1</sup> In most of the cases, these fractures are bilateral and conjoined with lumbar spine fractures. Calcaneal fractures can be intra-articular or extra-articular. Even with advanced surgical techniques and newer implant devices, still the treatment of calcaneal fractures remains challenging. Whatever treatment modality is used, calcaneal fractures are still prone for lot of complications and poor outcomes with significant long term quality of life issues. The primary source of debate has been the issue whether better results are achieved with operative or non-operative method. Operative treatment methods include open reduction and internal fixation, percutaneous fixation and primary arthrodesis.

Improvement in imaging technology has allowed a better understanding of fracture pathology and provided the basis for newer classifications, which has revolutionized the treatment of calcaneum fractures. There remains no consensus regarding the surgical approach, with many having been described, including medial, lateral, combined medial and lateral, extended lateral and sinus tarsi approaches. The method of fixation remains a point of debate, with various proponents advocating fixation with pins, screws, or plate fixation with screws. While the literature gives significant benefit from operative treatment of these fractures, complications have been shown to be a common problem in many studies. There are many methods of stabilization of calcaneal fractures, each having their own merits and demerits. Open reduction and fixation is not the preferred way of treatment among many surgeons probably because it demands good surgical expertise and due to the high complication rates associated with the fracture even with good fixation. Here comes the role of closed calcaneal pinning in intra-articular calcaneal fractures. This is a humble effort to quantify the functional and radiological outcome of calcaneal fractures treated with closed calcaneal pinning using Essex-Lopresti technique; so that more such cases can be treated with closed calcaneal pinning in future in our part of the world.

### **Mechanism of Injury**

Intra-articular fractures are almost always caused by axial forces. The tuberosity of the calcaneus is located slightly lateral to the talus. The axial load applied to the posterior facet through the talus results in shearing forces through the posterior facet, towards the medial wall of the calcaneus. The lateral process of the talus is driven downward into the neck of the calcaneus, forcing the subtalar joint into eversion thus creating the primary fracture line. Anteriorly, the fracture line may exit laterally, usually at the angle of Gissane, but occasionally it may progress distally as far as the calcaneal cuboid joint. The primary fracture line moves

medially, separating the calcaneus into two main segments: the sustentacular (anteromedial) and tuberosity (posterolateral) fragments. Because the sustentacular fragment is usually tethered by its attachment to the extremely strong talocalcaneal interosseous ligament, it is not markedly displaced and remains constant in its position. If the injury force continues to be applied 2 things happen- medial spike attached to the sustentaculum is pushed farther towards medial heel skin, and secondary fracture lines develop off the primary shear line. The posterior secondary fracture line creates the "thalamic fragment," which is the depressed portion of the posterior subtalar facet. When it exits behind the posterior facet and anterior to Achilles tendon, it is called a joint depression type, and when it exits distal to Achilles tendon, it is called a tongue type. As the body of the talus drives the thalamic fragment into the spongy, cancellous bone of the calcaneus body fragment, it usually shears the attachment of the thalamic fracture from the lateral wall and causes a "blowout fracture," leading to a well-organized lateral bulge. With the lateral displacement of the body fragment, the lateral bulge impinges on the fibula calcaneal space, predisposing it to fibula calcaneal impingement and peroneal tendon entrapment. The eccentric loading crosses the thalamic fragment's articular facet to rotate medially, and it is pushed into the calcaneal body fragment.

The fracture lines on the medial side are sharp, well-defined, and usually not comminuted because they are produced by a shearing force. In contrast, the lateral fracture lines are comminuted and poorly defined because they are produced from the axial impaction and expansion of the lateral wall.

### **Radiography**

The initial radiographic evaluation of the patient with a suspected calcaneal fracture should include:

1. A lateral x-ray of the hindfoot - to assess height loss and rotation of posterior facet
2. An antero-posterior and oblique x-ray of the foot - to assess anterior process and calcaneo-cuboid involvement
3. A Harris axial heel view - to assess varus of tuberosity and width of heel
4. Broden's view - to evaluate congruency of posterior facet.

### **Computed Tomography Scanning**

CT images are obtained in the axial, 30-degree semi-coronal, and sagittal planes. The coronal views provide information about the articular surface of the posterior facet, the sustentaculum, the overall shape of the heel, and the position of the peroneal and flexor hallucis longus tendons. The axial views reveal information about the calcaneocuboid joint, the anteroinferior aspect of the posterior facet, and the sustentaculum. Sagittal reconstruction view provides additional information as to the posterior facet, the calcaneal tuberosity, and the anterior process.

**METHODS**

Our study included patients who attended the Department of Orthopaedics, Govt. Medical College, and Thrissur during the period of study, that is, from 1st January 2017 to 1st June 2018 who have sustained tongue type intra articular fracture of the calcaneum and were treated with closed calcaneal pinning. All patients who were treated with Essex-Lopresti technique for tongue type intra articular fracture of calcaneum were evaluated during their hospital stay and in op. Patients with tongue type intra articular fracture calcaneum were initially assessed in the casualty or OP when they presented.

**Inclusion Criteria**

- Patients above 18 years of age with intra articular fracture calcaneum.
- Patients who give informed written consent.

**Exclusion Criteria**

- Patients who have associated neurovascular injuries.
- Patients with previous surgeries in the fractured area.
- Patients with musculoskeletal diseases or conditions.

A thorough history and clinical examination were taken and recorded. The skin condition was evaluated for swelling, blisters, and recorded. Roentgenograms were taken including lateral view and axial view of the calcaneum, PA view of the chest, AP and lateral views of the spine and other relevant views. Other relevant evaluations were made as needed. The patients were initially counselled about the condition and treated with below knee POP slab, limb elevation, analgesics and other supportive measures. All patients were classified with Essex-Lopresti classification and assessed. Computed Tomography was not taken as most of the patients are with poor socioeconomic status. The patients were planned for closed reduction and internal fixation and the pre op work up were done. After obtaining a written informed consent the patients were operated by closed reduction and internal fixation with a 4.5 mm Steinmann pin. The steps of surgery were strictly based on the axial fixation of calcaneal fracture described earlier.

**Follow Up and Evaluation**

All patients were evaluated whenever they come for follow up in OP, especially during 6 weeks, 12 weeks and 6 months and the progress of each patients were recorded. The patients were evaluated clinically and radiologically. The patients were clinically examined for assessing the wound status, skin condition, tenderness, stability, range of motion of ankle and subtalar joint. The patients were asked about any functional disability they were having and the pain they are experiencing. Plain x-ray lateral and axial views were taken and assessed in each visit. Clinical union was declared in our study when the fracture site became stable and pain free. The fractures were declared united radiologically when bony trabeculae crossing fracture site. The time taken for clinical as well as radiological union was noted for each

patient. If no clinical or radiological signs of union were present even after 16 weeks, patients were classified as delayed union in our study. American Orthopedic Foot and Ankle Society (AOFAS) ankle foot scoring system was used for assessing the functional outcome at 6 months. The AOFAS scoring system was developed by the American Academy of Orthopaedic Surgeons (AAOS) and has been validated by various studies. The AOFAS score is a 100 point scoring system assessing the pain, function and alignment of the foot. The functional outcome decreases as the score decreases. The result was then graded Excellent, Good, Fair and Poor as- Excellent – 89 to 100 Points, Good – 79 to 89 points, Fair – 69 to 79 points and Poor – Less than 60 points.

**RESULTS**

During the period of study, 38 patients presented to the casualty with displaced calcaneal fractures and out that 28 cases were included in our study and operated by Essex-Lopresti method. They were followed up and the following results were obtained.

18-24	25-34	35-44	45-54	55-64	Mean
4	8	4	9	3	39.14

**Table 1. Age Distribution**

The age distribution range of 28 patients ranged from 20 to 63 years in our study and the average age was 39.14. Of all the cases involved in the study, 26 were males and 2 were females. 16 (57.14) patients had their right calcaneum fractured while 12 (42.86) patients were with fracture of left calcaneum. All the patients were classified as tongue type according to Essex-Lopresti classification. 26 out of 28 (92.9%) were males and 2 were females (7.1%). The most common mode of injury in calcaneal fracture being fall from height (25/89.2%) in ours study, mostly being work site injuries and remaining road traffic accidents (3/10.2%).

Right	16 (57.14%)
Left	12 (42.86%)

**Table 2. Side of Injury**

Male	26	92.9%
Female	2	7.1%

**Table 3. Sex Distribution**

Fall from Height	25	89.2%
Road Traffic Accident	3	10.8%

**Table 4. Mode of Injury**

Complication	Pain (Persistent/Occasional)	Superficial Infection
No. of Patients	24	4
Percentage	85.71	14.28

**Table 5. Post-Operative Complication**

Of the 28 patients, 24 patients had post-operative pain out of which two patients had persistent mild to moderate pain for 3 months. 4 patients out of 28 developed moderate superficial infection. These patients were treated with intravenous antibiotics according to culture and sensitivity report for one week and then continuing on oral antibiotics.

All 4 patients got their infection subsided within 10 days and didn't have recurrence. Patients without any wound complications were discharged on day 14 after the surgery. Mean hospital stay after the surgery was 14.7 days. All patients had signs of radiological union at 12 weeks of follow up. All of them got united after 22 weeks of

<b>Pre-Operative</b>	<b>Post-Operative</b>
15.18	29.4
<b>Table 6. Pre and Post-Operative Bohler's Angle</b>	

The average pre op Bohler's angle for the 28 patients is 15.18 and the post-operative Bohler's angle average is 29.4. When comparing the mean pre op and post-operative Bohler's angle, after surgery the average Bohler's angle of all the 28 patients' falls into normal values.

	<b>Excellent</b>	<b>Good</b>	<b>Fair</b>	<b>Poor</b>
Results	16 (57%)	8 (28%)	4 (14%)	0
Mean Score	91.1	81.9	73.5	0
<b>Table 7. Results as Per AOFAS System</b>				

In our study, 16 patients (57%) had excellent functional outcome as per AOFAS Scoring system. The mean AOFAS score among these patients was 91.1. 8 patients (28%) had good functional outcome and their mean score was 81.9. 4 patients (14%) had fair functional outcome and their mean score was 73.5. None of them had poor functional outcome. Patients with excellent functional outcome had average 44 degrees of range of motion at subtalar joint (inversion + eversion) and 67 degrees mean range of motion at the ankle joint (dorsiflexion and plantar flexion combined). Patients with good functional outcome had 35.6 degrees of total range of motion at the subtalar joint and 54 degrees of total range of motion at the ankle joint. Patients with fair functional outcome had 28.5 degrees of mean range of motion at the subtalar joint and 35 degrees of mean range of motion at the ankle joint.

**DISCUSSION**

Calcaneum, which is the most commonly fractured tarsal bone, has always been a topic of debate among surgeons with respect to the perfect line of management probably because of the high complication rates associated with calcaneal intra articular fractures both in conservatively and surgically managed patients. The extra articular fractures comparatively have a better outcome and hence there is less confusion regarding their management. There are many systems for classifying displaced intra-articular fractures, but there is no consensus amongst surgeons as to which is the most practical one. Some studies with more than 100 cases showed good results after open reduction and internal fixation of intra-articular calcaneal fractures.<sup>2,3,4</sup> But some prospective randomized studies didn't show better results after surgery.<sup>5,6</sup> Hence, there always existed some controversies. However, in the largest prospective randomized trial described to date, Buckley et al. found better results in some subgroups of patients after surgery.<sup>7</sup>

There are many classification systems in fractures of the calcaneum like Essex Lopresti, Rowe's and Sander's. There are debates often among surgeons as to which classification system is authentic. Although, classifications show positive correlation with outcome, there is no correlation with choice of treatment.<sup>1,8,9</sup> In our study we have used the Essex-Lopresti classification. Historic cohort studies<sup>10,11,12</sup> have suggested equal clinical outcomes with operative and conservative treatment of displaced intra-articular calcaneal fractures. Some of the more recent studies<sup>13,14</sup> showed no advantage of operative treatment. There are many studies<sup>15,16,17,18,19</sup> which showed earlier studies demonstrated significant incidence of wound complications associated with operative treatment.<sup>20</sup> Studies also showed significant complications with conservative treatment also, like subtalar joint pain, heel varus and peroneal tendon impingement.<sup>19</sup>

We believe that displaced intra-articular calcaneal fractures should be treated by anatomical reduction and rigid internal fixation, to allow early movement and for a better functional outcome.<sup>21</sup> Application of these principles to intra-articular calcaneal fractures was always difficult because of complex bony anatomy, tenuous soft tissue envelope and difficulty of acquiring anatomic reduction and rigid fixation.<sup>22</sup> Till now there is no best clinical criteria for treating calcaneum fractures, in general it is well accepted that treatment should aim at anatomical restoration of joint surface and width height length of the heel to achieve functional recovery.<sup>3,22</sup> 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.

King<sup>23</sup> assessed the results of 75 consecutive fractures of Os calcis involving the posterior facet treated by Essex-Lopresti method. He concluded that the best results were encountered in tongue-type fracture and less satisfactory results were seen in joint depression type. Tornetta<sup>24</sup> evaluated 26 consecutive patients with Essex-Lopresti tongue-type fracture. There were 12(55%) excellent, 7(32%) good and 3(13%) fair results. He concluded that the Essex-Lopresti spike reduction is a useful method for the treatment of tongue-type fractures of the calcaneus and the results were superior to those in previous series of intra-articular fractures treated with open reduction and internal fixation. As recently as in 2007, Pillai<sup>25</sup> described a modification of the classical technique of Essex-Lopresti. Using the Maryland Foot Score, they achieved fair to excellent results in 67% patients.

Compared to open procedures, percutaneous reduction and fixation offers lower complication rates, shorter operating times and more rapid healing due to the undisturbed soft tissue envelope. For carefully selected patients, this technique provides good results comparable with open reduction and internal fixation.<sup>26,27</sup> Delayed wound healing is one of the most commonly encountered complications in open reduction of calcaneal fractures. With the use of percutaneous technique, this problem can be

obviated.<sup>28,29</sup> Our results conclude that the percutaneous technique is best suited for tongue shaped fractures. In tongue shaped fractures, the posterior articular facet is in continuous with posterior tuberosity. Direct manipulation of facet is possible by traction and a pin inserted into posterior tuberosity. This allows fracture to be reduced percutaneously.<sup>30</sup> In joint depression type, the posterior articular facet is depressed, rotated and impacted. Since direct manipulation of fragment is not possible. It becomes difficult to attain accurate reduction by this technique.<sup>30</sup>

Bohler's angle is commonly assessed when evaluating calcaneal fractures. A number of studies clearly indicate that Bohler's angle is good predictor of long term functional outcome in calcaneal fractures.<sup>31</sup> Patient with angles less than 15 degrees did significantly worse than those with greater angles. This was the reason for choosing Bohler's angle as the measure of surgical reduction in our patients. In our series mean Bohler's angle achieved postoperatively is was more than 29 degree.

There were certain limitations to our study. Only 28 patients with calcaneal fractures were treated with Essex-Lopresti technique and their functional outcome was measured at a mean follow-up of only 6 months. A study involving a comparatively large number of patients followed up for a longer period of time can more accurately assess the functional outcome of displaced intra-articular fractures of the calcaneum treated by this method. Therefore this discussion can be considered only as a preliminary assessment.

### Summary

28 patients with displaced intra-articular calcaneal fractures were treated with closed reduction and internal fixation using Essex-Lopresti technique during the study period. The mean age of the patients were 39.14 and all of them except two were males. The mode of injury of all patients were fall from height except for three which is road traffic accident. All were tongue type of fractures according to Essex-Lopresti classification. Postoperatively 24 patients had pain, 4 had superficial infections. Superficial infections healed with antibiotics and dressing. Of the 28, 16 had excellent functional outcome, 8 had good results and 4 had fair results. Hence we can conclude from the above findings that closed reduction and internal fixation of tongue type calcaneal fractures using Essex-Lopresti technique helps in improving the functional and radiological outcome of the patients with the supportive evidence of their physical and radiological findings.

### CONCLUSIONS

Fractures of the calcaneum are one of the common fractures affecting the public and treatment modality has to be decided carefully. We are of the opinion from our study experience that the operative treatment of intra-articular calcaneal fractures is needed, as anatomical reduction and rigid internal fixation is essential for early movement and

weight bearing. The Essex-Lopresti technique is good in terms of fracture union and functional outcome in tongue type intra articular calcaneal fractures. The post-operative complications are less when compared with ORIF. The limitations of our study are, the small sample size, the short follow up period of 6 months, and not taking other fracture patterns into consideration.

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