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(CASE REPORT)

Posterior and medial malleolar fractures managed via a posteromedial approach and a medialized window: A case report and brief literature review

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Abstract

Ankle fractures represent one of the most frequent pathologies in orthopedic clinical practice. Effective management relies on accurate injury recognition, classification, and the selection of the optimal surgical approach. While posterior malleolar fractures are commonly addressed through a posterolateral approach due to its established safety profile and surgical reliability, complex fracture patterns involving the medial or lateral malleoli necessitate alternative strategies. In these cases, a single-incision approach is imperative to achieve definitive fixation of multiple fragments while minimizing the risk of soft tissue compromise and skin necrosis.

Keywords: Malleolar fractures; Posteromedial approach; Medialized window; Internal fixation; Bartoníček classification; Ankle trauma

1. Introduction

Malleolar fractures involving the posterior and medial columns represent a significant surgical challenge, often requiring stable internal fixation to prevent post-traumatic osteoarthritis and joint instability. While traditional approaches provide adequate visualization for many patterns, the management of complex posterior fragments—specifically those extending medially—remains a subject of debate in orthopedic traumatology.(1,2,3)

The posteromedial approach has emerged as a versatile technique, allowing direct visualization and buttress plating of the posterior malleolus.(1) However, achieving optimal exposure of the medial malleolar component simultaneously can be technically demanding.(1,2,3) To address this, the implementation of a "medialized window" (or *modified posteromedial window*) offers an enhanced surgical interval,(4) facilitating anatomical reduction and rigid fixation of both fragments through a single, controlled dissection plane while minimizing soft tissue compromise.(4,5)

The aim of this case report is to describe the surgical technique and clinical outcomes of a patient with complex posterior and medial malleolar fractures managed via a posteromedial approach and a medialized window, highlighting the advantages of this strategy in achieving articular congruity.

2. Case presentation

We present the case of a 22-year-old male patient who sustained a high-energy rotational injury to the left ankle. Initial diagnostic workup included anteroposterior (AP) and lateral radiographs, followed by computed tomography (CT) for detailed fracture characterization (Figure 1). Imaging studies revealed a Herscovici (6) type B medial malleolus fracture

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and a **Bartoníček (7) type IV** posterior malleolus fracture. Initial management focused on soft tissue edema control, followed by definitive surgical intervention once the "wrinkle sign" was present.

Figure 1 (A-B) Anteroposterior (AP) and lateral ankle radiographs demonstrating medial and posterior malleolar fractures. (C) Axial computed tomography (CT) scan illustrating medial and posterior involvement

The patient was placed in a prone position. A conventional posteromedial (PM) approach was performed, identifying the Achilles tendon (AT) and the flexor hallucis longus (FHL). Dissection was carried out through the FHL-AT interval to achieve anatomical reduction and internal fixation of the posterior malleolus fragment. Subsequently, a medialized posteromedial window was developed. By retracting the tibialis posterior (TP) tendon, the neurovascular bundle (NVB), and the flexor digitorum longus (FDL) laterally, with minimal elevation of the TP, optimal visualization of the medial malleolar fracture was obtained, allowing for definitive stabilization (Figure 2).

Through the aforementioned posteromedial approach, the posterior malleolus was successfully addressed. Subsequently, utilizing the medialized posteromedial window(1,2,4) the medial malleolar fracture was identified and anatomically reduced. Internal fixation was achieved using one-third tubular plates, placed in a lag fashion to ensure antiglide.

Postoperative radiographic assessment demonstrated anatomical restoration of the articular surface and stable internal fixation (Figure 3). No intraoperative neurovascular complications were noted. The patient initiated a structured rehabilitation protocol focusing on early range of motion, showing favorable progression toward bone healing and functional recovery.

Figure 2 Posteromedial approach: (A) posterior window and (B) medial window. PM: posterior malleolus; NV: neurovascular bundle; FHL: flexor hallucis longus; AT: Achilles tendon; MM: medial malleolus; FDL: flexor digitorum longus; PTA: posterior tibial artery; TP: posterior tibial tendon

Figure 3 Anteroposterior (AP) and lateral radiographs showing internal fixation hardware in situ and anatomical restoration of the tibial articular surface

3. Discussion

The surgical management of complex ankle fractures involving the posterior and medial columns has evolved significantly over the last few decades. Historically, the posterior malleolus was often ignored unless it involved more than 25-30% of the articular surface. However, contemporary evidence has shifted the focus toward anatomical restoration of the posterior pilon to prevent joint instability and post-traumatic osteoarthritis. While the posterolateral approach has been the "workhorse" for most posterior fragments due to its familiar anatomy and safety profile, it offers limited access to fragments extending medially or those involving a concomitant medial malleolar fracture (1,2,3).

In the present case, the fracture "personality" presented a Bartoníček type IV posterior fragment and a Herscovici type B medial malleolar injury. This combination poses a technical challenge: the use of two separate incisions (posterolateral and medial) can increase the risk of skin bridge necrosis and wound complications. To mitigate this, we utilized the posteromedial approach, a technique that has gained traction for its versatility. As described in the anatomical analysis by Elgueta Grillo et al. (1), the posteromedial corridor provides a direct view of the posterior distal tibia while allowing for the safe identification of critical structures such as the neurovascular bundle (NVB) and the flexor tendons.

The innovation in our case lies in the implementation of the "medialized window" within the same posteromedial incision. Urrutia et al. (4) and Mitsuzawa et al. (3) have demonstrated through cadaveric studies that the use of different surgical windows—specifically the interval between the tibialis posterior and the flexor digitorum longus—significantly expands the exposure area of the medial and posterior columns. This strategy allowed us to address both fractures through a single surgical corridor, a choice supported by Porta et al. (5), who reported that a modified posteromedial approach is a safe and effective alternative to conventional access, particularly in complex patterns where medial visualization is paramount.

Regarding the fixation strategy, we opted for the antiglide principle using one-third tubular plates. In vertical shear injuries or large triangular fragments like the Bartoníček type IV, achieving interfragmentary compression via lag screws can be technically demanding or even contraindicated if the fracture geometry does not favor a perpendicular screw trajectory. Applying the plate at the apex of the fracture as a buttress neutralizes the vertical shear forces, a biomechanical advantage highlighted by Zhang (2) in the management of posterior pilon variants. This approach ensures stable fixation and maintains articular congruity while minimizing further soft tissue dissection.

In conclusion, the posteromedial approach with a medialized window is a robust and biologically respectful technique for complex malleolar fractures. It provides a superior surgical interval for anatomical reduction and allows for a single-incision solution that protects the precarious soft tissue envelope of the ankle.

4. Conclusions

In summary, a comprehensive understanding of the posteromedial tibial anatomy is imperative for the orthopedic surgeon. Utilizing the three-window technique within this approach facilitates superior visualization of the posterior distal tibia, ensuring safe fragment manipulation and precise reduction of posteromedial and high medial malleolar fractures. Cadaveric studies support this strategy, demonstrating improved surgical corridors and enhanced safety profiles. Ultimately, the integration of soft tissue status, fracture personality, surgical proficiency, and meticulous preoperative planning is essential to optimize clinical outcomes and ensure favorable short- and long-term recovery for patients.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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