

# Reconstruction of Lower Limb Necrotizing Fasciitis by Hydrosurgical Debridement and Multiperforator Anterolateral Thigh Flap

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**Summary:** The authors describe a surgical treatment that optimally combined the use of the hydrosurgical system and a free multiperforator anterolateral thigh flap to prevent lower limb amputation in a severe case of necrotizing fasciitis. A 43-year-old woman was diagnosed with necrotizing fasciitis, and amputation was performed at the level of the metatarsal shafts with an emergency debridement using the hydrosurgical system. In the second reconstructive surgery, a free anterolateral thigh flap measuring 28 × 8 cm<sup>2</sup> was harvested using the left thigh as the donor site and the vascular pedicle was made up of a total of 3 vessels, 2 perforating arteries from the descending branch of the lateral circumflex femoral artery, and 1 oblique branch from the lateral circumflex femoral artery. To thin the flap, we first resected as much subcutaneous fat as possible in the distal part of the flap (which would eventually cover the ankle joint) and ensured adequate residual volume of the proximal part of the flap (which would cover the metatarsal stumps). We then sutured the flap to the tissue defect on the left foot and then end-to-side anastomosing the lateral femoral circumflex artery and posterior tibial artery while the 2 veins were anastomosed to the posterior tibial veins under a microscope. Six months after the surgery, adequate flap volume was maintained over the metatarsal stumps with no postoperative complications such as infection or ulcer formation, and there were no other complications such as motor dysfunction at the donor site on the left thigh. (*Plast Reconstr Surg Glob Open* 2020;8:e3150; doi: 10.1097/GOX.0000000000003150; Published online 24 September 2020.)

**N**ecrotizing fasciitis is an acute bacterial infection of subcutaneous tissues and the superficial fascia that predominantly affects the limbs, the genitalia, and the abdomen in middle-aged individuals. It is characterized by a severe pain with localized redness and swelling, and it typically spreads rapidly, which in turn results in a rapid deterioration of the general condition.<sup>1</sup> In addition, the condition is also characterized by high fever, symptoms of shock, and multiorgan failure. High-dose effective antibiotic treatment and early surgical debridement are essential components of treatment.<sup>2</sup> However, it may be

extremely difficult to remove the extensive necrotic tissue that extends from the skin into deeper layers such as the subcutaneous tissue and fascia. In severe cases of necrotizing fasciitis, even limb amputation could be opted for as a life-saving measure.<sup>3</sup>

The Versajet II hydrosurgery system (HSS; Smith & Nephew, Watford, United Kingdom) has recently been developed as a novel tool for debridement. The tip of the handpiece is fitted with a slit that discharges a physiological saline solution in a horizontal direction through an extremely narrow tube in the tip. The fragile necrotic tissue is drawn toward the tool, after which it is dissected using hydraulic pressure and withdrawn from the body, a process that makes this tool highly effective.<sup>4</sup> The HSS is primarily used for debridement of second-degree burns,<sup>5</sup> diabetic ulcers,<sup>6</sup> and wounds that require skin grafts,<sup>7</sup> although there is just 1 report describing its use in 2 cases of necrotizing fasciitis.<sup>6</sup> In this report, we describe surgical treatment that optimally combined the use of the HSS and a free multiperforator anterolateral thigh (ALT) flap to prevent lower limb amputation in a severe case of necrotizing fasciitis.

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## CASE REPORT

The patient was a 43-year-old woman who was diagnosed as prediabetic 5 years earlier but was not examined at a medical facility and remained untreated. A few weeks before presentation, she developed pain in the left foot, and areas of black necrotic tissue were visible on her skin. X-ray findings of the left foot showed osteomyelitis in first to fifth metatarsal heads and a contrast-enhanced computed tomographic examination of the leg showed significant accumulation of gas and pus extending from the dorsum of the foot to the ankle joint. The condition was diagnosed as necrotizing fasciitis, and we performed amputation at the level of the metatarsal shafts, with emergency debridement using the Versajet II HSS at our department on the same day. Any skin that could potentially cause impaired perfusion as a result of infection was mobilized (Fig. 1) and resected using an electric scalpel, with debridement of the necrotic soft tissue, extensor hallucis brevis, extensor hallucis longus, extensor digitorum brevis, and extensor digitorum longus using the HSS (Fig. 2). Coagulase-negative staphylococci and *Corynebacterium* were detected from intraoperative wound culture samples. To facilitate a second reconstructive surgery to repair the covering over the amputated metatarsal stumps and tissue defects, we prepared the wound bed by administering intravenous antibiotics, irrigating the wound, and applying topical antibiotic ointment for 2 weeks postoperatively.

In the second reconstructive surgery, we first searched for a recipient vessel. There was poor perfusion via the dorsalis pedis artery; therefore, the exposure of the dorsum of the foot was extended to behind the medial malleolus, and the posterior tibial artery and vein were dissected and exposed. Subsequently, we designed a free ALT flap measuring  $28 \times 8 \text{ cm}^2$  using the left thigh as the donor site, which was then mobilized below the quadriceps muscle fascia. The vascular pedicle was made up of a total of 3 vessels, 2 perforating arteries from the descending branch of the lateral circumflex femoral artery, and 1 oblique branch from the lateral circumflex femoral artery. To thin the flap, we first resected as much subcutaneous



**Fig. 2.** Postoperative findings of the first surgery. Amputation at the level of the metatarsal shafts 1 to 5, as well as debridement using the HSS.

fat as possible in the distal part of the flap, which would eventually cover the ankle joint, and ensured adequate residual volume of the proximal part of the flap, which would cover the metatarsal stumps (Fig. 3). We then severed the vascular pedicle by first suturing the flap to the tissue defect on the left foot and then end-to-side anastomosing the lateral femoral circumflex artery and posterior tibial artery, while the 2 veins were anastomosed to the posterior tibial veins under a microscope.

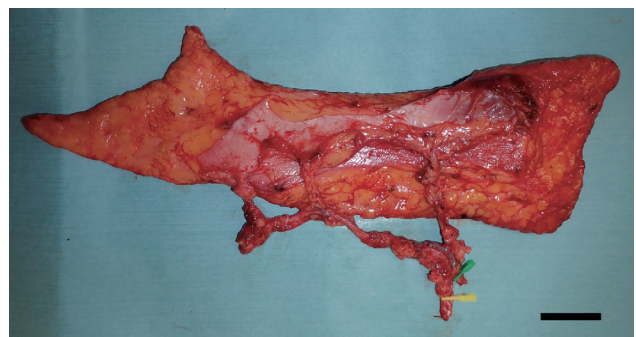
The affected leg was kept elevated for 2 weeks postoperatively, and walking practice was initiated from postoperative week 2. Six months after the surgery, adequate flap volume was maintained over the metatarsal stumps with no postoperative complications such as infection or ulcer formation, and there were no other complications such as motor dysfunction at the donor site on the left thigh (Fig. 4).

## DISCUSSION

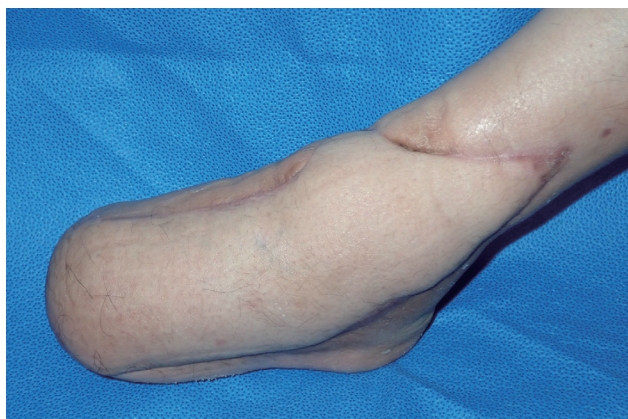
We previously used the HSS during reconstruction of an infected decubitus ulcer of the trunk with a pedicled flap, observing no recurrence of the ulcer or postoperative recurrence of infection, indicating the system is effective



**Fig. 1.** Intraoperative findings during the first surgery. Skin incision extending from the dorsum of the left foot to the ankle revealed the area filled with extensive necrotic skin and soft tissue.



**Fig. 3.** Intraoperative findings during the second surgery. An ALT flap measuring  $28 \times 8 \text{ cm}^2$  was raised from the left thigh as the donor site. The vascular pedicle made up of a total of 3 perforating vessels and the flap was thinned as much as possible while taking care to protect the perforating arteries from damage. Scale bar: 3 cm.



**Fig. 4.** Findings 6 months after surgery. There is complete attachment of the flap, with no complications such as wound infection, ulcer formation, or scar contracture.

for treating wound infection.<sup>8</sup> In addition, using the HSS enables not only the necrotic tissue to be cut away, but also healthy tissue to be selectively preserved.<sup>9</sup> We believe that our approach of irrigating the wound to manage infection and performing selective debridement to preserve the normal tissues of the leg helped preserve the limb in the present case.

Selecting the multiperforator ALT flap for reconstruction proved effective in this case. A free ALT flap has previously been used for reconstruction of the stump after limb amputation and suggested that the thinness and flexibility of the flap eliminated the need for the secondary repair of the prosthesis applied to the reconstructed forefoot stump.<sup>10</sup> In this case, the flap meant that no additional surgery was required for issues such as volume reduction after flap transplantation, and the patient progressed smoothly through rehabilitation from fabricating the prosthetic foot and fitting it to practicing walking. The flap in this case was mobilized with 3 perforating arteries, making it relatively thin. We were also able to mobilize a richly perfused ALT flap with a large skin paddle. We did

not observe any flap necrosis, and the patient completed rehabilitation with no issues such as wound dehiscence.

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#### PATIENT CONSENT

*The patient provided written consent for the use of her image.*

#### REFERENCES

1. Sarani B, Strong M, Pascual J, et al. Necrotizing fasciitis: current concepts and review of the literature. *J Am Coll Surg.* 2009;208:279–288.
2. Wong CH, Khin LW, Heng KS, et al. The LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score: a tool for distinguishing necrotizing fasciitis from other soft tissue infections. *Crit Care Med.* 2004;32:1535–1541.
3. Chang CP, Hsiao CT, Lin CN, et al. Risk factors for mortality in the late amputation of necrotizing fasciitis: a retrospective study. *World J Emerg Surg.* 2018;13:45.
4. Klein MB, Hunter S, Heimbach DM, et al. The Versajet water dissector: a new tool for tangential excision. *J Burn Care Rehabil.* 2005;26:483–487.
5. Jeffery SL. Device related tangential excision in burns. *Injury.* 2007;38(suppl 5):S35–S38.
6. Gurunluoglu R. Experiences with waterjet hydrosurgery system in wound debridement. *World J Emerg Surg.* 2007;2:10.
7. Vanwijck R, Kaba L, Boland S, et al. Immediate skin grafting of sub-acute and chronic wounds debrided by hydrosurgery. *J Plast Reconstr Aesthet Surg.* 2010;63:544–549.
8. Matsumine H, Giatsidis G, Takagi M, et al. Hydrosurgical debridement allows low-invasive and effective wound bed preparation of truncal pressure injuries before flap repair: a prospective uncontrolled case series. *Plast Reconstr Surg Glob Open.* 2020;8:e2921.
9. Tenenhaus M, Bhavsar D, Rennekampff HO. Treatment of deep partial thickness and indeterminate depth facial burn wounds with water-jet debridement and a biosynthetic dressing. *Injury.* 2007;38(suppl 5):S39–S45.
10. Yildirim S, Calikapan GT, Akoz T. Reliable option for reconstruction of amputation stumps: the free anterolateral thigh flap. *Microsurgery.* 2006;26:386–390.