Case Report

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A salvage strategy for heel pad degloving injury
A case report

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Abstract

Case: A 50-year-old female experienced a crush injury to the foot resulting in open degloving of her heel pad. This study details a surgical strategy to achieve healing and limb salvage.

Conclusion: Heel pad injuries with degloving are difficult to salvage and have a poor prognosis. Amputation is often the only therapeutic option, unless part of the blood supply to the heel pad is intact, rendering limb salvage a possibility.

Keywords: degloving, heel pad, limb salvage

1. Introduction

Injuries to the heel pad are difficult to repair and have a poor prognosis.[1–3] We report a case of an open-degloving injury to the foot, including the heel pad. This case emphasizes the use of circumferential skin and soft-tissue fenestration, reattachment of the heel pad with Kirschner wire (K-wire) fixation, split thickness skin grafting, and negative pressure wound therapy to achieve limb salvage.

The patient was informed that her case, including radiographs and photographs, would be submitted for publication, and she provided consent.

2. Case report

A 50-year-old female presented to a trauma center by ambulance after her right foot was run over by a bus. She sustained an open-degloving injury with complete detachment of the dorsal, medial, and plantar surfaces of the forefoot, midfoot, and heel pad, all detached from the deep fascia and bone. Her medical history was significant for bipolar disease controlled on medications, and open reduction and internal fixation of a right lateral malleolus fracture (20 years ago, which caused minor stiffness at baseline). She also reported being a former tobacco smoker, and a current alcohol (at least 4 plus drinks per day), marijuana, and cocaine user.

Physical examination revealed a 20 cm wound from the first metatarsophalangeal joint on the medial right foot extending to the posteromedial aspect of the ankle, with an open-degloving injury to the entire plantar surface, visible and probed from the metatarsal heads to the calcaneus, including the heel pad, also with circumferential degloving injury of the medial and dorsal foot on inspection and palpation (Fig. 1). The only soft tissue remaining adherent to the underlying muscle and bone was located over the lateral ankle and hindfoot (measuring approximately 4 cm in width) and extending over the lateral midfoot and forefoot (measuring approximately 2 cm in width). No gross ankle or foot structural deformity or instability was noted, clinically, or radiographically. She reported decreased sensation over the medial, plantar, and dorsal foot, but intact sensation over the lateral foot and ankle. Dorsalis pedis pulse was palpable, but the posterior tibial pulse was not palpable. She had no other injuries on tertiary examination.

Figure 1. Injury photograph reveals a 20 cm wound from the first metatarsophalangeal joint to the posterior ankle along the medial right foot with a complex open-degloving injury to the entire plantar heel pad with circumferential degloving injury to the midfoot and forefoot. On examination, the skin and subcutaneous tissue over the dorsal foot, medial hindfoot, and plantar surface were completely detached, leaving a large space between the plantar fascia and calcaneus and the adjacent plantar soft tissue.

All devices used in this study are FDA approved.

The patient provided informed consent for the content of this paper.

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Figure 2. Injury radiographs include anteroposterior and lateral views of the right ankle (A), and anteroposterior and oblique views of the right foot (B). Radiographs reveal a nondisplaced fracture of the cuboid, with no subluxation or dislocation of any of the articulations of the foot.

Plain radiographs of the right foot and ankle (Fig. 2) revealed a nondisplaced fracture of the cuboid and normal alignment of the foot. A remote healed fibula fracture with medullary implant was noted.

Initial management included dressing the wound with moist saline gauze, application of a short leg splint, and administration of cefazolin and gentamicin. Tetanus status was updated. Preoperative discussion was held regarding the severity of this limb-threatening injury, the likely need for serial operations, and the possibility of unsuccessful limb salvage.

On day 1, she underwent surgical debridement and irrigation of the wound. Devitalized subcutaneous tissue was excised from the dorsal and medial foot. Superficial portions of the abductor hallucis muscle were excised, while other muscle was viable. Dorsal and plantar skin appeared perfused, but several centimeters of medial skin was not viable and was excised. Several liters of normal saline irrigation were used to cleanse the wound via gravity flow. The heel pad, including the skin and plantar fat, had detached from the calcaneus during the injury. It was superficially debrided and repositioned over the mid- and

Figure 3. Intraoperative lateral view (A) demonstrates K-wires inserted through the heel pad to secure it to the calcaneus. Intraoperative photographs (B–D) demonstrate delayed closure of portions of the medial forefoot and hindfoot wounds, and circumferential fenestration of the degloved skin of the dorsal and plantar foot.

anterior-calcaneus and secured there with four 0.062 inch K-wires, which were inserted through the heel pad into the calcaneus (Fig. 3A) to keep the heel pad reduced and under gentle tension. Prolene-grasping sutures were placed in a tension-relieving fashion through 3 areas along the wound for soft tissue re-approximation. A 5 cm × 13 cm negative pressure dressing (125 mm Hg) was placed, and a splint was applied.

On day 3, she returned to the operating room for debridement and irrigation. The injured skin appeared vascularized but macerated. Small amounts of hematoma had accumulated within the dorsal tissues and along the mid-portion of the plantar wound. Overlying skin and subcutaneous tissue of both the injured dorsal and plantar surfaces was fenestrated with a scalpel, using a pie-crusting technique (approximately 1.5 cm incisions spaced apart by 1.5 cm). Monofilament sutures were placed to close portions of the wound along the distal forefoot and the posterior hindfoot (Fig. 3B–D). A negative pressure dressing was reapplied circumferentially to the entire foot. The intent of fenestrating the skin was to treat it as a full thickness, meshed graft. She returned to the operating room again on day 6 and day 8 for dressing changes, and no nonviable tissue was identified. The negative pressure dressing and splint were continued. On day 10, the soft tissues remained viable with adherence of the dorsal and plantar skin. A 3 cm × 10 cm split thickness skin graft was

Figure 4. One year post-injury radiographs include anteroposterior and lateral (A) and Harris (B) views of the foot demonstrating normal appearance of bone and soft tissues. Clinical photographs at 32 months (C–E) show mature and durable soft tissues of the lateral, medial, and plantar foot.

performed for the medial right foot followed by placement of a standard negative pressure dressing (75 mm Hg) on the skin graft. Nonweight bearing was advised.

Five days after the skin graft, all soft tissues were viable, although the foot was edematous and portions of the skin were macerated. The negative pressure dressing was discontinued. She was seen every 2 weeks in the orthopaedic clinic for the first 3 months following injury. At 10 weeks, radiographs and clinical presentation revealed a healed heel pad to the calcaneus, and K-wires were removed. The patient was provided gel pads for her heel and instructed to begin 50% partial weight bearing using a walking boot with progressive weight bearing over the subsequent 4 weeks. At 4 months, transition to regular shoe wear was recommended with heel pads. At 6 months, the patient was wearing regular shoes and experienced minor activity-related pain and swelling. Sensation of crude touch was intact over the dorsal and plantar foot, but fine, 2-point discrimination was absent. Trace swelling remained with slightly limited range of motion of the ankle. At 32 months post-injury, she was wearing regular shoes and was ambulating with mild level of daily pain similar to that pain she had in her foot and ankle preceding this injury. Her surgical scars were healed (Fig. 4). The heel pad had experienced very slight atrophy in size, but was otherwise durable, nontender, and adherent to the deeper tissues. Ankle

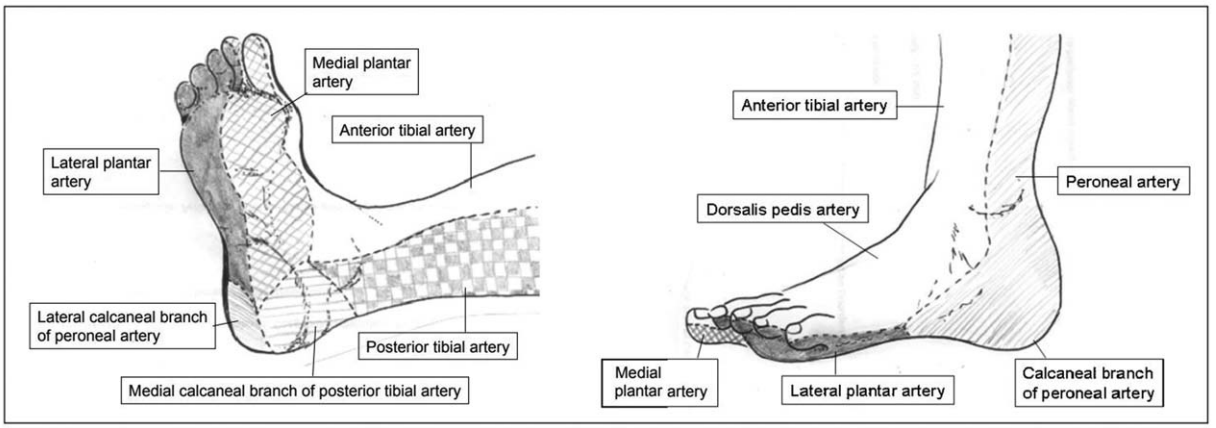

Figure 5. Anatomic illustrations of the vascular supply of the foot.[11] Reprinted with permission from Alexandrescu et al[11].

dorsiflexion was 20°, plantar flexion was 20°, and the subtalar joint had 75% of the motion of the contralateral foot.

3. Discussion

Heel pad degloving injuries traditionally have a very poor prognosis and often result in an unviable foot, especially in the case of complete subcutaneous detachment, for which amputation may be the only treatment option.[2–5] Neither skin graft nor free tissue transfer is durable to cover the entire plantar surface of the foot, as both grafts lack the resilience required for ambulation.[5,6] Overall, there have been limited reports of successful heel pad replantations in both adults and children.[7–10] Reattachment of partial avulsions of the heel pad have also been reported with wire fixation to secure the heel pad.[3] These cases, however, did not involve degloving of the adjacent medial or dorsal tissue, nor did they utilize negative pressure wound care. Our novel treatment strategy sheds insight into treatment for a subset of these injuries when vascular supply remains intact.

The vascular supply to the heel pad is provided by the lateral calcaneal branch of the peroneal artery and the medial calcaneal branch of the posterior tibial artery (Fig. 5).[11] During this injury, the medial plantar nerve and artery were transected; thus the preserved lateral calcaneal artery provided vascularity to the heel pad. Partial vascular integrity required for heel pad healing is supported by the previous literature.[3,7–9] The dorsalis pedis artery was also intact and likely provided ample circulation to the dorsal foot and anastomoses to the plantar surface within the midfoot.

4. Conclusion

In this case, we report a crush injury to the foot, resulting in degloving of the plantar surface, including the heel pad. We report a unique salvage strategy with serial debridements, wire fixation of the heel pad, fenestration of dorsal and plantar skin, effectively treating it as a full thickness skin graft, and using negative pressure dressing to encourage adherence of the skin back to the foot. Ultimately, the patient avoided amputation and was able to wear regular shoes and to ambulate as needed for daily activities without assistive devices.

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