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CASE REPORT
Reconstructive

Inferior Limb Salvage by Combined Free-tissue Transfer and the Crane Principle Revisited

Alessandro Thione, MD, PhD
Pedro C. Cavadas, MD, PhD

Summary: Aggressive treatment of ischemia of the lower extremities has decreased the number of amputations in both diabetic and nondiabetic patients; combined vascular reconstruction and microvascular free-flap transfer has been used to improve distal perfusion and cover large tissue defects caused by the critical limb ischemia during the past 30 years. We present our experience with a 71-year-old diabetic patient who underwent revascularization with a vascular bypass and a simultaneous microvascular flap reconstruction for limb salvage after domestic trauma. An extension of the "crane" principle was used to solve bypass exposure due to wound late complication. After 1-year follow-up, the patient was able to walk without pain. Combining 3 well-established methods of arterial revascularization and free-flap transfer and the old "crane principle," we achieved limb salvage, offering an alternative to below-knee amputation. *(Plast Reconstr Surg Glob Open 2017;5:e1315; doi: 10.1097/GOX.0000000000001315; Published online 20 April 2017.)*

Gangrenous lesions of foot or lower leg due to severe diabetic arterial disease resulting in extensive soft-tissue defects with exposed bones or tendons often end, even after successful revascularization, in staged or primary amputation. Free-tissue transfer is the method of choice over staged or primary amputation.[1] Furthermore, patients with critical limb ischemia (CLI) often suffer from comorbidities, which compromise the results of these demanding operations.

We present our experience with a 71-year-old patient, diabetic, affected by peripheral vascular disease and gangrenous lesions of the left foot that could not be treated by simple wound closure or skin grafting; revascularization with a long vascular bypass and a simultaneous microvascular flap reconstruction using the vein graft as the inflow were performed for limb salvage.

A late wound complication was solved by revisiting the old plastic surgery "crane principle,"[2] to avoid below-knee amputation: a pedicled subcutaneous tissue was lift and transposed from one area to another; after 4 weeks, the pedicle was returned to its original bed.

From the Plastic and Reconstructive Surgery Division, Clinica Cavadas, Valencia, Spain.
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CASE REPORT

A 71-year-old man, with no medical history, presented to the emergency department complaining of left toes necrosis, including metatarsal heads, plantar abscess, and dorsal medial skin necrosis of the foot (Fig. 1), after a domestic trauma.

Blood tests revealed that the patient was an untreated type II diabetic. He suffered the complications of severe diabetes including CLI. Physical examination revealed that both dorsalis pedis and posterior tibial pulses were absent. Computed tomographic angiography of the inferior limbs revealed good patency of the third portion of the left popliteal artery.

Surgical plan consisted of radical debridement and simultaneous revascularization by a long vascular bypass with ipsilateral great saphenous vein and coverage by free-flap reconstruction with a latissimus dorsi myocutaneous flap, using the vein graft as the inflow (Fig. 2). Great saphenous vein was end-to-side anastomosed to the third portion of the popliteal artery and end-to-end to anterior tibial artery. An ipsilateral latissimus dorsi myocutaneous flap was elevated using subscapular vessels as main pedicle but including the circumflex scapular artery and vein to anastomose the flap to the great saphenous vein bypass and thoracodorsal vein to posterior tibial comitans vein at the medial malleolus. An external fixator for limb elevation was used.[3]

Postoperative course was uneventful, and the patient currently started to ambulate without difficulty after 1 month. After 2 months, the patient presented with a

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Fig. 1. Preoperative view: left toes necrosis, including metatarsal heads, plantar abscess, and dorsal medial skin necrosis of the foot.

Fig. 2. Intraoperative view: revascularization and soft-tissue reconstruction were achieved by a long vascular bypass with ipsilateral great saphenous vein and a simultaneous microvascular latissimus dorsi myocutaneous flap, using the vein graft as the inflow.

wound complication and an exposed but functioning bypass, proximal to flap anastomosis, probably due to noncompliance with drugs treatment. Skin grafts were not a stable option, no regional flaps were available, and free flaps recipient sites were considered too technically demanding; to avoid a below-knee amputation, we decided to revisit and extend the "crane principle"[2]: a random pedicled partial medial latissimus dorsi muscle flap was sculptured from the previous free myocutaneous flap, deepithelized and 180° tilted to cover the bypass (Fig. 3). Donor site was skin grafted.

Four weeks later, bypass wound healed and the pedicled portion of the latissimus dorsi muscle removed, leaving a slice of tissue providing a stable coverage (Fig. 4).

After 1-year follow-up, the patient was able to walk without pain.

DISCUSSION

We present a complex case solved by 3 surgical steps: complex revascularization and soft-tissue coverage of foot managed to avoid limb amputation in the first simultaneous 2 steps.

To fix a difficult and possibly devastating late complication, the old "crane" principle, described in 1969, was revisited and extended in the third step[2,4,5]: a pedicled muscular tissue was lift and transposed from one area to another.

After 4 weeks, the pedicle was returned to its original bed. In this case, muscular tissue was "craned," showing that the second use of a random vascular pedicled portion of a free latissimus dorsi flap is possible and extending the original crane principle applied to fasciocutaneous flap.

Late exposure of vascular bypass needed a stable coverage, not solvable with a simply skin graft; large muscle mass offered well-vascularized free tissue to the ischemic area during first surgery and well-vascularized pedicled tissue for transposition during second surgery.[4] Soft-tissue reconstruction of the feet in diabetic patients with angiopathy, sensorial neuropathy, and immunopathy is a com-

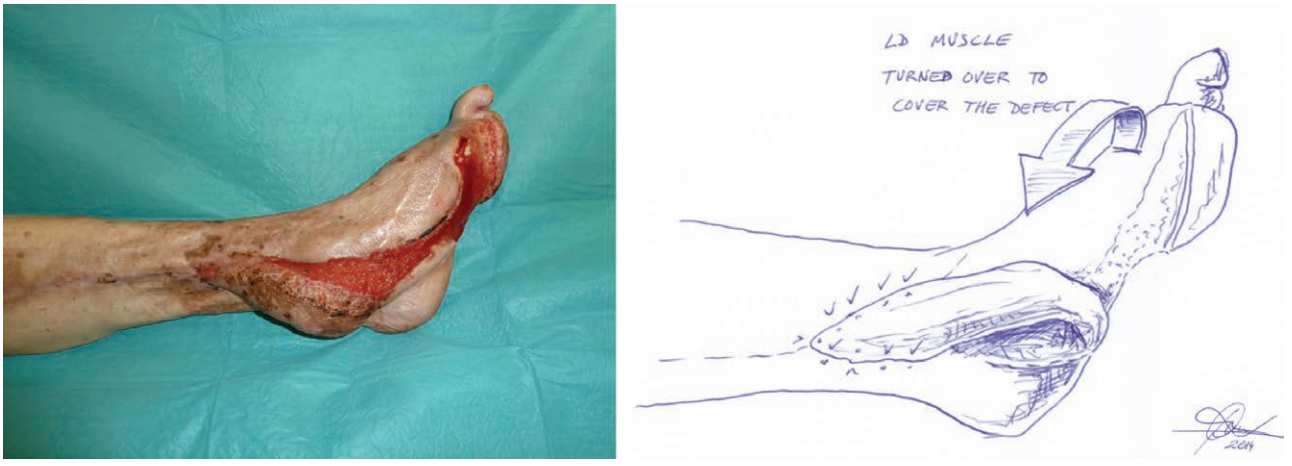

Fig. 3. Second postoperative view: random pedicled partial medial latissimus dorsi muscle flap sculptured from the previous free myocutaneous flap, deepithelized and 180° tilted to cover the exposed bypass.

Fig. 4. Final postoperative view: bypass wound healed, the pedicled portion of the latissimus dorsi muscle removed, leaving a slice of tissue above the great saphenous vein, providing finally a stable coverage.

plicated problem. Until the mid-1980s, chronic foot ulcers in diabetic patients were treated conservatively, because flap surgery was regarded as too risky.

To our knowledge, the idea of combining vascular reconstruction and microvascular free-flap coverage of ischemic lesion of the lower leg was first published in 1985.[6] Recently, early debridement and flap coverage have become popular reconstructive methods for diabetic foot wounds. Several flap donor sites are available, depending on the nature of the defect. The latissimus dorsi myocutaneous flap is an old flap that provides a large amount of muscle, skin, and subcutaneous tissue and low donor-site morbidity.[7,8]

Combined revascularization and free-tissue transfer has been described as a method of extending limb salvage to these patients.[7] Advantages are (1) immediate soft-tissue coverage limiting amputation level, resulting in early ambulation; (2) extra run-off to the revascularization, illustrated by a decrease in peripheral resistance; (3) limiting infection and enhancing neovascularization by application of healthy tissue; (4) preserving a full-length limb.[7,8]

Otherwise, graft patency is not absolutely necessary for flap survival. Mimoun et al.[9] first made the observation that neovascularization of the surrounding ischemic tissue by collaterals originating from the flap occurs as soon as 3 weeks after implantation and called this flap the "nutrient flap." Within the first 3 postoperative months, described complications leading to amputations are vascular graft thrombosis, no wounds healing and flap loss, no healing despite a vital flap, ischemic tissue defect in locations remote from the flap, necrosis of the flap a few years after primary operation, and healing vascular prosthesis infection.[8]

CONCLUSION

Combining 3 well-established surgical methods that include arterial revascularization, free-flap transfer, and the old "crane principle," we achieved limb salvage in a 71-year-old diabetic patient, offering an alternative to below-knee amputation.

Thione Alessandro, MD, PhD
Plastic and Reconstructive Surgery Division
Clinica Cavadas
Paseo de Facultades 1, bajo 8
46021 Valencia
Spain
E-mail: althione@gmail.com

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