Bicortical Fixation of Medial Malleolar Fractures

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Abstract

Medial malleolar fractures occur commonly and are often treated surgically. For any given fracture, treatment depends on the fracture configuration, and the clinical scenario. Multiple fixation options exist, including cortical or cancellous screws, tension band wiring, plates and screws, and even suture anchors according to some reports. When using screws alone, bicortical fixation of the medial malleolus may be desirable. This is especially true in the population of patients who demonstrate osteopenia. We present a simple technique that facilitates insertion of bicortical screws in the fixation of medial malleolar fractures.

Fractures of the medial malleolus are common. Isolated fractures with minimal displacement can be treated nonoperatively.[1] Displaced fractures and those in conjunction with lateral or posterior malleolus fractures usually require operative reduction and fixation. There are a variety of surgical options available for fixation of medial malleolus fractures including cortical or cancellous screws,[2-4] tension band wiring,[2,5,6] antiglide plates,[7] and suture anchors.[8] The most common technique for fixation of medial malleolar fractures uses lag screws, which is accomplished either by a lag technique or with the use of partially threaded screws. Usually, these screws terminate in the cancellous metaphyseal bone of the distal tibia. In patients with significant osteopenia or poor bone quality, screw purchase may be significantly compromised. Bicortical fixation of screws placed through the medial malleolus has been described for vertical malleolar fractures.[9] We have employed a variation on this technique in treating patients with more typical, horizontally oriented malleolar fractures as well. The goal is to place screws orthogonally across the fracture in a bicortical fashion. Because of the angle of the screw relative to the fracture, the tip will engage the far cortex of the tibia at a very acute angle. This will frequently cause deflection of the drill bit, causing it to bend and go up the tibial canal, along the far cortex. We describe a technique of placing bicortical screws across the medial malleolar fractures in the osteopenic population.

Technique

Placement of bicortical screws may be advantageous in a patient with a typical avulsion fracture of the medial malleolus and obvious osteopenia (**Figure 1**).

Figure 1. Lateral radiograph of a 75-year-old woman with osteopenia who sustained an open ankle fracture-dislocation after a twisting injury. Her medical comorbidities included polymyalgia rheumatica for which she had been treated chronically with oral corticosteroids.

The patient is positioned supine with a bump under the ipsilateral hip to allow lateral fixation if applicable, and to allow for a true supine positioning of the limb to ensure adequate intraoperative fluoroscopic imaging. After exposure and cleaning of the medial malleolar fracture itself, reduction and provisional stabilization can be achieved with a variety of methods according to the familiarity of the surgeon and confirmed both visually and fluoroscopically.

Typically, bicortical medial malleolar fracture fixation consists of two 3.5 mm cortical screws (fully threaded) placed in a lag fashion. Smaller screws can be used if the medial malleolar fracture fragment will not accommodate placement of 3.5 mm screws. A standard 3.5 mm drill bit is used for the outer cortex of the bone to the fracture itself. The universal drill guide inner sleeve is placed to ensure that the second drill bit is accurately centered. We have found that the long, fluted

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Figure 2. Intraoperative fluoroscopy demonstrating long 2.5 mm fluted drill bit attempting to penetrate the lateral cortex of the tibia.

Figure 3. Intraoperative fluoroscopy demonstrating long 2.5 mm fluted drill bit deflecting off the lateral cortex of the tibia without penetrating it.

Figure 4. Intraoperative fluoroscopy demonstrating penetration of the lateral cortex of the tibia with the use of a 2.4 mm Steinmann pin.

Figure 5. Intraoperative fluoroscopy confirms bicortical placement of a 3.5 mm cortical screw through the same trajectory.

Figure 6. Postoperative radiograph of the same radiograph with the final construct including fixation of the lateral malleolus and syndesmosis fixation.

2.5 mm drill bit is typically too flexible to allow for reliable drilling of the lateral tibial cortex given the significant obliquity of the angle of entry. As a result, the drill bit often deflects off the lateral cortex and travels up the canal of the tibia, or breaks (**Figures 2, 3**). Therefore, we use a 2.4 mm Steinmann pin through the drill guide centered in the glide hole to drill through the lateral cortex of the tibia (**Figure 4**). The Steinmann pin is stiffer than a similarly sized drill; furthermore, its end is sharper. Fluoroscopic imaging with the Steinmann pin in place confirms the anticipated screw trajectory and is saved. A 3.5 mm fully-threaded cortical screw can then be inserted either by power or by hand (**Figure 5**). The length of this screw is universally longer than 50 mm, which is the longest 3.5 mm screw in most small fragment implant sets. Longer screws can often be found with pelvic implants, or kept separate in the sterile supply department of the hospital. A second screw can then be placed in a similar fashion (**Figure 6**). Range of motion exercises are allowed when the incision is healed. Weight bearing is based on a variety of factors, both injury and patient related.

Discussion

Although nonoperative treatment of isolated medial malleolus fractures has been shown to have a high rate of union and good functional results,[1] these fractures are also commonly treated with surgical fixation. Fractures in patients with known osteoporosis or radiographically evident osteopenia are not uncommon.

Although current treatment protocols for the elderly generally do not significantly differ from those in younger individuals, the prognosis for elderly patients is typically significantly worse than their younger cohorts.[10] This may be due in part to the fact that osteoporotic bone is not as amenable to secure internal fixation with plates and screws, leading to a higher incidence of failure of fixation. Screws placed into cortical bone have better resistance to pullout than those placed into trabecular bone in osteoporotic bone.[11] This is due to the greater mineral density in cortical bone compared to adjacent trabecular bone.[12]

Many described techniques exist for fixation of medial malleolus fractures. Most commonly, parallel cortical or cancellous screws are used in lag fashion placed obliquely across the fractures.

A different technique of placing bicortical screws vertically across the fracture has been previously described.[9] This technique utilizes bicortical screws placed from distally to proximally across a transverse fracture plane to obtain cortical purchase in the medial shoulder of the distal tibia. This method utilizes much shorter screws with a decreased working length, compared with the technique described here. It is indicated for transverse fractures and not for oblique fractures seen in the medial malleolus. Although not described, screws that are placed bicortically in a vertical fashion have the possibility of being prominent causing irritation over the proximal screw tip. In addition, the vertical screws can be challenging to place.

We feel that our technique of bicortical medial malleolar screws is very useful in the treatment of some fractures of the medial malleolus, either isolated or in conjunction with other injuries about the ankle. It is easily performed and offers bicortical fixation, which may be advantageous in patients with osteopenic bone. Due to the improved bicortical purchase in strong cortical bone, overcompression is possible which can cause iatrogenic comminution of the fracture or even intussusception of the fracture into the metaphyseal bone. Particular attention is given to achieving predictable lateral cortical penetration when predrilling the path of intended screw fixation. Use of a Steinmann pin, instead of the more commonly used drill bit, greatly facilitates accurate drilling and screw placement.

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