Modified Technique for Unipolar Allograft Ankle Replacement: Midterm Follow-up. A Case Report

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Abstract

The management of tibiotalar arthritis remains a clinical challenge. Conventional treatment relies primarily upon arthrodesis or prosthetic arthroplasty. Fresh osteochondral total ankle allograft transplantation has been reported in limited cases. We report the case of a 42-year-old man who underwent a tibial refrigerated osteochondral allograft and a talar refrigerated osteochondral mosiacplasty. At 66-month follow-up, the patient demonstrated no limp with walking and was able to participate in tennis and snow skiing with no pain. His Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index, total WOMAC score, and American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale score were 0, 94, and 98, respectively. The final radiograph showed complete integration of the allograft with mild joint space narrowing. Osteochondral allografting for ankle arthritis may be considered an option in select patients.

Management of tibiotalar arthritis remains a clinical challenge because of the poor intrinsic healing of articular cartilage. Conventional treatment for tibiotalar arthritis relies primarily on arthrodesis or prosthetic arthroplasty. Use of "fresh" osteochondral allografts in the treatment of full-thickness articular cartilage defects in the knee has been well documented, with success rates of 75% reported at 5 years and slightly deteriorating to 63% at 14 years.[1-5] Fresh usually indicates graft harvest within 24 hours of the donor's death and time from graft harvest to implantation of 7 days or fewer.[2,3,5-13] Fresh osteochondral total ankle allograft transplantation has been reported in limited cases with varying success rates—ranging from 50% to 92% at early follow-up, with follow-up ranging from 3 to 12 years.[14-16] In 2008, Jeng and colleagues[17] published the largest series to date with 2-year follow-up. Twenty-nine patients were followed, with a success rate of 31%. There are limited reports documenting the outcome of total ankle allograft arthroplasty at midterm or long-term follow-up.

Most reports of tibiotalar allografting have described use of ankle arthroplasty cutting jigs that enable the shell allograft to be slid into place through an anterior incision. We report on a modified technique for tibiotalar allografting using bimalleolar osteotomies, a tibial osteochondral shell graft, and talar mosaicplasty with 5-year follow-up. The patient provided written informed consent for print and electronic publication of this case report.

Case Report

A 42-year-old, physically active man presented to our clinic reporting left ankle pain. He stated that, 20 years earlier, he had sustained a severe fracture-dislocation while playing football. His treatment had required open reduction and internal fixation and he had functioned reasonably well up until 5 years ago when left ankle pain and swelling began increasing with prolonged standing. Before the injury, he had participated in numerous sports, including skiing and tennis. Over the past 5 years,

Figure 1. Anteroposterior (A) and lateral (B) radiographs of patient's left ankle show tibiotalar joint narrowing and a previously placed medial malleolar screw. Mild anterior tibial spurring is also present.

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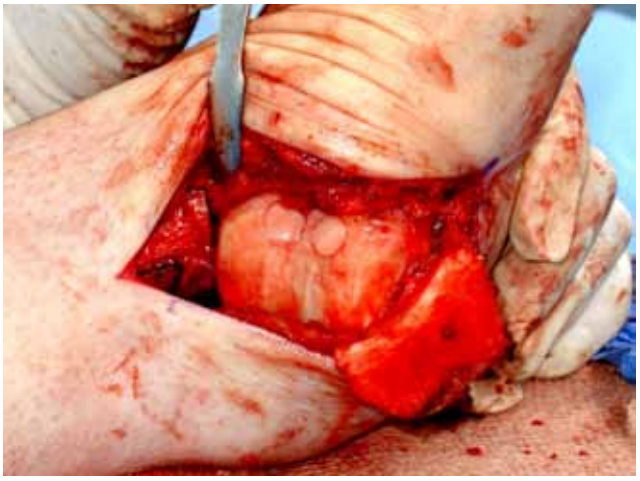

Figure 2. Intraoperative photograph of talus after placement of 2 osteochondral allograft plugs.

Figure 3. Intraoperative photograph of distal tibial osteochondral allograft preliminarily fixed to host tibia. Fibular osteotomy has been performed to facilitate exposure to distal tibia.

however, he had curtailed all athletic activities and limited daily walking because of constant ankle pain. He had also found it difficult to walk normally during daily activities because of decreased ankle range of motion. Weight-bearing activities were the worst for him, but dorsiflexion also caused some pain.

On physical examination, the patient was thin (body mass index [BMI], 26 kg/m^2) and walked with an antalgic gait on the left. He appeared not to have gross varus or valgus of the ankle and was neurovascularly intact. There was a well-healed scar on the lateral aspect of the ankle from previous plate placement and subsequent removal. He had dorsiflexion to neutral on the left side compared with 20° beyond neutral on the right. Plantarflexion was 50° on the right and 30° on the left. There was diffuse tenderness that he described deep within the ankle with standing. Pain was also elicited with dorsiflexion and plantarflexion.

Weight-bearing radiography showed tibiotalar narrowing and subchondral cyst formation within the distal tibia, and the lateral radiograph showed an anterior tibial exostosis (Figure 1).

Nonsurgical and surgical options were discussed with the patient, and he was started on dedicated ankle physical therapy for 3 months, a course of ankle viscosupplementation consisting of 1 injection per week for 5 weeks, and oral anti-inflammatories. Despite these measures, the patient noted minimal relief, and he requested surgical intervention. He did not want tibiotalar fusion and felt he was too young for total ankle arthroplasty. Tibiotalar refrigerated osteochondral allograft transplantation was discussed, and he was put on a waiting list for a size-matched allograft.

Surgical Technique

In preoperative planning, we decided to perform bimalleolar osteotomies to gain access to the talar surface, and we determined osteotomy levels and location for a tibial osteochondral shell graft and a talar mosaicplasty. The osteotomies would be placed above the tibiotalar joint line because we felt that, if they were placed slightly above the joint, portions of the anterior and posterior tibiofibular ligaments could be released to increase exposure of the talus. Significant exposure of the talus would be required to place mosiacplasty plugs or a shell graft directly on the distal tibia without sliding it in place, as is commonly done with total ankle arthroplasty. We felt that such exposure would allow for better fixation of the talar allograft.

After parenteral antibiotics were administered, the medial and lateral malleolar osteotomies were performed. Because of the limited dorsiflexion, a posterior capsular release of the tibiotalar joint was performed. The talus was dislocated and the distal tibia measured and cut. On the back table, measurements were taken of the refrigerated distal tibial allograft, and the graft was cut to match the articular piece removed from the patient. With the talus exposed, two 6.5-mm plugs were harvested from the talar allograft and impacted into the central area of the host talus. The allograft tibia was temporarily held in place with Kirschner wires and then secured to the host tibia with a one-third semitubular plate and 3.5-mm and 4-mm screws. The talus was reduced beneath the tibial plafond, and the fibula was reduced and fixed with a one-third semitubular plate (Figures 2–4).

The patient was placed in a posterior mold and admitted for 24 hours of left leg elevation and observation. He was maintained on non–weight-bearing for 8 weeks and then started on partial weight-bearing for 4 weeks. He was allowed full weight-bearing after 12 weeks. At 8 weeks postsurgery, gentle ankle range of motion was started. The patient was instructed to begin normal activities gradually and was discouraged from engaging in heavy loading activities and sports until 9 months after surgery. He was followed at yearly intervals. Most recent follow-up was at 66 months.

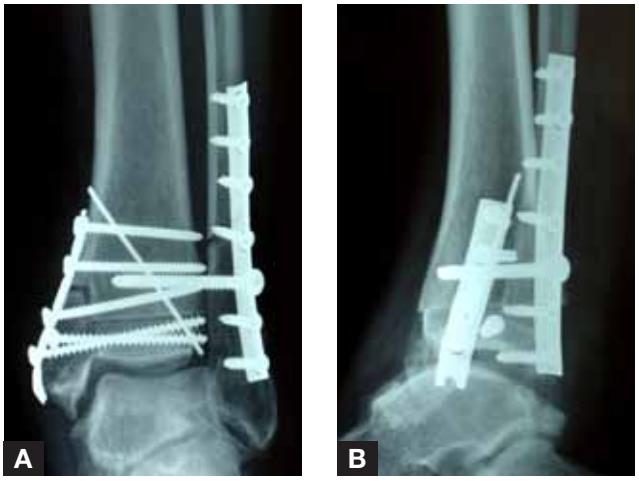

Figure 4. Anteroposterior (A) and lateral (B) radiographs immediately after surgery show excellent anatomical alignment of distal tibial allograft and reconstituted tibiotalar joint space.

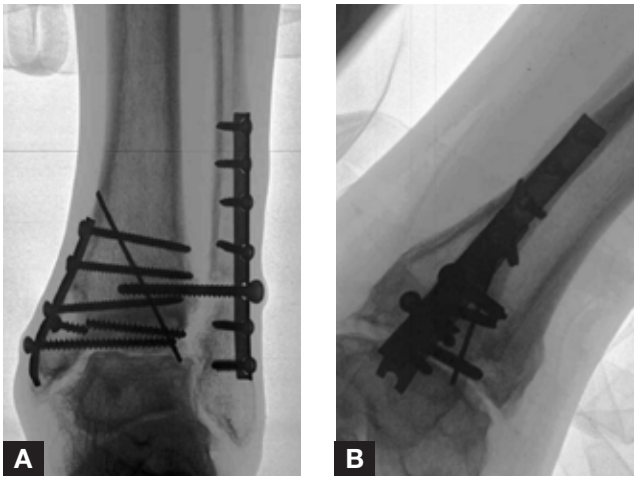

Figure 5. Anteroposterior (A) and lateral (B) radiographs 66 months after surgery show slightly narrowed but well-maintained tibiotalar joint space and evidence of anterior tibial spurring. American Orthopaedic Foot and Ankle Society score was 98.

Results

The patient underwent a physical examination and completed the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index and the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale before surgery and then at yearly intervals. In addition, anteroposterior and lateral weight-bearing radiographs were obtained before surgery and at yearly intervals. At most recent follow-up (66 months), the patient demonstrated no limp with walking, described only mild stiffness, and was able to participate in tennis and snow skiing with no pain. In addition, WOMAC pain index had improved from 20 to 0, total WOMAC score had improved from 32 to 94, and AOFAS score had improved from 35 to 98. The final follow-up radiograph showed complete integration of the allograft with some joint space narrowing (Figure 5).

Discussion

There have been few reports of using fresh bipolar osteochondral allograft transplants in the treatment of end-stage ankle arthrosis. In 2002, Brage and colleagues[18] were the first to describe the results of this procedure. Sixteen patients who had undergone fresh cadaveric ankle transplantation were followed for 62 months. There was an 87% allograft survival rate, with only 3 ankles requiring revision to an arthrodesis. Reasons for failure included graft fragmentation, graft subluxation, and nonunion. Later that year, Kim and colleagues[15] reported on the results of 7 ankle transplants followed for 148 months. At final follow-up, the rate of failure (caused by graft fragmentation, malunion, and nonunion) was 42%. Short Form 12 scores were not significantly improved at final follow-up.

Given the high failure rates reported for tibiotalar allografts and the difficulty in precisely implanting the grafts using freehand saw cuts, the procedure was modified to incorporate use of the Agility total ankle replacement cutting jig (DePuy Orthopaedics, Warsaw, Indiana) to better match allograft to host. Tontz and colleagues[19] reviewed the results of 12 Agility cutting jig cases followed for 21 months. A bipolar tibiotalar allograft was used in 9 of these cases, a unipolar talar allograft in 2 cases, and a unipolar tibial allograft in 1 case. Overall, 42% required an additional surgery, but only 1 allograft (partial unipolar allograft of lateral talar dome) had to be revised because of graft collapse; the other 11 allografts were in situ at final follow-up. Meehan and colleagues[16] reported significant improvement in the AOFAS scores of 11 ankle allograft transplantation patients followed for 31 months. Of these patients, 91% tested positive for cytotoxic serum human leukocyte antigen antibodies 6 months after surgery. Meehan and colleagues speculated that the immune response of the host may play a more important role in fresh osteochondral allograft survival than previously believed.

Vora and Parks[20] reviewed a series reporting on 10 patients who underwent ankle transplantation and were followed for a minimum of 1 year. With use of a novel lateral transfibular approach and custom cutting jigs, the failure rate at final follow-up was 50%.

Jeng and colleagues[17] reported on the largest series of osteochondral allograft ankle replacements to date. Given the high failure rate (69%) with their operative technique, we decided to examine this technique and compare its use with that in previous reports.[15,16,18,19] In those reports, mean time from donor death to implantation was 5 days to 7 days; Jeng and colleagues, on the other hand, reported a mean time of 23 days. This delay in implantation was the result of a change in tissue bank industry standards. At present, a minimum of 14 days is required for microbiologic testing before harvested allografts are released. Theoretically, this delay may

have an adverse effect on chondrocyte viability and ultimately may affect clinical outcome after allograft transplantation.

In earlier studies, 2 risk factors for allograft ankle transplantation failure were noted: allograft–host size mismatch and tibial or talar allograft thinness (allografts cut too thin).[16] Jeng and colleagues[17] reported somewhat different host-related risk factors, including BMI, age, and amount of preoperative varus or valgus ankle malalignment measured on anteroposterior radiographs. Transplants performed in patients with lower BMI, who were older, and with less preoperative deformity were more likely to survive. The patient in our present case report had low BMI, was relatively older, and had neutral alignment on preoperative radiographs. We believe that these factors contributed to his excellent functional outcome at 66 months. In addition, we believe that, with the talus surgically exposed, mosaicplasty is an excellent option that may prevent collapse, as has occurred with talar shell osteochondral grafts.

Currently, we use refrigerated osteochondral allografts implanted within approximately 2 weeks to 4 weeks from harvest. Surgeons at our institution have performed approximately 100 refrigerated osteochondral allograft transplantations in the knee and ankle over the past decade, and there has been no evidence of rejection. Therefore, despite the theoretical risk for immune rejection from bone antigens, we do not pulse-lavage grafts before implantation. We have not seen any failures attributable to the host issues that other authors have reported.

Fresh osteochondral total ankle transplantation is an alternative to ankle arthrodesis for the treatment of end-stage ankle arthritis. However, with its prohibitively high failure rate, it should be considered only under very rare circumstances. Lacking results from a larger prospective randomized study, it is impossible to determine who would be a good potential candidate for this procedure. In addition, salvage of failed allografts has proved to be extremely challenging. At our institution, we consider this procedure only in patients who are too young for ankle replacement; who have excellent ankle range of motion, low BMI, and normal radiographic alignment; and who refuse ankle arthrodesis.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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