

Functional Outcome of Percutaneous Screw Fixation of Displaced Intraarticular Calcaneal Fractures-A Prospective Study

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Abstract: ***Aim:** The aim of this study was to determine the functional outcome in displaced intraarticular calcaneal fractures operated by percutaneous screw fixation. **Patients and Methods:** 50 patients were randomized and studied for a period of 2years. Functional outcome using American orthopaedic Foot and Ankle Society (AOFAS) Hind foot score .Radiographic evaluation of fracture healing was done immediately and one year post surgery. **Results:** At a mean follow-up of 24 months there was statistically significant improvement in The clinical outcome of our cohort of percutaneous treated intra-articular calcaneal fractures was good to excellent in 90% with the American Orthopaedic Foot and Ankle Society ankle-hind foot scale (AOFAS) score. This percentage increases to 100% for tongue type fractures alone but decreases to 82% for joint depression type fractures. Infectious complications occurred in 1 (2.4%) and secondary arthrodesis was needed in 3 fractures (7.3%). The Sanders classification showed no prognostic value. The Essex-Lopresti classification was a strong prognosticator with a median AOFAS score of 92 for tongue type fractures and 75 for joint depression type fractures (P < .001). **Conclusion:** This study shows that this technique is suitable for most types of intra-articular fractures especially with compromised soft tissues in which open reduction and internal fixation is contraindicated. Good articulate reduction, preserved subtalar motion and decrease in level of residual pain were achieved*

1. Introduction

The optimal treatment of displaced intra-articular fractures of the calcaneus remains controversial. Historically, nonoperative treatment was commonly used due to the unpredictable results and high complication rates of operative treatment (1). In the past 2 decades, operative treatment, most commonly using an extensile lateral open approach to reduce and fix fractures using plates and screws, has become the preferred approach. Unfortunately, this approach is associated with high rates of wound complications. Yu et al performed a systematic review of 21 articles (2046 open approach cases) and found the rate of infection and skin flap necrosis to be 13.6%. To minimize complications, percutaneous approaches to reduce and fix calcaneal fractures have reported satisfactory results. In most case series, these techniques were used only for selected calcaneal fractures such as tongue type patterns because of concern that limited approaches lead to less accurate articular reductions. The senior authors developed a technique of percutaneous reduction and fixation with screws alone for all intra-articular calcaneal fractures without any exclusions and have used this technique since 1999(2). This study aimed to provide follow-up information for a large group of patients, with clinical outcomes and standard radiographic assessment. It directly assessed the articular reduction issue by using a novel comprehensive articular measurement technique based on postoperative computed tomographic (CT) scans. We hypothesized that the percutaneous technique for reduction and fixation with screws alone could yield comparable results to a standard open approach as reported in the literature with fewer complications. The study examined important factors relevant to the use of percutaneous techniques and fixation with screws alone: (1) early postoperative complications with an average 3-month follow-up (2) clinical outcomes,

early complications, and secondary procedures in patients with a minimum of 1 year follow-up; (3) the degree to which reductions were obtained and maintained as determined by initial and 3-month radiographs

2. Aims and Objectives

The aim of this study was to determine the functional outcome in displaced intraarticular calcaneal fractures operated by percutaneous screw fixation

Methodology

Sample size of 40 patients were taken
Study period of 2years

Inclusion criteria

- 1) Closed, Intra-articular
- 2) Tongue type
- 3) Depressed type
- 4) Fractures less than 2weeks old

Exclusion Criteria

- 1) Open, Extra-articular
- 2) Fracture dislocations
- 3) Fractures more than 2weeks, malunited, elderly and comorbid
- 4) All Type III Sanders classification

Operative Technique

- The patients were placed in lateral decubitus position on operating table, with a firm sand bag underneath the injured foot to support a perfect lateral position.
- The surgeon stood posterior to the patient with the C-arm entering the operative field opposite them from the end of the bed. The surgeon ensured that satisfactory lateral,

- In order to treat joint depression fractures, the tuberosity was reduced first using a Steinmann placed from lateral to medial through the calcaneal tuberosity followed by manipulation of the tuberosity out of an obstructing position to allow facet reduction. Once the tuberosity was reduced, 1.6-mm Kirschner wires placed from the posterolateral aspect of the tuberosity into the medial sustentaculum temporarily fixed the fracture.
- After the fractures were satisfactorily reduced on C-arm views (lateral and axial view) the surgeon then definitively fixed the fracture(s) with 3.5- and 4.0-mm cannulated screws (3).
- For tongue-type fractures, two 3.2-mm Steinmann pins were placed parallel to each other into the facet (tongue) fragment(s) posterior to anterior. Reduction of the fracture was achieved by manipulating the Steinmann pins in coordination with small instrument(s) placed through stab incision(s).

After a satisfactory reduction was confirmed by C-arm, multiple 3.5- or 4.0-mm screws were placed from posterosuperior to anteroinferior and from lateral to medial into the sustentaculum to stabilize the tongue fragment. The Steinmann pins were then removed postoperatively; the leg was placed into a short leg cast, followed by non-weight bearing for 8 to 10 weeks before the patient began progressive weight bearing.

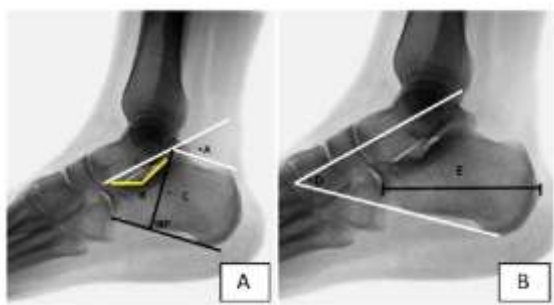


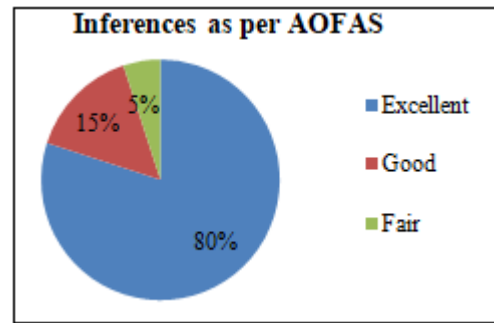
Figure 1: Lateral views of foot showing A) Bohler angle, B) Gissane angle C) calcaneal facet height, D) talocalcaneal angle, E) calcaneal length



Figure 2: C) Harris view

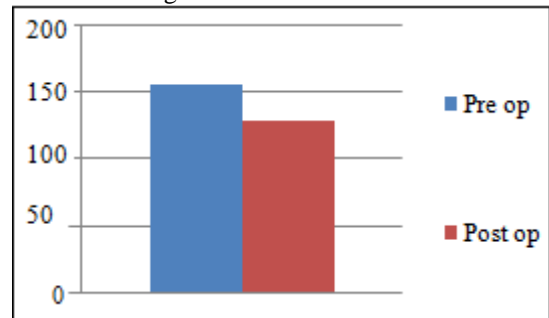
3. Observation and Results

‘N’ indicates number of patients in each group

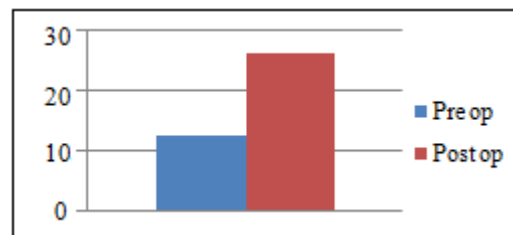


Graph 1: AOFAS percentage

21 tongue type and 29 were depressed. Of that 10 had depressed with maximum comminution of posterior facet, which didnot show good results. We have used 4 to 6 screws



Graph 2: Gissane angle



Graph 3: Bohler angle

Table 1: Radiographic data at follow-up

Parameters	Trauma (n=50)	Post operatively	Follow-up	Healthy side
Bohler angle(SD)	-2	19	14	31
Gissane angle(SD)	116	114	113	109
Height in mm(SD)	-	-	47	50
Length in mm(SD)	-	-	82	83
Width in mm(SD)	-	-	46	40



Figure 3: Pre-op X-ray



Figure 4: Intraop reduction



Figure 5: Reduction under C-arm



Figure 6: Screw fixation percutaneously



Figure 7: Post op X-ray at 6month follow-up



Figure 8: Axial view of post op x-ray

4. Discussion

Open reduction and internal fixation techniques have reported rates of soft tissue complications in the range of 15% to 32%. Moreover in high risk patients like diabetics, Smokers, drug addicts and open fractures the complication rate further increases (4). The soft tissue dissection and scarring that follows open procedures further leads to a compromised Functional outcome.

Minimally invasive techniques provide a bridge between open and conservative management providing the benefits of both. Minimally invasive methods allow the patient to be operated early thereby decreasing the hospital stay as well as hastening the recovery of the injured limb. Early surgery leads to less soft tissue swelling and earlier resolution of the oedema as the normal anatomy is regained. Moreover early surgery helps in better reduction as mobilization of the displaced fragments is easy initially. A delay of more than 14 days makes it difficult for percutaneous reduction methods and conversion to open reduction becomes higher.

Percutaneous fixation techniques using k-wires and protruding Steinmann pins are prone to superficial and pin track infections.

In this series because percutaneously applied screws were used which were buried underneath the skin the incidence of pin tract infection and superficial infections was Negligible. Most of the patients were treated by 4mm screws so the problem of implant impingement under the skin leading to hardware removal was negligible. The rate of infection in this study was comparable to other series, where it ranged from 7% to 15%.

In this series, the radiographic parameters like the Bohler and Gissane angles along with calcaneal width were corrected to near normal at follow-up indicating restoration of the normal calcaneal anatomy. Percutaneous treatment minimizes the soft tissue complications and postoperative scar formation leading to a less incidence of subtalar joint stiffness and peroneal tendon dysfunction. Functional outcomes were better than conservative methods and comparable to other operative series. This series included a fracture pattern which was relatively simple however the good results obtained are an indicator that these types of fractures do not require open procedures.

Limitations of this study are the small number of patients and no direct comparison with another method of treatment. However the strength of this study is that it was carried out on a select group of patients having a well defined inclusion parameter. Future randomized trial with other methods can be of help in understanding these complex fractures. (5)

Displaced intraarticular fractures are best treated operatively. Closed reduction and percutaneous fixation of Essex- Lopresti

Tongue type fractures is a reliable, relatively easy and reproducible technique giving good outcomes without significant complications.

5. Conclusion

Percutaneous screw fixation is good with regards to fracture union and functional outcome with minimal infection. The function of calcaneus and subtalar joint can be restored to near normal with minimal hospital stay. Displaced intraarticular fractures are best treated operatively. Closed reduction and percutaneous fixation of Essex- Lopresti tongue type fractures is a reliable, relatively easy and reproducible technique giving good outcomes without significant complications. This technique when used in appropriate cases can result in good outcomes for these challenging fractures. However a uniform application of percutaneous reduction and fixation methods to all types of calcaneal fractures is not possible as there is a considerable risk of inadequate joint reconstruction and redisplacement in more complex joint depression fractures.

References

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