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The Emerging Role of the Posterior Malleolus in the Interpretation and Management of Ankle Fractures

The diagnosis and treatment of these fractures remain controversial.

BY ANDREW J. MEYR, DPM, FACFAS

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Introduction

There can be little argument that an evidence-based approach to scientific inquiry now plays an essential role in the future of podiatric science. This doesn't mean, however, that the practice of evidence-based medicine (EBM) is fool-proof and without limitation. One of the most important restrictions that we should all recognize is that it is relatively easy to assume that a study can be designed with EBM to "prove" the answer to any scientific question.

In other words, one might propose that it would be theoretically possible to design a study to "prove" what the best bunion procedure is. Most scientists would argue that you can never actually hope to "prove" anything with a given study, but instead simply add evidence either in support of or against a given hypothesis.

A recurring theme that consistently comes up during my resident's journal club is that "you can never prove anything, simply add to the ever expanding body of knowledge." The underappreciated nature of this first restriction can often be heard at CME events where the lecturers will often lament a "lack of level 1 evidence," on a given topic, essentially assuming that there is a single answer out there to every question that we just haven't discovered yet.

This point leads into a second important restriction that is underappreciated with respect to EBM and involves the levels of clinical evidence. Let's be clear that the levels of clinical evidence are important and should influence our medical decision-making. But, we as physicians have a tendency to think of higher levels of evidence (levels 1 and 2) as being "good", whereas lower levels of evidence (3, 4 and 5) are "bad". This line of thinking disregards the absolute fact that each and every scientific investigation has flaws and limitations. Even the best designed, level 1, randomized, double-blinded, multicenter study has limitations that should influence the interpretation of results. So, while we may feel more confident in the results of studies with higher levels of evidence, that doesn't necessarily mean that they're "better" than the results of a study with lower levels of evidence that perhaps we feel less confident in.

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This admittedly verbose introduction leads into the actual topic explored with this article, specifically the role of the posterior malleolus in the interpretation and management of rotational ankle fractures. This has been an interesting topic of some debate recently, but it highlights some of our current limitations with an EBM approach.

First of all, although we have learned more about the role of the posterior malleolus in the last decade or so, it is extremely likely that we currently have an incomplete understanding of its role in ankle fractures, and it's also possible that we as physicians may never fully understand the role in our lifetimes!

Additionally, we can point to no level 1 or level 2 evidence on the topic, but we can provide some interesting data that may lead you toward or away from a given treatment intervention. These two "flaws" take nothing away from the interesting nature of the topic, and what we can all learn to improve our treatment of patients with ankle fractures.

What Is the Posterior Malleolus?

Beginning with anatomy, although most people agree that the posterior malleolus plays an important role in the structure and function of the ankle mortise, it is interesting that the term "posterior malleolus" has an inexact anatomic definition that may refer to any or all of the posterior tibial tubercle forming the posterolateral margin of the incisura fibularis of the tibiofibular syndesmosis, the posterior aspect of the tibial plafond articular cartilage, and the entire posterior margin of the tibia extending from the incisura fibularis to the medial malleolus.[1-3]

These osseous landmarks are reinforced by adjacent soft tissue structures that influence the function of the ankle joint, subtalar joint and the tibiofibular syndesmosis (lateral ankle collateral ligaments, lateral and posterior subtalar joint ligaments, ankle joint capsule, syndesmotic ligaments including the posterior inferior tibiofibular ligament (PITFL), and inferior transverse ligament). Damage to any of these structures has been found to contribute to adhesive capsulitis, arthrofibrosis, soft tissue impingement syndromes, and reduced joint motion about the ankle.[4,5]

When a specific osseous injury occurs to this area, particularly with rotational ankle fractures, it appears to do so in a relatively predictable pattern. In 2006, Haraguchi, et al.[6] published a descriptive classification of posterior malleolar fractures from a retrospective review of patients who underwent a pre-operative CT scan following ankle fractures involving a posterior fragment. They found that the majority of fractures (67%)

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were triangular-shaped fragments involving the posterolateral corner of the tibial plafond and included the posterior tubercle of the incisura fibularis and PITFL (Figure 1).

This fracture pattern may involve a significant portion of the articular cartilage of the tibial plafond, likely contributes to the stability of the syndesmosis, and is most amendable to surgical reconstruction. They even went on to describe that the angle between the fracture line and the bimalleolar axis was approximately 21 degrees.

When should the posterior malleolus be operatively reduced and fixated? It has traditionally been accepted that posterior malleolar fractures involving greater than 25% of the tibial articular cartilage are more appropriately treated with open reduction and internal fixation versus indirect or closed reduction. As with many numbers within our profession, however, the arrival of this number of "25%" is the result of relatively imperfect science. McLaughlin[7] first reported the number of 25% in a textbook published in 1960, although he reports that his data comes from a "large number of cases treated over 20 years" without objective measurement.

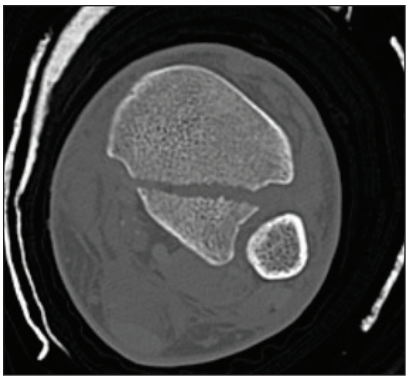

Figure 1: Posterior malleolar ankle fracture characteristics. Haraguchi, et al., found that the majority (67%) of posterior malleolar ankle fractures followed the above pattern of a triangular-shaped fragment involving the posterolateral corner of the tibial plafond and included the posterior tubercle of the incisura fibularis and PITFL. They further described the average angle of the fracture plane to be 21 degrees to the bimalleolar axis.

To provide further evidence, in 1977, McDaniel and Wilson[8] retrospectively compared the outcomes of 15 posterior malleolar fractures involving greater than 25% of the articular cartilage and concluded that the 7 treated with internal fixation did better than the 8 treated with closed reduction, specifically with respect to ankle joint motion and the development of post-traumatic arthritis.

Interestingly, however, they provided no specific statistical analysis for their results, and it is possible to go back and perform a Fisher's exact test for their data and find that they did not achieve statistical significance (getting p-values of 0.25 and 0.28 for the comparison of ankle joint motion and the development of post-traumatic arthritis, respectively).

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This is likely secondary to their small sample size. Despite these somewhat questionable beginnings, more recent outcome studies have generally demonstrated improved post-operative patient results with posterior malleolar reduction/fixation.[9-14]

The way that we measure fracture fragment size is also a matter of some debate. This has traditionally involved measurement from a standard lateral plain film radiograph (Figure 2). However, the measurement of CT scans has recently been demonstrated to be more reliable than plain film radiographs.[15-17] Our group recently presented data at the 2014 ACFAS Annual Scientific Conference providing evidence that an additional externally rotated lateral radiograph taken down the plane of the posterior malleolar fracture may provide more information than a standard radiograph alone[18] (Figure 3).

Figure 2: Measurement of posterior malleolar fracture fragment size. The size of the posterior malleolar fracture is most commonly performed from a lateral plain film radiographic projection, although CT scan measurements have been demonstrated to be more reliable. This plain film and CT scan of the same ankle fracture demonstrates how the fracture is more easily visualized and measured on the CT.

How should posterior malleolar fractures be fixated? There is not a standardized or universally accepted fixation construct for stabilization of the posterior malleolus, but most people agree that it is intrinsically more logical for fixation to be orientated in a posterior-anterior direction. This allows for direct visualization of fracture reduction, usually allows for the surgeon to get greater screw thread purchase into the larger osseous fragment, and can allow for biomechanically stable plate fixation similar to the anti-glide principle often utilized for the lateral malleolus.

However, it does involve signifi-

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cantly more dissection during the initial procedure and if hardware ever needs to be extracted. In contrast, fixation applied in an anterior-posterior direction can usually be performed percutaneously with clamps and cannulated screws, but it may be more difficult to achieve compression with partially threaded screws and ascertain reduction without direct visualization. Depending on the size of the fracture fragment and orientation of screw placement, it may be challenging to get all of the threads across the fracture fragment without the screw being prominent posteriorly (Figure 4).

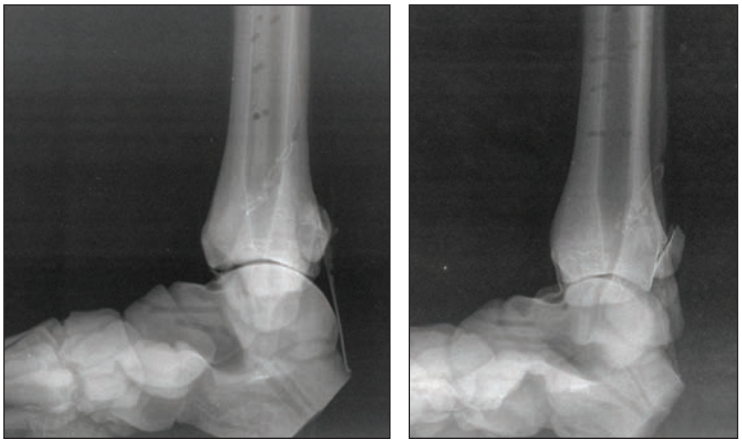

Figure 3: Standard lateral versus externally rotated lateral radiographic examination of posterior malleolar fractures. These figures demonstrate evaluation of a posterior malleolar fracture involving 10% of the tibial plafond articular cartilage and 5mm of proximal displacement. The first image is a standard lateral projection while the image on the right demonstrates an externally rotated lateral projection (externally rotated 21 degrees along the plane of the fracture). Our study provided evidence that the accuracy and reliability of physician measurement of posterior malleolar fractures was improved with the externally rotated projection.

What Role Does the Posterior Malleolus Play in Syndesmotic Stability?

A final matter of clinical relevance with respect to the posterior malleolus involves its role in stabilization of the ankle syndesmosis. As we have already discussed, fractures involving the posterolateral aspect of the tibial plafond often also involve portions of the syndesmotic ligaments, particularly the PITFL. Several studies have recently pointed to the seemingly important role of the posterior malleolus with respect to stabilization of the syndesmosis[19-22], some even concluding that fixation of the

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posterior malleolus alone obviates the need for any other syndesmotic fixation.

My group has not found this to be the case; however, we recently presented another set of data at the 2014 ACFAS Annual Scientific Conference to this effect.[23] Although this data has yet to be published, it bears mention here. We performed a retrospective review of 30 surgically corrected tri-malleolar fractures where fixation of the posterior malleolus was performed. Following fixation of all osseous fracture components, stress examination of the syndesmosis was performed. We found that >50% of fractures still had an unstable syndesmosis requiring fixation, even after fixation of the lateral, medial, and posterior fracture fragments.

Specifically, we found that PER fractures were more likely to require additional syndesmotic stabilization compared to SER fractures, those with a deltoid rupture were more likely to require additional syndesmotic stabilization compared to anterior colliculus fractures, and smaller posterior malleolar fractures (less than 22.45% of the articular cartilage) were more likely to require additional syndesmotic stabilization compared to larger posterior malleolar fractures (Figure 5).

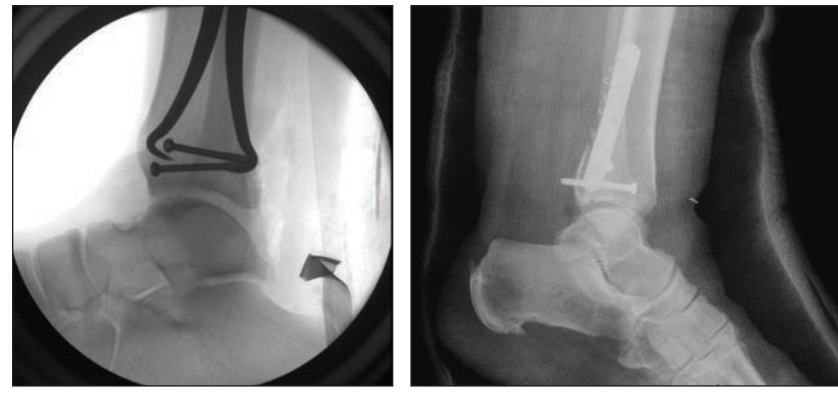

Figure 4: Fixation of posterior malleolar fractures. Although it may be technically easier to fixate posterior malleolar fractures from an anterior-posterior orientation with the use of percutaneous clamps and cannulated screws, surgeons need to be mindful of screw length. Particularly when partially threaded screws are utilized, all of the threads need be across the fracture in order to achieve compression, and it can be difficult to achieve a balance between screw length and thread position.

We think the results of this in-

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vestigation provide data that demonstrate that although the posterior malleolus may impart some stability to the syndesmosis, every ankle ORIF involving the posterior malleolus warrants a specific and separate evaluation of syndesmotic stability.

Figure 5: The effect of posterior malleolar fixation on syndesmotic stability. This figure demonstrates continued syndesmotic instability even after fixation of the lateral and posterior fracture fragments. We found that >50% of ankles had continued syndesmotic instability even after fixation of all osseous fracture components, including the posterior malleolus.

Conclusion

The intention of this review was to discuss aspects of the diagnosis and treatment of posterior malleolar fractures that may be of some controversy. Although it likely asked more questions than provided answers, it hopefully provides the groundwork for your treatment of these fractures in the future. **PM**

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Dr. Meyr is an Associate Professor in the Department of Podiatric Surgery at the Temple University School of Podiatric Medicine, Philadelphia, Pennsylvania. He is a Fellow of the American College of Foot and Ankle Surgeons.