



## **A Comparison of the Essex-Lopresti Technique and Conservative Treatment for Displaced Tongue-Type Calcaneus Fractures**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author CI designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author MT literature research, wrote the protocol. Author NC performed the statistical analysis, Literature research. Author RA writing the manuscript, and performed the literature research. Author SG managed the analyses of the study. Author MB performed the senior consultant and editor of text. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Aims:** This study aimed to evaluate the mid-term clinical and radiological results of conservative treatment and surgical treatment made with the Essex-Lopresti technique in tongue-type calcaneus fractures.

**Study Design:** A comparison of two treatment options (the Essex-Lopresti Technique and conservatively). Radiological comparison, Functional comparison and isokinetic dynamometer

were used to evaluate.

**Place and Duration of Study:** 3 separate centers between November 2005 and April 2013 were examined.

**Methodology:** A retrospective evaluation was made of 19 patients (Group 1) who were operated on with the Essex-Lopresti Technique and 27 patients (Group 2) who were treated conservatively. Radiological comparison was based on correction in Bohler's angle. Functional comparison was made using the Maryland Foot Score (MFS). In the comparison of the gastrosoleus muscle complex strength, an isokinetic dynamometer was used. To determine the distribution of all the variables in the comparisons of the groups, the Kolmogorov-Smirnov test was used. For variables showing normal distribution, Student's t-test (Independent Sample T Test) was applied.

**Results:** The Maryland Foot Score was determined as 96.2 in Group 1 and 85.6 in Group 2 ( $p=0.002$ ). While findings of subtalar arthrosis were determined in 2 (10.5%) patients of Group 1, subtalar arthrosis was seen to have developed in 7 (25.9%) patients of Group 2 ( $p=0.014$ ). In the isokinetic muscle strength measurements, the mean plantar flexion muscle strength was 106.2 (85-122.4) Nm in Group 1 and 96.4 (73.3-124) Nm in Group 2 and this difference was statistically significant ( $p=0.034$ ).

**Conclusion:** The Essex-Lopresti Technique is an effective method in the treatment of tongue-type calcaneus fractures.

*Keywords: Calcaneus; muscle strength dynamometer; osteosynthesis-fracture; subtalar joint.*

## 1. INTRODUCTION

Calcaneus fractures comprise 2% of all fractures and 60% of tarsal bone fractures. Approximately 25% of tongue-type calcaneus fractures are extra-articular fractures [1].

The current preference in the surgical treatment of calcaneus fractures is open reduction and internal fixation made with a wide lateral approach using a full layer skin flap. However, there may be quite dramatic results from this technique such as flap necrosis, deep infection and non-union [2-7]. In selected cases, it is possible to obtain reduction with a percutaneous approach with the Essex-Lopresti Technique using an axial pin. In this way complications can be reduced. This type of approach is most appropriate in tongue-type fractures which show displacement and fully torn posterior facet [8,9].

This study aimed to evaluate the mid-term clinical and radiological results of conservative treatment and surgical treatment made with the Essex-Lopresti technique in displaced tongue-type calcaneus fractures.

## 2. MATERIALS AND METHODS

All the patients who were diagnosed and treated for displaced (more than 2 mm between the fracture ends) tongue-type calcaneus fractures between November 2005 and April 2013 were

examined. All of these fractures were evaluated as Essex-Lopresti Tongue-type fracture. Patients were excluded where there was a concomitant foot or ankle fracture or where the calcaneus fracture was bilateral. The choice of surgical (Essex-Lopresti Technique) or conservative treatment approach was affected by the general health status of the patient, concomitant injuries and the patient's wishes. Thus, 19 patients (Group 1) operated on with the Essex-Lopresti Technique and 27 patients (Group 2) treated conservatively, were retrospectively evaluated. There was no significant difference between the two groups in respect of fracture type and patient demographics. The patients in Group 1 underwent surgery at mean 9.4 days (range, 6-14 days) in a prone or lateral decubitus position. After appropriate sterilization and draping, a longitudinal mini incision was made from the tuber calcanei and 1 Steinman nail was entered from the lateral of the Achilles tendon attachment and placed on the calcaneus. Under fluoroscopic guidance, the nail was directed towards the fracture line and using the Steinman nail as a lever, the fallen fragment was reduced upwards. The surgery was finished with the application of a long-leg circular plaster cast (Figs. 1, 2). In Group 2, following a mean 8.2 days (range, 5-14 days) of elevation, and edema monitoring with cold compress and bandage, a long-leg circular plaster cast was applied with the ankle positioned in an additional 15-20° (Figs. 3, 4).



**Fig. 1.** Preoperative lateral radiograph of a patient treated with the Essex-Lopresti technique



**Fig. 2.** Postoperative lateral radiograph of a patient treated with the Essex-Lopresti technique



**Fig. 3. Lateral radiograph at first presentation of a patient treated conservatively**

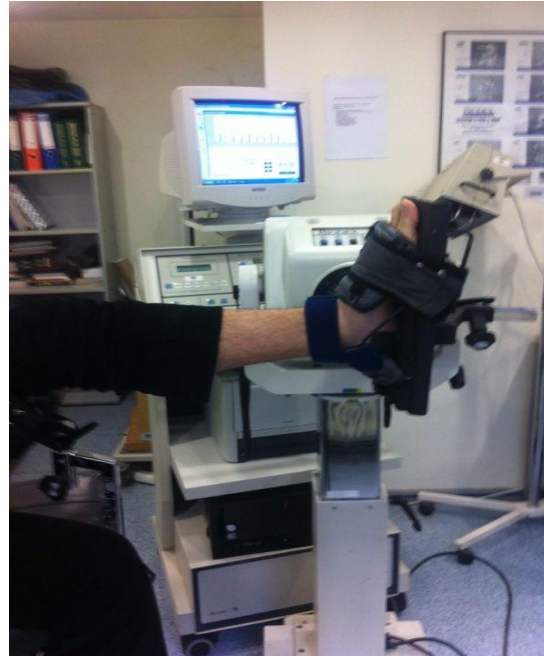


**Fig. 4. Lateral radiograph after plaster casting of a patient treated conservatively**

Radiological comparison was based on correction in the Bohler's angle. The Maryland Foot Score (MFS) was used in the functional comparison. In the comparison of the gastrosoleus muscle complex strength, an isokinetic dynamometer was used (Biodex Pro System 3, Biodex Medical Systems, Shirley, NY, USA) (Figs. 5, 6). Both the injured and the contralateral gastrosoleus muscle complexes were examined for each patient and side dominance was ignored. With the patient in a sitting position, the dynamometer was attached to the chair and the knee was firmly fixed in semiflexion. The dynamometer sensitivity was set at 120°/sec and measurements were taken at this level of sensitivity. With the ankle in a neutral position, paste was placed on the plantar region of the foot and the patient was required to apply plantar flexion with full force 5 times. The mean of these values was taken for each patient. In the calculation of muscle strength, the peak torque value (force (N) x distance (m)) was used. In the summarizing of numerical parameters, means and standard deviations were used. To determine the distribution of all the variables in the comparisons of the groups, the Kolmogorov-Smirnov test was used. For variables showing normal distribution, Student's t-test (Independent Sample T Test) was applied.



**Fig. 5. Patient position for the measurement of isokinetic plantar flexion muscle strength**



**Fig. 6. Foot position for the measurement of isokinetic plantar flexion muscle strength**

### 3. RESULTS AND DISCUSSION

More than three quarters of the patients in both groups were male ( $p=0.36$ ). the mean age was 38 years (range, 17-63 years) in Group 1 and 41 years (range, 22-71 years) in Group 2 ( $p=0.45$ ). In Group 1, the side distribution was right: left, 11:8 and in Group 2, 15:12. The mechanism of injury in Group 1 was fall from a height in 16 patients, twisting in 1 and traffic accident in 2, and in Group 2, fall from a height in 19, twisting in 5 and traffic accident in 3. There were open fractures in 3 (15.7%) patients in Group 1 and in 5 (18.5%) patients in Group 2. The mean follow-up period was 38 months (range, 8-90 months) in Group 1 and 36 months (range, 10-87 months) in Group 2 (Table 1). In Group 1, the Steinman nails were removed from all patients in the sixth week at the latest. Patients in both groups were followed up until union was observed and partial weight-bearing was allowed at 8-10 weeks.

The Maryland Foot Score was determined as 96.2 in Group 1 and 85.6 in Group 2 and this difference was statistically significant ( $p=0.002$ ) (Table 2). Pin site infection developed in 3 (15.7%) patients of Group 1 and these pins were removed in the 4th week and treatment was continued with the plaster cast. In 1 of these patients, as reduction loss was seen, open reduction and internal fixation was applied after

treatment of the infection. In 2 (10.5%) patients, skin ischemia was seen to have developed around the pin but this recovered without the need for any surgical intervention. No skin problems were observed in any patient in Group 2.

While findings of subtalar arthrosis were determined in 2 (10.5%) patients of Group 1, subtalar arthrosis was seen to have developed in 7 (25.9%) patients of Group 2 (Table 2). This difference between the groups was statistically significant ( $p=0.014$ ). The post-trauma Bohler's angle was mean  $8^\circ$  ( $-3/20$ ) in Group 1, and  $11^\circ$  ( $5/28$ ) in Group 2 ( $p=0.64$ ). At the end of treatment, the Bohler's angle had increased to mean  $22^\circ$  ( $14-42$ ) in Group 1 and to mean  $16^\circ$  ( $10-28$ ) in Group 2. The difference between the 2 groups was determined to be statistically significant ( $p=0.023$ ) (Table 2). In the isokinetic muscle strength measurements, the mean plantar flexion muscle strength was 106.2 (85-122.4) Nm in Group 1 and 96.4 (73.3-124) Nm in Group 2 and this difference was statistically significant ( $p=0.034$ ) (Table 2). There was no significant difference between the operated and contralateral plantar flexion muscle strength at group 1 patients ( $p=0.847$ ). However, plantar flexion muscle strength was significantly different according to the other side at group 2 patients ( $p=0.031$ ).

Treatment of calcaneus fractures is a difficult process. As it is a cancellous bone, it may easily become deformed with a traumatic blow. Besides the difficulty of anatomic restoration, there are various obstacles to protecting it. As most of the bone is surrounded by a thin layer of skin, this skin covering is often damaged in fractures and devascularisation of the bone may develop [5,10]. Thus, protection of the soft tissue circulation is directly associated with bone recovery. In this context, recovery of soft tissue edema and bullae if present should be anticipated in surgical planning. In the current study, surgery was applied to the patients of Group 1 at mean 12.6 days and continued soft tissue bleeding was shown the utmost attention.

In a study by Wong et al in which the results of intra-articular and extra-articular fractures were examined, the MFS results of the extra-articular fractures were reported as 98.2 and the intra-articular fractures as 88.8 [11]. In the current

study, the MFS scores were found to be mean 96.2 in Group 1 and mean 85.6 in Group 2. The statistically significant difference between these showed that calcaneus fractures treated with the Essex-Lopresti Technique gave better clinical results providing a pain-free and functional foot. In another study, de Vroome et al examined the results of another minimal invasive technique called 3-point distraction technique [12]. They found that the clinical outcomes for tongue type fractures was good to excellent in all patients with American Orthopaedic Foot and Ankle Society ankle-hindfoot scale (AOFAS) score.

A significant complication which may be seen following calcaneus fracture is subtalar arthrosis [3,6,13]. In a study by Dewall et al of calcaneus fractures surgically treated with open reduction and internal fixation with a 2-year follow-up, there was a need for subtalar fusion in 60.5% of cases and in those to which the Essex-Lopresti Technique had been applied, 49.4% of cases [14]. In the current study, at the end of a mean 38-month follow-up period in Group 1, findings of subtalar arthrosis were determined at the rate of 10.5% and in Group 2 at the end of a 36-month follow-up at 25.9%. This statistically significant difference of the frequency of subtalar arthrosis shows that the rates are lower with the Essex-Lopresti Technique, not only compared to open reduction internal fixation but also in comparison with conservative treatment.

In the treatment of calcaneus fractures, Bohler's angle is one of the important radiological indicators [6,7]. Continuation of the reduction in the short, mid and long-term is important. Therefore, monitoring the Bohler's angle throughout follow-up is directly related to the success of the treatment. Dewall et al. [14] reported that at the end of a 2-year follow-up, the Bohler's angle in open reduction internal fixation patients was mean  $18.4^\circ$  while that of the Essex-Lopresti Technique patients was  $19.9^\circ$  but this difference was not statistically significant. In the current study, at the end of treatment, the Bohler's angle of Group 1 was mean  $22^\circ$  and Group 2 was mean  $16^\circ$ . The difference was statistically significant. From these results, it was seen that the calcaneal height had been better corrected in the Essex-Lopresti Technique compared to conservative treatment and this improvement could be effectively protected in the short and mid-term.

**Table 1. Patient characteristics**

	Mean age	Right/Left	Mean follow-up period (Month)	Period between initial trauma and discharge from hospital (Day)
Group 1	38 (17-63)	11/8	38 (8-90)	12.6 (8-15)
Group 2	41 (22-71)	15/12	36 (10-87)	8.2 (5-14)

**Table 2. Results at the end of follow-up**

Evaluation parameters	Group 1	Group 2	p value
Maryland Score	96.2 (92-98)	85.6 (80-98)	p=0.002
Subtalar Arthrosis	%10.5	%25.9	p=0.014
Plantar Flexion Power (Nm)	106.2 (85-122.4)	96.4 (73.3-124)	p=0.034
Bohler's angle after initial trauma (Degree)	8 (-3/20)	11 (5/28)	p=0.64
Bohler's angle at the end of follow-up (Degree)	22 (14-42)	16 (10-28)	p=0.023

The gastrosoleus muscle mass is held on the tuber calcanei and all the force of plantar flexion is provided from this area. In tongue-type fractures, the lever function of the calcaneus is significantly damaged and this directly affects the plantar flexion force. In a study where muscle strength was measured in healthy subjects, Moraux et al reported plantar flexion force to be mean 118.5 Nm [15]. Naim et al. [16] reported mean plantar flexion force of 155 Nm at mean 16 weeks after surgical treatment for Achilles tendon rupture. In the current study, plantar flexion muscle strength was 106.2 Nm in Group 1 and 96.4 Nm in Group 2 and the difference was statistically significant. According to these results, plantar flexion strength was better protected by the Essex-Lopresti Technique compared to conservative treatment.

#### 4. CONCLUSION

The Essex-Lopresti Technique, which is based on percutaneous reduction and fixation with a pin, is a minimally invasive method which is effective in the treatment of calcaneus tongue-type fractures. It is superior to conservative treatment in respect of better clinical results, lower rates of subtalar arthrosis, providing an effective and continuing improvement in the Bohler's angle and greater protection of plantar flexion strength.

#### CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images.

#### ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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