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Management of Combined Soft Tissue and Osseous Defect of the Midfoot with a Free Osteocutaneous Radial Forearm Flap: A Case Report

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ABSTRACT

Extensive soft tissue and osseous defects of the foot are difficult to manage and often result in amputation. Most of these wounds are created by trauma, but other causes, such as infection and malignancy, can create similar defects. A variety of wound management options exist for the treatment of these challenging wounds, including negative pressure wound therapy, autogenous skin grafting, and the use of skin substitutes, as well as internal and external fixation methods. In the present report, we describe the use of a free osteocutaneous radial forearm flap to manage a 10-cm × 5-cm dorsal soft tissue defect and a 2.5-cm second metatarsal diaphyseal defect in an adult male.

Several investigators have described various reconstructive options and the advantage of limb preservation over primary amputation (1,2). Free tissue transfer with concurrent bone grafting has been widely described for upper extremity trauma, war injuries, and maxillofacial defects (3,4). This technique allows the skeletal defect to be filled with autogenous bone graft, with the soft tissue lesion covered with a free tissue transfer. These free osteocutaneous flaps contain a vascularized segment of bone and soft tissue. Free osteocutaneous grafts have been used for various reconstructions, but their application in the foot and ankle has been limited.

A paucity of data is available pertaining to osteocutaneous vascularized flaps in foot and ankle surgery. Lykoudis et al (5) described a free fibular osteocutaneous flap to manage multiple tarsometatarsal defects. In their report, the fibula was osteotomized into 3 segments and used to reconstruct the bone defects. The skin paddle of the flap was used for stable soft tissue coverage. These investigators reported a very good functional and aesthetic outcome (5).

The use of a free osteocutaneous radial forearm flap to manage a 10-cm × 5-cm dorsal skin defect and a 2.5-cm second metatarsal diaphyseal defect is described in the present case report. To our knowledge, this flap has not been previously described in the biomedical data for this particular application.

Case Report

A 24-year-old white male presented to the emergency department with a close range gunshot wound to the left foot. The patient had been shot with a 12-gauge shotgun with a metallic slug. The dorsal entry wound measured 15 cm × 8 cm (Fig. 1), and the plantar exit wound measured 11 cm × 6 cm (Fig. 2). The patient also sustained fractures of the first, second, third, and fourth metatarsals, and the second metatarsal fracture was segmental with a 2.5-cm diaphyseal defect (Fig. 3). The patient presented to the emergency department 2 hours after the injury. The patient's neurovascular status was intact. The patient had no pertinent medical or surgical history. He was taking no medications and reported no medicinal allergies.

The patient received tetanus, 2 g of intravenous cefazolin, and 80 mg of intravenous gentamicin in the emergency department, and was taken urgently to the operating room for operative management. The wounds were thoroughly debrided and irrigated, and a multiplanar external fixator was applied to achieve skeletal stabilization. A negative pressure wound therapy device was also applied, and this initial care was followed by a second irrigation and debridement 48 hours later. The patient remained hospitalized for pain control and continued intravenous cefazolin, 1 g every 8 hours, and gentamicin, 80 mg every 8 hours. The patient was treated with daily 40-mg enoxaparin subcutaneous injections. A limited unilateral angiogram was performed on postoperative day 3 to identify a recipient target vessel for free flap anastomosis. After in-depth discussion of the treatment options with the patient, the operative team, which consisted of the treating podiatrist and consulting microvascular surgeon, decided to proceed with single-stage reconstruction of the midfoot using an osteocutaneous radial forearm free flap.

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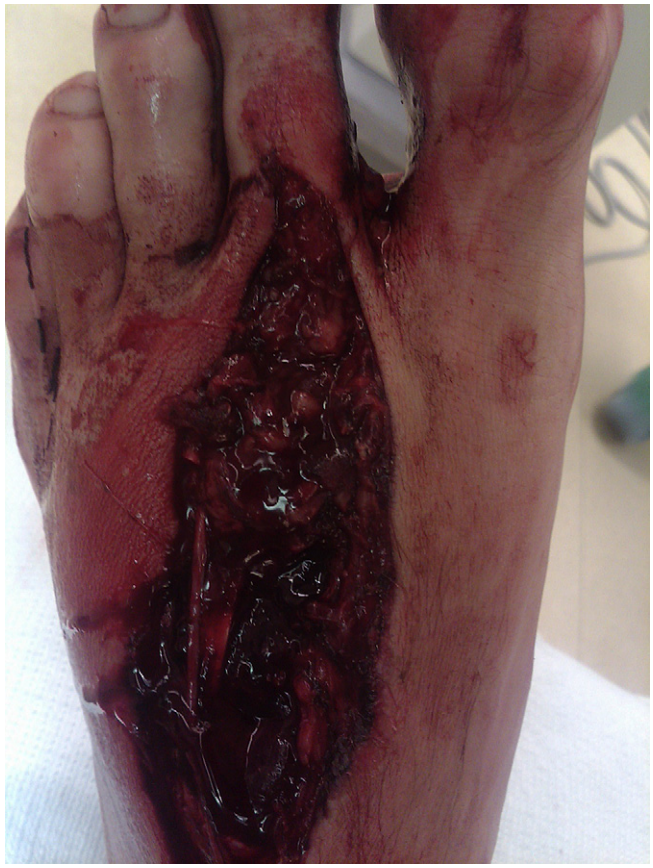

Fig. 1. Dorsal entry wound measuring 15 cm × 8 cm.

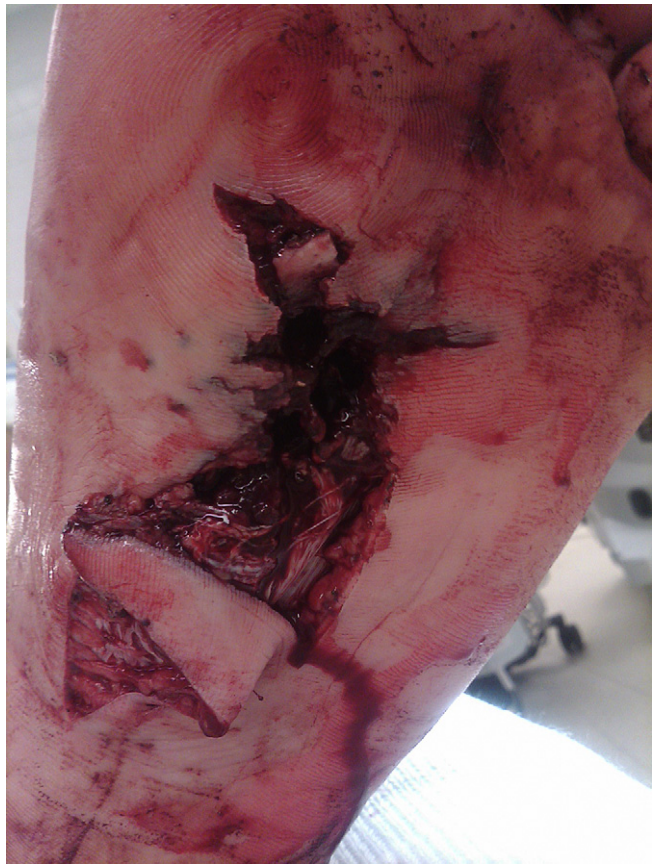

Fig. 2. Plantar exit wound measuring 11 cm × 6 cm.

The patient was brought to the operating room and placed on the operating table in the supine position. General anesthesia was induced. A tourniquet was used for hemostasis on the patient's right upper extremity. No tourniquet was used on the lower extremity. The right upper extremity was positioned on a hand table and the left lower extremity was positioned in standard fashion on the foot of the bed. The left lower extremity and right upper extremity were prepared and draped in the usual sterile fashion. The defects were measured. The soft tissue defect measured approximately 10 cm × 5 cm, and the defect of the second metatarsal approximately 2.5 cm. A flap of appropriate size was marked approximately 3 cm proximal to the radial styloid, extending approximately 10 cm proximally and approximately 5 cm in width, overlying the course of the radial artery. Doppler examination confirmed ulnar dominance of the hand perfusion. The flap was raised in standard fashion based on the fasciocutaneous perforators from the antegrade radial artery pedicle. Deep septal perforators were identified and carefully preserved as the blood supply for the bone flap. A branch of the cephalic vein was identified and preserved for venous drainage of the flap. The appropriate-size radial artery pedicle was exposed. The radius was exposed distal to the pronator teres insertion. The perforators from the radial artery were preserved, because they course transmuscularly into the anterior and radial aspect of the distal radius. A 2.5-cm × 1-cm bone graft was marked at the midportion of the pronator quadratus. The decision was made to take a section of the bone, along with the perforator and the pronator quadratus, for reconstruction of the metatarsal. The bone was marked out, and a knife was used to incise the periosteum and the pronator quadratus. Multiple drill holes were created within the radius osteotomy sites and an osteotome and oscillating saw were used to finalize the harvest of the donor bone from the radius. The bone was then lifted out of its bed. The tourniquet was deflated, and bleeding from the bone flap was observed. The radial artery was then clamped distally to the flap, and good perfusion of the hand and thumb were observed. The radial artery was ligated distally and then transected. The flap was then raised from distally to proximally, ligating additional perforators that had been preserved previously. Once the flap had been fully raised, it was carefully placed into some moist gauze in the proximal forearm area.

The foot and ankle preparation was performed concurrent with the flap harvest in an attempt to reduce the operative time. The wounds were debrided, and all remaining nonviable bone was removed. The proximal and distal ends of the second metatarsal were cut flat to allow for a better fit of the bone graft. The dorsal wound was extended toward the ankle to the level of the extensor retinaculum. This dissection was carried through the extensor hallucis longus and extensor digitorum longus tendons to expose and mobilize a 10-cm section of the dorsalis pedis artery and the vena comitans. In preparation for vascular anastomosis, the vessels were raised out of the wound bed, placed on a suction micro-background, separated and "de-adventitialized." A double reapproximating clamp was placed onto the anterior tibial artery, and an arteriotomy was done to prepare the artery for an end-to-side anastomosis.

Once the vessels had been prepared, the radial forearm osteocutaneous flap was carefully harvested from the right upper extremity. The radial artery was ligated proximally, and the pedicle was transected. The flap was then carefully moved to the left lower extremity and brought into the microscopic field. The pedicle was brought toward the anterior tibial vessel, and a 9-0 nylon stitch was used to create an end-to-side anastomosis in the standard fashion under microscope magnification. Once this had been accomplished, the double reapproximating clamps were removed, and excellent