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Use of Dermal Regeneration Template for Successful Coverage of Chronic Exposed Tibia with Osteomyelitis

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Abstract

Introduction Wounds located in the distal third of the lower extremity pose a challenge to reconstructive surgeons, and the current standard of care is free tissue transfer. Unfortunately, not all patients are suitable candidates for microsurgical reconstruction. Alloplastic soft tissue reconstructive techniques have evolved applications in this setting.

Method We here report a case of a patient with depleted vascular status not sufficient for microvascular reconstruction, with chronically-exposed tibia and underlying osteomyelitis, who was successfully treated with serial cortical bone fenestration, bone debridement and Integra® bilayer dermal matrix placement.

Results The patient ultimately had stable soft tissue coverage of his composite wound, and was ambulatory at most recent followup.

Conclusions With a specific surgical management protocol, Integra can be used for complex soft tissue coverage of bony defects in patients with contraindications to microvascular reconstruction.

Keywords

Osteomyelitis; Microsurgical reconstruction; Depleted vascular status

Introduction

Wounds located in the distal third of the lower extremity pose a challenge to reconstructive surgeons as local tissue is scarce and regional flaps prove tenuous. The current standard of care for these distal third wounds is free tissue transfer. Free flap reconstruction is costly, requires highly specialized care, and prolonged length of hospital stay. Unfortunately, not all patients have suitable vasculature to accommodate microvascular anastamosis. Alloplastic soft tissue replacement products, including dermal regeneration templates (e.g., Integra) have continued to develop applications in such challenging settings. We here report a case of a patient with depleted vascular status (clinically judged to be not sufficient for microvascular reconstruction), with chronically-exposed tibia and underlying osteomyelitis, who was successfully treated with serial cortical bone fenestration, bone debridement and Integra® bilayer dermal matrix placement.

Case Report

A 61-year-old male smoker with a history of peripheral vascular disease initially presented 14 months after a Gustillo IIIc right distal third tibial fracture repair and femoral artery – to – distal tibialis anterior revascularization procedure. He subsequently developed a full thickness eschar of the medial distal third of the leg. He underwent serial debridements resulting in a 12 x 4 cm wound with exposed tibia (Figure 1). Infectious disease consultation was obtained, and a diagnosis of chronic osteomyelitis was made on the basis of 1) frank exposure of the tibia bone for longer than 3 months, and 2) bone biopsy cultures positive for methicillin-resistant *Staphylococcus Aureus* (MRSA). The patient was started on 3 month course of intravenous vancomycin, although the patient had no probability of clearing the osteomyelitis without adequate debridement and soft tissue coverage. The wound was initially treated with negative pressure therapy for 12 months with minimal healing, and plastic surgical consultation was obtained. At this time, the patient was ambulatory with a walker, and limited to touch-toe weight bearing.

Angiography demonstrated single-vessel perfusion to the distal leg, based only on the previous saphenous vein graft. In this setting, microvascular reconstruction was deemed to be prohibitively high-risk (although technically possible), and a conservative approach using Integra® bilaminar dermal regeneration template followed by a split-thickness skin graft was initiated. Intraoperatively, the patient underwent sharp debridement of necrotic soft tissue, followed by cortical fenestration and burring of the surface of the tibia with an osteotome and surgical drill. Given the steady incorporation of the dermal regeneration template over the exposed tibia, the bone debridement, fenestration, and Integra placement was repeated (Figures 2-3). The third round of fenestration and dermal template placement showed successful neovascularization of the complete template, and the wound was subsequently skin grafted (figure 4). The graft was bolstered with negative pressure wound therapy for seven days and showed good healing (Figure 5). At this time, he weight bearing status was increased to weight bearing as tolerated. Follow up at 4 months showed a viable skin graft, no recurrence of the wound, and the patient was ambulating without assistance on the affected leg (Figure 6).

Discussion

Integra® is a synthetic dermal matrix bilayer composed of a deep bovine collagen crosslinked with shark chondroitin-6-sulfate layer and a superficial silicone epidermal substitute layer. It may be used to aid wound coverage where autologous tissue repair is not feasible [1].Originally used for burn wounds, applications have recently expanded to include complex soft tissue injuries with exposed vital structures, including scalp resurfacing over exposed calvarium with use of cortical fenestration [2].

Integration of the dermal template requires neovascularization from the surrounding host tissue and angiogenesis within the graft. Vessels may develop from local vascularized soft tissue, underlying granulation tissue, or blood supply brought in from the bony medullary canal via cortical fenestration. In the reported case, a healthy wound bed never formed likely due to chronically exposed, nonviable tibia with osteomyelitis, and underlying peripheral vascular disease. Due to the established success of Integra® integration with cortical fenestration in the calvarium and foot, we adapted this technique to the distal tibia [2]. Further supporting our decision to fenestrate the bone was evidence that the wound had not contracted or produced granulation tissue after 12 months of conservative wound treatment,

including negative pressure therapy. Repeated cortical debridements of the tibia did not produce sufficient neovascularlization to support granulation tissue or healing, likely secondary to a compromised blood supply and chronic infection. In this instance, cortical fenestration was necessary to augment the wound bed blood supply, at the cost of additional operations and time.

Dermal templates can undergo integration without in-growth from the periphery or the wound base, so long as the blood supply is derived from a reliable source, such as the underlying medullary canal. Consistent with Chen, et. al., fenestration to aid in neovascularization of a cellular dermal matrix is unpredictable, as demonstrated by our patient requiring three rounds prior to integration of the matrix [3]. As others have shown, cortical abrasion and fenestration in other exposed bone sites have been able to provide suitable vasculature to denuded sites allowing granulation tissue formation [4-6]. However, this is the first case in which a composite tissue defect of this magnitude (i.e., chronically exposed, devitalized, osteomyelitic tibia in the setting of advanced peripheral vascular disease) has been successfully treated with Integra.

In the absence of other options, or when microsurgery is unavailable, undesired by the patient, or deemed technically impractical, wound reconstruction of the distal lower extremity with exposed bone may be successfully achieved with cortical fenestration and the use of an a cellular dermal matrix. Furthermore, our case highlights that reconstructive surgeons should not be deterred on initial attempts with cortical fenestration, as neovascularization occurred after three attempts.

Figures

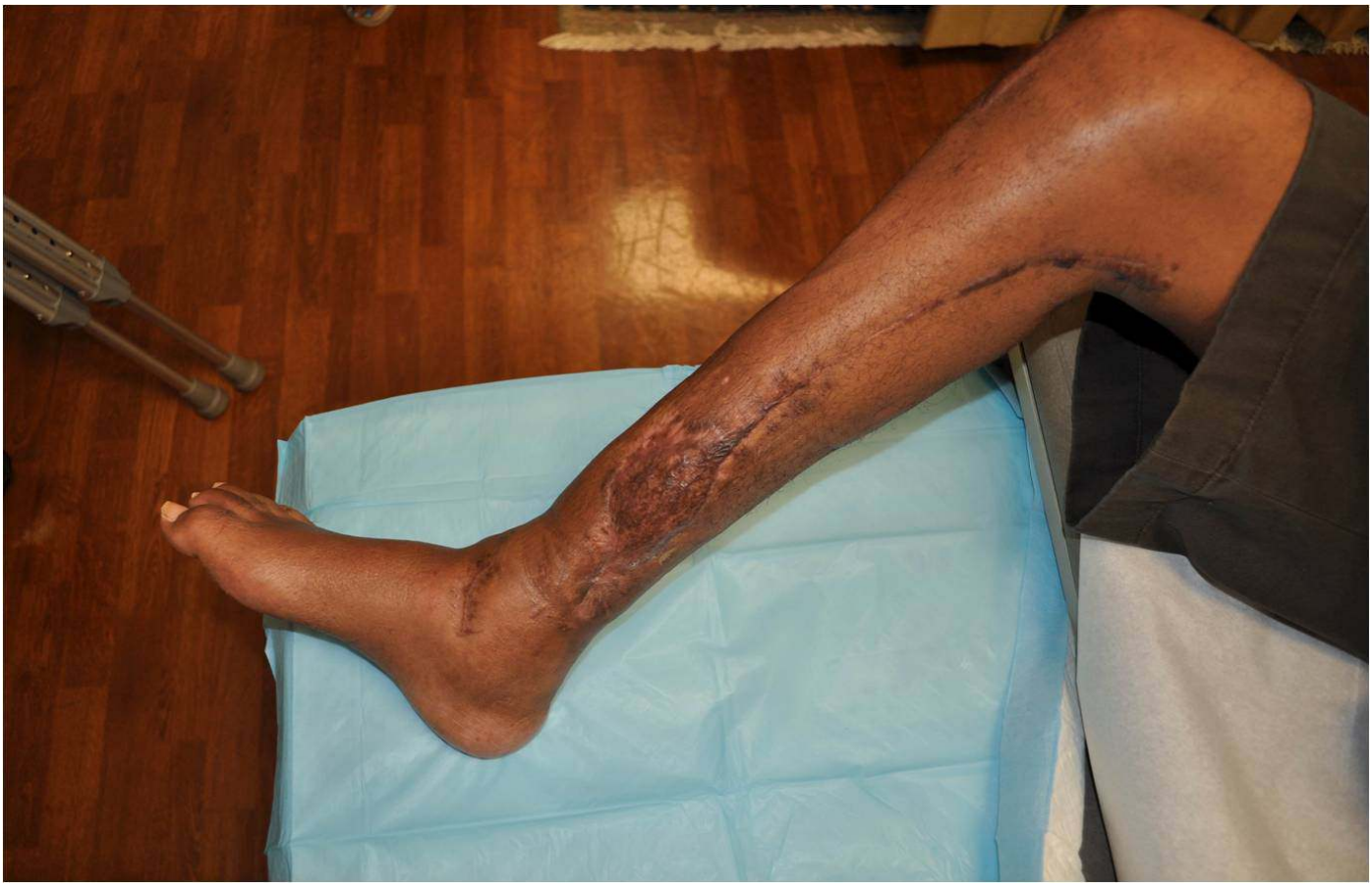

Figure 1: A 61-year-old male smoker with a history of peripheral vascular disease initially presented 14 months after a Gustillo IIIc right distal third tibial fracture repair and femoral artery – to – distal tibialis anterior revascularization procedure. He subsequently developed a full thickness eschar of the medial distal third of the leg. He underwent serial debridements resulting in a 12 x 4 cm wound with exposed tibia.

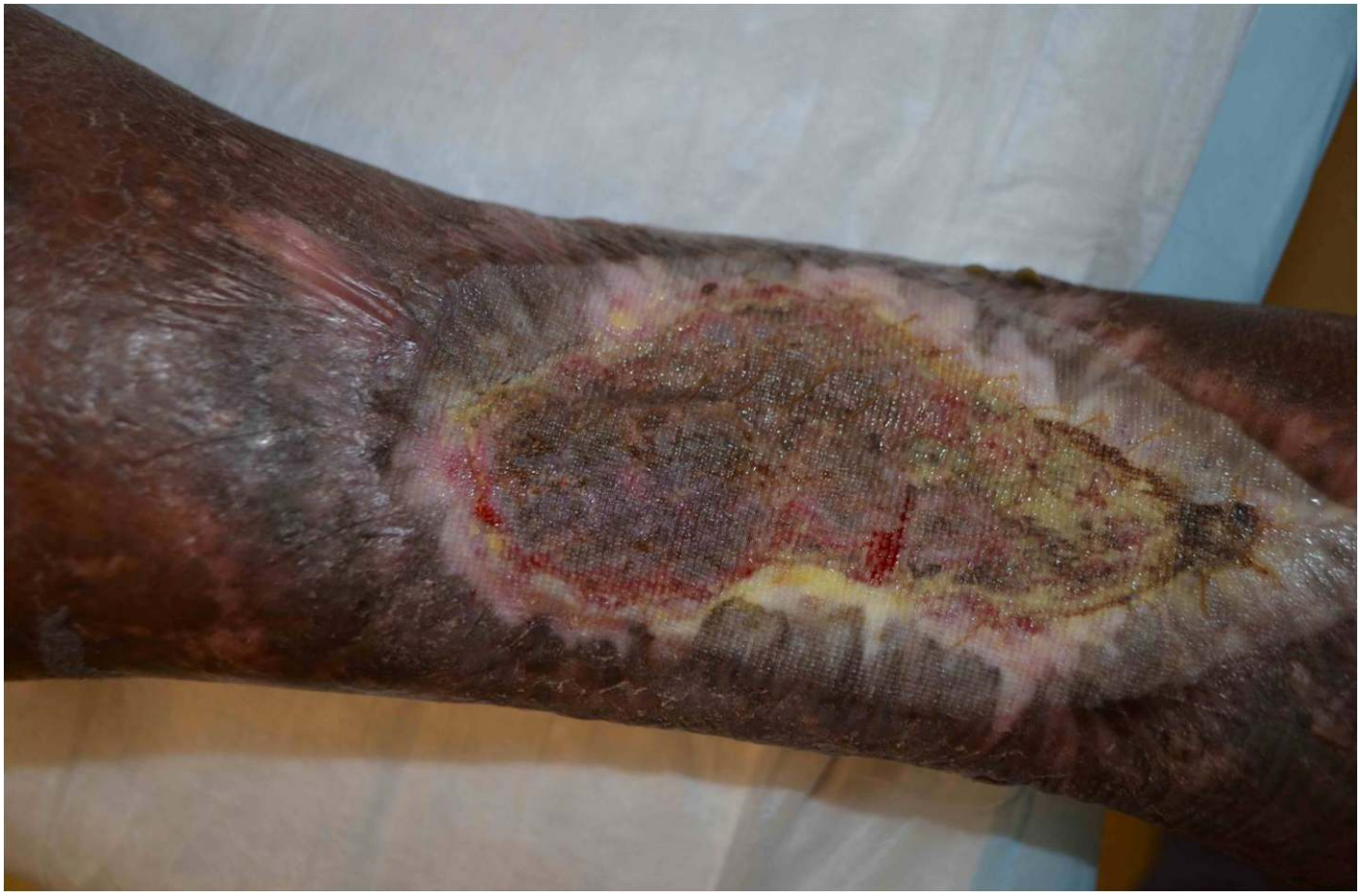

Figure 2: Appearance of wound after first debridement, prior to Integra placement.

Figure 3: Appearance of wound after first Integra placement.

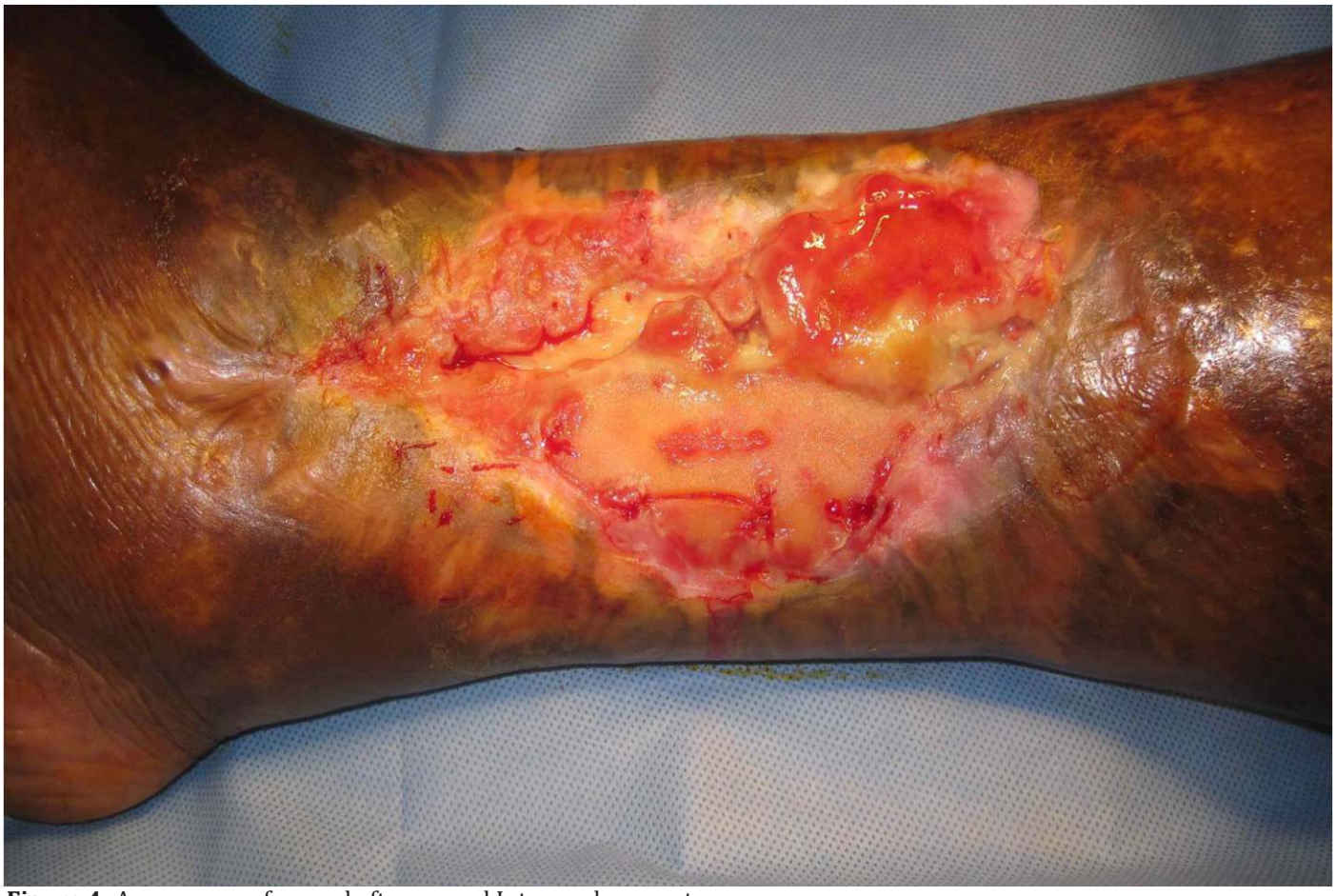

Figure 4: Appearance of wound after second Integra placement.

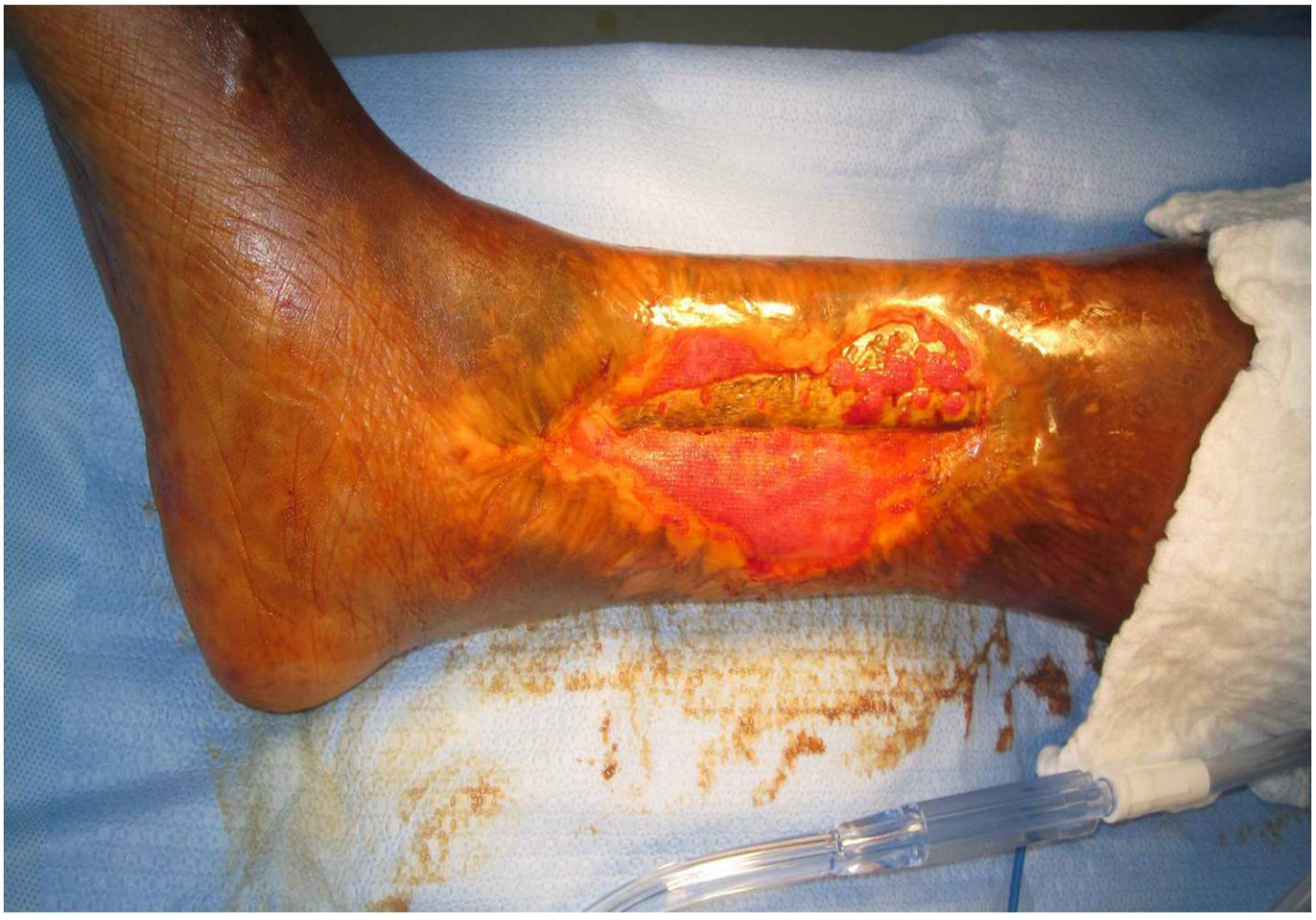

Figure 5: Appearance of wound after skin grafting, at the time of first dressing change.

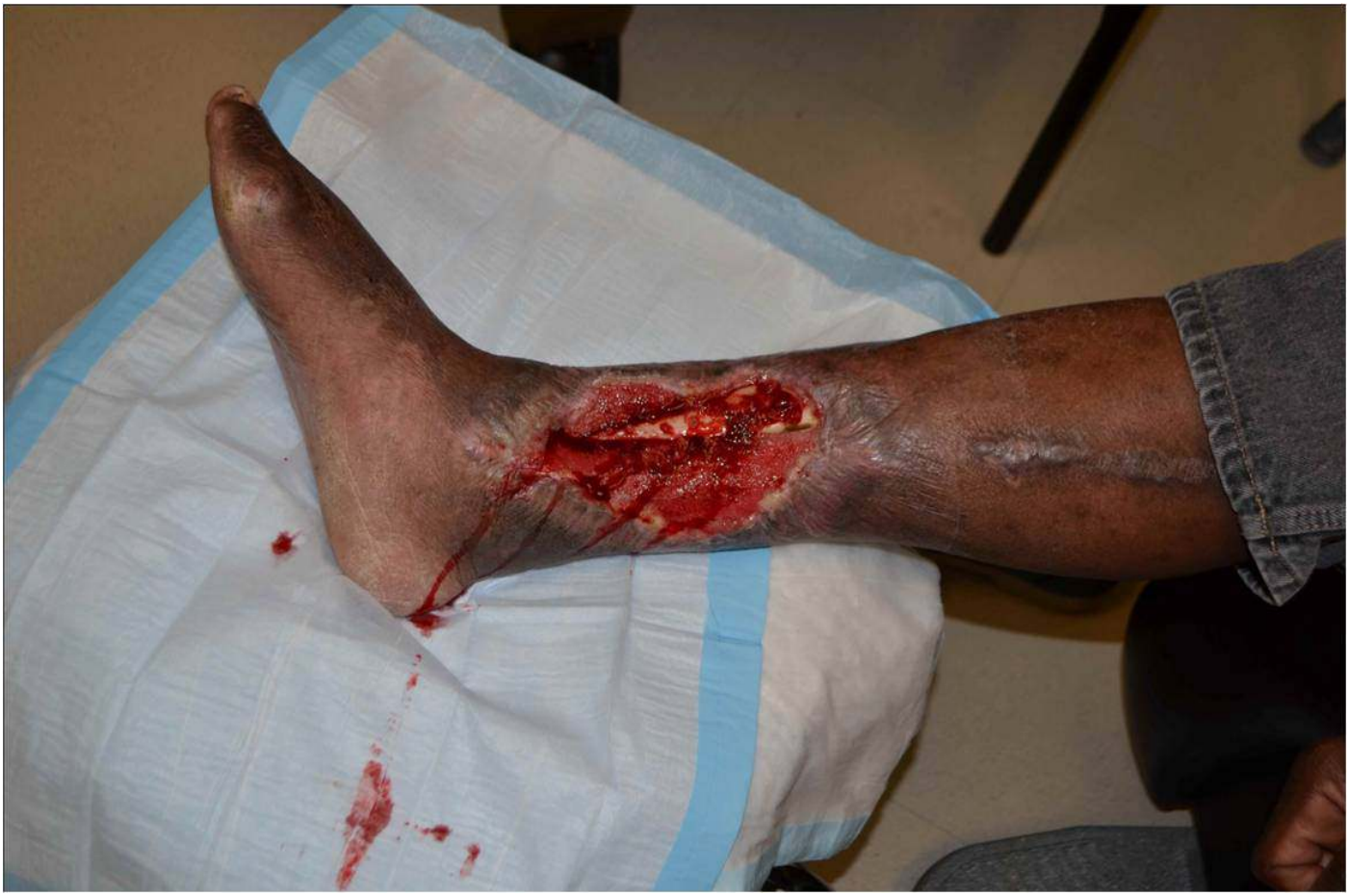

Figure 6: Appearance of leg at four-month postoperative visit. Skin graft has healed completely over exposed tibia, and soft tissue coverage is stable. Patient is ambulatory on affected limb.

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