

Case Report

Anterograde fixation of inverted oblique medial malleolus fractures: case report

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Abstract

Fractures of the medial malleolus are common, with avulsion being the main trauma mechanism. In simple transverse fractures, retrograde fixation with interfragmentary screws is the most common means of achieving anatomical reduction and absolute stability. However, greater attention must be paid in cases of inverted oblique fractures, which make traditional fixation difficult. We report a case in which anatomical reduction and stabilization were achieved using a reduction clamp and two headless compression screws placed anteriorly, resulting in a mechanically stable, safe and effective repair.

Level of Evidence V, Therapeutic Studies; Expert Opinion.

Keywords: Ankle Injuries/surgery; Bone screws; Fracture fixation, internal/methods; Range of motion, articular; Treatment outcome.

Introduction

Different mechanisms of trauma to the ankle result in different fracture patterns and associated ligament injuries⁽¹⁻²⁾. The precise identification of these injuries, as well as defining the direction of the fracture line, is essential for the best surgical planning and treatment.

In joint fractures, interfragmentary compression is more effective when the forces act perpendicular to the fracture line, otherwise shear forces and fracture deviation can occur⁽¹⁾. In these small deviations, incongruence in the tibiotalar joint and joint instability can result in residual pain and joint degeneration⁽³⁾.

The fracture classification system allows us to identify possible mechanisms of injury and determine which surgical technique is necessary⁽²⁾. In an assessment of Herscovici's classification⁽⁵⁾ for fractures of the medial malleolus, Aitken et al.⁽⁴⁾ observed greater disagreement in interpretation between types B and C due to the obliquity of the fracture line, and there was no subtype for inverted oblique type B fractures, which, in our understanding, require a different approach from conventional type B treatment (Figure 1).

In the medial malleolus, variation in the direction of the fracture line is responsible for different bone injury presentations, as well as the involvement of the deltoid ligament, especially its deep portion⁽⁶⁾.

Several techniques have been described for the internal fixation of medial malleolus fractures, the most common being osteosynthesis with two partial thread screws for interfragmentary compression and the tension band technique. The latter is more indicated in cases of fragmentation, poor bone quality or small avulsed fragments⁽⁷⁾.

In supracolicular avulsion fractures of the medial malleolus, the tension band technique has greater biomechanical resistance to pullout and can be used in all cases⁽⁷⁾. However, these conventional fixation methods present several complications, mainly related to irritation to soft tissue and the deltoid ligament, which in some cases requires removal of the osteosynthesis material⁽⁸⁾.

The use of headless double compression screws for medial malleolus fractures has proven efficient and seems to be related to a shorter consolidation time and less soft tissue irritation⁽⁹⁻¹⁰⁾. In addition, the anterograde approach allows bicortical fixation, which provides greater resistance and less aggression to the deltoid ligament⁽⁸⁻¹⁰⁾.

Study performed at the Casa de Saúde São José, Rio de Janeiro, RJ, Brazil.

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The purpose of this case report is to draw attention to medial malleolus fractures with an inverted oblique pattern in the anteroposterior view and the use of an anterograde approach with headless double compression screws to achieve osteosynthesis.

Case report

This study was approved by the Institutional Review Board under the protocol number: CSJ000-688-21 and the patient provided written informed consent.

This 21-year-old female patient suffered torsional trauma in the right ankle and was referred to the emergency department. Physical examination revealed deformity of the right ankle, severe pain, functional limitation, excoriation and edema (+++/4+). Radiographs and computed tomography showed a trimalleolar fracture-dislocation (Figures 2 and 3). As comorbidities, the patient was obese and glucose intolerant, and was using an oral hypoglycemic agent.

The patient was immediately taken to the operating room and underwent surgery for fracture dislocation reduction and definitive osteosynthesis, since the condition of the soft tissue was good. We will describe the fixation of the medial malleolus fracture, classified as a Herscovici type B with an inverted oblique profile, which was directly reduced with a reduction clamp and fixed with two 3.0mm No. 16 long-thread headless compression screws, which were inserted anterograde, as detailed below.

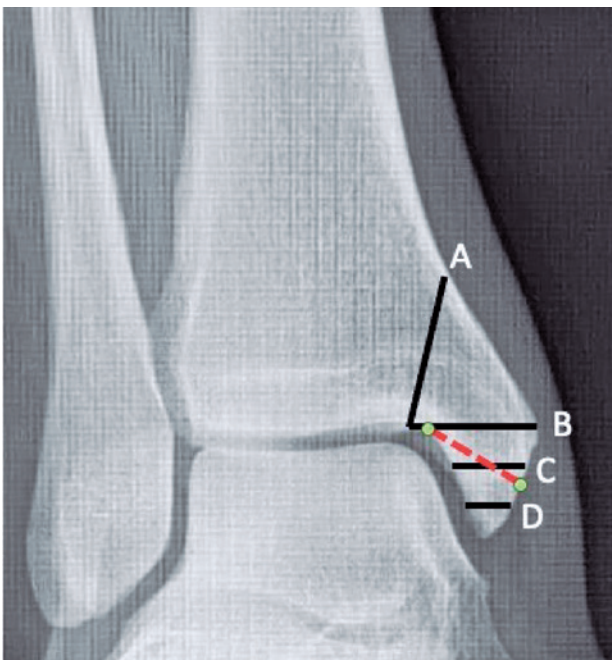


Figure 1. Medial malleolus fracture lines classified by Herscovici (types A, B, C and D); the red dotted line illustrates the patient's inverted oblique fracture (subtype not classified).

Surgical technique

The patient was placed in the supine position on a radiolucent table under spinal anesthesia and peripheral nerve block. The pneumatic cuff was positioned in the proximal third of the right thigh and we followed the usual steps for asepsis and placement of the surgical fields.

The reduction and fixation of the fibular fracture was performed according to AO foundation guidelines regarding anatomical fracture reduction, fixation with interfragmentary screws, and the use of a neutralization plate.

After osteosynthesis of the fibular fracture, a large opening was observed in the joint clamp, which hindered reduction of the medial malleolus due to the integrity of the deltoid ligament. Thus, it was necessary to reduce and stabilize the syndesmosis with two screws.

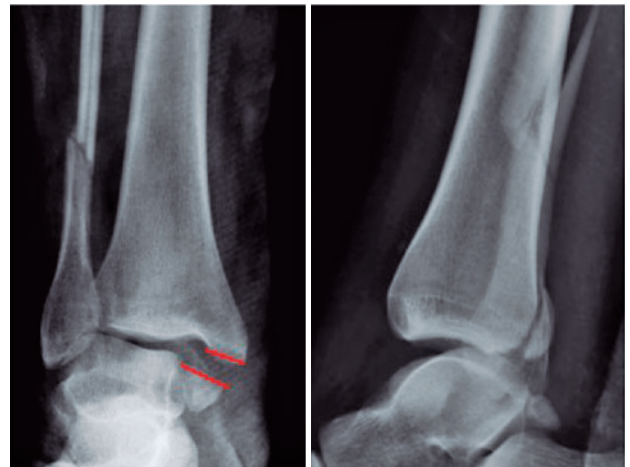


Figure 2. AP and ankle profile radiographs showing the trimalleolar dislocation fracture. The red lines show the inverted oblique fracture pattern in the medial malleolus.

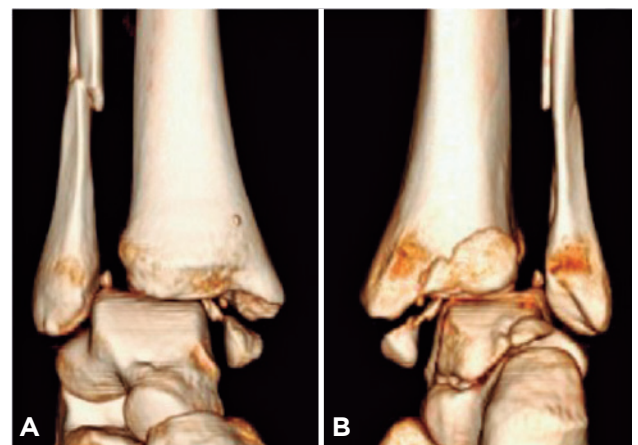


Figure 3. 3D tomographic reconstruction. (A) Trimalleolar fracture in the anteroposterior view. (B) Posteroanterior view. In the medial malleolus, the entire anterior colliculus is fractured, including a small fragment of the posterior colliculus.

A medial incision of approximately 3-4cm was made using the anteromedial cortex of the distal tibia as a reference and curving distally and posteriorly, preserving the saphenous vein and nerve. An anterior colliculus fragment and a small posterior colliculus fragment were identified, with the intact deltoid ligament attached to the fracture fragment. The fracture was reduced using a Backhaus clamp placed perpendicular to the fracture line (Figure 4).

Two guidewires were then introduced from the proximal to the distal end, perpendicular to the fracture line and with a good angle of attack, since this technique allows greater freedom of inclination than a distal-to-proximal placement. After measurement, two cannulated 3.0mm No. 16 long-thread headless compression screws were inserted anterograde, resulting in perfect interfragmentary compression between the fracture fragments (Figure 5). Through fluoroscopy we confirmed the correct placement of the guidewires and screws, which prevented them from becoming intra-articular.

After osteosynthesis of the medial malleolus, intraoperative stress radiographs showed no instability and that the ankle anatomy was restored.

At the end of the procedure, the pneumatic cuff was opened and the blood perfusion was checked. The skin was sutured after revision of hemostasis. The patient was initially immobilized with a plaster cast and then a short ankle orthosis at discharge.



Figure 4. Intraoperative fluoroscopy image showing anatomical reduction of the medial malleolus fracture with Backhaus forceps, whose upper end was introduced through the medial cortex after drilling with a 1.5mm bit.

Discussion

To classify the medial malleolus fracture, we observed the size of the fragment, relating it to the height of the horizontal line of the fracture (Herscovici types A, B and C) and the vertical direction (shear - Herscovici type D)⁽⁵⁾.

Pancovich and Shivran identified 6 main medial malleolus injury patterns⁽⁶⁾, which facilitates selection of the osteosynthesis type (all retrograde) for each fracture pattern.

We have observed that fractures involving the entire anterior colliculus and a small fragment of the posterior colliculus may be associated with an inverted oblique pattern.

The Herscovici classification differentiates four main fracture patterns and helps determine the treatment. However, as found by Aitken in 2016, there is a high prevalence of disagreement between types B and C due to the obliquity of the fracture, which we believe is essential for selecting the surgical technique^(4,5).

Fractures in which the medial cortex fracture pattern is compatible with Herscovici type B and the joint face fracture pattern is compatible with Herscovici type C can be characterized as an inverted oblique pattern, a subtype not considered in this classification system.

In this fracture “subtype”, it is difficult to obtain perpendicularity during compression with any conventional retrograde technique. Anterograde fixation with cannulated headless screws is a more mechanically stable alternative that involves less consolidation time, less pain due to the

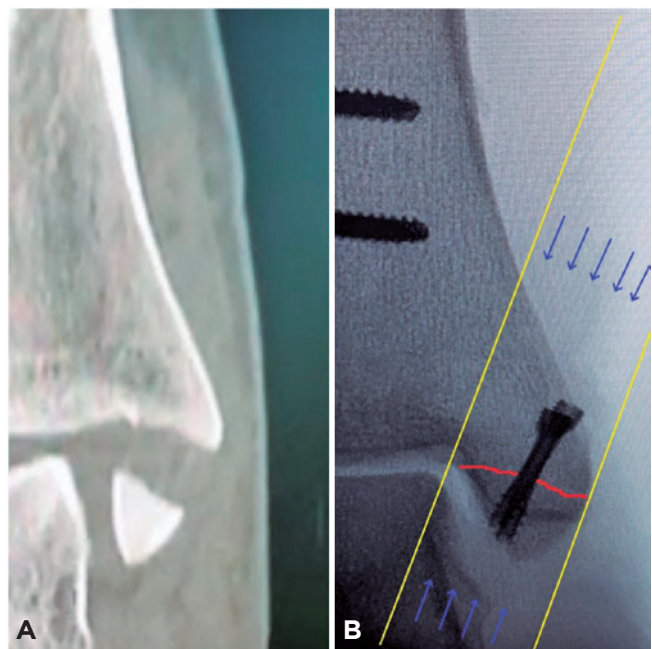


Figure 5. (A) Coronal CT section showing the inverted oblique fracture line; (B) AP radiograph of intraoperative control showing screws inserted in the perpendicular “corridor” to the fracture line.

implants (reducing the need for removal), an easier surgical approach, and less damage to the medial ligament complex (Figure 6).

Conclusion

Inverted oblique type B Herscovici fractures hinder conventional retrograde osteosynthesis and are a challenge due to difficulties in intraoperative reduction and fixation. The surgeon must prepare for these fractures with good planning and a collection of images that enable identification of this unusual pattern. Reduction and provisional stabilization that applies the correct compression force in the correct direction is fundamental for success. The anterograde approach allows the compression screw to be inserted perpendicular to the fracture line, which is adequate for interfragmentary compression and absolute stability.

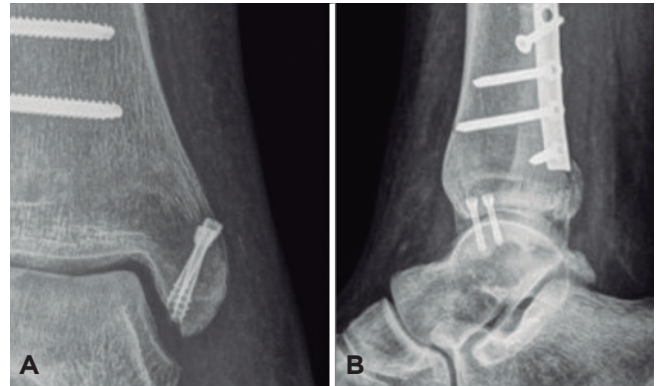



Figure 6. (A) AP radiograph showing the consolidated medial malleolus 4 weeks after surgery. (B) Ankle profile 30 days after surgery.

Authors' contributions: Each author contributed individually and significantly to the development of this article: SMC *(<https://orcid.org/0000-0001-6416-5865>) performed the surgeries; TLL *(<https://orcid.org/0000-0002-5242-4548>) participated in the review process; ABP *(<https://orcid.org/0000-0001-9785-1642>) performed the surgeries; BJS *(<https://orcid.org/0000-0001-5817-2743>) participated in the review process; JSF *(<https://orcid.org/0000-0002-4964-0979>) conceived and planned the activities that led to the study; RCB *(<https://orcid.org/0000-0003-3199-4055>) participated in the review process. All authors read and approved the final manuscript. * ORCID (Open Researcher and Contributor ID) .

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