of dissection, as these structures should be avoided (Fig. 8.17). An incision is carried directly down through the deep muscle fascia, and then subfascial flaps are elevated to expose the medial sural artery perforators. The largest perforator is selected and a retrograde intramuscular dissection is performed, which will lead to the medial sural vessels, which are mobilized proximally as required for anastomosis. The veins are typically large (2–3 mm) but the artery is consistently in the neighborhood of 1.5 mm. Preoperative MRA can be helpful in assessing the branching patterns. If both the lateral thoracic and thoracodorsal artery and veins are to be anastomosed, there is often a large bifurcation of the medial sural vessels making four anastomoses quite straightforward (Fig. 8.18). The final step is to excise a window of the deep investing muscle fascia and a portion of the subcutaneous fat to allow room for the lymph node flap and ingrowth of new lymphatics. Care must be taken to limit the width of dissection in order to avoid the greater saphenous vein and sural nerve. Anastomosis is performed to all proximal vessels that are present, which is dependent on the anatomic variability of the patient (Fig. 8.19).

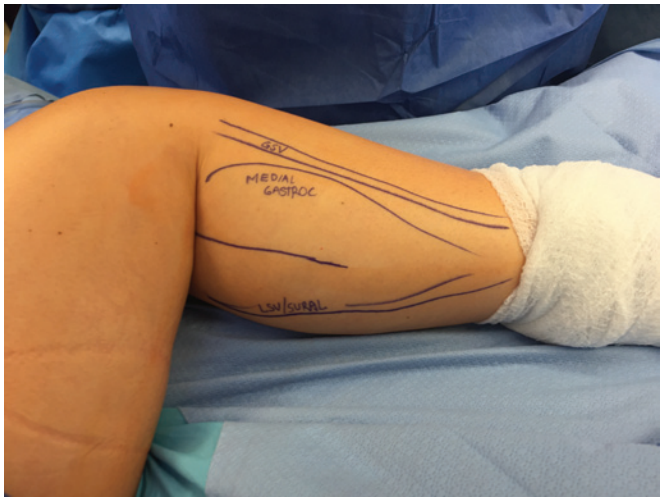

Figure 8.17 Marking for the medial sural recipient vessels.

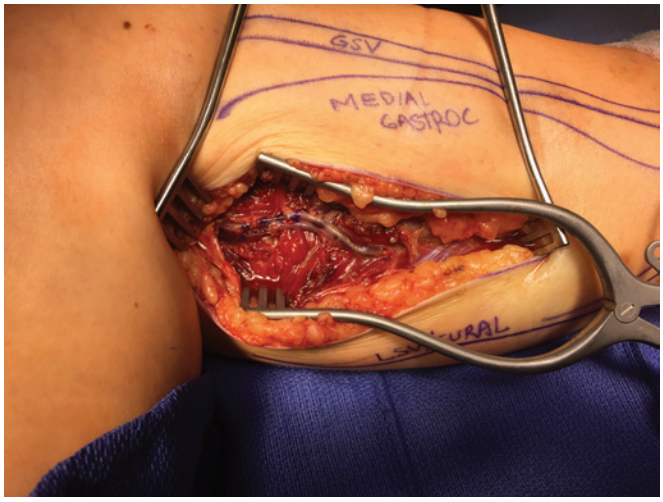

Figure 8.18 Exposure of medial sural vessels.

VASCULARIZED SUPRACLAVICULAR LYMPH NODE TRANSFER WITH REVERSE LYMPHATIC MAPPING

The supraclavicular flap is another common option for lymph node transfer. It was initially favored because of the misperception that there is no risk of upper extremity lymphedema, but this has since been shown to be false. This has prompted us to use a modified technique of reverse lymphatic mapping that identifies not only potentially critical lymph nodes to upper limb drainage but also the right lymphatic duct and thoracic duct, which can be injured during dissection. A dose of 0.2 mL of filtered technetium is injected into the first and second web spaces of the hand prior to surgery, and 0.5 mL of indocyanine green is injected into the medial upper arm, which is massaged proximally. The gamma probe is used to sweep for any hot nodes in the supraclavicular region. If they are present, the site is abandoned. The indocyanine green dye will highlight major lymphatic ducts using near infrared imaging, which are critical to upper limb drainage.

Thorough knowledge of anatomy of the supraclavicular region is critical to safely elevating this flap, which is based on the transverse cervical artery (see Ch. 33; Fig. 11.1 and Fig. 8.1). This artery commonly originates from the thyrocervical trunk, situated on the subclavian artery. However, there can be significant variability and it may originate from the suprascapular artery or directly from the subclavian artery as well. Venous drainage of the flap can be based on the transverse cervical vein, which is also variable or from the external jugular vein. Major lymphatic ducts can be encountered during dissection and have variable entry points into the internal jugular vein and subclavian vein. The phrenic nerve, spinal accessory nerve, and brachial plexus are all in the field of dissection. Patients should be aware they will have loss of sensation in the supraclavicular/upper chest region because of division of supraclavicular nerves that pass through this flap. Some patients may also experience temporary but profound neuropathic pain as well.

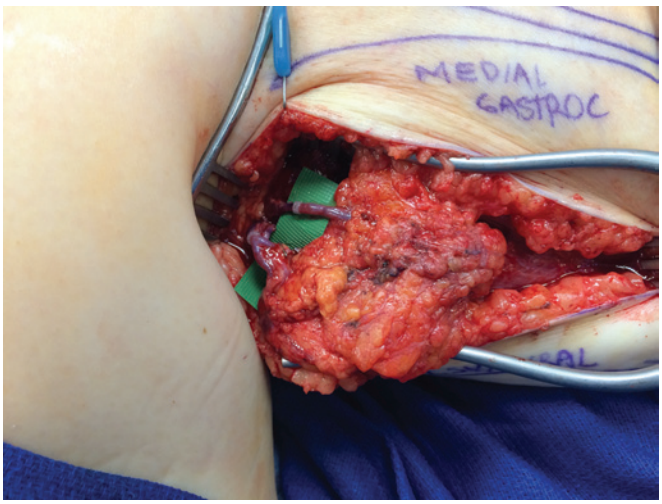

Figure 8.19 Flap inset with thoracodorsal artery, vein, and lateral thoracic vein anastomosed to medial sural vessels.

FLAP MARKINGS AND ELEVATION

Most commonly we will not include a skin paddle and will orient the incision parallel to Langer's lines midway between the clavicle and the base of the neck to minimize the scar. The sternal notch, sternocleidomastoid, and external jugular vein are all marked for orientation (Fig. 8.20). A skin paddle can be included if desired with the perforator located at the midclavicular line.

The incision is carried down through the platysma and flaps are elevated to expose the supraclavicular fat pad in a subplatysmal plane. The external jugular vein will traverse the superficial surface of this flap and is divided at the superior border. The external jugular vein is dissected proximally at the inferior border and divided with a microvascular clamp placed on the flap side as it may be required for venous outflow. The sternocleidomastoid is exposed and retracted medially. Dissection is carried deep along the border of the sternocleidomastoid where the omohyoid muscle is divided, which will bring the internal jugular vein into view. Dissection can then proceed from a lateral and superior approach where the inferior belly of the omohyoid is divided. Relatively large branches of the supraclavicular nerve pass through the flap at the superior margin and must be divided. The flap is elevated from the trapezius muscle where the spinal accessory nerve is carefully avoided. As dissection continues medially over the anterior scalene muscle, the phrenic nerve is preserved where it lies on the superficial surface and the brachial plexus is avoided deep to this muscle. At this point, the transverse cervical artery and vein are explored, which arise deep and inferiorly near the base of the anterior scalene muscle. On occasion, the transverse cervical vein is not draining the flap and the external jugular vein is used instead (Fig. 8.21).

During the course of this dissection, near infrared imaging is used to confirm the location of major lymphatic ducts, which are avoided, or if they pass through the lymph node flap and are divided, they can be anastomosed to large neighboring veins to restore their physiologic function and avoid the risk of lymphedema. We have encountered a situation where these ducts required lymphovenous anastomosis as they passed through the lymph node flap. We have also encountered a scenario where the medial-most supraclavicular nodes were hot when inspected with the gamma probe and the flap was modified to preserve these lymph nodes.

Figure 8.20 Supraclavicular flap markings.

POSTOPERATIVE MANAGEMENT

All lower extremity lymph node transfers are kept nonweightbearing for 2 weeks with a walker and daily prophylactic enoxaparin. Compression is completely avoided except for over the foot during this period. After 2 weeks, the patient is seen by a lymphedema therapist and can start compression wrapping over the entire limb, including the area of the lymph node flap. Regarding ambulation, the patient is instructed to place 25% weightbearing on the limb for 2 days after the 2-week period, followed by 2 days at 50%, 2 days at 75%, then full weightbearing. The purpose of this gradual increase is to avoid inflammation, which could precipitate swelling. At 6 weeks the patient returns to full normal activity. Between 6 and 8 weeks, the patient is often fitted for a custom compression garment, although this can vary depending on the patient's response to surgery and therapy. In general, the patient is under close care of a certified lymphedema therapist for 6 months. There is often the question of a standardized postoperative therapy protocol, which has yet to be developed. However, patients have different stages of lymphedema that respond differently, and so the therapy is often guided by the individual patient and therapist with the main clinical end-point being the most effective volume reduction in the limb.

OUTCOMES

While there have been several reports on outcomes following lymphatic surgery, most of these have focused on limb volume, which can easily be manipulated by postoperative compression. Even if this is controlled for, many other

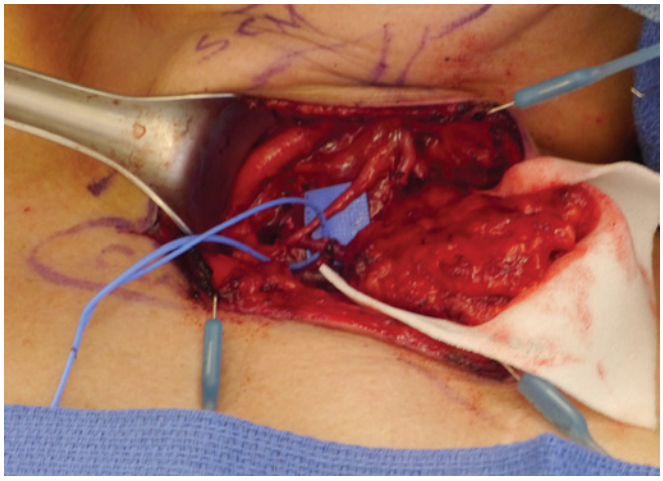

Figure 8.21 Supraclavicular flap elevated.