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Obtaining Correct Ankle Alignment Using Intraoperative External Fixation for Ankle Arthrodesis

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ABSTRACT

Ankle arthrodesis remains an important treatment option for patients with ankle arthritis. Many methods have been described; however, no consensus has been reached regarding the best technique to achieve both successful fusion and a good position for optimal foot mechanics. Furthermore, as arthroplasty has become more popular, preservation of the fibula to allow for future arthroplasty has become critical. The present report describes an innovative technique in which temporary external fixation at operative fixation is used, along with internal fixation, to achieve both an optimal foot position and high fusion rates, while maintaining the integrity of the fibula. Seventeen patients were identified who met the criteria for inclusion. Their medical records, including pre- and postoperative radiographs, were reviewed retrospectively. Preoperative and postoperative coronal and sagittal alignment was determined. All patients achieved successful fusion, although 1 (5.9%) patient experienced delayed union. The average tibial/talar ratio preoperatively was 21% (range 8% to 33%), demonstrating anterior subluxation. Postoperatively, this ratio improved to 33% (range 26% to 40%), approximating the normal anatomic ratio. Of the 17 patients, 5 (29.4%) had preoperative varus or valgus alignment of the talas >5°. All 5 cases were successfully corrected to within 2° of normal anatomic alignment. This technique allows the surgeon to achieve good visualization of the joint for preparation and to obtain the optimal position of the foot at arthrodesis without compromising the lateral column significance of the fibula. All patients obtained fusion, and minimal complications were associated with the use of this technique.

Ankle arthrosis is a problem that foot and ankle surgeons face routinely. The origin of the arthrosis can be related to a number of factors, most of which include a post-traumatic, rheumatic, septic, and/or neurogenic etiology. The pain and deformity that results in the arthrosis are initially treated with conservative medical management. After nonoperative methods have been exhausted, the patient has the option of either joint arthroplasty or ankle arthrodesis. Although considerable progress has been achieved in the past 15 years in the field of ankle replacement, the indications for this surgery remain limited, especially in the younger population. Arthrodesis continues to be the mainstay of treatment, with several techniques available to achieve fusion. Although no consensus has been reached, most surgeons use some combination of external fixation or internal fixation with an open or arthroscopic approach (1–6). The specific goal of the present report is to describe an arthrodesis technique using open internal fixation plus the use of an external fixator to achieve successful union and minimize deformity. We report on a series of patients who underwent this technique and their outcomes.

Surprisingly little consensus has been reached regarding how best to achieve ankle arthrodesis. Numerous techniques exist, from which 3 basic themes emerge: (1) the sagittal alignment of the foot must avoid equinus, (2) the fixation must be strong enough to allow fusion, and (3) the hindfoot must to be positioned in slight valgus and external rotation to permit more natural gait mechanics. These goals seem straightforward; however, great variability exists in their interpretation and execution.

Although numerous operative techniques have been described for obtaining fusion of the tibiotalar joint, we believe that our technique is unique. The principle difference between our technique and others is that we use an external fixator and do not perform fibular osteotomy. The external fixator allows us to gain access to the ankle and facilitate joint surface preparation. The fixator can then be used to assist in correction of the deformity and maintenance of alignment for joint fixation. In addition to the obvious advantages of this adjunctive measure, it obviates the need to osteotomize the fibula, leaving intact the primary lateral stabilizer of the ankle joint.

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Fig. 1. The operative leg is placed on a ramp to aid in lateral imaging of the leg. The ipsilateral upper extremity is crossed over the chest, and an additional bump can be placed under the ipsilateral torso.

Patients and Methods

Preoperative Planning

Preoperative clinical and radiographic evaluation is of paramount importance to obtain a plantigrade foot. Many patients present with chronic pain, ankle arthrosis, and nonanatomic alignment of the tibiotalar articulation caused by traumatic injury. Any misalignment in the patient's mechanical axis (especially in the tibia and foot) must be recognized in advance to permit preoperative planning. For example, a typical pattern in post-traumatic arthrosis cases caused by pilon fractures is the development of avascular necrosis of the anterolateral aspect of the pilon in the region of the tubercle of Chaput. This results in anterior extrusion of the talus relative to the tibia, with dissolution of the distal tibial articulation. Varus and valgus deformity of the ankle is also common, depending on the injury pattern.

Preoperative planning should account for previous incisions and also assess whether previously inserted plates will permit redirection of screws to assist with fusion. For example, anterior T- and L-shaped plates can be used as washers for distally directed compression screws into the talus. The same can be used with fibular plates if the trajectory of the lag screws through the plate is appropriate.

Surgical Technique

With the patient in the supine position, the operative leg is placed on a ramp to aid in lateral imaging of the leg (Fig. 1). A gastrocnemius recession, which has been previously described (7), is performed based on the preoperative clinical and radiographic assessment of bilateral lower extremities for the presence of an equinus contracture.

Incisions from previous surgeries should be marked and any symptomatic hardware removed. Medial distal tibial plates tend to cause irritation owing to the minimal soft tissue coverage; therefore, we recommend the routine removal of these plates. As noted previously, anterior distal tibia plates can be left in place to assist with fusion.

The external fixator is assembled by placing a 5-mm, centrally threaded, transfixion Schanz pin through the calcaneus. It is critical to stay in the "safe zone," as defined by Casey et al (8), to prevent injury to the surrounding neurovascular structures. Specifically, a 5-mm Schanz pin should be placed anteriorly to posteriorly at the junction of the proximal and middle third of the tibia after predrilling with a 3.2-mm drill.

Typically, an anterolateral approach is used to gain access to the lateral aspect of the ankle joint. This approach also allows access to any plates that might have been placed for previous pilon fixation. When needed, an anteromedial approach can also be used.

Next, the external fixator is assembled. Medial and lateral bars are attached through a transverse bar that has been attached to the Schanz pin in the tibia (Fig. 2). This provides distraction and posterior translation, which allows access to the back of the joint and allows progressive distraction and posterior translation of the talus on the tibia. Varus angulation can be corrected by distracting through the medial bar and valgus angulation by distracting through the lateral bar. Some external fixator manufacturers provide instruments that allow for controlled distraction. When not available, an additional bar clamp can be attached to the bar, and distraction can be obtained by placing a laminar spreader between the 2 clamps.

Visualization and the attainment of the correct ankle position can be impeded by large osteophytes on the anterior tibia and/or anterior aspect of the talar neck. The tibial osteophyte should not be removed, because it provides a buttress against talar anterior extrusion and a bony surface for screw placement from the tibia into the talus. The talar neck osteophyte can be removed using osteotomes, which will allow for better visualization and, in some cases, improved posterior translation of the talus in relation to the tibia.

A laminar spreader can be used to facilitate entrance into the medial and then lateral ankle space to remove any articular cartilage. Once all the cartilage has been removed, the subchondral bone of the talus and tibia can be drilled with a 2-mm drill to promote bleeding. Attention should then be placed on obtaining the bone graft. Although we recommend autologous bone from the proximal tibia, it is important to consider other sources of bone grafts and the potential use of biologic agents.

The bone graft was packed into the ankle joint defect. The position of the ankle and talus was radiographically reassessed to ensure it is centrally placed on the anteroposterior and lateral views. Any necessary adjustments should be done through the external fixator. With the foot in neutral position, a series of percutaneous 2.3-mm Steinmann pins are placed. Two to three of them can be placed medially through the metaphysis of the tibia, and 2 tubercle Chaput pins should be placed through the anterolateral approach to anchor the tibia into the talus. Whenever possible, these pins can be placed through a previously existing plate on the anterior aspect of the distal tibia. Two Steinmann pins are placed from the fibula to the tibia and two from the fibula into the talus to solidify the lateral pillar. Appropriate pin placement is verified radiographically, and C-arm radiographs are used to demonstrate that the appropriate translation of the talus and medialization of the talus within the plafond is correct (Fig. 3).

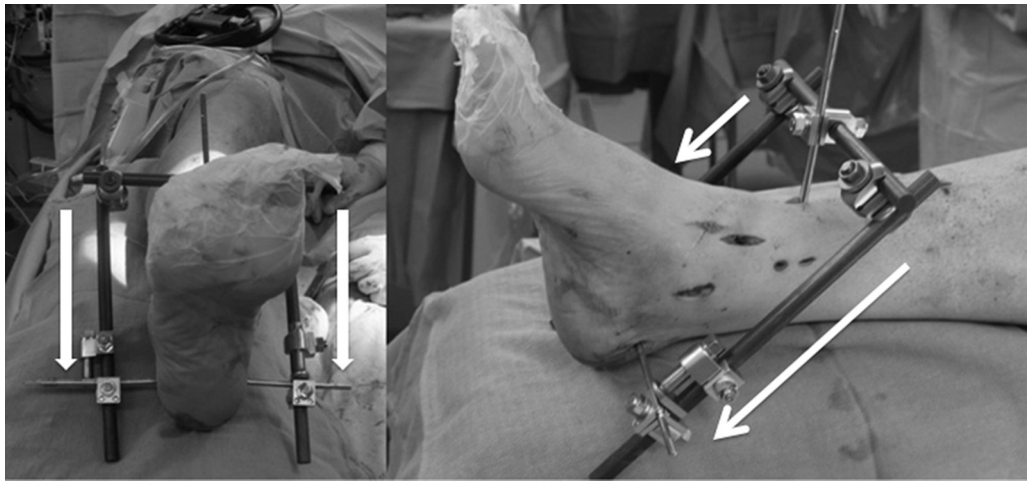

Fig. 2. *(Left)* View of a transcalcaneal pin with 1 tibial pin. Bar was connected from the anterior tibial pin to both the medial and the lateral portions of the transcalcaneal pin. Note, the distraction devices are connected on the distal extent of the bars. Varus/valgus angulation can be corrected by distracting the medial and lateral bars, respectively. *(Right)* View of the posterior vector, which can be used to posteriorly translate the talus relative to the tibia.