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Modified Blair Tibiotalar Arthrodesis for Post-traumatic Avascular Necrosis of the Talus: A Case Report

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ABSTRACT

Surgical treatment of post-traumatic avascular necrosis of the talus coupled with collapse often results in limited treatment options. Of those options, the Blair tibiotalar arthrodesis has been beneficial in preserving limb length and subtalar motion. The complications associated with Blair tibiotalar arthrodesis have led to modifications to improve stability and functional outcomes with rigid internal fixation. We present the case of a 29-year-old female with a history of an open fracture dislocation of the talus 10 years previously, with subsequent development of avascular necrosis of the talus. The purpose of the present case report was to describe the surgical approach and use of an anterior compression plate to augment the modified Blair tibiotalar arthrodesis.

Complications occurring after an open fracture dislocation of the talus have had significant correlations with the subsequent development of ankle joint arthrosis and degeneration, despite treatment, often secondary to osteonecrosis, arthrofibrosis, and pseudoarthrosis (1–5). Of these complications, osteonecrosis of the talus after fracture of the talar neck produces degenerative sequelae that can be substantial if not treated. Post-traumatic osteonecrosis of the talus coupled with collapse of the talar body is one of the toughest challenges for any foot and ankle surgeon (2,6–9). The predisposing factors for talar avascular necrosis after fracture include the constrained anatomy and tenuous extraosseous and intraosseous blood supply of the talus (10–13). Previous studies have shown talar avascular necrosis is preceded by traumatic events to the talar head and neck in 75% of cases and the risk increases with the injury severity (3,4,9,10). Reports of specific geographic regions of the talus susceptible to osteonecrosis of the talar body have been presented, with the anterolateral portion of the talar body having the greatest incidence (10,12).

The operative treatments used for postcollapse osteonecrosis of the talus have included talectomy, tibiocalcaneal fusion, tibiotalocalcaneal fusion, Blair-type fusion, pantalar fusion, total ankle arthroplasty, and amputation. The published data have revealed numerous purported benefits and complications associated with each surgical treatment option. Specifically, the Blair tibiotalar arthrodesis, using an anterior sliding tibial corticocancellous graft to a notch created in the talar neck, has been described when the talar body is not salvageable (2,6,8,14–18). Subsequently, modifications to this procedure were made to increase the incidence of bony union and long-term stability (15,16,18). The present report describes a Blair-type fusion for treatment of post-traumatic osteonecrosis of the talus with talar body collapse and ankle joint arthrosis. The patient gave permission for this information to be published.

Case Report

A 29-year-old female presented with chronic pain in her right ankle and hindfoot with a history of multiple fractures sustained during a motor vehicle accident (MVA) 10 years before her initial presentation. The fractures sustained during the MVA include right pelvis fracture dislocation, left femur fracture, and open fracture dislocation of her right talus. All fractures sustained were surgically treated with open reduction and internal fixation. She subsequently developed severe post-traumatic arthrosis in her right ankle joint. The patient reported experiencing pain with every step and while standing.

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A review of the patient's medical history was unremarkable, with the exception of a 5-pack year smoking history and the MVA.

The physical examination revealed a painful right ankle joint and range of motion that was approximately 30° of the total. Significant pain and crepitus was reproduced on end range of motion and throughout manipulation. Tenderness was appreciated at the medial and lateral gutters. No sign of joint effusion, edema, or erythema at the right ankle was present. The initial radiographic workup included plain film radiography and computed tomography from which signs of advanced degenerative changes at the tibiotalar joint and to a lesser extent subtalar joint were appreciated (Fig. 1). Computed tomography revealed cystic and sclerotic changes at the lateral talar body, consistent with avascular necrosis (Fig. 2). Magnetic resonance imaging studies were omitted because of the difficulty of interpretation with the internal fixation hardware from the initial operative treatment after the MVA.

At this time, an arthroscopic evaluation and debridement were performed, and advanced degenerative changes at the tibiotalar joint were appreciated intraoperatively. The extent of osteonecrosis was confined to the talar body, with associated talar collapse (Fig. 3). With radiographic evidence and direct visualization of talar collapse, coupled with the absence of any abnormal preoperative laboratory results suggesting infection or other bone pathologic entities, we were confident that specimens for histologic analysis were not needed. The patient experienced no alleviation of her painful symptoms after the arthroscopic debridement, leading to discussions of the potential operative treatment options. Ultimately, removal of the retained hardware and tibiotalar arthrodesis with an anterior sliding tibial bone graft was presented to the patient, and this treatment option was agreed on.

A consultation with the orthopedic surgery department from our facility was obtained to determine the best surgical approach for the autogenous bone graft to supplement the arthrodesis site. It was determined that the use of an anterior iliac crest autogenous graft would best supplement the procedure, with consideration of the patient's 5-pack year smoking history and current smoking status. The orthopedic surgeon at our facility harvested the anterior iliac crest autogenous bone graft. This was performed as a single-stage procedure.

The patient was placed in the prone position, and an indwelling popliteal nerve block was placed. The patient was then placed supine, and the right lower extremity was prepared and draped using the standard technique. Attention was directed to the anterior ankle, where a linear incision was made just lateral to the anterior tibial crest coursing distally over the anterior ankle joint toward the third ray. Dissection was continued down through the anterior compartment to the ankle joint capsule. A linear arthrotomy was performed in which visualization of the anterior ankle joint was achieved. At this time, end-stage degenerative changes throughout the ankle were noted. The talus and tibia were debrided of articular cartilage and subchondral bone using a combination of rongeurs, osteotomes, and curettes. The lateral body of the talus was dysvascular and was debrided back to healthy cancellous bone, leaving a large bone void in the talus. The internal fixation was removed, which required extensive dissection both medially over the medial malleolus and meticulous dissection and evacuation of bone from the talar body. Fragments of broken hardware were removed from the talus, creating additional large bone voids. Once all the hardware had been removed, the ankle joint was copiously irrigated. The articular surfaces were prepared for arthrodesis using a fish scaling technique.

A tibial osteotomy was performed that was 2 cm × 5 cm in length. This involved the anterior tibial cortex and underlying cancellous bone. The corticocancellous tibial graft was then mobilized for transposition. The foot was held in a corrected position, and the anterior dorsal talar neck and body were excavated to allow the anterior sliding tibial graft from the distal tibia to fit into the talus. Once this had been performed, the talus was manipulated into its corrected position and stabilized with one 6.5-mm cancellous screw. An anterior locking plate was then placed over the tibial sliding graft to stabilize the tibiotalar arthrodesis (Fig. 4). The remaining bone voids were then grafted with cancellous bone from the anterior iliac crest. The talar defect from the hardware removal was also grafted at this point.

Next, 60 mL of bone marrow aspirate was removed from the ipsilateral proximal tibia and was harvested and spun down on the

Fig. 1. (*A* and *B*) Preoperative plain film radiographs demonstrating osteonecrosis with radiopaque areas of necrotic bone localized to the lateral talus.

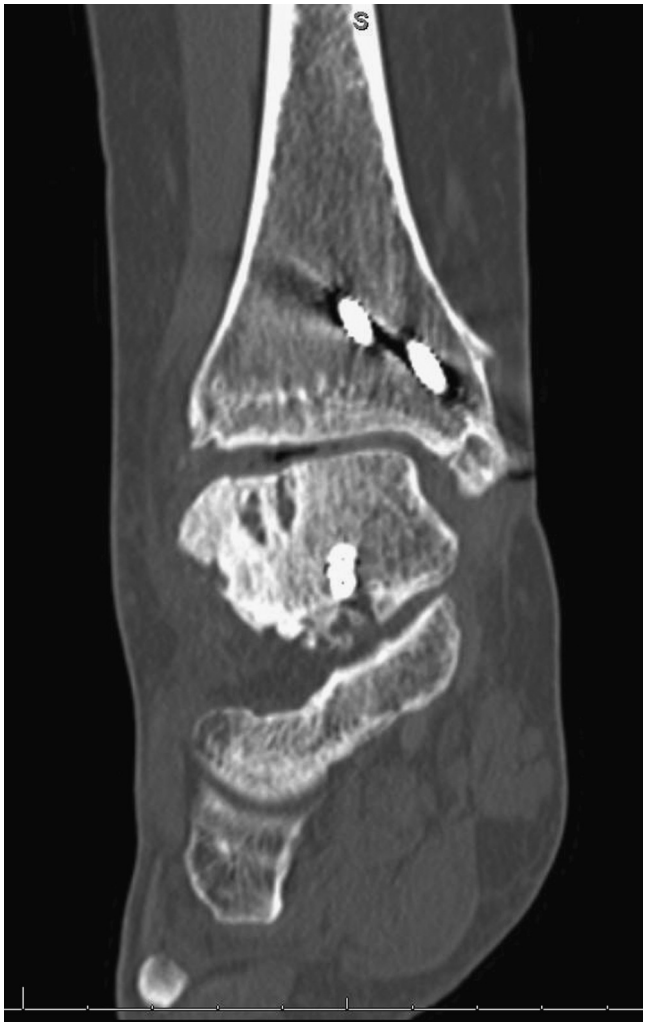

Fig. 2. Preoperative computed tomography image demonstrating lateral talar collapse.

surgical field. The 7 mL of bone marrow aspirate concentrate was then injected into the arthrodesis site. The cuff was deflated, hemostasis verified, and layered closure performed with Vicryl, Monocryl, and skin staples. Both visual inspection and fluoroscopic evaluation of the hindfoot and ankle showed the ankle joint to be well aligned in the frontal and sagittal planes. Residual rigid varus positioning of the subtalar joint was present. At this point, it was determined that realignment of the hindfoot with the mechanical axis of the leg was needed and that a posterior displacement calcaneal osteotomy was indicated.

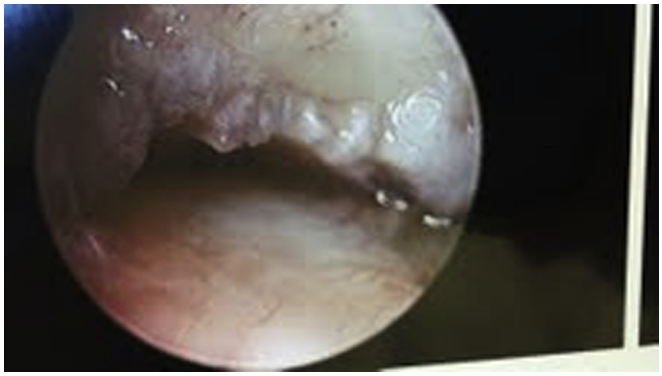

Fig. 3. Arthroscopic debridement revealing talar collapse and avascular necrosis.

Fig. 4. Intraoperative fluoroscopy image.

Four small stab incisions were made at the corners of the posterior calcaneus, and a Gigli saw was passed in a subperiosteal fashion through these incisions. A through and through Gigli osteotomy of the calcaneus was performed. A large Steinmann pin was then placed through the calcaneal tuberosity to help position the tuber fragments. One 6.5-mm retrograde screw was placed across the osteotomy to maintain stability. This appeared sufficient for realignment of the mechanical axis of the leg. The small stab incisions were closed with staples.

The patient tolerated the procedure well and was admitted to the medical-surgical floor for postoperative pain control, limb elevation, and deep vein thrombosis prophylaxis.

Postoperatively, the patient was continued non-weightbearing until radiographic signs of bony healing was appreciated. Plain film radiographs were obtained 6 weeks postoperatively in which full incorporation of the anterior sliding tibial graft was visualized (Fig. 5). She was then transitioned to an ankle brace until pain-free ambulation was achieved. At the latest follow-up visit, no limb length discrepancy was observed, and no pain or loss of sensation was reported. The patient was also able to use normal shoe gear. However, the clinical and radiographic follow-up with this patient was limited to 3 months owing to her military obligations that required relocation to another state (Fig. 6).

Discussion

The sequelae of post-traumatic avascular necrosis have varying presentations, depending on the extent and duration of the

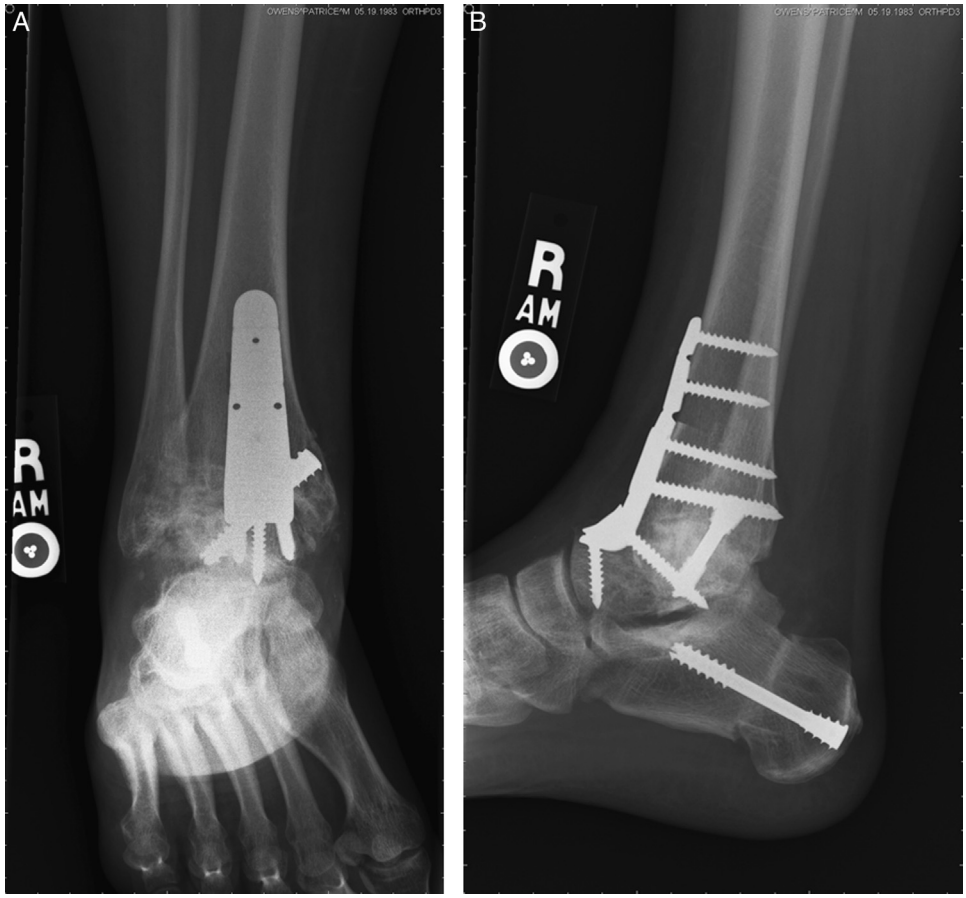

Fig. 5. Plain film radiographs 6 weeks postoperatively: (*A*) anteroposterior and (*B*) lateral views.

destructive process. The initial evaluation of the viable and vascular portions of the talus is paramount to the success of any surgical intervention involving the talus. Reports of specific geographic regions susceptible to osteonecrosis of the talus have been postulated, with the anterolateral portion of the talar body having the greatest incidence (10,13). When isolated osteonecrosis of the talar body presents with a viable head and neck of the talus, a Blair-type fusion provides as an excellent salvage option.

As reported by Blair (6) in 1943, the Blair fusion originally consisted of tibiotalar arthrodesis, with excision of the body of the talus and an anterior tibial sliding corticocancellous bone graft between the anterior aspect of the tibia and the neck of the talus. This

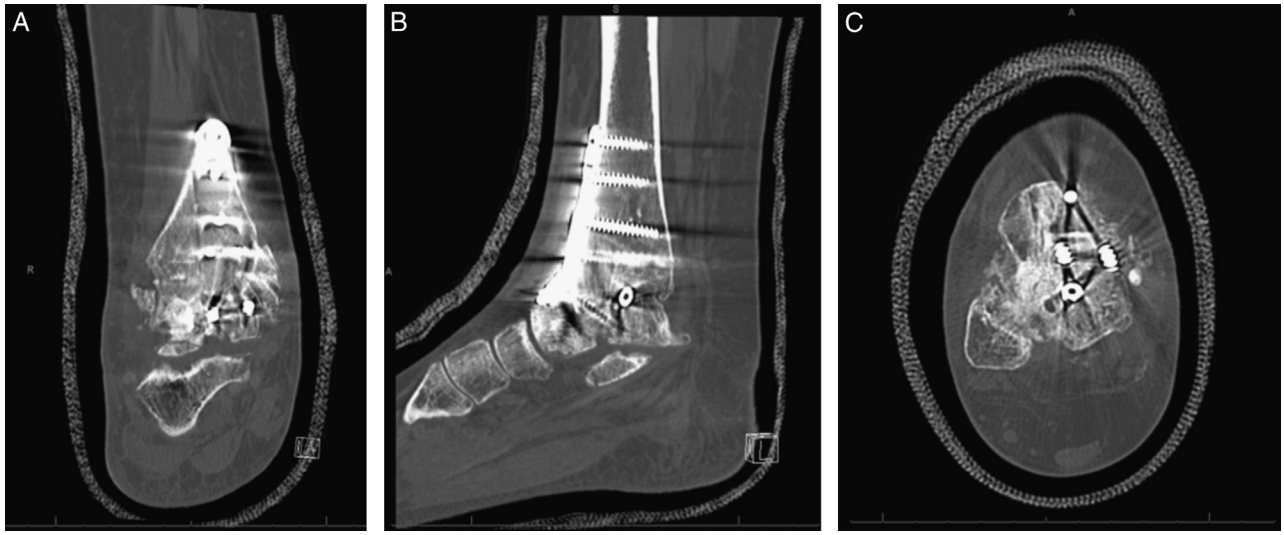

Fig. 6. Computed tomography images 3 months postoperatively: (*A*) coronal, (*B*) sagittal, and (*C*) axial.

procedure was purported to be beneficial for acute fractures and instances of isolated talar body osteonecrosis, provided the talar head and neck remained viable. The benefits of this technique compared with talectomy or tibiocalcaneal arthrodesis include preservation of subtalar joint motion, preservation of hindfoot height, good relative cosmesis of the foot, and preservation of some sagittal and frontal plane motion of the foot (2,6,8,14–19). Of these benefits, preservation of subtalar joint function is the most important, with proper function correlating directly to quality of life. Previous reports on the conventional tibiotalar arthrodesis have found delayed or nonunion rates as great as 38% (19–21). These rates of delayed union or nonunion have been attributed to the inherent lack of viable, vascularized bone surface area (16).

Since the initial report by Blair (6), modifications have been presented that enhance stability and increase the rate of bony union. The corticocancellous tibial block acts primarily as a graft, but does provide some inherent stability. Furthermore, the addition of rigid internal fixation and compression plate to the arthrodesis site provides excellent stability to the arthrodesis site. Morris et al (17) described the use of temporary Steinmann pin fixation to improve the stabilization of the calcaneus to the tibia during the early postoperative period. Van Bergeyk et al (16) used anterior plate fixation to decrease the incidence of nonunion by limiting superoinferior motion of the head fragment. Their study of 7 cases revealed 71% healing at 16 weeks. With the use of the anterior compression plate, additional stability of the tibiotalar arthrodesis is achieved by limiting talar head motion in the sagittal and coronal planes (22).

Before treatment, whether total ankle replacement would be appropriate for our patient was discussed. The current data (23,24) have revealed decreased implant survivorship and increased rates of revision procedures in patients younger than 54 years. Specifically, Spirt et al (23) found that a median age of 54 years or younger resulted in a 1.45 times greater risk of reoperation and a 2.65 times greater risk of implant failure compared with patients older than 54 years. Because of our patient's age (29 years at the procedure), it was determined that she would benefit more from the treatment we have outlined instead of total ankle replacement.

In the present case, significant osteonecrosis of the lateral talar body with collapse had resulted from an open talar fracture dislocation that had occurred 10 years before her initial presentation. Given the patient's age and comorbidities, we believed that a Blair-type fusion would produce the most optimal and functional result compared with the other treatment modalities. The present report hopes to expand on the armamentarium of surgical treatment options for talar osteonecrosis and collapse.

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