Technical Note

Posterior Malleolus Arthroscopic Reduction and Internal Fixation Technique

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Abstract: Adequate reduction of posterior malleolar fractures leads to better outcomes. Arthroscopic reduction and internal fixation presents an opportunity for excellent reduction with a minimally invasive approach. Herein, we present a technique with some discussion on outcomes.

Management of posterior malleolar fractures continues to evolve, with variability of opinions on both indications and approach. The historical convention was to repair fractures with sizes >25% of the tibial plafond, largely based on a 1992 cadaveric study by Raasch et al.,[1] which tested nonrotational posterior translation of the tibia after syndesmosis transection and progressive sectioning of the posterior malleolus. Although it has been shown that larger posterior malleolar fragments result in measurable alterations to ankle mechanics,[2] higher-level data to support this threshold are insufficient.[3] With the great heterogeneity of fracture morphology, considerations regarding the posterior malleolar contributions to joint congruity and ligamentous attachments are important.[3] The size of the fracture, amount of displacement, presence of syndesmotic injury, degree of posterior instability, and presence of fibular fracture all deserve attention. We recommend anatomic reduction and fixation regardless of fracture size to restore stability to the posterior inferior tibiofibular ligament.

Closed or indirect reductions of the posterior malleolus using anteroposterior screws have been previously described.[3] Although this approach is minimally invasive, it does not allow for adequate visualization of the fragment and reduction or provide the opportunity to remove interposed periosteum, small osteochondral fracture fragments, or organized blood clots.[3,4] An indirect approach may not achieve the same degree of adequate anatomic reduction as open or arthroscopic approaches.[4] Conversely, an open approach allows for partial visualization of the posterior malleolus fracture but involves significantly more dissection for a limited improvement in visualization.[4] Open reductions also increase the risk of skin complications, neurovascular injury, prolonged hospital stays, and increased time off work.[5]

Fig 1. A patient secured and draped in the "bean bag lateral" position, with the patient completely on the right lateral side and the left leg externally rotated. This position allows the operative leg to be rotated internally or externally comfortably for access or ports from every aspect of the foot/ankle. A distal extremity leg holder is used to keep the operative foot level with a noninvasive ankle distractor.

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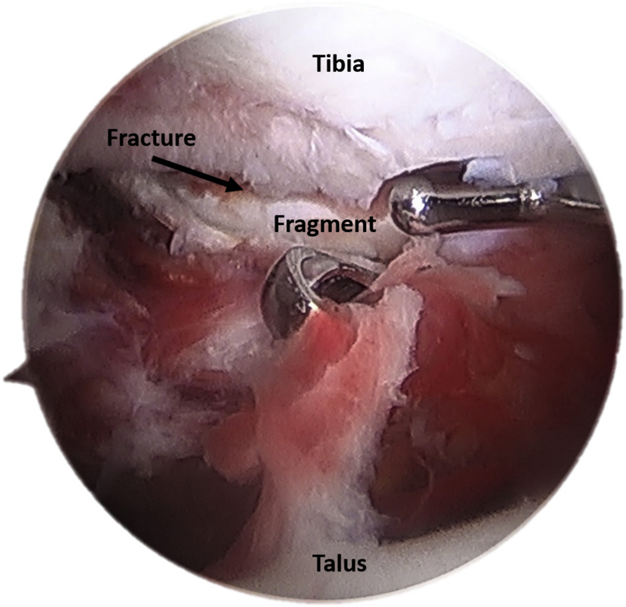

Fig 2. Arthroscopic hematoma removal at a left posterior malleolar fracture site. In this image, visualization is provided from the anteromedial portal, and a probe is inserted from the anterolateral portal and shaver from the posterolateral portal.

We present a technique for an arthroscopic-assisted fixation of the posterior malleolus, which we believe provides a minimally invasive approach to posterior malleolar fixation and maximizes direct visualization of the intraarticular fracture, resulting in improved articular congruity and joint stability.

Surgical Technique

See Video for the entire surgical technique. After administration of adequate anesthesia, the patient is secured on the contralateral side in the "bean bag lateral" position (Fig 1), with the ankle sufficiently past the end of the radiolucent table for intraoperative imaging. Bony prominences are padded, a thigh tourniquet is placed to allow for maximum visualization, and the patient is prepped in the usual sterile fashion. An Arthrex distal extremity leg holder and noninvasive ankle distractor are used to keep the externally rotated operative foot level and allow flexibility during surgery.

After initiating traction, landmarks are palpated, and the skin is marked just medial to the anterior tibial tendon at the level of the ankle. An 18-gauge needle is inserted through the site of the planned anteromedial portal, and the joint is insufflated with saline to confirm intraarticular placement and reduce the cartilaginous impact of the trocar placement. With confirmation of the portal site, and after a small skin incision and blunt dissection down to the capsule, the capsule is entered with a blunt trocar. Saline return through the trocar provides additional confirmation of proper placement. Continuous saline insufflation is then provided through a Stryker CrossFlow arthroscopy pump, and a Stryker arthroscopy camera is inserted through the trocar for intraarticular arthroscopic visualization.

Under direct arthroscopic visualization and transillumination, a lateral arthroscopic portal is developed just anterior to the syndesmosis. Diagnostic arthroscopy is performed in the standard fashion, including the articular surfaces, syndesmosis, and fracture sites. Hematoma is cleared away using a Stryker Aggressive Plus 3.5-mm shaver. Any loose bodies are evaluated for incorporation into the reduction or removal from the joint space.

After sufficient clearance is performed, a posterolateral portal is obtained under direct arthroscopic visualization, midway between the Achilles and peroneal tendons at the joint line, to allow use of a nerve hook to aid further clearance of the fracture site and reduction planning (Fig 2). A Kirschner wire (K-wire) is percutaneously advanced into the posterior malleolus to act as a joystick. The K-wire joystick and a nerve hook are used to obtain

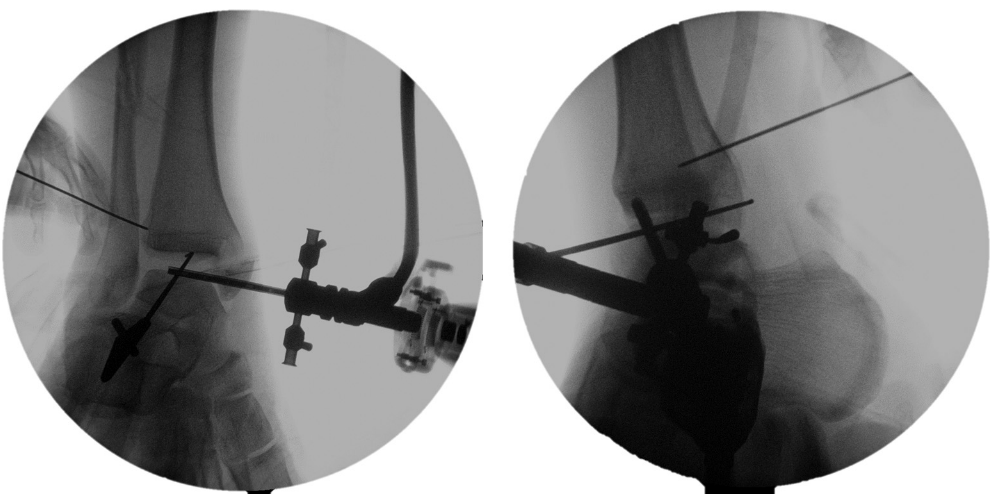

Fig 3. Anterior and lateral images of an inverted left ankle demonstrating use of Kirschner wire as a posterior joystick in combination with an anterior nerve hook to facilitate reduction of a posterior malleolus fracture under arthroscopic and fluoroscopic guidance.

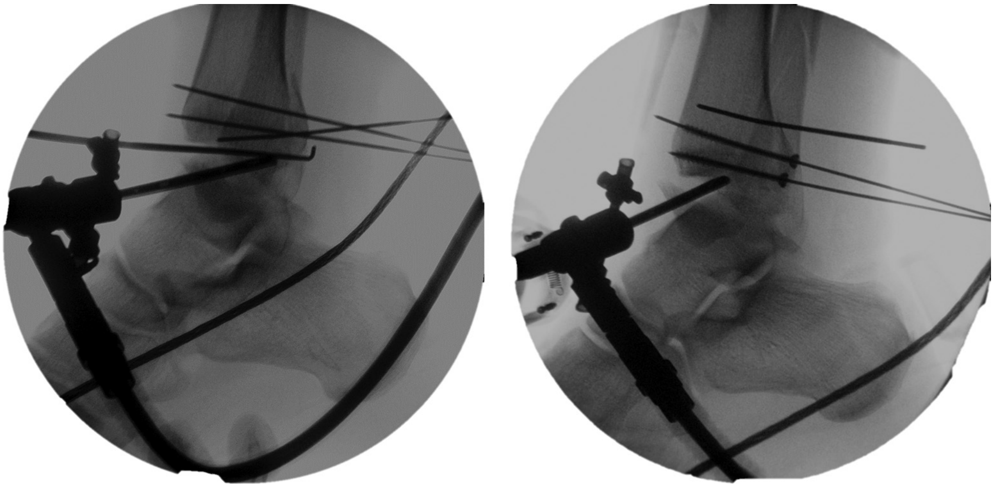

Fig 4. Lateral radiographs of a left ankle showing posterior to anterior placement of guidewires followed by cannulated screws after reduction of posterior malleolus.

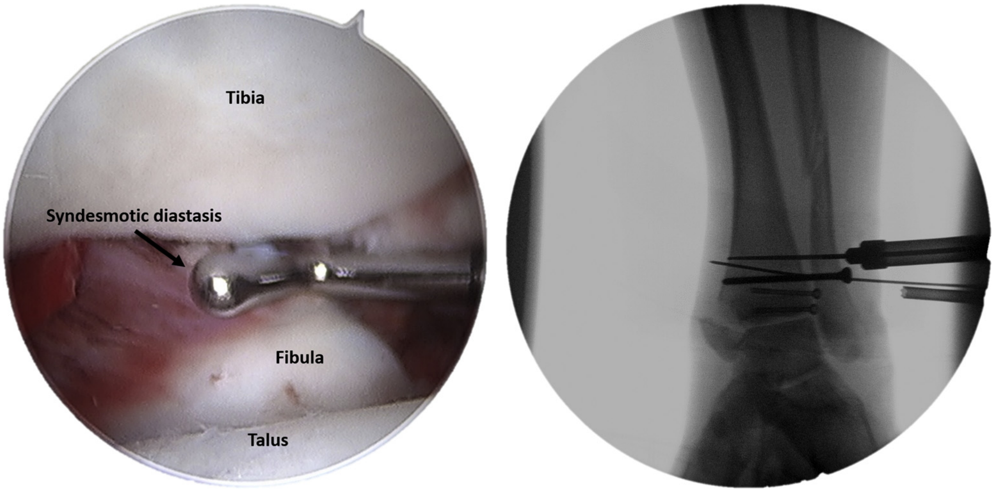

Fig 5. Reduction of left ankle syndesmosis under arthroscopic visualization from an anteromedial portal with evaluation of syndesmotic diastasis with a calibrated nerve hook. Anteroposterior radiograph showing the arthroscopic reduction held with guidewire followed by fixation with 2 screws using a percutaneous technique.

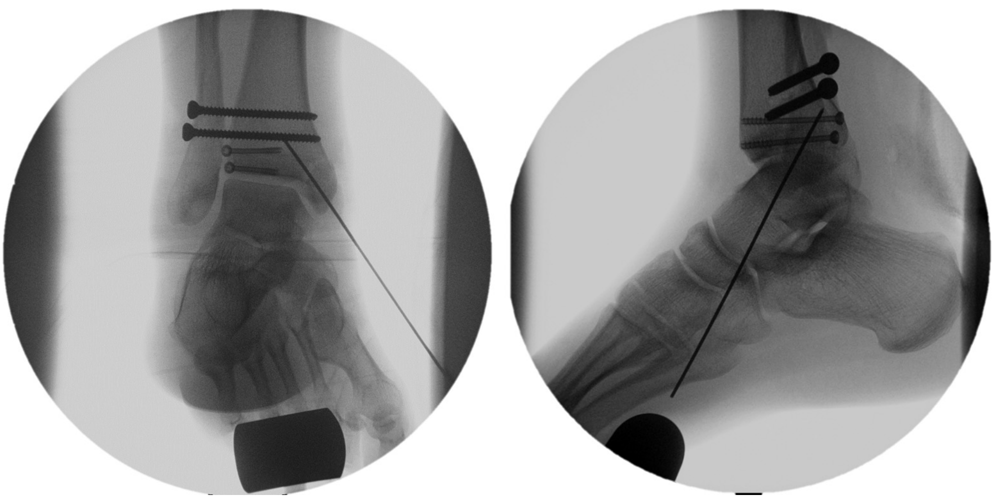

Fig 6. Inverted anteroposterior and lateral radiographs showing a minimally invasive reduction of the left medial malleolus using percutaneous pinning and manipulation, after previous fixation of the posterior malleolus and syndesmosis.

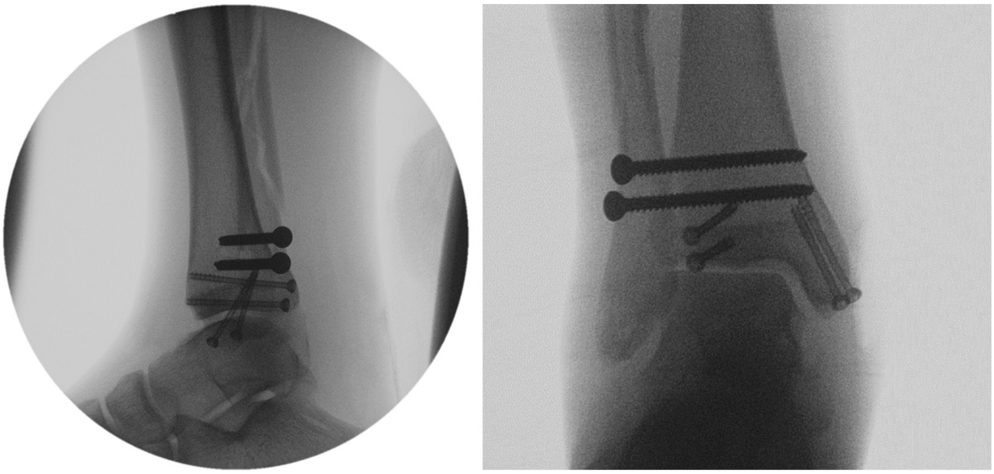

Fig 7. Final construct of arthroscopic reduction and internal fixation of a left posterior malleolar fracture, followed by syndesmotic fixation and minimally invasive reduction and fixation of medial malleolus.

reduction under arthroscopic visualization with fluoroscopic confirmation (Fig 3). After satisfactory reduction, the K-wire is advanced to maintain anatomic position, and 2 screws are placed across the posterior malleolus (Fig 4). Reduction may again be confirmed under arthroscopy and fluoroscopy. At this point, the syndesmosis or other fractured malleoli may be addressed in a standard fashion (Figs 5-7). Our patients are typically immobilized in an L&U splint (a combination of an 'L' posterior splint and a 'U' stirrup splint) for 2 weeks and then advanced to a controlled ankle movement boot for 6 total weeks of protected non-weightbearing.

Discussion

Arthroscopy allows direct visualization for enhanced evaluation, debridement, and confirmation of reduction adequacy.[5] Patients regain range of motion faster and start rehabilitation earlier than after open approaches.[5] Ankle synovial fluid after an intraarticular fracture has significantly elevated inflammatory cytokines and matrix metalloproteinases that may contribute to cartilage damage and synovitis.[6] One additional advantage to arthroscopy is that lavage may theoretically reduce these factors that may be worsening outcomes of otherwise appropriate reductions.[7]

Much of the risk and limitations of this technique are standard for typical arthroscopic approaches, including a steeper learning curve than open reduction and internal fixation, as well as increased surgical time and risk of soft tissue extravasation (Table 1). However, ankle arthroscopic portals are relatively safe neurovascularly, and postoperative complications are rare.[8] Beyond inherent issues with arthroscopy, an anticipated difficulty for a less-experienced surgeon would be frustration in clearing the fracture site and difficulty in achieving a satisfactory reduction (Table 2). Because this situation may result in conversion to an open procedure, proper patient position before beginning is critical. The patient should be completely lateral to allow for full posterior access with internal rotation.

Outcomes of injuries involving the posterior malleolus historically have poor prognosis, with or without surgical intervention. A review of 1,822 patients, followed up over 4 years postoperatively, revealed that only 58.1% had good or excellent results after any type of surgical management.[9] Possible explanations include cartilaginous damage from the injury that was not recognized due to inadequate visibility or the previously mentioned inflammatory factors remaining in the joint space. A recent prospective study of arthroscopic posterior malleolar fixation with 1-year follow-up yielded encouraging results. All 12 patients showed good reduction and even joint space on radiography. All patients had returned to preinjury activity levels and reported full satisfaction (scale 9.42/10).[5]

Table 1. Advantages, Disadvantages, Risks, and Limitations

Advantages
Relatively minimally invasive, excellent visualization, opportunity to lavage inflammatory factors from joint space
Disadvantages
Increased surgical time, risk of tissue extravasation
Risks
If performed properly, low risk of injury to articular cartilage or neurovascular structures during initial portal creation
Limitations
Steep learning curve

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
Instability of the joint is an indication for reduction and fixation of the fragment, regardless of the size threshold.	Inadequate clearance of the fracture site will make reduction more difficult.
Proper patient positioning is critical, particularly if a transition to open surgery is indicated.	

Conclusions

Despite being first described by Holt in 1994[10] and a general positive experience from adopter publications, there is a dearth of research and documentation on arthroscopic reduction and internal fixation of posterior malleolar fractures.[5] In our experience, we have found this to be reliable technique to restore articular congruity and ankle stability in posterior malleolar fractures.

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