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CASE REPORT
Reconstructive

Flow-through Anterolateral Thigh Flaps: Report of 3 Consecutive Cases and Review of its Utility

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Summary: In the field of plastic and reconstructive surgery, soft tissue reconstruction of Gustilo 3B with peripheral vascular disease or 3C fractures is a complex treatment algorithm. The concomitant issue of soft tissue coverage with vascular reconstruction is the main challenge when opting for free tissue transfer. The flow-through flap offers the surgeon the ability to treat a vascular injury or high-grade stenosis to maintain distal perfusion, while also providing soft tissue coverage. In this study, we present a case series of 3 patients who underwent flow-through anterolateral thigh free flap for lower extremity soft tissue coverage. Each patient had a history of trauma and either single vessel runoff or a dominant branch with diminutive secondary blood flow to the foot. All patients successfully underwent free flap reconstruction of lower extremity wounds while concomitantly reconstructing diseased arterial supply. Only 1 patient suffered partial flap loss postoperatively that was treated with debridement and split thickness skin grafting. Flow-through free tissue transfer is a valuable treatment option not only in Gustilo 3C fractures requiring soft tissue coverage, but also in patients with Gustilo 3B fractures with peripheral vascular disease. *(Plast Reconstr Surg Glob Open 2021;9:e3584; doi: 10.1097/GOX.0000000000003584; Published online 27 May 2021.)*

INTRODUCTION

Soft tissue coverage of the lower extremity can range from local tissue rearrangement to free tissue transfers. In Gustillo 3B and 3C wounds, free tissue transfer has become an increasingly utilized option, as microsurgery has gained popularity over the past 20 years. Evaluation of the wound and vasculature is of paramount importance before undertaking reconstruction, guiding the surgical team toward successful reconstruction.

A critical aspect of lower extremity salvage is maintaining distal perfusion after reconstruction. If a patient has single vessel runoff or diminutive secondary arterial supply, the operative plan must ensure continuity of distal perfusion; options include performing an end-to-side anastomosis or harvesting a flow-through flap. In this review, we present a series of 3 patients who underwent lower extremity reconstruction with a flow-through anterolateral thigh (ALT) free flap.

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Received for publication January 4, 2021; accepted March 18, 2021.

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DOI: 10.1097/GOX.0000000000003584

An ALT flow-through free flap has 2 main indications in our practice: (1) traumatic injuries of the extremities with segmental loss of an artery and need for soft tissue coverage (Gustillo 3C); (2) patients with peripheral vascular disease with high-grade stenosis of the recipient vessel and a chronic wound requiring soft tissue coverage. In vasculopaths, instead of performing a balloon angioplasty, the segment can be resected and reconstructed while simultaneously providing soft tissue coverage.

PATIENTS AND METHODS

We performed a flow-through ALT free flap on 3 consecutive patients. One patient suffered an acute traumatic injury, while 2 patients suffered from chronic wounds with exposed critical structures from a remote trauma.

SURGICAL TECHNIQUE

After the wound was adequately debrided, measurements were taken, which guided the dimensions of the flap. We began by making the anterior incision, and carried it through the fascia. A subfascial dissection was performed, and all perforators were identified and preserved and dissected back to the pedicle. After the pedicle was identified, the posterior incision was made down through the fascia, and a subfascial dissection was done

Disclosure: *All the authors have no financial interest to declare in relation to the content of this article.*

to completely raise the flap. The descending branch of the lateral femoral circumflex (LFCA) was then dissected back to its origin off the LFCA, and continued to the profunda femoris artery. Once the vessels were prepared in the lower extremity, we measured the length of pedicle and the amount of interposition artery needed. At that point, the anatomy of the LFCA was assessed and the

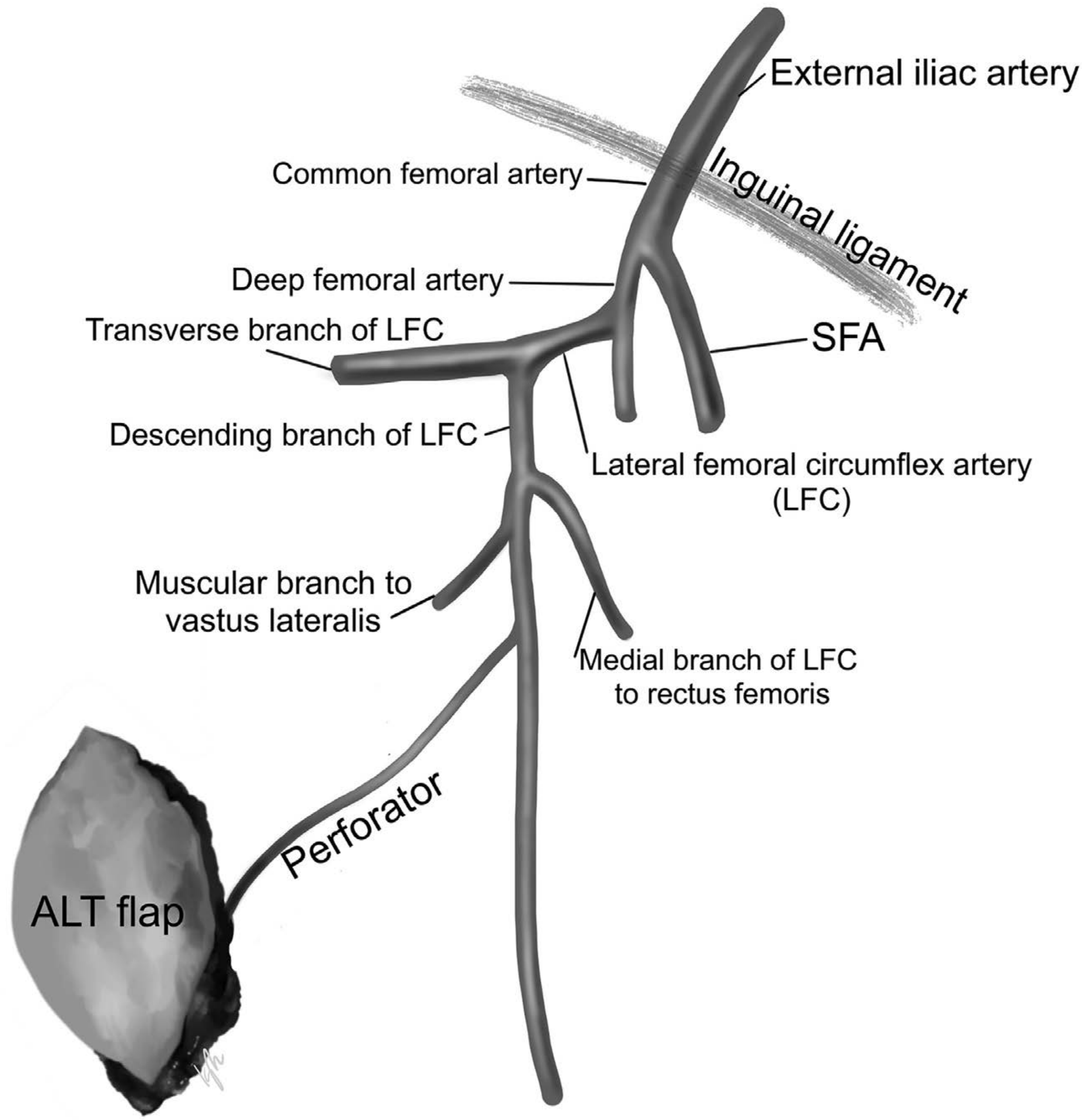

Fig. 1. Anatomy of the LFCA. Shortly after its take off from the proximal aspect of the profunda femoris, it branches laterally into 2 main branches: the transverse (or ascending) branch, which provides the blood supply to the tensor fasciae latae muscle, and the descending branch, which travels in the septum between the vastus lateralis muscle laterally and the RF medially. The descending branch of the LFCA divides into a medial branch that provides blood supply to the RF and a lateral branch that travels caudally in the septum. This descending branch gives muscular and cutaneous perforators (either true septocutaneous or musculocutaneous perforators) that are the basis of the anterolateral thigh (ALT) flap. The most important aspect of designing a successful flow-through flap is measuring the exact segment of resected/missing artery, and harvesting only what is needed from the donor site. Additionally, dissecting back to the profunda such that the transverse branch is exposed, as well as the medial branch supplying the RF is important. That allows the surgeon the largest number of options for designing the arterial reconstruction. Finally, one must ensure that if the medial branch of the LCFA is harvested, there is risk of ischemia to the RF. Likewise, if you take the transverse branch the blood supply to the TFL is compromised.

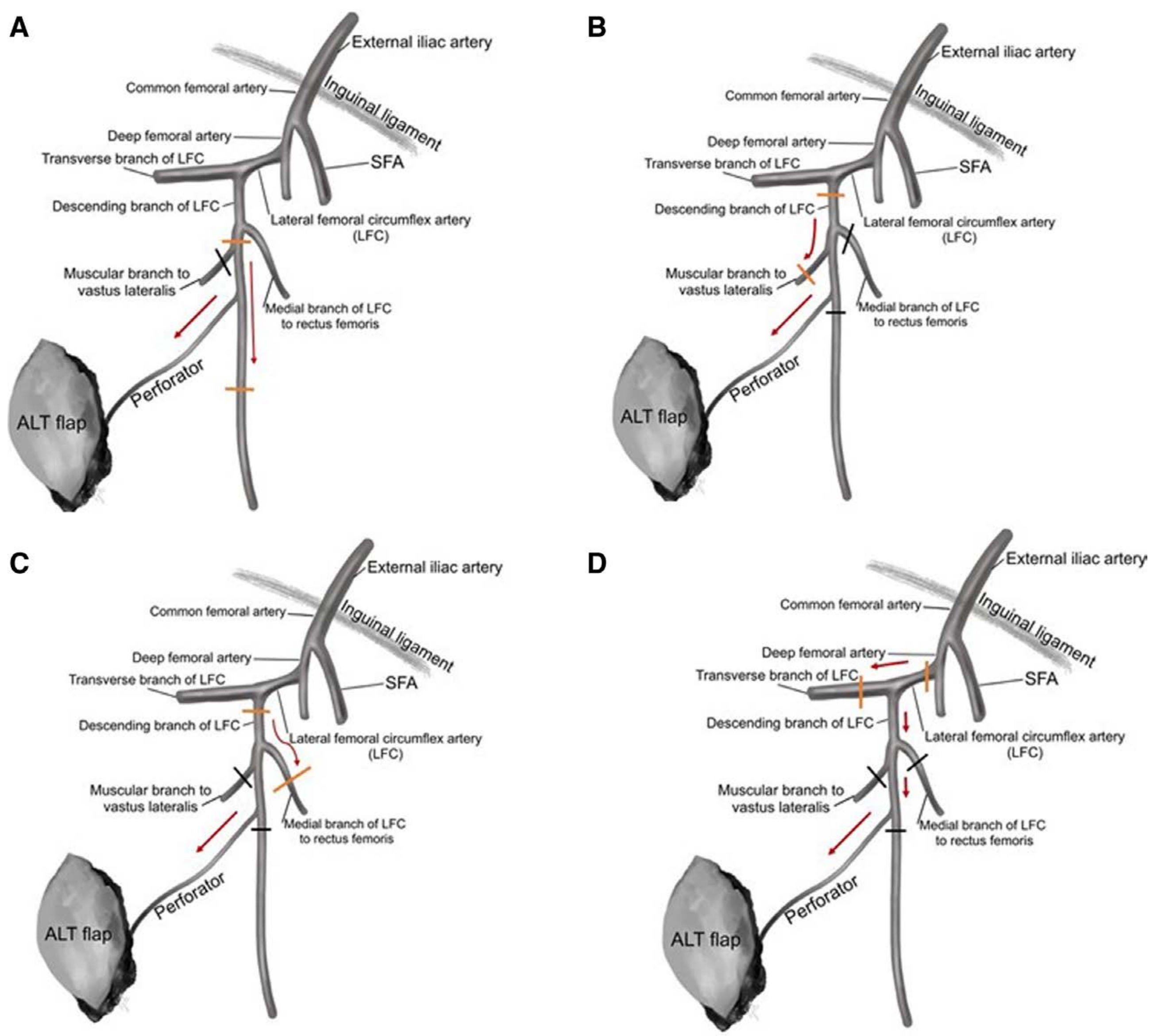

Fig. 2. Variation in harvesting the flow-through ALT free flap. The decision on the inflow and outflow of a flow-through ALT requires clinical experience and judgment of the recipient and donor vessels. The orange lines represent the inflow and outflow of the flap. The black lines represent the branches that need to be ligated. The red arrows represent the blood flow through the arterial system in each variation. In Figures 2B, C, and D one should be cognizant of the possibility of ischemia to the RF if dividing the medial branch. A, the most common variation. The inflow is the descending branch of the LFCA just distal to the take-off of the medial branch to the RF. The outflow is from the distal descending branch of the LFCA. B, The inflow is the descending branch of the LFCA just proximal or distal to the take-off of the medial branch to the RF, depending on the size match of the recipient vessels. The outflow is from a proximal muscular branch to the vastus lateralis. C, The inflow is the descending branch of the LFCA just proximal or distal to the take-off of the medial branch to the RF, depending on the size match of the recipient vessels. The outflow is from the medial branch to the RF. D, The inflow is from the common LFCA just lateral to the profunda femoris artery. The outflow is from the transverse branch of the LFCA.

decision was made regarding the length of inflow and the outflow vasculature was decided (Figs. 1, 2).

CASE 1

A 60-year-old woman suffered an acute Gustilo 3B fracture of her right calcaneus, and had a history of diabetes mellitus type 2. A preoperative angiogram showed a single highly stenotic lesion of the posterior tibial artery. The anterior tibial artery was patent while the peroneal was diminutive. The posterior tibial artery (PT) was reconstructed with a portion of the transverse branch of LFCA, as shown in Figure 2D. There were no postoperative complications, and the patient was discharged to rehab.

CASE 2

A 61-year-old woman with a remote history of a closed left tibial fracture who underwent an open reduction

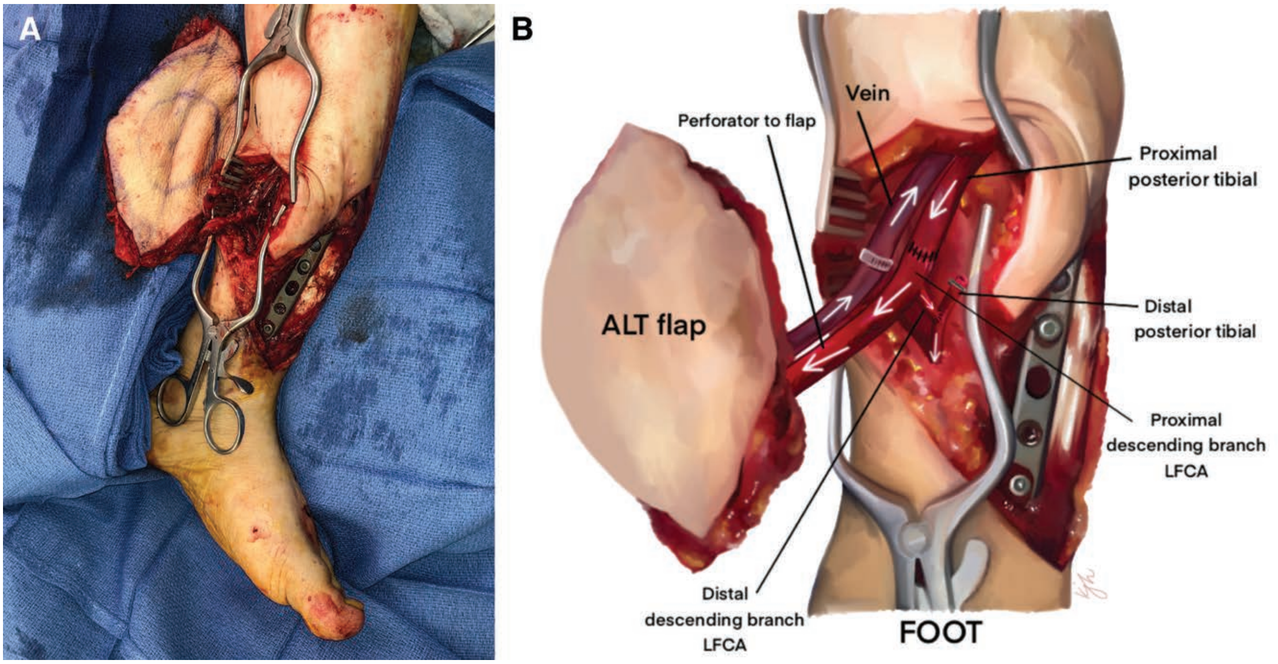

Fig. 3. Intraoperative demonstration of an ALT flow-through flap. A, The anastomoses have been performed, the foot assessed for distal perfusion and the ALT is about to be inset. B, Schematic illustration of the anastomoses and the anatomy of the ALT shown in 3A. The proximal PT was anastomosed with the proximal descending branch of the LFCA in an end-to-end fashion. The distal LFCA was used as the outflow. Due to the size discrepancy, an end-to-side anastomosis was performed, restoring the blood flow through the PT.

Fig. 4. Back table view of a flow-through ALT.

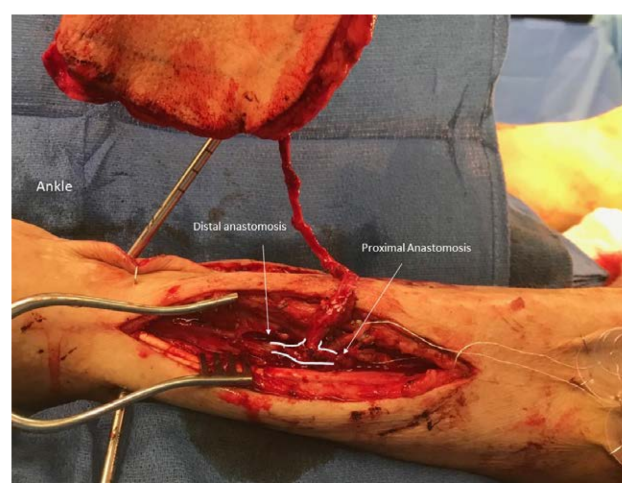

Fig. 5. Intraoperative view of a flow-through ALT. Two end-to-end anastomoses were performed to reconstruct the defect of the posterior tibial artery. The white lines outline the LFCA.

subsequently developed a wound with exposed hardware. She had a medical history of fibular hemimelia, and diabetes mellitus type 2. Preoperative angiogram of her left lower extremity showed a stenotic lesion of the proximal PT. The patient subsequently underwent a flow-through ALT with anastomosis to the PT, as shown in Figure 2B. The proximal anastomosis was performed in the descending branch distal to the branch to the RF, and the distal anastomosis was performed with the distal aspect of the descending branch (Fig. 3). There were no postoperative complications, and the patient was discharged to rehab.

CASE 3

The patient in Case 3 was a 60-year-old man with a 7-year history of chronic non-healing wound of his right ankle with exposed calcaneus, who failed local wound care. He had a medical history of insulin-dependent diabetes mellitus type 2 and atherosclerosis. Preoperative angiogram showed dominant blood supply to the foot via the PT, with severe stenosis of the anterior tibial artery (AT). A flow-through ALT with anastomosis to the AT after resecting the stenotic portion was performed (Figs. 4, 5). The proximal anastomosis was performed in the descending branch proximal to the branch to the RF. The distal anastomosis was via a lateral muscular branch to the vastus lateralis.

DISCUSSION

Flow-through free tissue transfer was first described in rats in 1981 by Nakayama et al, and then in humans by Soutar et al in 1983.[1,2] The appeal of flow-through flaps is that one can reconstruct a soft tissue defect, while maintaining distal perfusion.

Flow-through flap reconstruction has been described previously in the setting of traumatic extremity wounds.[3–6] Additionally, flow-through flaps have been utilized in non-trauma patients, such as reconstruction of head and neck neoplasms, corrosive esophageal injuries, and in patients with a history of peripheral vascular disease.[2,7,8]

There are 3 options for arterial reconstruction in Gustilo 3C fractures needing soft tissue coverage. The first is to perform a reverse venous interposition graft, then an end-to-side free flap arterial anastomosis. The second option is performing a proximal to distal bypass graft with vein for the vascular reconstruction, then an end-to-end free flap arterial anastomosis distally. The last option is to perform a flow-through flap with 2 end-to-end arterial anastomoses. Flow-through flaps have 2 main advantages; first, end-to-end anastomoses are technically less challenging, and second, with reestablishment of distal blood flow, there will be no steal syndrome from the flap.

CONCLUSIONS

We present 3 cases of trauma patients with a history of diabetes mellitus; each patient has either 1 vessel runoff, or single dominant vessel. Due to their histories of diabetes with underlying small vessel damage and intimal damage to blood vessels, we opted to perform a flow-through flap instead of end-to-side anastomoses.

Of our 3 patients, only 1 had a minor complication of distal venous congestion due to pressure on the flap postoperatively. There were no incidences of arterial insufficiency of the flap, nor of the distal extremity.

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