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Tibiotalocalcaneal Arthrodesis With Intramedullary Fibular Strut Graft With Adjuvant Hardware Fixation

Ashish B. Shah, MD [1], Caleb Jones, BS [2], Osama Elattar, MD [3], Sameer M. Naranje, MD, MRCS [4]

[1] Assistant Professor of Surgery, Division of Orthopedic Surgery, University of Alabama at Birmingham, Birmingham, AL
[2] Medical Student and Research Assistant, Division of Orthopedic Surgery, University of Alabama at Birmingham School of Medicine, Birmingham, AL
[3] Research Fellow, Foot and Ankle Surgery, Division of Orthopedic Surgery, University of Alabama at Birmingham, University of Alabama at Birmingham School of Medicine, Birmingham, AL
[4] Attending Orthopedic Surgeon, Forrest City Medical Center, Forrest City, AR

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ABSTRACT

Tibiotalocalcaneal arthrodesis (TTCA) is a well-established operative procedure for different severe pathologic conditions of the ankle and hindfoot joints. We present our results with a modified technique of TTCA using an intramedullary fibular strut graft in a series of complex cases of patients treated for multiple etiologies shown to have improved union rates. The technique involves inserting the fibular strut graft intramedullary after joint preparation and the use of either a Taylor spatial frame or plate and screws for definitive fixation. We reviewed the records of 16 patients who had undergone TTCA with this technique at our hospital from September 2013 to April 2015. Sixteen patients (10 males [62.5%] and 6 females [37.5%]) were included in the present study. These patients had complex cases and multiple risk factors, including diabetes, smoking, poor bone stock, and a history of previous surgeries. The mean follow-up time was 9.1 (range 9 to 18) months. Thirteen patients (81.2%) subsequently achieved union. The mean visual analog scale scores at the final follow-up examination had improved from 6.9 to 1.2. We suggest that our technique of TTCA with intramedullary fibular strut graft with fixation is a reasonable option to salvage complex cases with risk factors for operative complications.

Tibiotalocalcaneal arthrodesis (TTCA) is a well-established operative procedure for different severe pathologic conditions of the ankle and hindfoot joints (1–6). TTCA is considered a salvage procedure owing to the significant loss of motion in cases of concomitant severe malfunction and arthritis of the tibiotalar and subtalar joints (1–6). The common indications for TTCA include avascular necrosis of the talus, failed total ankle arthroplasty with subtalar intrusion, failed ankle fusion with talar body insufficiency, and intractable deformities resulting from Charcot arthropathy, rheumatoid arthritis, or paresis. Other indications for TTCA include the loss of the talus as a sequela of trauma, infection, or tumor resection. Many techniques using multiple screws, external fixation alone, intramedullary pins or screws, intramedullary nails, and anterior and posterior plates with or without bone grafts have been described (1–8). The primary goal of these numerous surgical techniques is to achieve a solid pain-free arthrodesis in a functional and biomechanically stable position with creation of a stable, plantigrade foot for ambulation (9).

The nonunion rate has been shown to be high in many studies, ranging from 10% to 25% (10–18). The chances of achieving successful arthrodesis diminish further in the presence of comorbidities such as diabetes, smoking, and poor bone stock (10–16). Hence, TTCA is a particularly challenging surgical procedure in these patients. We present our results with a modified TTCA technique using the ipsilateral fibula as a strut autograft with rigid fixation to help improve the fusion rate and functionality in a case series of patients with complex cases treated for multiple etiologies.

Materials and Methods

We retrospectively reviewed the records of 16 patients who had undergone TTCA with this technique in our hospital from September 2013 to April 2015. Tibiotalar and subtalar joint lesions had been diagnosed in all 16 patients from ankle and foot weightbearing radiographs (Fig. 1), computed tomography, and/or magnetic resonance imaging. The eligibility criteria included severe tibiotalar joint lesions combined with subtalar joint lesions and a failure to respond to a fair trial of conservative therapy. The exclusion criteria were active infectious disease, progressive Charcot arthropathy, and uncontrolled diabetes mellitus. All patients had completed a preoperative and

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Address correspondence to: Ashish B. Shah, MD, Division of Orthopedic Surgery, University of Alabama at Birmingham, 1201 11th Avenue, Suite 200, Birmingham, AL 35294.
E-mail address: ashishshah@uabmc.edu (A.B. Shah).

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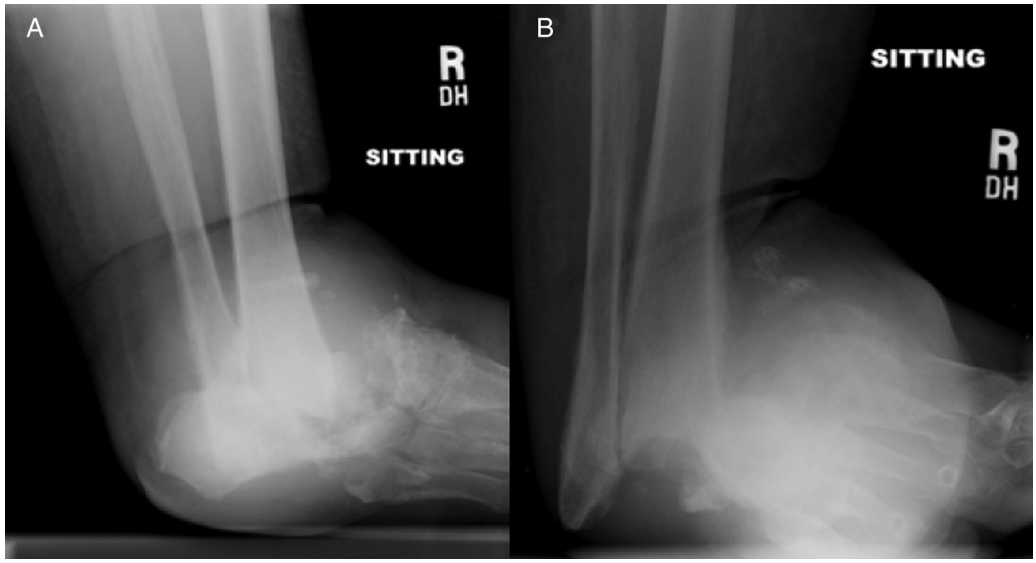

Fig. 1. Preoperative (*A*) anteroposterior and (*B*) lateral radiograph of a patient with severe Charcot joint arthropathy and multiplanar deformity of the right leg.

postoperative visual analog scale. The institutional review board of our university approved the present study.

Surgical Technique

The patient should be placed in a supine position on a fluoroscopy table with a well-padded tourniquet on the upper thigh. A sandbag is placed under the ipsilateral hip to enhance the visibility of the lateral side of the foot and ankle.

Lateral Exposure

To expose the lateral ankle and subtalar joints, a 10-cm curvilinear incision is made over the distal 6 to 8 cm of the fibula, extending inferiorly and anteriorly over the sinus tarsi toward the base of the fourth metatarsal. This is an internervus plane between the superficial peroneal nerve anteriorly and the sural nerve posteriorly.

The skin flaps are developed to create a full-thickness flap along the skeletal plane. The periosteum is stripped from the fibula anteriorly and posteriorly, and the incision is continued distally to expose the posterior facet of the subtalar joint and the sinus tarsi.

Using a sagittal saw to apply a beveled cut, the fibula is resected obliquely at a 45° angle approximately 6 cm above the ankle (or according to the desired length of the fibular strut). The fibular strut is decorticated and drilled, and the cartilage is removed from the lower end of the fibular strut on the side table.

Through the same incision, the tibiotalar and subtalar joints are thoroughly prepared in the standard fashion. Once the joints have been adequately prepared, the foot is positioned with 0 degrees of dorsiflexion, 5° of external rotation in relationship to the tibial crest, and 5° of hindfoot valgus, maintaining a plantigrade foot.

For a correct alignment of the hindfoot, temporary fixation can be achieved using Kirschner wires (the Kirschner wires must be positioned carefully to allow for later reaming of the medullary canal and insertion of the fibular strut graft).

Plantar Exposure for Insertion of the Fibula Strut

We use a guide pin 1 to 2 cm distally from the subcalcaneal fat pad to locate the starting point for fibula nail insertion. The starting point should be determined primarily on the lateral fluoroscopic view. After insertion, the starting point is confirmed using lateral, ankle anteroposterior, and axial views.

Next, a 3- to 4-cm longitudinal incision is made midline on the plantar foot of the heel pad. After the incision is made, blunt dissection is continued down to the plantar fascia, which is split longitudinally. Using a small Cobb elevator, the soft tissue is dissected to the plantar os calcis.

A guidewire is inserted through the plantar incision into the calcaneus to pierce the center of the talus and pass 3 or 4 inches up the center of the medullary cavity of the tibia. A series of flexible reamers are used to open the tibiotalocalcaneal canal, reaming to a full 1- to 2-mm diameter larger than outer diameter of the fibular strut to facilitate insertion of the fibular strut graft. The foot position should be monitored during reaming to ensure the proper hindfoot alignment is maintained. The graft, which should fit the hole like a slightly oversized square peg, is loaded over the guidewire and gently tapped up until its lower end is flush with calcaneus (Fig. 2). We use 1 or 2 extra taps to ensure close coaptation and compression of the 4 surfaces to be fused. Final fixation can be achieved using either a plate and screw construct (Fig. 3) or a spatial frame using standard techniques (Fig. 4). Postoperatively, the patients should be kept non-weightbearing for 5 weeks and then allowed weightbearing as tolerated.

Results

A total of 16 patients (10 males [62.5%] and 6 females [37.5%]) with a severe tibiotalar joint lesion combined with a subtalar joint lesion that had failed to respond to a fair trial of conservative therapy or a failed response to previous surgery underwent TTCA surgery with our fibular strut technique. Of the 16 patients, 7 (43.7%) received a fibular strut with a plate and screw construct and 9 (56.2%) patients received a fibular strut with a spatial frame.

The mean age at surgery was 54.5 (range 28 to 77) years. The mean BMI was 30.4 (range 29.2 to 38.4) kg/m^2. Of the 16 patients, 6 (37.5%) were everyday smokers and 4 were former smokers; 7 patients (43.75%) had diabetes. Twelve patients (75%) had severe multiplanar deformities. The main cause of disease was secondary arthritis resulting from previous infection (n = 6; 37.5%), followed by Charcot arthritis (n = 5; 31.2%), secondary arthritis resulting from avascular necrosis (n = 4; 25%), and rheumatoid arthritis (n = 1; 6.2%). Also, 11 of the 16 patients (68.75%) had a history of previous surgery on the same foot.

The mean follow-up time was 9.1 (range 9 to 18) months. Of the 16 patients, 13 (81.2%) achieved union as confirmed by CT (Fig. 5) or radiographs (Fig. 6). Of the 16 patients, 14 (87.5%) underwent CT evaluation at 4 to 6 months postoperatively. The mean visual

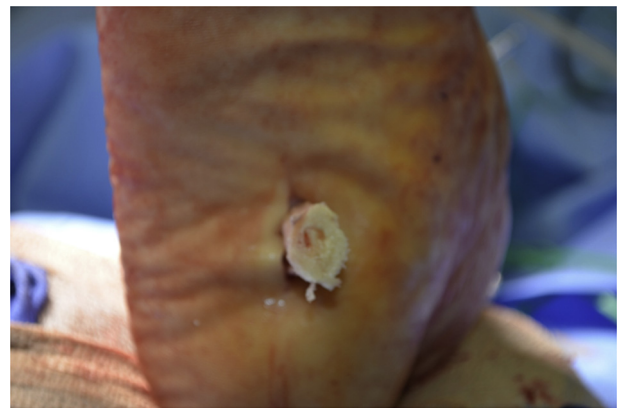

Fig. 2. Clinical photograph of a patient's right foot showing insertion of the fibular strut autograft.