Replantation and simultaneous free-flap reconstruction of severely traumatic forefoot amputation: a case report

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ABSTRACT
We report a successful replantation of a severely damaged and partially amputated foot covered by a simultaneous free flap. Arterial thrombosis occurred at the flap anastomosis, causing partial flap loss, which were resolved through re-anastomosis and skin-grafting. The patient resumed full, unassisted ambulation 10 months after replantation.

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Foot replantation; avulsion; free flap; microsurgery

Case report
A 23-year-old man and steel factory worker presented to the emergency unit with an amputated left forefoot, having sustained direct dorsal impact by a heavy steel bar (1000 kg). The severed portion extended from first to fourth toe, demonstrating ragged devitalized muscles, tendons, and nerves along the first and second metatarsals/phalanges and third distal/middle phalanges (Figure 1(A–C)). The patient was taken to the operating room for attempted replantation and simultaneous free-flap coverage of the exposed wound. Devitalized tissues, including muscles, tendons, and the first metatarsal bone, were also radically debrided. Bony fixation was achieved using two Kirschner wires inserted through the first and second toes (Figure 1(D)). To revascularise the partial amputation, end-to-end arterial/venous anastomoses of dorsalis pedis and first dorsal metatarsal vessels with the interposed vein grafts harvested from the intact left leg, and direct end-to-end anastomosis of the greater saphenous vein were undertaken (Figure 2(A)). Immediately thereafter, the replanted foot appeared well vascularized.

A gracilis musculocutaneous flap of medial ipsilateral leg was originally planned to provide wound coverage. While in progress, we discovered that a perforating artery from the adductor longus supplied the skin island, the musculocutaneous flap with partial adductor longus muscle and the perforating vessels (one artery, two comitant veins, and subcutis) were harvested (Figure 2(B)). The distal end of the posterior tibial artery and two comitant veins were anastomosed (end to end) to the flap’s pedicle vessels. The cutaneous vein of the flap was anastomosed (end to end) to a recipient branch of the greater saphenous vein (Figure 2(A)). Once inset on the dorsum of the foot, the flap provided ample coverage of the exposed bones and tendons (Figure 2(C)). A branch of the medial plantar nerve and the deep peroneal nerve were severely damaged and unsalvageable.

The procedure lasted 12 h and 22 min, with a total ischaemic time of approximately 14 h. Arterial thrombosis occurred at the flap anastomosis on postoperative day 1, causing partial flap loss and colonisation by methicillin-resistant Staphylococcus aureus was problematic. These issues were resolved through re-anastomosis, skin-grafting, and a course of intravenous vancomycin. Upon hospital discharge 3 months after replantation, the injured foot was capable of partial load-bearing. The patient resumed full, unassisted ambulation 10 months after replantation, unencumbered by pain or ulcers (see Video, Supplemental

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Digital Content 1, which demonstrates smooth, unassisted ambulation), and reported to be satisfied with the surgical results (Figure 3).

**Discussion**

As of July 2018, at least 101 publications on lower limb replantation were listed by MEDLINE (discounting those with no abstracts or non-English offerings), 38 of which addressed whole/partial foot replantation (whole foot, 17; toe, 10 [big toe, 9; little toe, 1]; heel, 6; partial foot, 5) [1–5]. These reports indicate that most surgeons consider big toes and heels worthy of salvage. To our knowledge, this is the first account of partial foot replantation after heavy damage to include simultaneous free-flap coverage. Given the advances made in microsurgical anastomotic techniques, we feel that replantation is often the best option for traumatic partial foot amputation. Compared with the leg, there is much less muscle in the foot, so the risk of replantation toxae-mia is low. The rehabilitation period is also shorter

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**Figure 1.** Amputated portion of patient’s left foot. (A) Devitalized, contaminated muscles and tendons (dorsal aspect). (B) View of plantar aspect. (C) Avulsed medial half of dorsal skin, leaving visibly crushed first metatarsal bone exposed. (D) Bony fixation was achieved using two Kirschner wires inserted through the first and second toes.

**Figure 2.** Simultaneous free-flap coverage design. (A) Innominate perforator flap with muscle cuff of adductor longus substituted for initially planned gracilis musculocutaneous flap (skin paddle untethered to gracilis muscle). (B) Photograph at end of surgery. (C) Schematic of vascular anastomoses (flap depicted as transparent to delineate vessels).
by comparison, and the aesthetic/sociopsychological outcomes are superior to those of a prosthetic foot.

Disclosure statement
The authors report no conflict of interest.

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Figure 3. Outcome of partial foot replantation (postoperative month 10). (A) Dry insensate skin of replanted foot. (B) Patient ambulating without crutches and satisfied with outcome.