DOI: https://doi.org/10.30795/jfootankle.2025.v19.1872

Technical Tips

Modified posterolateral approach for fixation of posterior malleolar fractures associated with distal tibiofibular syndesmosis injury: A surgical technique

Beatriz Marinho Guimarães[1], André Vitor Kerber Cavalcanti Lemos[1], Caio Augusto de Souza Nery[1], Gustavo Henrique Carillo Ambrosio[1], Eduardo Souza Maciel[1]

1. Universidade Federal de São Paulo – UNIFESP, Escola Paulista de Medicina, São Paulo, SP, Brazil.

Abstract

Posterior malleolar fractures are challenging to treat in ankle injuries and, when not treated properly, can lead to unfavorable results, especially if associated with syndesmosis injury. Posterior access approaches (posterolateral and posteromedial) are recommended for reduction and adequate fixation of the posterior malleolus; however, they usually do not allow direct visualization of the syndesmosis, one of the main prognostic factors in the treatment of these injuries. We present a modified posterolateral approach that enables direct visualization of the syndesmosis, in addition to the use of syndesmosis fixation implants integrated with lateral implants when associated with a lateral malleolar fracture.

Level of evidence IV; Case series.

Keywords: Ankle fractures; Ankle joint; Ankle injuries.

Introduction

Posterior malleolar fractures are present in up to 44% of ankle fractures[1], are a challenge in the treatment of ankle injuries, and when not properly treated can lead to tibiotarsal instability, degenerative arthropathy, and poor long-term results[2-4], especially when the injury is associated with distal tibiofibular syndesmosis[5].

Access to concomitant fractures and injuries involving the posterior malleolus can be challenging due to the local anatomy and morphology, as well as the reduction and fixation of these injuries[6]. In the literature, there are two main approaches to addressing the posterior malleolus fragments: the posterolateral approach, used in more than 60% of cases, and the posteromedial approach (conventional and modified)[7]. The choice between these approaches is primarily based on tomographic findings, which are considered essential for assessing the pattern and size of fragments and are a mandatory assessment in bimalleolar and trimalleolar ankle fractures[6,8,10].

This conduct differs from previous definitions that advocated the indirect reduction of the posterior malleolus through ligamentotaxis and its fixation with percutaneous cannulated anteroposterior screws[11]. The main limitation of percutaneous reduction in dorsal decubitus is that when indirect reduction of the posterior malleolus is not adequate, the traditional lateral approach to the lateral malleolus does not allow access to the posterior fragment, which can cause harm to the patient since non-anatomical reduction functions as a predictive factor for progression to osteoarthritis and poor results[12,13].

However, the posterolateral approach, as classically described by Gatellier[8], despite being a good resource for anatomical reduction and adequate fixation of the posterior malleolus, demonstrates limitations in evaluating stability

Study performed at the Universidade Federal de São Paulo–UNIFESP, Escola Paulista de Medicina, São Paulo, SP, Brazil.

Correspondence: Beatriz Marinho Guimarães. Rua Córrego da Mata 296 AP 1, Horto, 31030-030, Belo Horizonte, Minas Gerais, Brazil. **Email:** bmarinhoguimaraes@gmail.com. **Conflicts of interest:** None. **Source of funding:** None. **Date received:** January 24, 2025. **Date accepted:** July 18, 2025.

How to cite this article: Guimarães BM, Lemos AVKC, Nery CAS, Ambrosio GHC, Maciel EE. Modified posterolateral approach for fixation of posterior malleolar fractures associated with distal tibiofibular syndesmosis injury: A surgical technique. J Foot Ankle. 2025;19(2):e1872.

and direct reduction of the distal tibiofibular syndesmosis, thereby impairing adequate treatment of associated injuries.

In 2020, Kummer et al.[14] presented a cadaveric study of the anterior extension of the posterolateral approach for anterior visualization of the syndesmosis, named PAMELA. Based on this scenario, we present the clinical use of the modified posterolateral approach that provides access to the posterior malleolus and its direct reduction, combined with access to the lateral malleolus and its fixation with posterior or lateral implants, direct visualization of the anterior distal tibiofibular syndesmosis and anterolateral tibial fragments (Tillaux-Chaput), all through the same access.

Methods

A technique description of the modified posterolateral approach for fixation of posterior malleolar fractures associated with distal tibiofibular syndesmosis injury. The method was applied by the authors on a multicenter basis from 2015 to 2025 for the treatment of posterior malleolar fractures with intracisural involvement, except for those classified as Bartoníček type 3[4], in which a posteromedial approach is preferable.

The postoperative protocol followed was the same as that used for fractures treated with the traditional posterolateral approach. After surgery, patients were immobilized with a cast splint, and the surgical wound was evaluated one week after the procedure. Suture removal occurred at the end of the third week, when all patients were referred for physiotherapy sessions to relieve pain and increase range of motion. The patients were released to perform progressive partial weight-bearing, using a boot-type immobilizer orthosis, after six weeks postoperatively. Release to full weight-bearing occurred after eight weeks if signs of bone consolidation were present on postoperative radiographs.

This study was approved by the Institutional Review Board, and informed consent forms were obtained from the patients.

Surgical technique

After the anesthesia, the patient is placed in the prone position, with a pad beneath the ankle to support the foot and another under the trunk and pelvis to protect the patient's chest and face. We recommend using a tourniquet for easy viewing and access.

The incision is made longitudinally in the posterolateral region of the ankle, halfway between the lateral edge of the calcaneal tendon and the posterior edge of the lateral malleolus, previously marked with a surgical pen (Figure 1). The incision is curved from the distal edge of the lateral malleolus to the anterior, about 1cm away from it, towards the base of the fourth metatarsal (Figure 2), which allows visualization of the anterior distal tibiofibular syndesmosis and/or anterolateral malleolus fragments (Figure 3). If necessary, it can also be expanded proximally, with a slight inclination toward the anterior, especially in cases involving complex fibular fractures with long oblique patterns, which facilitates exposure and reduction. To reduce the risk of postoperative skin complications, during this step, the skin and subcutaneous tissue are lifted in a single layer, with no divulsion between them.

Following the skin incision, careful attention must be given to at-risk neurovascular structures, particularly the sural nerve and the small saphenous vein, which are located lateral to the calcaneal tendon (Figure 4). The posterior fascia of the leg is opened medially to the fibular tendons, exposing the flexor hallucis longus. After medial retraction of the flexor hallucis longus muscle, protecting the deep posterior neurovascular bundle, the posterior malleolus and the fracture

Figure 1. Preoperative surgical marking of the traditional posterolateral approach at the midpoint between the lateral malleolus and the lateral edge of the calcaneal tendon.

Figure 2. Modified posterolateral approach with anterior extension towards the base of the fourth metatarsal.

apex are identified. At this moment, if there is no impact component of the joint surface, the anatomical reduction of the metaphysis allows satisfactory joint reduction (Figure 5). Then, through a lateral window to the peroneal tendons, the lateral malleolus is medially separated and reduced and fixed with lateral implants, as performed in the traditional lateral or posterolateral approach. Still in the prone position, access to the medial malleolus is performed. Internal rotation of the limb or knee flexion allows for access and reduction of a medial malleolus fracture without altering the patient's decubitus position.

Following malleolar fixation, the anterolateral tissues of the ankle are retracted, preserving the ligamentous structures. This provides a direct view of the distal tibiofibular joint, allowing for anatomical reduction and proper fixation using position screws or a suture-button system. This anterolateral extension of the posterior approach also allows for visualization and fixation of anterolateral tibial fractures, as well as complete and adequate treatment of quadrimalleolar fractures[15].

Figure 3. Modified posterolateral approach allowing direct visualization of the anterior region of the syndesmosis.

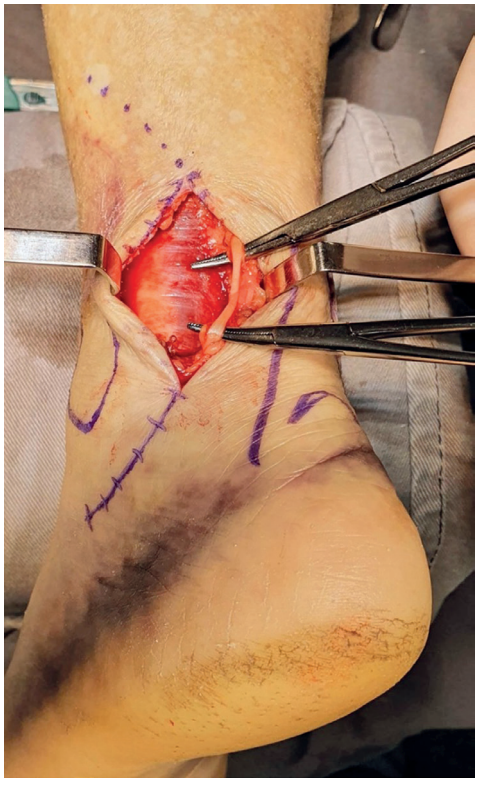

Figure 4. Posterolateral approach with emphasis on sural nerve dissection in its anatomical path under the surgical wound.

Results

The modified posterolateral approach allowed not only direct and anatomical reduction of the posterior malleolus but also visualization of the adequate reduction of the syndesmosis and its flexible fixation using a suture-button system without the need for an additional lateral approach and with a lower risk of inadequate reduction and fixation compared to the percutaneous technique for the treatment of distal tibiofibular syndesmosis injuries.

During the 10-year period of this study, minor complications, such as superficial skin necrosis and wound dehiscence, both of which occurred without the need for additional surgical

Figure 5. Intraoperative fluoroscopy demonstrating reduction and fixation of the posterior malleolus associated with fixation of the distal tibiofibular syndesmosis.

intervention, were observed at a frequency consistent with the data in the literature[16].

It is believed that the wide elevation of the skin flap, combined with the delicate retraction of the incision edges, helps minimize soft tissue trauma, thereby reducing the incidence of phlebitis and wound edge maceration. Moreover, no cases of postoperative pain higher than expected levels for the surgical treatment of ankle fractures were observed.

Although the technique allows for direct visualization of the syndesmosis and accurate evaluation of reduction parameters, there was an isolated case of reduction loss in a patient submitted to rigid fixation. Osteosynthesis review was necessary and, even after a new surgical intervention with arthroscopic guidance, the patient evolved with implant failure and severe post-traumatic arthrosis 12 months after the primary surgical procedure (Figure 6).

Discussion

A posterior malleolar fracture is a severe ankle injury that requires careful and complex treatment. It is essential to perform a detailed tomographic evaluation in all cases of isolated posterior malleolar fractures, as well as in bimalleolar and trimalleolar ankle fractures, to define treatment, surgical approach, and appropriate fixation methods.

Figure 6. Postoperative radiographic of surgical reintervention of a patient undergoing modified posterolateral approach demonstrating implant failure and early advanced tibiotarsal arthrosis.

Inadequate treatment of this injury can lead to long-term complications such as post-traumatic arthritis, tibiotarsal instability, and chronic ankle pain. These complications can result in significant limitations in the patient's daily and sports activities, in addition to substantial economic impact, particularly among the economically active population.

In addition to posterior malleolar fractures, it is important to properly evaluate and treat associated injuries, such as those involving the distal tibiofibular syndesmosis and the lateral ligament complex of the ankle. Neglecting these injuries can lead to unfavorable clinical and radiological outcomes, requiring additional surgeries to treat neglected concomitant injuries and resulting in longer treatment time and functional rehabilitation.

The surgical approach described above was previously published in a cadaveric study by Kummer et. al.[14] in 2020. The authors used a single extended posterolateral incision to expose the posterior, lateral, and anterolateral aspects of the ankle joint, presenting in detail the anatomical findings of each region and delimiting safe zones of dissection of the structures.

The need for meticulous dissection during the posterolateral approach is highlighted to prevent neurovascular injuries. The sural nerve, located superficially in the subcutaneous tissue just below the cutaneous incision, and the saphenous vein are the first structures at risk in the posterolateral approach to the ankle. When access is extended towards the tarsal sinus, the nerve becomes susceptible to injuries due to traction or divulsion, which reinforces the importance of a delicate technique and the systematic identification of these elements throughout the surgical path.

During the dissection of the deep posterolateral planes, there is still a risk of injury to the tibial nerve and the posterior tibial vascular bundle. Careful removal of the tissues and proper use of the window between the flexor hallucis longus tendon (distended medially) and the fibular tendons allows access to the posterior tibial surface with a substantial reduction in the risk of iatrogenic damage.

The objective of the technical modification of the posterolateral approach is to ensure accurate visualization and reduction of the distal tibiofibular joint, which may include Tillaux-Chaput and anterolateral ankle fractures. Anatomical fixation using position screws or a suture-button system promotes adequate stability of the syndesmosis, aiding in healing and preventing long-term complications. In addition, direct reduction of the posterior malleolus decreases the risk of poor reduction and unfavorable clinical outcomes[17].

Regarding lateral malleolar fixation, traditionally, when approaching the ankle through the posterolateral region, implants are placed at the back of the fibula, providing shear strength in Lauge-Hansen (Supination external rotation) injury patterns and greater resistance to torsional failure in Weber B fractures[16], especially in osteoporotic bones[15].

However, the implant's posterior position in the lateral malleolus can result in tendinitis of the fibular tendons as a postoperative complication due to the constant friction

between the synthetic material and these tendons[15,18]. Furthermore, this position prevents the use of syndesmosis position screws and suture-button systems integrated with a plate.

On the other hand, the presence of a well-developed skin and subcutaneous tissue flap capable of covering the implants placed on the lateral aspect of the fibula, along with incision and suture away from the most prominent area of these implants, allows for safe implant placement. This reduces the risk of local skin complications and enhances the biomechanical advantages of the construct.

Finally, it is important to emphasize that the ideal treatment for posterior malleolar fracture must be individualized, considering the specific characteristics of the injury as established by Arrondo et al., Bartoníček et al., and Haraguchi et al.[2,4,9], where they correlate the tomographic findings of injury pattern, fragment size, and distal tibiofibular joint involvement with the most indicated surgical access.

Conclusion

The modified posterolateral surgical approach presents advantages in the treatment of posterior malleolar fractures and syndesmosis injuries. This technique allows direct visualization of the reduction and fixation of the distal tibiofibular syndesmosis, potentially reducing the risk of complications associated with poor reduction of ankle fractures. However, additional studies comparing this approach with the conventional posterolateral approach are needed, especially regarding local skin complication rates, healing time, and functional recovery.

Authors' contributions: Each author contributed individually and significantly to the development of this article: BMG *(https://orcid.org/0000-0002-7428-2798) Wrote the article, participated in the review process; AVKCL *(https://orcid.org/0000-0001-8974-5815) Conceived and planned the activity that led to the study, wrote the article, participated in the review process; CASN *(https://orcid.org/0000-0002-9286-1750) Participated in the review process; GHCA *(https://orcid.org/0000-0002-6458-6317) Wrote the article, participated in the review process; ESM *(https://orcid.org/0000-0002-8572-7764) Participated in the review process. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

References

1. Ahn J, Kim S, Lee JS, Woo K, Sung KS. Incidence of Peroneal Tendinopathy After Application of a Posterior Antiglide Plate for Repair of Supination External Rotation Lateral Malleolar Fractures. J Foot Ankle Surg. 2016;55(1):90-3.
2. Arrondo GM, Joannas G. Complex Ankle Fractures: Practical Approach for Surgical Treatment. Foot Ankle Clin. 2020;25(4):587-95.
3. Bartonícek J, Rammelt S, Kostlivy K, Vanecek V, Klika D, Tresl I. Anatomy and classification of the posterior tibial fragment in ankle fractures. Arch Orthop Trauma Surg. 2015;135(4):505-16.
4. Bartoníček J, Rammelt S, Tuček M, Naňka O. Posterior malleolar fractures of the ankle. Eur J Trauma Emerg Surg. 2015;41(6):587-600.
5. Büchler L, Tannast M, Bonel HM, Weber M. Reliability of radiologic assessment of the fracture anatomy at the posterior tibial plafond in malleolar fractures. J Orthop Trauma. 2009;23(3):208-12.
6. Buscharino B, Moretti RG, Hungria JOS, Christian RW, Mercadante M, Raia F, et al. Biomechanical Study: Resistance Comparison of Posterior Antiglide Plate and Lateral Plate on Synthetic Bone Models Simulating Danis-Weber B Malleolar Fractures. Rev Bras Ortop. 2013;48(3):221-7.
7. Drijfhout van Hooff CC, Verhage SM, Hoogendoorn JM. Influence of fragment size and postoperative joint congruency on long-term outcome of posterior malleolar fractures. Foot Ankle Int. 2015;36(6):673-8.
8. Gatellier, J. The juxtoretroperoneal route in the operative treatment of fractures of the malleolus with posterior marginal fragments. Surg., Gynec. & Obst. 1931; 52:67-70.
9. Haraguchi N, Haruyama H, Toga H, Kato F. Pathoanatomy of Posterior Malleolar Fractures of the Ankle. J Bone Joint Sur. 2006;88(5):1085-92.
10. Horisberger M, Valderrabano V, Hintermann B. Posttraumatic ankle osteoarthritis after ankle-related fractures. J Orthop Trauma. 2009;23(1):60-7.
11. Irwin TA, Lien J, Kadakia AR. Posterior malleolus fracture. J Am Acad Orthop Surg. 2013;21(1):32-40.
12. Jaskulka RA, Ittner G, Schedl R. Fractures of the posterior tibial margin: their role in the prognosis of malleolar fractures. J Trauma.1989;29(11):1565-70.
13. Kimball JS, Ruckle DE, Rajfer RA, Johnson JP. Anatomic Analysis of a Percutaneous Fixation Technique for the Posterior Malleolus Using Posterior-to-Anterior-Directed Cannulated Screws: A Cadaveric Study and Technique Description. J Am Acad Orthop Surg Glob Res Rev. 2021;5(2).
14. Kummer A, Cadas H, Crevoisier X. Posterior to anterior malleolar extended lateral approach to the ankle (PAMELA): a cadaveric anatomic study. Arch Orthop Trauma Surg. 2021;141(3):427-35.
15. Rammelt S, Bartoníček J, Kroker L, Neumann AP. Surgical Fixation of Quadrimalleolar Fractures of the Ankle. J Orthop Trauma [Internet]. 2021;35(6):e216-22.
16. Milton, Berkes MB, Lazaro LE, Sculco PK, Helfet DL, Lorich DG. Complications Following Treatment of Supination External Rotation Ankle Fractures Through the Posterolateral Approach. Foot & Ankle International. 2013;34(4):523-9.
17. McDaniel WJ, Wilson FC. Trimalleolar fractures of the ankle. An end result study. Clin Orthop Rel Res. 1977;(122):37-45.
18. Ramos LS, Gonçalves HM, Freitas A, Oliveira MP, Lima DMS, Carmargo WS. Evaluation of the Reproducibility of Lauge-Hansen, Danis-Weber, and AO Classifications for Ankle Fractures. Rev Bras Ortop. 2021;56(3):372-8.