

Definitive coverage of distal vein graft in a case of early skin necrosis following popliteal to dorsalis pedis bypass

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ABSTRACT

Inframalleolar bypass is an effective intervention for chronic limb threatening ischemia. A successful outcome can be compromised by early pedal wound disruption with secondary bypass exposure. We describe the case of a 74-year-old man with a WIfI (wound, ischemia, foot infection) clinical stage 4 foot who underwent popliteal–dorsalis pedis bypass, complicated by early skin necrosis overlying the pedal anastomosis. This necessitated a multidisciplinary approach to obtain tissue coverage over the anastomosis. The wound healed within 28 days, and at 2 years, the patient was mobilizing independently. We outline the approach taken and discuss the management of this challenging limb salvage problem. (*J Vasc Surg Cases Innov Tech* 2023;9:101233.)

Keywords: Bypass; Chronic limb-threatening; Diabetic foot; Ischemia; Wound infection

Inframalleolar bypass is an effective intervention for chronic limb threatening ischemia (CLTI) for which the only viable target is a pedal one.¹ Primary patency rates are reported at 1, 2, and 5 years as 71.2%, 67%, and 59.7%, respectively.^{2,3} The 1- and 2-year amputation-free survival rates are reported as 81% and 72%, respectively.^{2,4} Pedal wound disruption with secondary bypass exposure is reported in 10% of cases.⁵ Management strategies include wound care, leg elevation, bypass revision, and flap coverage. We present our management of early postoperative skin necrosis with pedal anastomosis exposure and a successful outcome. The patient provided written informed consent for the report of his case details and imaging studies.

CASE REPORT

A 74-year-old male farmer was transferred from a rural hospital with diabetic foot sepsis related to left third, fourth and fifth toe gangrene. He had a previous acute left popliteal artery

thrombosis 12 months prior with partially successful intra-arterial thrombolysis, with occluded tibial runoff unable to be recanalized. His comorbidities included previous coronary artery bypass graft, left ventricular failure, type 2 diabetes mellitus (hemoglobin A1c, 54 mmol/mol), stage 3 chronic kidney disease, atrial fibrillation, and ex-smoker (30 pack-years).

His presenting WIfI (wound, ischemia, foot infection) clinical stage score was 4 (wound, 3; ischemia, 3; foot infection, 3). Diagnostic catheter angiography demonstrated patent iliofemoral–popliteal inflow with chronically thrombosed tibial runoff and reconstitution into a patent dorsalis pedis (DP) with a diameter of 1.3 mm on ultrasound and a pedal acceleration time >300 ms.^{6,7}

Broad-spectrum intravenous antibiotics were started, and he underwent infragenicular popliteal–DP bypass and third to fifth mid-metatarsal amputation the next day. The reversed great saphenous vein was tunneled subcutaneously along the medial aspect and across the dorsal foot. The DP exposure was lateral to the artery, facilitating skin coverage over the vessel. Bilateral pedal dorsal release incisions were left open to facilitate tension-free skin closure over the anastomosis. The postoperative pedal acceleration time was 120 ms. He returned to the operating room 48 hours later for repeat examination of the forefoot. The left second toe was amputated. Preference was given to hallux preservation over transmetatarsal amputation, given our experience with acceptable functional outcomes and the avoidance of a larger forefoot wound. The forefoot was covered with a fetal bovine dermis graft (PriMatrix; Integra LifeSciences) and secured with negative pressure wound therapy (NPWT) set at –80 mm Hg. Care was taken to keep the NPWT adhesive separate from the pedal bypass wound. The patient remained in the hospital and was immobilized. By day 14, the PriMatrix graft had taken, with the forefoot filling with granulation tissue.⁸ However, skin necrosis was evident along the pedal anastomosis incision margins (Fig 1).

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Fig 1. Day 14 postoperative image demonstrating superficial skin necrosis overlying pedal anastomosis.



Fig 2. Intraoperative image demonstrating superficial necrosis involving anterior wall of vein bypass.

Our plastic and reconstructive surgery colleagues provided regular input. Given the superficial appearance of the skin necrosis, initial conservative management was adopted. On day 30, he was taken to the operating room because of progression of the wound necrosis. After debridement of the skin necrosis, a patch of superficial necrosis was seen on the vein bypass surface (Fig 2). Although consideration was given to performing an interposition vein graft repair, we proceeded with a trial of coverage first, because the latter would avoid a pedal bypass revision. A proximally based random flap was raised in the superficial fascia plane lateral to the skin defect, with the lateral border the previous lateral release incision. This was mobilized medially to cover the anastomosis and secured with 5-0 Pronova suture (Ethicon; Fig 3). The donor site was covered with a left thigh split-thickness skin graft, and both sites were protected with NPWT set at -80 mm Hg.

By the second wound review 8 days later, the flap had developed minor necrosis on its distal margin. Thus, he was taken

back to the operating room on day 42. The necrotic edge was excised and the underlying vein graft exposed. This time the vein was well incorporated into the surrounding tissue, and the superficial vein wall necrosis was no longer evident. Using the previous medial release incision, the skin medial to the defect was freed, covering the defect without tension (Fig 4).

During the next 2 weeks, the skin flap healed without further complications, and the forefoot wound decreased in size. He was subsequently discharged to a rehabilitation ward on day 56. At follow-up 6 weeks later, both the forefoot and the dorsum of the foot had healed without further tissue loss (Fig 4). At 2 years of follow-up, the patient was mobilizing independently and had had no further foot-related hospitalizations (Fig 5).

DISCUSSION

The presence of tissue loss with CLTI is a significant risk factor for major lower limb amputation.⁹ Patients presenting with Wifl clinical stage 4 have a 40% risk of major amputation at 1 year.¹⁰ Inframalleolar bypass is a viable limb salvage strategy when crural artery disease prohibits endovascular therapy or tibial bypass, with lower limb wound healing rates of $\leq 76\%$ at 3 months after bypass in patients with CLTI and diabetes.²

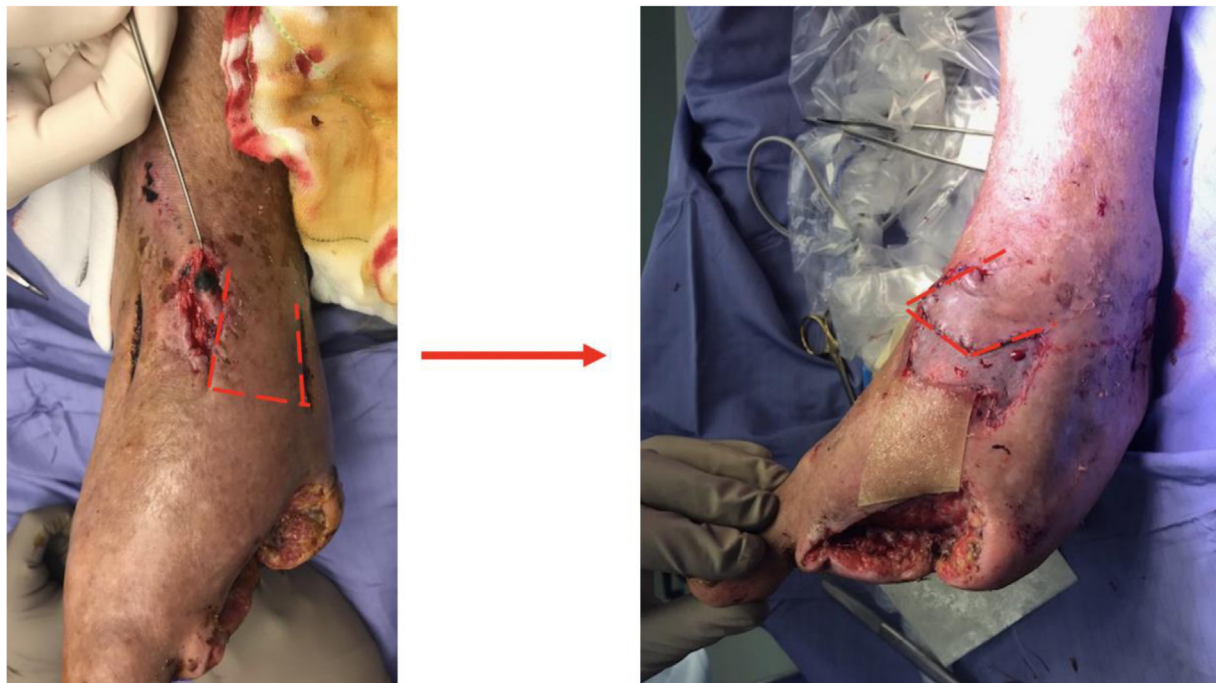


Fig 3. Intraoperative images showing the skin flap rotated medially to cover the pedal anastomosis (dashed red lines).



Fig 4. Chronologic images of flap coverage progress. **A**, Photograph showing first random local flap with donor site split-thickness skin graft. **B**, Photograph showing distal necrosis of flap. **C**, Intraoperative image during flap revision after debridement of necrotic edge, exposing underlying vein bypass. **D**, Photograph after flap revision. **E**, Photograph at 6 weeks after discharge.

Early postoperative skin necrosis over a pedal anastomosis jeopardizes the limb salvage outcome with the risk of graft rupture and occurs in $\leq 10\%$ of cases.^{5,10} Perioperative and patient risk factors include wound edge tension, postoperative edema, infection, age >70 years, and diabetes.⁵

We used bilateral release incisions to allow for tension-free closure of the pedal incision, with strict postoperative bed rest and leg elevation to minimize the development of edema. Despite this, we noted early postoperative wound edge skin necrosis. Our patient did have pedal edema at the index bypass surgery. We hypothesize that the resulting level of wound edge tension combined with his underlying diabetic microvascular disease could have contributed to the development of the skin edge necrosis.

With the inherent risk of graft rupture, postoperative skin necrosis overlying the pedal anastomosis should be managed proactively. Strategies include graft preservation with wound debridement with or without flap coverage or graft revision. With involvement of the anterior vein wall in our case, we considered graft revision. Because the involvement of the vein wall was superficial, we elected to try a trial period of tissue coverage.

Various types of coverage in this setting have been described, including split-thickness skin grafts, local random flaps, rotation advancement fasciocutaneous flaps, bipedicle muscle or fasciocutaneous flaps, and free tissue transfer.^{11,12} With our previous release incisions, it was straightforward to use a local random flap with skin grafting of the donor site. These are susceptible to



Fig 5. Photograph at 2 years of follow-up demonstrating complete healing of the forefoot.

distal necrosis because of poor perfusion and tension but can be easily revised, as we have demonstrated. The index release incisions enhanced the likelihood of the flap's success, because of preconditioning of the flap's circulation by dividing its skin perfusion from the sides. When creating relaxing incisions, it is important to consider the need for a rotation flap. The base of the flap should be a ratio of 1:3 to the original incision length; thus, the relaxing incisions should be ~2 cm medial and/or lateral to the original incision.

The complexity in our patient necessitated a prolonged admission (56 days), highlighting an issue inherent to patients with complex foot wounds that reside in rural geographic areas with challenging access to vigilant follow-up. Improving equitable access to healthcare for some patients and accepting a prolonged length of hospital stay results in improved limb salvage rates and fewer hospitalizations for this group of patients.⁸

CONCLUSIONS

Early skin necrosis involving the pedal anastomosis following inframalleolar bypass can jeopardize a

successful outcome. A multidisciplinary approach with expertise in flap techniques for adequate soft tissue coverage of a distal wound break down can improve limb salvage outcomes.

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