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Can Biological Fibular Plates Provide Viable Fixation For Tibiocalcaneal Arthrodesis?

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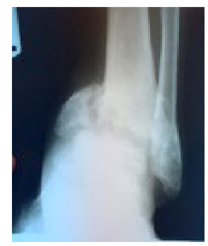
In a case study involving significant ankle and subtalar joint instability in a patient with diabetes and a smoking habit, these authors discuss the use and benefits of fibular fixation in a tibiocalcaneal (TTC) arthrodesis procedure.

Two years prior to the initial presentation in our clinic, a 61-year-old African-American male with a history of Type 2 diabetes developed septic arthritis of his left ankle and subtalar joint. Initially, he developed a urinary tract infection (UTI) and subsequently became bacteremic. This infection eventually seeded the infection into the left ankle and subtalar joint via hematogenous spread. The patient experienced a painful, red, swollen ankle joint that required surgical incision and drainage and bone debridement by another surgeon at an outside institution. He then completed six weeks of intravenous antibiotics for treatment of osteomyelitis.

Over the course of the next 18 months, the ankle became progressively painful and unstable. He began to notice his ankle turning inward, leading to a varus deformity. Outside providers used multiple braces to stabilize the deformity without success. Evaluation of foot and ankle serial radiographs led to a diagnosis of septic arthritis with Charcot arthropathy of the left ankle and subtalar joints. He then presented to our clinic with a painful varus deformity and a chronic neglected medial malleolus fracture. Prior to his presentation to our practice, the other surgical option offered to the patient was below-knee amputation. The patient describes significant instability of his left ankle joint, which forces him to walk on the most lateral aspect of his foot. The patient's hemoglobin A1c was 9.5 percent and he noted a 0.5 pack per day smoking habit.



Preoperative Considerations: What The Surgeon Should Know

The initial examination confirmed Charcot arthropathy with a malaligned varus deformity as well as a chronic malpositioned and malunited medial malleolus fracture. Clinically, the patient had significant instability of the ankle and subtalar joints with excessive varus motion in the frontal plane. We identified a one cm limb length discrepancy to the affected side. Evaluation of his plantar pressures indicated the majority of his weight distribution was on the lateral aspect of the foot. He adamantly expressed that he did not want a below-knee amputation and preferred to pursue reconstruction.

A plan for reconstruction seemed viable pending confirmation that his bone was clear of any quiescent or persistent infection. Magnetic resonance imaging (MRI) showed findings consistent with Charcot arthropathy, including significant bony fragmentation at the level of the ankle. We could not exclude osteomyelitis based on these findings. Blood work did not reveal evidence of infection. Bone biopsies from multiple sites under fluoroscopic guidance, including the talus, tibia, fibula and calcaneus, surrounding the area of concern were all negative for osteomyelitis on pathology exam. Cultures of these same samples also did not reveal infection.

We also referred this patient for smoking cessation classes and to a dietitian and primary physician for better glucose management. With regard to reconstruction, there appeared to be adequate bone stock of the hindfoot and ankle to allow for surgical reconstruction. We chose a tibiotalarcalcaneal (TTC) fusion due to the patient's significant unstable ankle and subtalar joint deformities. A positional ankle arthrodesis would realign the hindfoot and ankle to minimize potential shortening. We also needed to fuse the subtalar joint for realignment and added stability of the hindfoot as the patient also had peripheral neuropathy. The TTC fusion facilitated hindfoot and ankle realignment as well as deformity stabilization.

Step-By-Step Insights On The TTC Fusion

Ensuring supine positioning of the patient, the operative team used an ipsilateral hip bump and then applied a thigh tourniquet, which was subsequently inflated to 300 mm/Hg. The incision was full-thickness, 14 to 15 cm, lateral and directly over the fibula. After dissection of the soft tissues to expose the fibula, we performed a fibular osteotomy approximately 12 to 13 cm proximal to the distal tip of the malleolus. Then we completely removed the distal fibula and placed it on the back table in sterile saline with the intention of using it as an autograft and a fibular plate.

After subsequently debriding and preparing the ankle and subtalar joints for fusion, we realigned and corrected the varus angular deformity. Guide wires provided temporarily fixation from the posterior inferior calcaneus to the anterior distal tibia. We employed fluoroscopy to confirm proper positioning with AP, lateral and calcaneal axial views. We subsequently performed a V-cut depression and bone debridement of the lateral aspect of the tibia, talus and calcaneus.

We subsequently decorticated and exposed the medial portion of the fibular graft/plate to allow for fusion with the lateral tibia, talus and calcaneus. Then we morselized the debrided medial fibular graft for use as the biological plate for the fusion.

Placing the fibula onto the lateral aspect of the fusion site (tibia, talus and calcaneus), we inserted it into the inlay V cut depression of the tibia, talus and calcaneus. This required translation of the fibula inferiorly three to four cm from its original position. We proceeded to place two large, fully-threaded cannulated screws from posterior-inferior to superior-anterior obliquely across the ankle and subtalar joints for adjunct fixation. Bicortical lag screws provided fixation for the fibular plate (bone graft). At this time, we packed any remaining bone graft into the fusion sites. Lastly, we performed a standard incision closure and subsequent placement in a plaster cast.

Keys To Ensuring A Smooth Postoperative Course

A post-op, univalved, below-the-knee cast remained intact for two weeks until the first dressing change. At this time, the patient transitioned into a below-knee fiberglass cast.[1] We removed the sutures at postoperative week three and the patient remained non-weightbearing for six weeks. After six weeks, the patient began weightbearing in a CAM boot and also started physical therapy, progressing to 100 percent weightbearing at 10 weeks.

We obtained serial radiographs every three weeks. The patient demonstrated good stability and signs of bony consolidation at the ankle and subtalar joint by 12 weeks postoperatively. At this time, he transitioned to his normal shoes. During the entire postoperative course, we paid careful attention to aggressive edema control. At his six-month follow-up, the patient maintained good anatomical position of the hindfoot and complete bony fusion.

Reviewing Essential Concepts With This Procedure

The main components of the hindfoot and ankle are the tibiotalar joint and the subtalar joint.[2] Tibiotalocalcaneal joint pathology may cause chronic pain, instability and significant deformity. A tibiotalocalcaneal fusion is often recommended as a means of improving function and stability, and reducing varus or valgus hindfoot deformity.[3]

In these cases, conservative treatment typically has poor outcomes. Surgical treatments aimed at tibiotalocalcaneal arthrodesis, however, often lead to more positive clinical outcomes.4 Patients with diabetic peripheral neuropathy, rheumatoid arthritis, osteoporosis, poor bone stock, poor circulation as well as some smokers can present particular challenges during the postoperative period. Often with these populations. there can be complications related to healing of surgical wounds as well as fusion rates. These comorbidities result in overall lower bone fusion rates for these patients than their healthier counterparts.[5-10]

There are several different ways to achieve a tibiotalocalcaneal joint fusion. The use of crossed screws or a retrograde nail are most common. Our case suggests that the use of a fibular graft provides similar stability and bony healing as traditional fixation. We believe using the fibula as the primary source of fixation reduces the chance of rejection or repeat infection in a previous infected area, and provides autograft properties that aid in bone consolidation.

In our view, using the fibula as a strut inlay graft provides adequate stability and bone contact after filling the existing bone void. This approach facilitates the use of less fixation and allows the screws we do use to create a stable construct that requires less hardware. Having reduced hardware is advantageous as more hardware can lead to greater bacterial adhesion on the surface of the implants, possible infection, bone resorption and, eventually, loss of the stable construct.[11]

There is no added procedural time and donor site morbidity as no additional incisions are necessary to harvest the fibula. The same incisional approach the surgeon uses to carry out the fusion can provide access to the fibula and a means to accurately measure the size of fibular graft one will need prior to harvest. Using the autogenous fibula as both the plate and graft requires minimal hardware, and thus negates the need for allograft. This should reduce overall costs associated with implants.

In Conclusion

This case involved a complicated left ankle Charcot deformity with a neglected medial malleolar fracture secondary to previous septic arthritis and osteomyelitis. This patient subsequently developed a significantly unstable ankle varus deformity in the setting of peripheral neuropathy. Ultimately, we performed a successful TTC arthrodesis using alternative biological fibular plates for primary fixation and autogenous autograft. This construct has shown similar stability and rates of bony healing as traditional constructs. We believe this is a viable alternative to traditional fixation of a TTC fusion.

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