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Surgical tip: Titanium foam blocks can simplify fusion of failed total ankle replacements

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ABSTRACT

Ankle arthrodesis following failed ankle replacements is a technically challenging task because of the large defect left behind after the prosthesis is removed. The usual practice is to use bulk grafts which are either autografts or allografts to fill the defect. We report our experience with the use of a titanium foam block specifically designed for fusion of failed ankle replacements. This particular method was chosen to avoid the technical difficulties and morbidities associated with the use of bulk autografts and allografts. We describe the surgical technique and early results in the first two cases performed in our unit. The satisfactory clinical and radiologic results in the two cases demonstrate the ability of the titanium foam block to simplify an otherwise complex procedure without compromising the outcome.

1. Introduction

Ankle arthrodesis following failed ankle replacements remains a technically challenging task for a number of reasons. The large defect left by the prosthesis requires large volume of graft for structural support as well to promote healing and fusion. They are associated with prolonged healing, poor union rate and limb shortening [1] and only about two-thirds will fuse at the first attempt [2,3].

Various techniques have been used to address these problems. The most common techniques described in the literature include the use of either an autograft or allograft. Iliac or fibular autograft combined with either an internal or external fixation device is considered the gold standard. It has a high fusion rate of 87–100% [4–10] but comes in limited supply and is associated with fairly high donor-site morbidity, postoperative complications in 3–39% [11,12] and risk of graft collapse [11]. On the other hand, allograft carries the risk of infection, poor structural strength and slow integration with the host bone that can lead to failure [11,13,14].

Trabecular metal has been used successfully in revision total hip and knee replacements to fill large gaps that would otherwise require massive amount of bone graft [15–21]. Its porous architecture promotes bony in-growth into the implant for better osteointegration and its structural strength is closely similar to trabecular bone [22].

There have been recent reports of the successful application of trabecular metal in ankle fusion using devices which were not specifically designed for, but has worked remarkably well, with ankle fusion. Friggs et al. reported the use of spinal fusion blocks for hindfoot fusion [23]. Henricson and Rydholm used tibial cones intended originally for revision knee replacements [24].

We report our experience with the use of a titanium foam block that was specifically designed and manufactured for fusion of failed ankle replacements. The decision to use this device was taken on account of the senior authors previous experience with fusing failed ankle replacements using bulk grafts which were fraught with difficulties. The reported advantage of using trabecular metal on hip and knee replacement in terms of filling up large bone defects was also encouraging, as well as the previous report of using trabecular metal on ankle and subtalar fusion as mentioned above.

In this article, we describe the first two cases that we have treated in our unit using this relatively new device giving particular attention to the surgical technique and early radiologic and clinical results.

1.1. Titanium foam block

The BIOFOAM® Ankle Spacer Block (Wright Medical Technology, Inc.) is a cancellous titanium block that comes in various heights, mediolateral and anteroposterior dimensions with a standard slot dimension in order to accommodate the VALOR® Ankle Fusion Nail.

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Fig. 1. The Biofoam cancellous titanium comes as a U-shaped block with an open slot on one side to accommodate the Valor nail.

The device is specifically manufactured for fusion after failed ankle replacements. It has a porous microarchitecture and its structural rigidity is between cancellous and cortical bone (see Fig. 1).

2. Surgical technique

We describe the surgical procedure with slight deviation from the official surgical technique of the manufacturer. The technique is similar for both cases except that the first case was done in 2 stages because of infection. The same case also involved the use of antibiotic spacer in the first stage of revision.

The cases were performed by the senior surgeon (NK) and the senior fellow (SA) under general anaesthetics with a limb tourniquet and prophylactic antibiotics.

An anterior approach to the ankle was used utilising the old total ankle replacement incision. The neurovascular bundle was identified and protected. The prosthesis (or antibiotic spacer) was removed preserving the malleoli and as much normal bone as possible while maintaining a flat surface on both the tibia and the talus. The defect between the tibia and talus was measured using a sterile paper tape measure.

The guide wire for the nailing was inserted via the calcaneus with the hind foot in neutral and gentle manual traction applied under imaging. Reaming was performed over the guide wire into the tibial medullary canal. The appropriate size block ($30\,mm \times 30\,mm \times 20\,mm$ and $37\,mm \times 37\,mm \times 15\,mm$) was selected to fit into the defect.

The guide wire was then retracted into the talus to allow the insertion of the metal block. The block was inserted with the open side facing the incision. Final adjustments were made to ensure a uniform contact between the bone and the block. The block was then fully impacted into the gap until the path of the nail was clear so it would not impede the nail insertion. The guide wire was passed back into the tibia. The appropriate size Valor ankle fusion nail was carefully inserted and could be visualised passing through the open slot in the metal block. The foot was kept in plantigrade position throughout the preparation and insertion process. Cancellous iliac graft was impacted anteriorly between the nail and the foam block filling up the open slot. The internal compression device of the Valor nail was used. Locking screws were applied and the wound was closed in layers after haemostasis. Postoperative antibiotic was given. DVT prophylaxis was provided while the patient was non-weight bearing in plaster.

Note that the official surgical technique from the manufacturer describes the insertion of the foam block after the nail is already in place and before compression is applied. This is done with the open U-slot facing towards the back of the joint [33]. However, it was the impression of the senior operating surgeon (NK) that the implant could potentially extrude or migrate anteriorly if implanted in that position. Hence the decision was taken to insert the implant in a more secure reverse position behind the nail as described above (see Fig. 2).

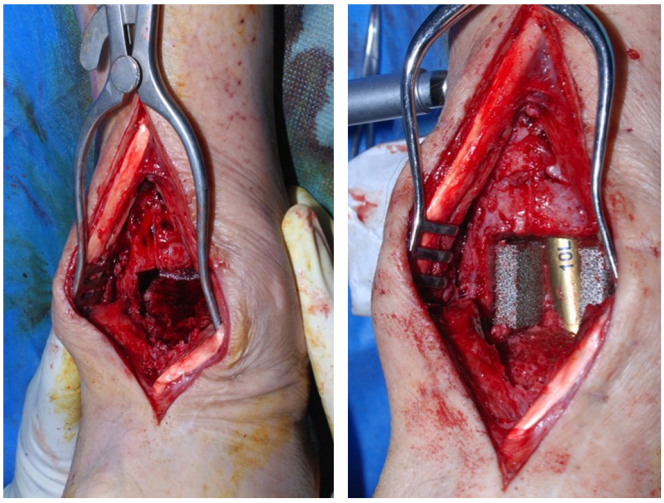

Fig. 2. Intraoperative photos showing a large defect after the prosthesis was removed subsequently filled up by the metal block. Note the open slot is facing the wound with the metal block secured behind the nail. The open slot was later packed with cancellous bone graft.

3. Case reports

3.1. Case no. 1

This patient had a left total ankle replacement at the age of 59 using a DePuy Mobility ankle prosthesis. The immediate postoperative recovery was uneventful. However, six months later he presented with worsening ankle pain on weight bearing associated with radiographic loosening around the tibial component. His CRP was normal but isotope bone scan showed increased uptake around both the tibial and talar components. He underwent first stage revision 13 months after his ankle replacement where the prosthesis was found to be loose with no evidence of integration with the host bone. The components were removed and a cement spacer with vancomycin and gentamycin was left in place. The second stage was performed 6 weeks later consisting of fusion with Valor nail. A Biofoam spacer was used to fill the large gap supplemented further with cancellous iliac graft. He was nonweight bearing in a below knee cast for the first 6 weeks. Gradually increasing weight bearing was started thereafter. He was in a cast for a total of 10 weeks. He improved steadily but around the third month he noted medial ankle pain associated with tenderness over the talar neck. His radiographs at that time were satisfactory with no sign of fracture. This was put down to stress reaction and settled within a couple of weeks. He was seen again at 8 months after surgery with a clinically and radiographically fused and painless ankle. However he was having considerable lateral foot pain and this was attributed to a excessive laxity of his first tarsometatarsal joint associated with hallux valgus causing his weight to shift onto the lateral fourth and fifth rays. He also had slight fibular impingement. He underwent fusion of the first tarsometatarsal joint and excision of the tip of the lateral malleolus which resolved his midfoot and lateral pain. Radiographs at 10 months showed solid bony integration of the foam block with a rim of bone visibly bridging the tibia to the talus. There had not been any sign of infection since the ankle was fused (see Fig. 3).