INTRODUCTION

Distally based flaps are useful for the treatment of skin defects of the extremities, but venous congestion sometimes occurs, followed by partial flap necrosis. Although almost all of the venous flow is from distal to proximal in the extremities, the venous flow of distally based flaps is reversed in many cases. The congestion in the peripheral part of the flap due to reverse flow can cause partial flap necrosis. Thus, to improve the reliability of distally based flaps, sufficient venous drainage is important. Previously, we reported on the effectiveness of venous anastomoses to rescue peripheral congestion of distally based flaps and applied this idea in a clinical setting. In this report, we present clinical cases of distally based flaps with venous supercharge anastomoses for changing the reverse venous flow into physiological flow, thereby reducing venous congestion.

METHODS

Four patients with skin defects of the extremities (2 cases with defects of the knee and the upper third of the lower leg, 1 case of the lower third of the lower leg, and 1 case of the distal third of the forearm) were treated with local flaps (2 cases with distally based greater saphenous venoadipofascial sartorius muscle combined flaps, 1 case with distally based lesser saphenous venoadipofascial flap, and 1 case with a distally based ulnar artery perforator flap). In each reconstruction, 1 or 2 veins in the flaps were anastomosed with superficial veins in the recipient area to change the reverse venous flow into a normal, physiologic flow. All flaps healed completely without any obvious venous congestion or flap necrosis. The coverage quality provided by these defects was satisfactory. Adding venous anastomoses may reduce the risk of venous congestion and improve the outcomes of the distally based flaps. (Plast Reconstr Surg Glob Open 2017;5:e1585; doi: 10.1097/GOX.0000000000001585; Published online 22 December 2017.)

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the distance from the pedicle of the flap to the defect. Also, the portion of the flap chosen was decided according to the particular venous anatomy of the flap. In each reconstruction, the additional venous anastomosis was performed between a flap vein and a cutaneous vein near the defect. By performing these anastomoses, the reverse venous flow was changed into antegrade venous drainage.

RESULTS

In all of these distally based flaps with venous supercharge, there was no venous congestion and no partial flap loss. The time to perform the anastomosis was approximately 20–30 minutes. All flaps survived uneventfully. The clinical results were satisfactory after several months of follow-up.

Case Reports

Case 1

A 59-year-old woman suffered from a malignant soft-tissue tumor on her left lower leg 20 years previously. Radical resection and radiation therapy were performed. Subsequently, she developed a radiation ulcer and underwent three debridements and skin grafts. Recurrence of the ulcer occurred (Fig. 1A). A fourth debridement resulted in a 20 × 8 cm skin defect with exposed tibia. A distally based greater saphenous venoadipofascial sartorius muscle combined flap, measuring 10 × 30 cm in size, was harvested (Fig. 1B), preserving enough of the greater saphenous vein for the anastomosis. The flap was designed to incorporate the superior genicular artery identified by Doppler. An additional incision was made on the distal side of the defect to identify and dissect the peripheral side of the greater saphenous vein. The flap was transposed onto the skin defect. The central side of the greater saphenous vein and the peripheral side of the greater saphenous vein were anastomosed to each other with 8-0 nylon. The donor site and the part of defect covered with subcutaneous tissue or muscle from the flap were covered with a meshed skin graft from the opposite side of the leg (Fig. 1C). The flap survived without any congestion and necrosis. Three months postoperatively, the flap had healed well (Fig. 1B).

Case 2

A 79-year-old man suffered from a synovial sarcoma on his right knee 14 years previously. Radical resection was performed, and the skin defect was covered with a sural flap from the same side. Two months previously, recurrence of the tumor occurred in the same knee. To cover the skin defect, measuring 10 × 10 cm in size, caused by the resection (Fig. 2A), a distally based greater saphenous venoadipofascial sartorius muscle combined flap, measuring 12 × 30 cm in size, was harvested (Fig. 2B). The greater saphenous vein was identified and dissected, leaving sufficient length for anastomosis. The lesser saphenous vein had already been divided and included in the sural flap in the previous operation. The flap was transposed to the skin defect. The central side of the greater saphenous vein and the peripheral side of the lesser saphenous vein were anastomosed to one another (Fig. 2C). The donor site of the flap was covered with a meshed skin graft from the opposite side of the leg. The flap healed without any congestion or necrosis. One and a half years postoperatively, the flap and graft were well healed without any functional loss (Fig. 2D).

Case 3

A 51-year-old woman suffered from a leiomyosarcoma on her left lower leg. Radical resection of the tumor resulted in a 6 × 10 cm skin defect, including partial defects of the tibia (Fig. 3A). A distally based lesser saphenous venoadipofascial flap, measuring 10 × 21 cm in size, was harvested from the posterior left lower leg (Fig. 3B), preserving enough of the lesser saphenous vein for anastomosis. An additional incision was made on the dorsal region of the foot to identify and dissect a cutaneous vein for supercharge. The flap was transferred to the skin defect. The central side of the lesser saphenous vein and the dorsal cutaneous vein were anastomosed to each other with 9-0 nylon (Fig. 3C). The donor site of the flap was covered with a skin graft from the buttocks. The flap survived without any congestion or necrosis. Three months postoperatively, the flap and skin graft had healed well (Fig. 3D).
A 67-year-old man suffered from a malignant soft-tissue tumor on his left wrist. Radical resection of the tumor was performed and resulted in a 6 × 7 cm skin defect. Cutaneous perforators of the ulnar artery were identified by Doppler and marked. Subsequently, a distally based ulnar artery perforator flap, measuring 9 × 15 cm in size, was designed (Fig. 4A). An additional skin incision was made on the central side of the flap and 2 cutaneous veins for venous anastomoses were identified and atraumatically dissected. The flap was rotated 180 degrees to cover the skin defect (Fig. 4B). An additional incision was made on the peripheral side of the defect, and the cephalic vein and basilic vein for supercharge were identified. These 2 veins and the 2 cutaneous veins in the flap were anastomosed to each other with 9-0 nylon (Fig. 5). The donor site of the flap was covered with a skin graft from the patient’s right thigh (Fig. 4D). The flap survived without any congestion or necrosis. Two months postoperatively, the flap and skin graft were healing well with no ulcers and no scar contracture (Fig. 4E).

**DISCUSSION**

In the reconstruction of extremity defects, free flaps or distant flaps are frequently designed. However, free flaps not only require longer surgery time but also have the risk of anastomotic artery spasm–inducing flap necrosis. Distant flaps require patients to be in an uncomfortable position for a long time and require an additional operation for dividing the flap. On the other hand, distally based flaps are useful for the reconstruction of skin defects of the extremities in terms of ease of harvest and the large arc of rotation. Moreover, distally based flaps can be elevated with no risk of flap loss caused by arterial spasm. In distally based flaps, particularly when large flaps are harvested or in diabetic or elderly patients who have peripheral vascular disease, flap congestion frequently occurs because of insufficient venous drainage due to nonphysiologic, reverse venous flow. Partial necrosis of the flaps frequently starts not with arterial ischemia but with venous congestion. Therefore, if distally based flaps can be harvested with a lower risk of congestion, reconstruction of difficult skin defects of the extremities can be performed more safely.

Previously, the importance of venous drainage has been reported in breast reconstruction with transverse rectus abdominis musculocutaneous flaps. Fukushima et al. reported the effects of microvascular venous flow augmentation on the survival area of skin flaps in rat models.
They demonstrated that the survival area of flaps extends with venous augmentation alone and that decongestion in the early postoperative period can stabilize blood circulation in the flap and increase the survival area. Recently, the clinical utility of venous supercharge in extremity reconstruction with distally based flaps has been reported by several authors. Although almost all of the venous flow is from distal to proximal in the extremities, the venous flow of distally based flaps is reversed. When considering venous drainage, the direction of the venous valve should also be taken in account. In this report, we presented several clinical cases to demonstrate a method for preventing venous congestion of distally based flaps by adding venous augmentation in order that the reverse venous flow changes to a normal flow along the direction of the venous valves. In cases 1, 2, and 4, intraoperative venous congestion was diagnosed before the venous anastomosis. In case 3, despite the fact that the flap did not demonstrate intraoperative venous congestion, we performed a venous anastomosis because venous congestion in distally based sural flaps due to retrograde venous flow has been reported; furthermore, the flap was relatively large in this case. In all these cases, no venous congestion and no partial necrosis occurred. All flaps survived completely. This method is particularly useful for the extremities because there are usually many cutaneous veins in the superficial layer of the extremities. Veins for supercharge are thus easily found and can be safely dissected without sacrificing main vessels. As we showed in this report, this technique is applicable to a variety of distally based flaps. Adding venous anastomoses, which is a simple and short procedure, may improve venous drainage, avoid venous congestion, and increase complete flap survival.

In terms of aesthetic outcome, free flaps may be better than distally based flaps because of the dog-ear created at the pedicle of distally based flaps. However, in these cases, we thought covering the defect more conservatively was more important than aesthetic outcome. This was because in cases 2, 3, and 4, the defect was caused by a malignant tumor, and in case 1, the defect was caused by a recurrent radiation...
ulcer. Free flaps have the risk of anastomotic arterial spasm—inducing flap necrosis, especially in flaps involving the lower limb. On the other hand, distally based flaps can be harvested with no risk of flap loss caused by arterial spasm.

Our experience demonstrates that venous anastomoses provide physiological antegrade venous drainage for relieving venous congestion in distally based flaps. In the reconstruction of skin defects of the extremities with flaps that have nonphysiologic, retrograde venous flow, especially when venous congestion of the flap is diagnosed during the operation or when a large flap is planned, the addition of superficial vein anastomoses from the flaps with a superficial vein in the recipient area makes it possible for a variety of distally based flaps to cover defects more safely. However, we cannot definitively espouse venous anastomoses in distally based flaps based on the findings of this report; our series is too small. Further studies in a larger cohort are needed comparing flaps with and without venous anastomoses.

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