Flowthrough Omental Flap for Vascularized Lymph Node Transplant of the Lower Extremity

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Summary: Vascularized lymph node transplantation is a surgical approach for the treatment of chronic lymphedema. However, there is no clinical standard for flap placement nor vascular anastomoses. The authors propose a novel flowthrough configuration for an omental vascularized lymph node transplant in the popliteal space. To prepare the popliteal space for an omental free flap, the medial popliteal fat pad and medial head of the gastrocnemius muscle were debulked. Venous anastomoses were completed with vein couplers, joining the right gastroepiploic vein to the medial sural venae comitantes and the left gastroepiploic vein to the lesser saphenous vein. Arterial anastomoses were hand sewn, joining the right gastroepiploic artery to the proximal medial sural artery and the left gastroepiploic artery to the distal medial sural artery, to create the flowthrough configuration. A retrospective review of patients who underwent this procedure at a single institution was performed. Six patients with chronic lymphedema of the lower extremity underwent vascularized lymph node transplantation from June of 2019 to November of 2020. Five patients underwent at least 3 months of postoperative surveillance, with no postoperative complications reported. In this technique contribution, the authors describe a novel flowthrough configuration for an omental free flap to the popliteal space. The popliteal space offers an aesthetically favorable recipient location when appropriately prepared. The medial sural vessels are ideal recipient vessels for the flowthrough omental flap. (*Plast. Reconstr. Surg.* 149: 542e, 2022.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

Vascularized lymph node transplantation is a surgical treatment for chronic lymphedema. The omental flap has gained popularity as a vascularized lymph node transplant given the flap's unique lymphangiogenic properties and the decreased risk of donor-site lymphedema.[1–4] Vascularized lymph node transplants, including the omental flap, are prone to venous hypertension, and we have previously described a flowthrough configuration in the upper extremity to alleviate this risk.[5] Specifically, in a swine model, it has been demonstrated that arterial inflow into an omental flap is reduced in a flowthrough configuration.[6] In our current report, we propose a novel flowthrough configuration for the omental vascularized lymph node transplant in the lower extremity.

There are many recipient sites for vascularized lymph node transplantation in the lower extremity, and both distal and middle leg placements have yielded similar outcomes.[7] The advantages to middle leg placement include greater potential space for composite transfer, improved scar, faster healing, decreased need for a skin graft, and increased surface contact with overlying skin.[7] Flap physiology must also be considered. To minimize venous hypertension in the omental vascularized lymph node transplant, the addition of a secondary venous outflow has been proposed.[8] In the upper extremity, we proposed a novel inset with a second arterial and venous anastomosis, thereby recreating the omentum's natural flowthrough physiology.[5] In this case series, we describe our lower extremity approach to omental vascularized lymph node transplantation with a middle leg recipient site and flowthrough configuration.

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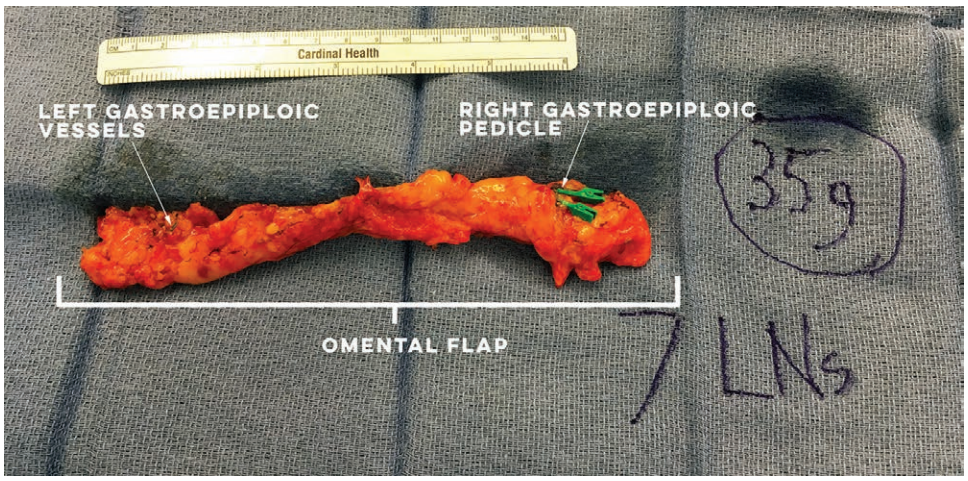

Fig. 1. A back table photograph of a harvested omental flap weighing 35 g. Intraoperative ultrasound was utilized to confirm the presence of seven lymph nodes (*LNs*) along the gastroepiploic vessels.

METHODS

Retrospective Review

A retrospective review of a prospectively maintained quality improvement database was performed. Institutional review board approval was obtained (protocol no. 2020P001171). Consecutive patients who underwent vascularized lymph node transplantation of the lower extremity were identified. Patient characteristics, intraoperative data, and postoperative outcomes were analyzed.

Surgical Technique

The omental flap was harvested in collaboration with general surgery with the patient supine. The omental flap harvest has previously been described (Fig. 1).[5,9] The flap is placed in a cold, moistened gauze. The patient was then turned prone.

Under tourniquet control, a transverse incision was placed within the popliteal flexion crease, with a 4-cm extension cranial on the lateral side and caudal on the medial side. The superficial tissues were then dissected above the deep fascia 5 cm above and below the popliteal crease. The deep fascia was opened in the midline and the lesser saphenous vein was dissected to 4 cm below the crease, divided, and reflected cephalad. Care was taken to preserve the sural cutaneous nerves.

The popliteal space was debulked by excising the medial aspect of the popliteal fat pad (Fig. 2).

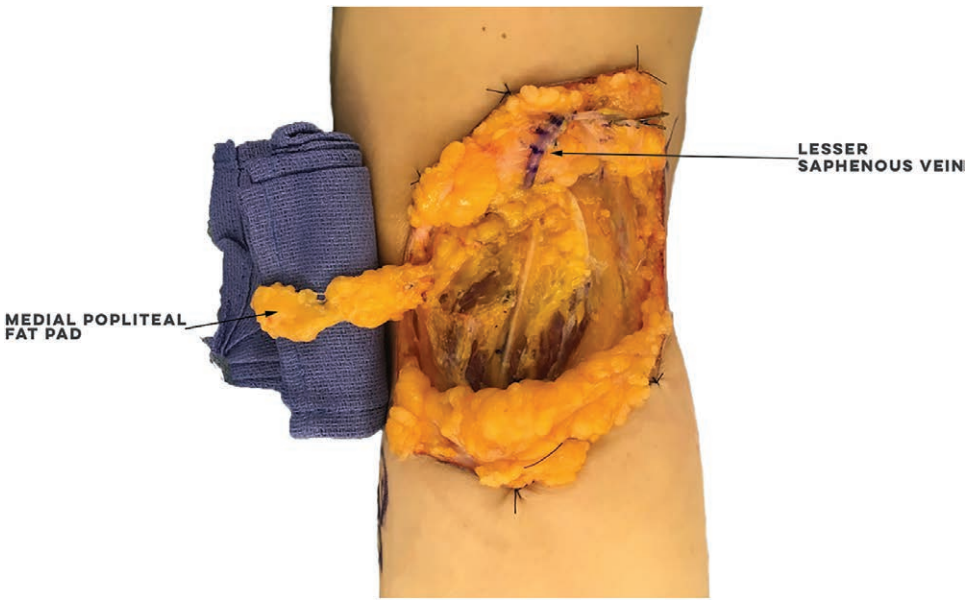

Fig. 2. The lesser saphenous vein has been ligated distally and reflected proximal. This vessel will later be utilized to provide a second venous outflow. A portion of the medial fat pad has been isolated and removed. More can be removed if necessary.

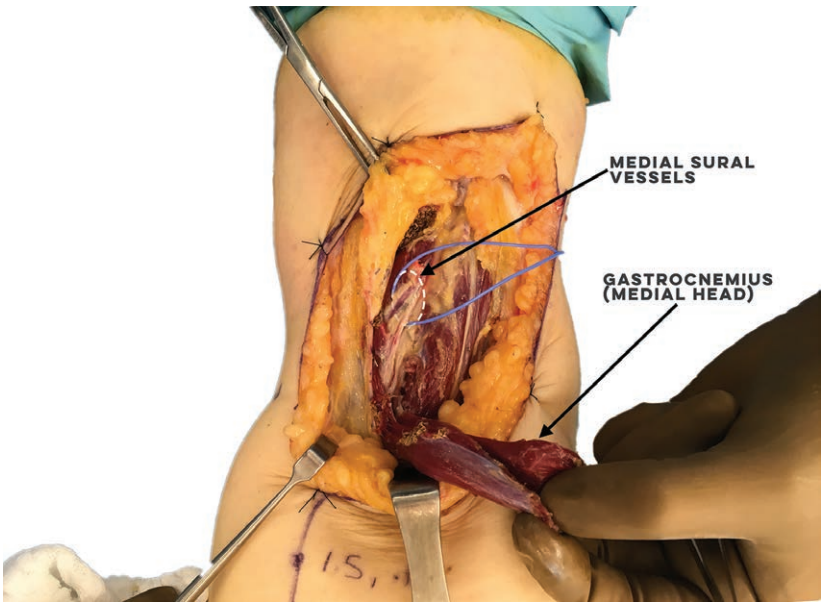

Fig. 3. The medial sural recipient vessels are identified and dissected for a length of 6 cm. Once the vessels are isolated, the head of the medial gastrocnemius superficial to the vessels is resected.

The median raphe between the two heads of the gastrocnemius muscles was then reflected, exposing the medial sural vessels which were dissected intramuscularly to obtain 6 cm of length. The head of the medial gastrocnemius muscle superficial to the medial sural vessels was then resected (Fig. 3). The exposed medial sural artery was divided at its midpoint. The right gastroepiploic artery was anastomosed to the proximal medial sural artery and the left gastroepiploic artery was anastomosed to the distal medial sural artery, thereby creating the flowthrough configuration. The right gastroepiploic vein was coupled to the proximal medial sural vena comitans. The left gastroepiploic vein was coupled to the previously prepared proximal lesser saphenous vein (Fig. 4). Patency was confirmed with handheld Doppler ultrasound and indocyanine green angiography. The surgical field was then closed primarily in a layered fashion over a no. 15 Blake drain. Postoperative flap monitoring was performed utilizing transcutaneous Doppler ultrasound.

RESULTS

Six patients with chronic lymphedema of the lower extremity underwent an omental flowthrough vascularized lymph node transplant to the popliteal space. Their mean age was 58 years (range, 51 to 70 years) and mean body mass index was 22.9 kg/m^2 (range, 16.4 to 27.7 kg/m^2). Five patients had cancer-related lymphedema (83 percent). Four patients had undergone debulking surgery via power-assisted liposuction of the operative extremity before vascularized lymph node transplantation.

Mean flap weight was 23.7 g (range, 14 to 35 g) and the median number of lymph nodes transferred as detected by intraoperative ultrasound was seven (range, five to nine). The mean length of the omental flap was 12.5 cm (range, 12 to 15 cm), and mean width was 2.8 cm (range, 2 to 3 cm). The mean tissue weight debulked from the popliteal space was 19.7 g (range, 10 to 24 g). The median coupler size for the right and left gastroepiploic veins was 2.5 mm (range, 2 to 3 mm) and 2.0 mm (range, 2 to 2.5 mm), respectively. The mean ischemia time was 266 minutes.

One intraoperative duodenal tear occurred during omental harvest in a patient with a history of sleeve gastrectomy. This tear was immediately repaired with no subsequent sequela. No postoperative complications were reported.

Mean follow-up time was 7 months (range, 3 to 12 months). [**See Figure, Supplemental Digital Content 1**, which shows axial, T1-weighted, fat-saturated magnetic resonance image of the left lower extremity at the level of the femoral condyles (*F*). The transplant, at 1 year follow-up, demarcated by the *blue arrows*, is located posterior to the medial head of the gastrocnemius (*G*). The flap vessels are denoted by the *red arrow*. Surgical clips result in focal susceptibility artifacts with a signal void

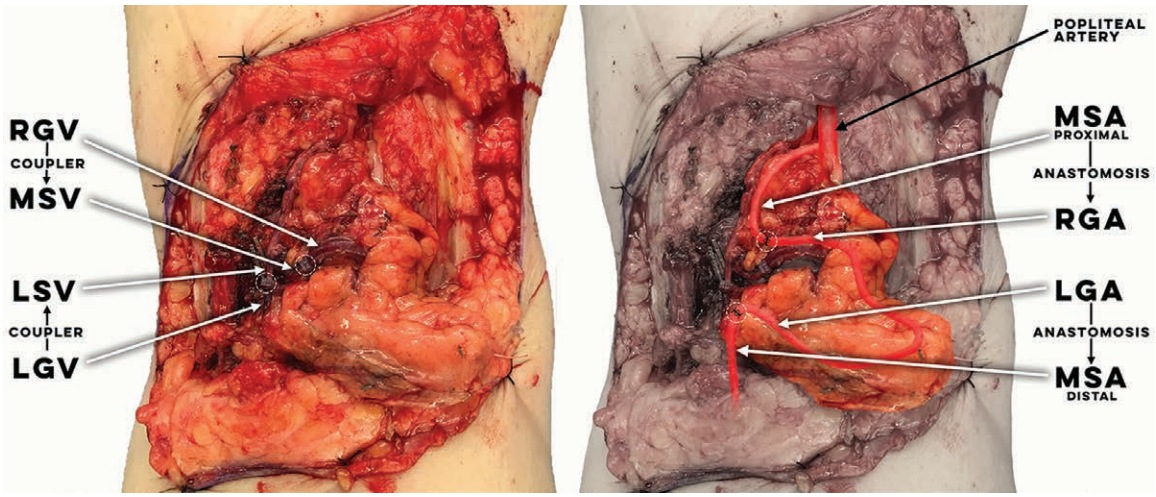

Fig. 4. (*Left*) The flap has been inset and venous anastomoses completed with vein couplers joining the right gastroepiploic vein to the medial sural venae comitantes and the left gastroepiploic vein to the lesser saphenous vein. (*Right*) The same picture (color saturation reduced by 70 percent to demonstrate the omental flap in the popliteal space) is again demonstrated on the right to highlight the arterial connections. The course of the artery is drawn after handsewn anastomosis of the proximal medial sural artery and the right gastroepiploic artery and the distal medial sural artery to the left gastroepiploic artery. *RGV*, right gastroepiploic vein; *MSV*, medial sural venae comitantes; *LSV*, lesser saphenous vein; *LGV*, left gastroepiploic vein; *MSA*, medial sural artery; *RGA*, right gastroepiploic artery; *LGA*, left gastroepiploic artery.

(*yellow arrow*), ***http://links.lww.com/PRS/E915***.] One patient with bilateral lymphedema was excluded from outcome analysis. Average preoperative excess volume was 193 ml (SD, 608 ml), and average postoperative excess volume was 529 ml (SD, 440 ml). Median preoperative and postoperative bioimpedance spectroscopy (L-Dex; ImpediMed, Brisbane, Australia) was 36.1 (range, 7.1 to 53) and 37.2 (range, 13.2 to 95), respectively. Mean preoperative and postoperative quality of life measures for limb lymphoedema scores demonstrated an improvement in overall quality of life from 7.3 to 8.2. All mean quality of life measures for limb lymphoedema subscores also demonstrated an improvement: function, 1.5 to 1.3; body image, 2.2 to 1.7; symptoms, 1.8 to 1.5; and mood, 2.0 to 1.3.

DISCUSSION

In this technique contribution, we describe a flowthrough omental vascularized lymph node transplant in the popliteal space. The popliteal space offers an aesthetically favorable recipient location when appropriately prepared. The medial sural vessels are ideal recipient vessels for the flowthrough omental flap.

The popliteal space offers an aesthetically favorable recipient location if prepared for primary closure. Specifically, removal of the popliteal fat pad and the medial head of the gastrocnemius muscle allowed for us to make up over 80 percent of the volume of the omental vascularized lymph node transplant, thereby allowing for primary closure without undue tension on the underlying flap. This tissue can be removed without functional consequence. Moreover, the popliteal space is a familiar anatomic area for plastic surgeons who use the region for recipient vessels for free tissue transfers around the knee, fasciocutaneous medial sural artery flaps, medial gastrocnemius muscle flaps, and vascularized sural nerve transfers.[10–14] In this technique contribution, we demonstrate that the medial sural vessels offer a good anatomic configuration for flowthrough anastomoses, thereby minimizing the potential for venous hypertension.[5,6] Adequately sized arteries and veins allow for ease of microsurgical anastomosis and a longitudinal inset. In addition, the medial sural vessels are not a source of distal leg perfusion and there is no risk even if sacrificed.

While the primary purpose of this report was a technique contribution, we note that early follow-up data demonstrated an increase in excess volume. As per our center's protocol, most of the patients described initially presented with fat hypertrophy and therefore underwent preoperative debulking and utilized 24/7 compression before vascularized lymph node transplantation. Following vascularized lymph node transplantation, compression

is discontinued initially. Therefore, an increase in excess volume in the early follow-up period is expected. As we refine this technique, long-term follow-up with comparative outcomes will be necessary for validation.

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