The Posterolateral Approach for Calcaneal Fractures

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Abstract

Background: Conventionally, the extended lateral approach (ELA) served as the standard extensile approach for intraarticular calcaneal fracture fixation. However, this approach has a high rate of wound complications. The purpose of this study was to describe an alternative approach, the posteriorlateral approach (PLA) and compare it to the ELA regarding soft tissue complications and functional outcome. **Materials and Methods:** 32 patients operated through PLA and 66 patients treated through ELA were included in this retrospective study. Major and minor soft tissue complications up to 3 months postoperatively were recorded. Eighteen patients of the PLA group and 32 patients of the ELA group were available for 1-year functional outcome assessment with the American Foot and Ankle Score (AOFAS) score. **Results:** The PLA group had no major complications requiring surgical intervention. Six patients (19%) had minor wound complications. The ELA group had 8 (12%) major complications and 9 (14%) minor complications. There were no significant differences in AOFAS scores at 1-year followup. PLA is a safe and efficient approach for open reduction and internal fixation of displaced intraarticular calcaneal fractures. **Conclusion:** In selected cases when fracture comminution and displacement may not be adequately treated through a less invasive approach, it is a good alternative with less concern about wound complications as in ELA.

Keywords: *Approach, calcaneum, fracture, wound complications*
MeSH terms: *Tarsal joint; intertarsal joint; fracture fixation; calcaneus*

Introduction

Intraarticular fractures of the calcaneum are some of the more technically challenging fractures to operate. Several operative exposures have been described. Conventionally, the extended lateral approach (ELA) has served as the workhorse for these fractures.[1] Modifications of this approach included the "L" and the "smile incision" lateral approaches.[2,3] Concerns about soft tissue complications resulted in the popularization of less invasive techniques, including the lateral "sinus tarsi" approach, limited medial incisions, posterior incisions, combined approaches, and percutaneous techniques.[4-8] These less invasive techniques allow adequate reduction and fixation of most calcaneal fractures with less soft tissue complications.[6-8] However, the severely comminuted fracture may still necessitate wider exposure with sufficient visualization of the fragments. The main limitations of ELA include limited exposure of the posterior aspect of the fracture and a high rate of wound complications.[3] Skin necrosis of the lateral part of hindfoot may be the result of increased need for soft tissue stripping, skin retraction and injury to the lateral calcaneal branch of the peroneal artery.[9-14]

To decrease complications related to injury of the artery and allow better visualization of the posterior part of the calcaneum, we developed the posteriorlateral approach (PLA). The incision is a combination of the ELA and the lateral arm of the Cincinnati approach used for clubfoot.[15]

The purpose of this study was to describe the technique and evaluate soft tissue complications and functional outcome of calcaneal fracture reduction and fixation through PLA compared to ELA.

Materials and Methods

This is a retrospective study, assessing the clinical outcomes and complications of open reduction and internal fixation of intraarticular calcaneal fractures utilizing the PLA compared to the traditional ELA. Until the year of 2008, we used ELA and since 2008 we have been using PLA. Since 2011 we started using the sinus tarsi approach for most fractures but still use PLA for selected cases.

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102 patients underwent open reduction and internal fixation of calcaneal fractures between 2001 and 2011. We included patients with intraarticular fractures as determined by plain radiographs and computed tomography scans. Open fractures were excluded. Patients who were lost to followup before complete wound healing and/or fracture union were excluded as well. For functional outcome analysis, we included only patients who completed a minimum of 1 year followup. Many of the trauma patients in our hospital are uninsured foreign workers for whom completion of 1-year followup is not always possible. Ninety-eight patients met the inclusion criteria. The study group included 32 patients operated through the PLA between 2008 and 2011, and which were compared with group 2 patients included 66 patients operated through the ELA between 2001 and 2008. All patients were operated by the senior author (ZF). There were no significant differences in patients' demographics, clinical characteristics, and fracture patterns, except for the longer followup period of the control group [Table 1]. The study was approved by the ethics committee of our medical center.

All patients were followed in our out-clinic until complete soft tissue healing, radiographic fracture union, and completion of rehabilitation. Patients were encouraged to attend a 1-year postoperative followup visit. Patients medical records were reviewed, and complications or further surgeries were recorded. We focused on early local soft tissue complications, occurring within 3 months postoperatively. These were considered as major when requiring operative intervention. Minor complications included wound discharge, swelling or infections that were treated successfully with antibiotics and local wound care. Functional outcome was evaluated using the American Foot and Ankle Score (AOFAS). Unfortunately, we could not perform a radiographic analysis since adequate postoperative radiographs were not available for most of the patients in the control group, operated before we started using digital radiographs.

Operative procedure

Surgeries were performed after the subsidence of local swelling and appearance of skin wrinkles, and not before 5–7 days from the trauma. Prophylactic antibiotics were administered, and tourniquets were applied in all cases. Patients were placed in the lateral position.

Table 1: Clinical details of patients

Characteristic	Extended lateral (*n*=66), *n* (%)	Posterior-lateral (*n*=32), *n* (%)	*P*
Female:male ratio	12:54	5:27	0.97
Age (years)	44.1±13 (18-75)	42.3±14 (19-80)	0.53
Smokers	26 (39)	14 (44)	0.84
Diabetes	3 (4)	1 (3)	0.73
Sanders Type II	17 (26)	14 (43)	0.16
Sanders Type III	30 (45)	11 (34)	
Sanders Type IV	19 (29)	7 (22)	

The PLA is a novel modification combining the classic Cincinnati approach and the extended "L" lateral approach.[2,15,16] The distal arm of the incision is similar to that of ELA, placed in line with the fifth metatarsal base, following the glabrous junction. At the point below the posterior border of the fibula, the incision is gently curved 40° superiorly toward the Achilles tendon, utilizing the first or second proximal natural creases of the heel and reaching the level of the tibiotalar joint [Figure 1]. The incision is carefully carried directly down to bone and a full thickness flap is developed, elevating the peroneal tendon sheath. This provides an excellent exposure of the lower part of the talus, sinus tarsi and distally to the calcaneocuboid joint. Inferiorly, the distal arm of the incision lies over the fifth toe abductor and its fascia. The fascia is divided and the muscle split with a cautery in line with its fibers. Posteriorly, between the posterior facet and the Achilles tendon, the deep fascia is identified and divided bluntly upwards parallel to the tendon. This facilitates the opening of the wound and enhances exposure. On completion of dissection, two or three 2 mm retraction pins are placed at the body of the talus and bent superiorly to retract the flap [Figure 2a]. After reduction, fractures were fixed using a calcaneal plate (Variax calcaneal plate, Stryker, Kalamazoo, MI) [Figures 2b and 3]. Wounds were closed with 3/0 absorbable subcutaneous sutures, followed by 4/0 nylon sutures to the skin. Stitches were removed at 2 weeks. All patients were immobilized in a plaster slab for 2 weeks after which a removable plastic boot brace was applied and gentle mobilization was allowed. Weight bearing was allowed at between 6 and 8 weeks postoperatively.

Statistical analysis

Continuous variables were compared using the *t*-test for independent samples. Discrete variables were analyzed with Fisher's exact test. Differences of $P < 0.05$ were considered to be statistically significant.

Figure 1: Clinical photograph showing the incision line of posteriorlateral approach marked on the skin

Results

The overall soft tissue complication rate was similar in both groups. However, major complications, requiring surgical treatment was necessary in 8 patients of the ELA group and none of the patients in the PLA group [Table 2]. These included local infection with skin necrosis in 6 cases which were treated with repeated debridements and eventual plate removal. Two other patients had surgical site dehiscence and infection that resolved with debridement, lavage and antibiotics. One of these 8 patients had diabetes ($P = 0.24$) and 5 patients ($P = 0.30$) were smokers.

Late re-operations included one plate removal in the ELA group and one ankle arthroscopy due to gutter adhesions with calcaneal plate removal in a PLA patient. No patient underwent subsequent arthrodesis.

Eighteen patients of the PLA group (62%) and 32 patients of the ELA group (48%) completed 1 year of followup. Mean AOFAS score was 78 ± 14 (range, 33–95) for the PLA group and 73 ± 16 (range, 30–95) for the ELA group ($P = 0.48$).

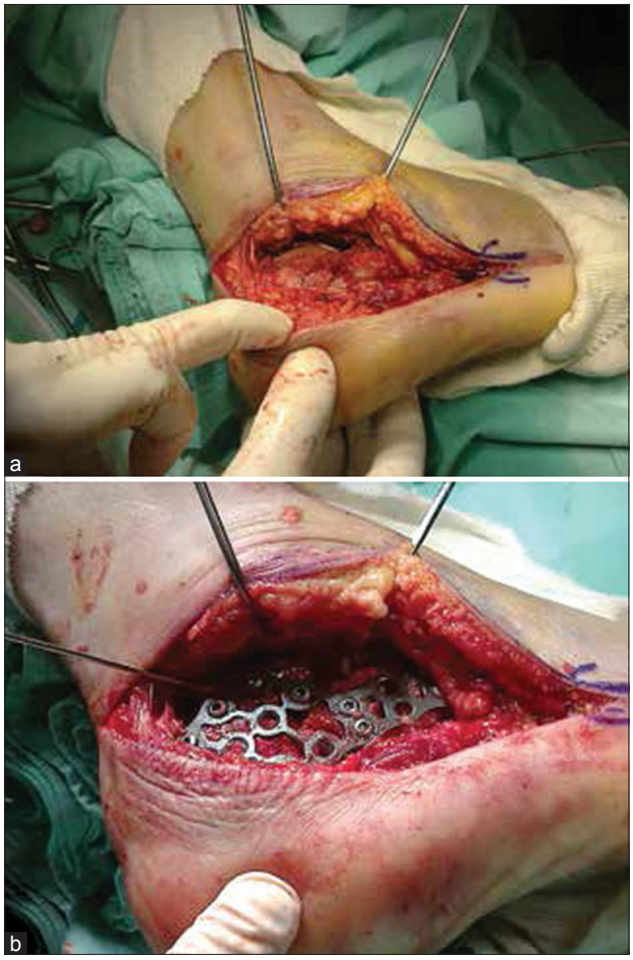

Figure 2: (a) Intraoperative photograph showing excellent exposure of the posterior facet (b) The exposure provides comfortable approach for plate fixation

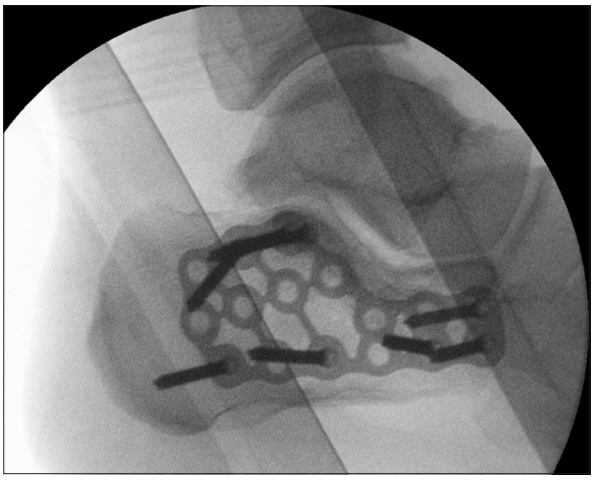

Figure 3: Intraoperative fluoroscopic view showing restoration of the angles of Bohler and Gissane'

Discussion

Although surgery is not always the optimal treatment of intraarticular calcaneal fractures, open reduction and internal fixation of these fractures is still commonly indicated.[17] Nowadays, most fractures can be successfully dealt with through minimal invasive techniques with lower rates of soft tissue complications and sufficient exposure to obtain acceptable reduction and reliable fixation.[6-10,18,19] However, some fractures necessitate wider exposure. In this study, we described and evaluated our modification of the ELA and compared it to the standard approach. Our purpose was to demonstrate that PLA allows a good exposure for fracture reduction and fixation as ELA, with less soft tissue complications.

The high soft tissue complication rate associated with ELA is related to the need to develop a large skin flap. This flap is dorsally and distally based but receives most of its blood supply from the lateral calcaneal artery, a branch of the peroneal artery. The PLA does not have a sharp corner as the ELA. This corner is considered one of the etiologies of this high complication rate.[20] Furthermore, less soft tissue stripping and skin retraction are needed in PLA to achieve adequate exposure of the posterior facet and the calcaneal fragments. The distal arm of the PLA incision, just along the glabrous junction, passes between the lateral calcaneal branch of the peroneal artery and the lateral calcaneal branch of the posterior tibial artery.[14] Borrelli and Lashgari in a comprehensive cadaveric anatomic study, demonstrated that the lateral calcaneal artery is responsible to the majority of blood supply to the flap. This artery

Table 2: Postoperative soft tissue complications

Type	Extended lateral (*n*=66), *n* (%)	Posterior-lateral (*n*=32), *n* (%)	*P*
Major complications	8 (12)	0	0.05
Minor complications	9 (14)	6 (19)	0.55
Overall	17 (26)	6 (19)	0.61

emerges posterior to the lateral malleolus, passes between the malleolus and the Achilles and curves anteriorly distal to the malleolar tip.[20] At this level, the posterior arm of the PLA incision curves posteriorly to parallel the course of the artery and avoid crossing it. Although this course has a higher potential to meet the sural nerve at the level of the Achilles,[1,21] we encountered no complaints related to this nerve.

Although the overall complication rate in both groups in the current study was around 20%, all of the complications in the PLA group were minor complications and required only symptomatic treatment. For comparison, most series utilizing minimally invasive approaches report of <10% complications of which only a few percentages require reoperation.[3,6,8] On the other hand, 12% of the patients in the ELA group had major complications that required at least one surgical intervention. This is consistent with the literature, reporting 13%–29% of major complications, including wound dehiscence, necrosis and infections, with up to 21% need for operative treatment.[6,8-11,18,19]

The study has several limitations. Patients in both groups were operated by a single surgeon, but in a different time frame. Second, only about half of the patients were available for 1 year clinical followup. There may have been a bias towards worse AOFAS scores due to the high rate of followup loss. However, we believe that loss of followup was not different between groups and was related to personal circumstances.

Conclusion

The study findings suggest that the PLA for open reduction and internal fixation of displaced intraarticular calcaneal fractures is a safe and efficient surgical technique. In selected cases when fracture comminution and displacement may not be adequately treated through a less invasive approach as the sinus tarsi incision, PLA is a good alternative with less concern about wound complications as in ELA.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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