Operative Technique: A Modification of the "Push-Pull Screw" Distraction Technique for Obtaining Fibular Length

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Introduction

Attaining fibular length during fixation of a comminuted distal fibula fracture is important to restoring ankle joint integrity and normal biomechanics. Restoring length of a comminuted fracture pattern utilizing a bridge plate construct can prove challenging, and in this manuscript we describe a modification of the "push-pull screw" distraction technique. Specifically, we distract using a laminar spreader with tongs placed between a "push-pull screw" and a threaded drill guide secured in a locking compression plate hole. This technique produces a force vector that both distracts across the fracture site to achieve length and pushes the plate onto its bony footprint. This method utilizes instruments commonly found on compression plating sets, and we have had good clinical and radiographic outcomes. We received IRB approval at our institution to review patients who underwent fixation using this technique.

Background

The goal of surgical fixation of ankle fractures is to restore the integrity of the joint and near-physiologic biomechanics. An asymmetry of the articulation between the talus and the tibia and fibula suggest ankle instability. A cadaveric study by Ramsey found that 1 mm of tibiotalar displacement may decrease ankle joint contact area by 42%.[1] Restoring anatomic fibular length after lateral malleolus fracture is a well described radiographic parameter for assessing adequacy of a reduction. On an anterior-posterior radiograph disruption of the "ball sign" and on the Mortise view an abnormal talocrural angle are suggestive of fibular shortening.[2] Attaining fibular length during open reduction and internal fixation can present a technical challenge, particularly when the fracture is comminuted. In this paper we describe a modification of a distraction technique using a "push-pull screw"[3] and a lamina spreader for attaining length when bridge plating comminuted lateral malleolus fractures.

Preoperative Evaluation and Indications

This operative technique is useful in the setting of a comminuted and shortened distal fibula fracture amenable to bridge plate fixation. Preoperative evaluation is the same as for any ankle fracture, and includes a thorough physical examination with particular attention to the integrity of the soft tissue envelope and a standard series of ankle radiographs.

Procedure

The patient is positioned supine on a radiolucent table with a small bump under the ipsilateral hip to prevent external rotation of the extremity. A non-sterile tourniquet is placed on the proximal thigh, although we do not routinely inflate it during the procedure. The operative extremity is elevated on a radiolucent foam ramp to facilitate intraoperative fluoroscopy. The contralateral extremity is well padded and secured. The fluoroscopy unit is placed on the contralateral side of the table, and the fluoroscopy monitor is positioned at the foot of the bed. The injured extremity is then prepped and draped in the usual sterile fashion.

We prefer a direct lateral approach to the distal fibula in the absence of a posterior malleolus fracture in need of fixation. A 10 to 15 cm skin incision is made over the posterior aspect of the fibula centered over the fracture. The deeper tissue is incised in line with the skin taking care to protect the superficial peroneal nerve proximally and the sural nerve and peroneal tendons posteriorly. Careful placement of small Homan retractors facilitates exposure for deeper dissection. The fracture site is identified and exposed for evaluation of comminution severity. If the fracture is comminuted enough to preclude fixation with an absolute stability construct all efforts are made to preserve the periosteal soft tissue around the fracture site with the intention of placing an extraperiosteal plate. The dissection along the fibula is extended to accommodate a bridge plate of sufficient working length (at least three times the length of the fracture, usually longer). We use a precontoured locking compression plate (LCP) capable of accepting 2.7 mm locking screws distally and 3.5 mm cortical or locking screws proximally. An appropriately sized plate is placed on the fibula, properly positioned using fluoroscopy, and provisional fixed with a point-to-point clamp or Kirschner wires.

If the fibula appears shortened on fluoroscopy we prepare to distract across the fracture site using a modification of the "push-pull screw" technique. First, the LCP is fixed to the distal fracture fragment using 2.7 mm locking screws with unicortical purchase using a threaded drill guide. Next, the "push-pull screw" is placed: a 3.5 mm cortical screw is placed in the fibular shaft in a lateral-to-medial direction approximately 1 cm proximal to the plate with bicortical purchase (i.e., outside the plate). A threaded drill guide is placed in the proximal most hole of the LCP with an inner sleeve able to accommodate a Kirscher wire. A Kirschner wire is loaded in a wire driver and kept on the ready. Next, the prongs of a toothed lamina spreader are placed on the "push-pull screw" and the base of the proximal threaded drill guide (i.e., in the axilla formed by the end of the drill guide and the surface of the LCP). A force is applied by opening the tongs of the lamina spreader creating both distraction across the fracture site and a downward force pushing the plate onto bone. The fibular length and plate balance is checked fluoroscopically. When the appropriate length has been obtained the prepared Kirschner wire is placed through the inner sleeve of the proximal threaded drill guide to hold the distraction (Figures 1 and 2). The lamina spreader is then removed. Thereafter, two or three 3.5 mm cortical screws are placed in the plate proximal to the fracture attaining bicortical fixation. The Kirschner wire and threaded drill guide in the proximal most hole is then removed and replaced with another 3.5 mm cortical screw. One to two more 2.7 mm locking screws are placed in the distal fragment using the appropriate threaded drill guide. Finally, if we are satisfied with our reduction and fixation the "push-pull screw" is removed.

Our attention is then turned to any other injuries about the ankle warranting fixation. Prior to closing we routinely irrigate the wound with normal saline through cystoscopy tubing. The wound is then closed in the normal fashion with the utmost respect for the soft tissue and vasculature.

Postoperative Protocol

Immediately following surgical fixation the patient is immobilized in a short leg splint and instructed to be non-weight bearing on the operative extremity. If the patient has any risk factors for venous thromboembolism we prescribe a course of aspirin as prophylaxis. Patients return to the office two weeks after surgery for wound examination and suture removal. Our postoperative weight bearing protocol varies based upon the pattern of the ankle fracture (e.g., isolated fibula fracture versus a trimalleolar pattern). For example, in the case of a bimalleolar fracture pattern the patient is transitioned to a cam walker boot two weeks after surgery but remains non-weight bearing. The patient is re-evaluated six weeks after surgery and if there is evidence of fracture healing they are advanced to weight bearing as tolerated and prescribed formal physical therapy.

Figure 1. Model of a distal fibula demonstrating the instrumentation for the distraction technique.

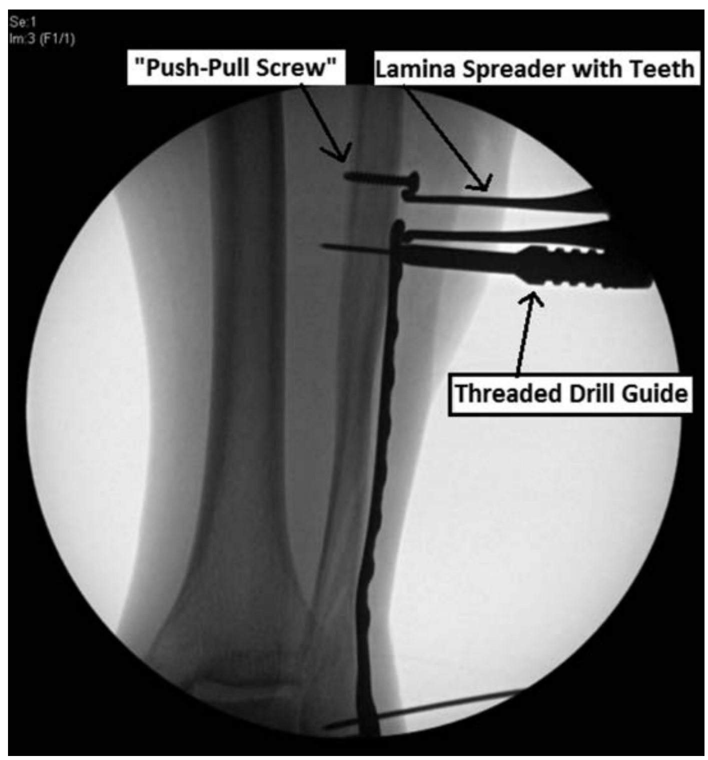

Figure 2. Intraoperative fluoroscopy showing the instrumentation for the distraction technique. Specifically note the placement of the tongs of the lamina spreader on the proximal "push-pull screw" and in the axilla formed by the plate and the threaded drill guide.

Figure 3. Injury and postoperative AP radiographs for the patient in Figure 2. The length of the comminuted fibula fracture has been restored and fixed with a bridge plate construct.

Discussion

Restoring fibular length during ankle fracture fixation is important to restoring joint stability and biomechanics. This paper describes a technique to achieve fibular length in the setting of comminution utilizing a "push-pull screw", threaded drill guide, and a lamina spreader with a bridge plate construct. Unique to our technique is the placement on the lamina spreader tongs between the "push-pull screw" and the threaded drill guide in the LCP (Figure 2). The tong located in the axilla formed by the threaded drill guide and the surface of the plate creates a downward force pushing the plate onto the bone in addition to the distraction force. This is an improvement over our prior experience of placing the tongs between the "push-pull screw" and the proximal end of the plate, which would create a troublesome lifting force that pushes the plate away from the bone while attempting to achieve distraction. We have had clinical success using our described technique in properly selected patients. A patient's injury, intraoperative, and postoperative radiographs are included as an example (Figures 2 and 3). The technique is low risk and can be accomplished using instruments commonly found on commercially available fracture plating systems.

References

1. Ramsey PL, Hamilton W. Changes in tibiotalar area of contact caused by lateral talar shift. *J Bone Joint Surg Am* 58A:356-357 (1976).

2. Weber BG, Simpson LA. Corrective lengthening osteotomy of the fibula. *Clin Orthop Relat Res* 61-67 (1985).

3. Schutz M, Ruedi TP. Principles of internal fixation. In: Bucholz RW, Court-Brown CM, Heckman JD, *et al.*, eds. Rockwood and Green's Fracture in Adults. Philadelphia, PA: Lippincott Williams & Wilkins; 162-190 (2010).