Trauma Monthly 2022; 27(6): 661-667

10.30491/tm.2023.307157.1377

Trauma Monthly

Original Article

Modified Posteromedial Approach for Distal Tibia Fracture Fixation

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Received 2022-04-14; **Accepted** 2022-11-19; **Online Published** 2022-12-27

Abstract

Background: This study aimed to compare a new posteromedial approach with a conventional anteromedial approach to treat extra-articular distal tibia fractures.

Method: Thirty-two patients underwent distal tibia fracture surgery. The patients were divided into two groups (anteromedial: n=17 and posteromedial: n=15) and followed for one year. Approaches were compared regarding their union time, American Orthopedics Foot and Ankle Society (AOFAS) score, and complications.

Results: AOFAS score was 87.3 ± 3.1 and 88.5 ± 2.8 in anteromedial and posteromedial groups, respectively, and there was no statistically significant difference (P-value = 0.282). The union time was 6.1 ± 3.8 months and 6.4 ± 3.1 months in the groups, which was not statistically significant (P-value = 0.807). The prevalence of non-union and delayed union was not significantly different between the two groups (p-value = 0.99).

Conclusion: The modified posteromedial approach is a safe and feasible alternative surgical method for distal tibia extra-articular fractures.

Keywords: Distal tibia fracture; Posteromedial approach; Anteromedial approach; Complications.

Introduction

Distal tibia fractures are common to complex injuries and are challenging to treat [1,2]. Open reduction and plate osteosynthesis are the most common treatment techniques. The anteromedial approach provides:

- Appropriate exposure for the medial malleolus.
- The anterior margin of the tibia.
- The medial and middle third of the tibiotalar joint.

Still, it has been associated with wound complications (**Figure 1**) [3-5] . Skin necrosis is due to damage to perforating vessels originating from anterior and posterior tibialis arteries supplying discrete angiosomes territories of the skin and subcutaneous tissue of the lower leg [6]. A branch of the saphenous nerve also passes along the anterior side of the tibia crest to innervate the foot [7,8]. Consequently, incisions or dissection at the anterior part of the distal tibia or medial malleolus can damage the anterior tibia artery and saphenous nerve, resulting in inadequate blood supply and cutaneous sensation in the foot.

Another approach for distal tibia fractures is anterolateral. In this approach, the thin subcutaneous tissue of the anteromedial surface of the tibia is protected. Still, there are some disadvantages, such as

injury to anterior perforating branches of the peroneal artery and complicated plate contouring in the lateral surface of the tibia[9].

Posterolateral, posteromedial, and its modification are previously described in intra-articular pilon fractures for better visualization and reduction of the posterior column of the distal tibia[5,10-15]. These approaches need extensile soft tissue dissection and posterior compartment muscle mobilization and are described for complex intra-articular pilon fractures.

In this clinical trial, we modified the posteromedial approach for extra-articular distal tibia fractures that did not need to dissect posterior structures. We hypothesized that this approach would better preserve the skin vascularity and less impair angiosome territories, reducing surgical wound complications.

This study aimed to compare a new posteromedial approach with a conventional anteromedial approach to treat extra-articular distal tibia fractures.

Figure 1: Superficial skin necrosis in anteromedial approach.

Methods

This randomized clinical trial was performed on 34 patients (two patients have excluded due to withdrawal from the follow-up protocol, and 32 patients completed our study manner). These patients were referred to our level 1 trauma hospital between 2017 and 2020 with extra-articular distal tibia fracture located between 2 cm and 11 cm from the tibia plafond. Exclusion criteria were intra-articular or suspected pathologic fractures, compartment syndrome, presence of vascular damage, uncontrolled diabetes mellitus, peripheral vascular disease, connective tissue disease, previous surgery and fracture in the ankle or distal tibia, or those who consumed immunosuppressive or chemotherapeutic drugs and patients with 1-year follow-up.

The patients were divided into two groups and assigned to patients prospectively through sequentially numbered opaque envelopes. Radiographs determined the location and AO/OTA classification of the fractures. The Tscherne classification, which categorizes soft tissue injuries, classified the severity of soft tissue damage. The same surgical team under regional anesthesia performed all Operations. Data such as age, sex, trauma to surgery time, operation time, AOFAS score, and time of union were collected in both groups.

Statistical analysis

All outcomes were analyzed using appropriate summary statistics, including 95% confidence intervals where applicable. Baseline covariates were assessed to ensure homogeneity between groups. Independent Student's T-Test compared numerical variables, and categorical variables were analyzed with the chi-square test.

Surgical Technique

Anteromedial Approach

The patient was positioned supine on a radiolucent table. The incision began 15 mm distal to the tip of the medial malleolus and curves anteromedial, extending proximally along the tibia's subcutaneous anterior border. The branches of the saphenous nerve and the saphenous vein were found in the subcutaneous tissue and spared if possible. When needed, the extensor retinaculum was incised vertically to the anterior tibialis tendon (**Figure 2**).

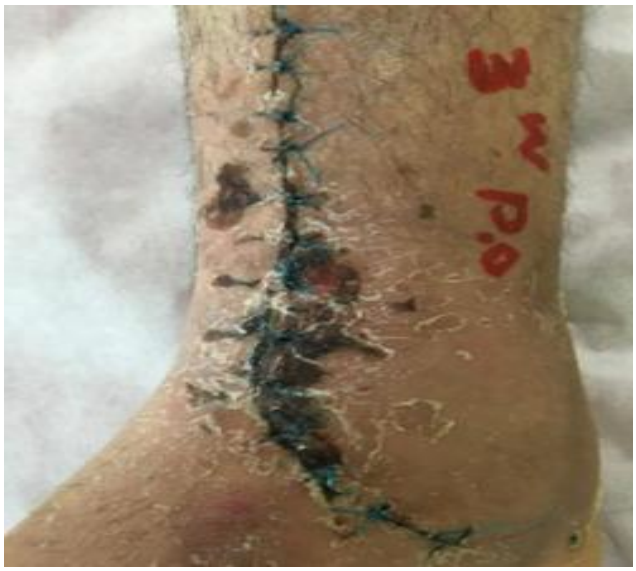

Figure 2: Anteromedial approach incision.

Posteromedial Approach

The patient was positioned supine on a radiolucent table. Skin incision begins at the tip of the medial malleolus curves posteriorly following the medial malleolus's posterior border and the distal tibia's posteromedial border in line with the posterior tibialis tendon (**Figure 3**). Full-thickness skin flaps were continued to the subcutaneous tissue and tibialis posterior tendon sheath. The anterior skin flap was retracted forward, protecting the saphenous vein and nerve. Then, sharp dissection was continued to expose the distal part of the tibia (**Figure 4 a, b**).

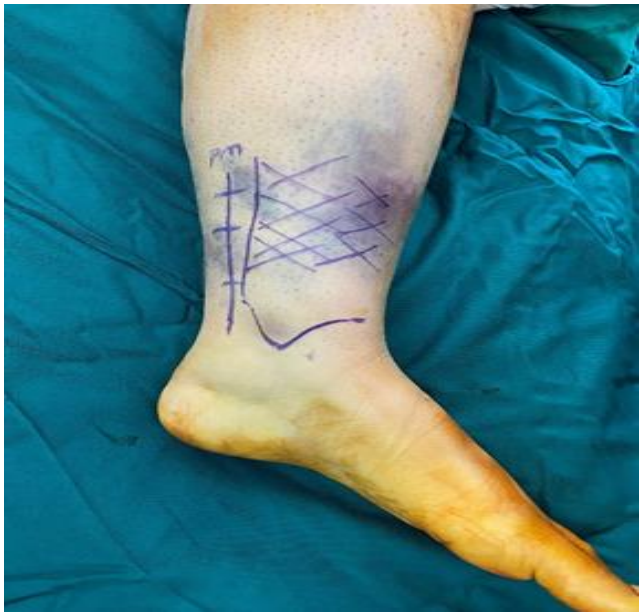

Figure 3: Posteromedial approach incision.

After the completion of approaches, fracture fragments were reduced directly or indirectly according to MIPO principles. Then the fracture was fixed with an anatomical medial distal tibia locking plate by at least six cortexes distal and proximal to the fracture (**Figure 5**). Skin closure was done by simple interrupted suture with Nylon 3/0 USP. The limb was subsequently splinted in a neutral position until the sutures were removed at two to three weeks.

Operation time, as the time between the placement of the incision to the completion of sterile wound dressing, was recorded for each patient.

The rehabilitation program was the same for all patients. Partial progressive weight-bearing was initiated after splint removal. Follow-up evaluation was performed at six weeks, three, six, and twelve months postoperatively and yearly after that (**Figure 6 a, b**). At each follow-up session, plain radiographs were obtained, and patients were evaluated for wound complications, sensory impairment, posterior tibial tendon function, and time of union. The functional outcome of each patient was assessed using the American Orthopedic Foot and Ankle Society (AOFAS) scoring system six months postoperatively.

Sensory impairment was defined as a significant difference in tactile sensation on the posterior and anterior sides of the skin incision. Tibialis posterior tendon function was evaluated by the continuity of the foot's medial arch and the patient's ability to walk on the toes.

Nonunion was defined as a combination of radiographic lack of bridging callus on four cortices.

Figure 4: Posteromedial approach deep dissection.

Figure 5: Plate fixation in posteromedial approach.

Figure 6: Fracture union occurred 5 months after surgery with posteromedial approach.

Results

Among 32 patients, 17 participants were operated on with the anteromedial approach (group A), while 15 underwent posteromedial exposure (group B). The mean age was 37 ± 13.1 and 41.8 ± 13.9 in groups A and B, respectively (p-value = 0.32). Twenty-four cases were male, and eight were female (p-value = 0.838). Seven patients were smokers, and one patient with diabetes type II.

According to the AO classification of distal tibia fractures by Muller (16), this study included ten simple fractures (A1), 13 wedge fractures (A2), and nine complex fractures (A3). There was no statistically significant difference between groups regarding the AO classification of fractures (p-value = 0.434). Twenty-nine (90.6%) patients had close fractures, and 13 of them were operated on with a posteromedial approach, while 16 underwent anteromedial surgery. Only three patients (9.4%) suffered from open fractures. Two were operated on with posteromedial, and one was operated on with an anteromedial approach. There was no significant difference in fracture type between groups (p-value = 0.739), Trauma to surgery time, and the duration of surgery. Five patients needed a two-staged operation. Similar to the AO classification, the distribution of Tscherne classification, type of trauma, trauma to surgery time, operation time, and AOFAS score were equal in both study groups. One case of tibialis posterior tendon insufficiency (grade II) was reported in the posteromedial group. The union time was 6.1 ± 3.8 and 6.4 ± 3.1 months in groups A and B, respectively, which was not statistically significant (P-value = 0.807). Delayed union occurred in two cases of the anteromedial approach and one of the posteromedial approach. One patient in the posteromedial group had a nonunion treated successfully with an autologous bone graft from the iliac crest eight months after the initial surgery. Nonunion and delayed union prevalence was not significantly different between the two groups (p-value = 0.99) (**Table 1**).

Internal fixation loosening, malalignment, and malunion were not seen in any patients. There were no cases of deep infection, deep necrosis, or wound dehiscence in any therapeutic approaches. One case with superficial skin infection was seen in the anteromedial group, while it was not seen in the posteromedial approach. Five patients in group A and one in group B had superficial skin necrosis (p-value= 0.116).

Post-surgery sensory examination of the affected limbs showed only one case of sensory impairment in the posteromedial approach. Four patients who underwent anteromedial surgery experienced hypoesthesia on their medial malleolus. This difference was also not statistically significant (p-value = 0.338)

Table 1. Objective's summary of findings in two groups.

		Anteromedial (n=17)	Posteromedial (n=15)	P-value
AO classification, n (%)	A1	7 (41.2)	3 (20)	0.434 *
	A2	6 (35.3)	7 (46.7)	
	A3	4 (23.5)	5 (33.3)	
Tscherne, n (%)	0	1 (5.9)	1 (6.7)	0.739*
	1	12 (70.6)	11 (73.3)	
	2	3 (17.6)	1 (6.7)	
	Open fracture	1 (5.9)	2 (13.3)	
Type of trauma, n (%)	High energy	6 (35.3)	8 (66.7)	0.503*
	Low energy	11 (64.7)	7 (58.3)	
Two stage surgery, n (%)	No	13 (76.5)	14 (93.3)	0.41*
	Yes	4 (23.5)	1 (6.7)	
Trauma to surgery time (hour), Mean (SD)		16.8 (1.8)	15.3 (3.2)	0.57**
Operation time (min), Mean (SD)		73.4 (6.2)	78.7 (4.3)	0.89**
AOFAS score, Mean (SD)		87.3 (3.1)	88.5 (2.8)	0.282**

- AO classification: Arbeitsgemeinschaft für Osteosynthesefragen
- AOFAS score: The American Orthopedic Foot and Ankle Score
*Chi-Square test, **Student's T-Test

Discussion

Due to wound complications, treatment of distal tibia fracture has been much discussed [11,12]. This study shows that the modified posteromedial approach can be safely used to address distal tibia fractures.

In this study, the modified posteromedial approach for extra-articular distal tibia fracture was comparable with the conventional anteromedial method with less wound complication.

The anteromedial approach has yielded the highest percentage of complications among the other methods in intra-articular pilon fractures [5,13]. Although it was not statistically significant, the anteromedial approach had

more wound infection and skin necrosis in patients with extra-articular distal tibia fractures.

The posterior approach to the distal tibia was explained by Ketz et al. to correct the shortening and malalignment of the posterior column and serve as a template to reduce the anterior column [14]. Except for one, which reported a 47% incidence of complications in the posterolateral approach[16], the others have said fewer complications, precisely wound healing problems with the posterior approach to the ankle [5,10,14].

A concern when using the classic posteromedial approach is that it includes exposure of the neurovascular bundle. And care must be taken to mobilize and protect it throughout the procedure [16,17]. But in our modification, exposure stays anterior to the tibialis posterior tendon sheet, and the neurovascular bundle is out of danger.

Moreover, the incision design guaranteed proper perfusion of fasciocutaneous flaps. Our modified posteromedial incision is between the angiosomes of the tibialis posterior and anterior tibialis artery in the distal tibia and does not harm their main branches [18]. As well, the saphenous vein does not disturb our posteromedial approach. However, surgery was not performed until the soft tissues were judged ‘‘ready’’ by a senior surgeon [19].

Although prior studies have shown distal tibia articular surface fractures can be devastating injuries that result in poor functional outcomes[20,21], in a study by Chen et al., the ankle score in patients who underwent posteromedial approach for posterior pilon fracture was 93.6 [22]. Though we evaluated patients with extra-articular distal tibia fractures, the functional ankle score was good in both groups (87.35 in group A and 88.5 in group B). The modified posteromedial approach is an effective distal tibia fracture reduction and plate fixation technique. But we acknowledge that our approach has yet to offer any improvement in direct visualization of the articular reduction compared with other methods for distal tibia fractures.

No study has ever evaluated the posteromedial approach to treat extra-articular distal tibia fractures.

When deciding on the treatment strategy, the treating surgeon must consider the relatively poor soft tissue coverage in the distal tibia before determining the surgical approach to perform open reduction and internal fixation.

According to the results of the current study, five cases (29.4%) of superficial wound necrosis occurred in the anteromedial group. The posteromedial approach group was associated with only one point of superficial wound necrosis (6.7%). Our results showed that the incidence of complications was lower in the posteromedial approach. Otherwise, there was no significant difference in complications between the two groups in our study.

The main concern and limitation of this study was our small sample size regarding our statistics which may influence our results in some subjects. We recommend a study design with a larger sample size and further extended and precise evaluations to achieve more significant and accurate results.

Conclusion

In conclusion, the Posteromedial approach is a safe and feasible alternative surgery method in distal tibia extra-articular fractures. This approach can provide better anatomic and biological fixation and reduce soft tissue complications.

The modified posteromedial approach should be considered a similarly practical surgery approach as an anteromedial approach but with fewer soft tissue concerns in extra-articular distal tibia fractures.

Acknowledgements

The authors declare that they have no sources of funding.

Disclosure statement

None.

Authors' contributions

MA. O: Study Design and Intervention. Ak and MS: Intervention and data collection. SHMM, RZ and MMS: Data Collection and Data analysis. A.E: Study Design and Manuscript Submission.

Funding Sources

Funding sources (including "grant ID", the name of the grant-receiving researcher, and the grant provider) should be clearly stated.

Ethical Statement

Ethics approval and consent to participate the study was approved by ethical committee of Shahid Beheshti University of our Medical Science (Ethical code: IR. SBMU.RETECH.1396.324) and (IRCT code: IRCT20180306038971N3).

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