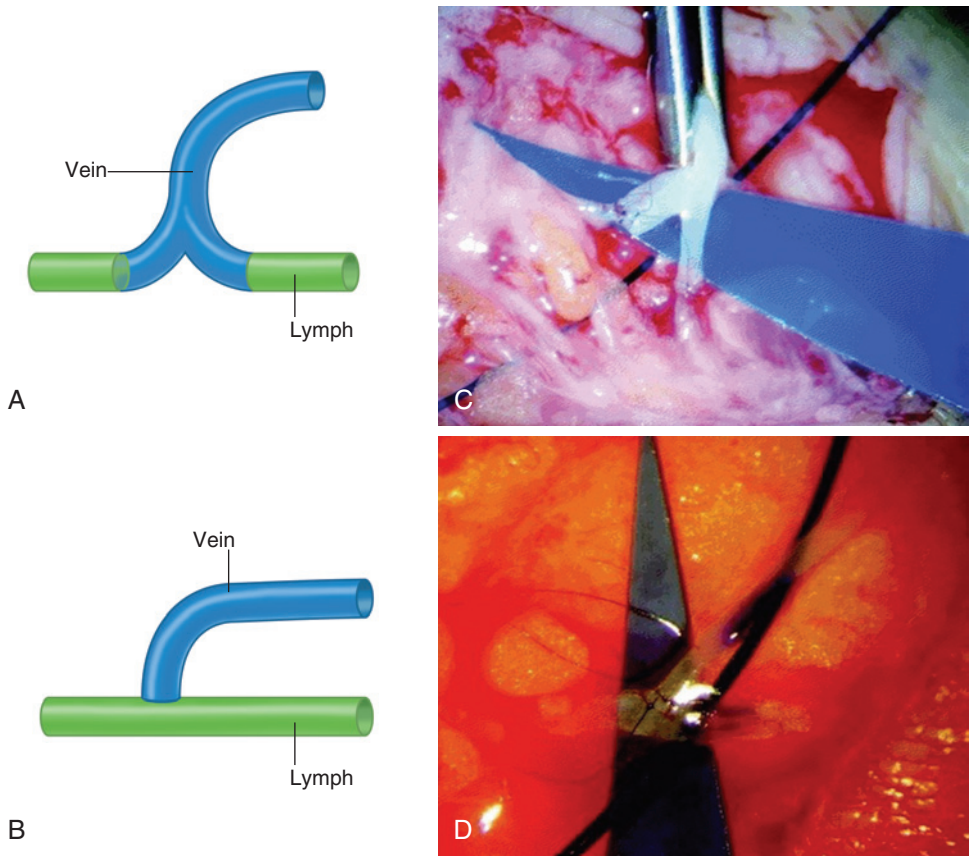

Figure 8.7 (A) Diagram of completed flow-through lymphaticovenous anastomosis, in which a Y-shaped vein (V) and lymphatic channel (L) are anastomosed. (B) End-to-side lymphaticovenous anastomosis is performed when a similar size vein (V) and lymphatic channel (L) are present, as shown in this diagram of completed anastomosis. (C) Intraoperative photograph of completed flow-through anastomosis. (D) Intraoperative photograph of completed end-to-side anastomosis. A bent stent aids in performing the anastomosis. (Redrawn from Narushima, et al. The intravascular stenting method for treatment of extremity lymphedema with multiconfiguration lymphaticovenous anastomosis. Plast Reconstr Surg 2010;125[3]:935–43.)

anastomosed to the end of a proximal vein. This allows for bidirectional drainage into the proximal vein. While conceptually appealing, this is also technically challenging. Placing a temporary microvascular clamp proximally on the lymphatic vessel will allow it to dilate to a point where creating the window and performing the anastomosis is more feasible. Using the parachute technique and/or intravascular stenting methods can minimize back-walling these tiny anastomoses. A nylon suture 2/5 the width of the lymphatic vessel, is sharply cut with a blade (and not a scissors, to avoid creating a barb) and is introduced intraluminally into the lymphatic vessel and vein across the planned anastomotic site. This allows for enough room to pass a needle while blocking it from back-walling the vessel. The stent is removed prior to tying the last knot. When the lymphatic vessel is much smaller than the neighboring vein, a variety of alternative arrangements have been used such as a side-to-side anastomosis or the "Pi" arrangement, where the lymphatic is divided and both proximal and distal ends are attached end-to-side to a single larger vein (Fig. 8.7).

POSTOPERATIVE MANAGEMENT

Many surgeons advocate some form of massage distal to the most distal LVA in order to propel lymph across the anastomoses in the hopes of preserving their patency, including gentle massage of the fingertips if the LVA was performed in the hand or wrist. The effects can be appreciated intraoperatively and are continued in the perioperative period. Any significant compression is generally avoided in the first 2 weeks following surgery. There is currently no consensus on a postoperative compression regimen, but all patients are generally back in the care of their lymphedema therapist in the postoperative period.

TREATMENT OF UPPER EXTREMITY LYMPHEDEMA WITH LYMPH NODE TRANSFER

FLAP OPTIONS

We have yet to find one ideal donor site for VLNT, but it is important to be familiar with several options because some of these donor sites may not be available.[4,17,19,64–71] The most commonly used flaps include the groin, axilla, supraclavicular, and submental/submandibular flaps. A midcervical flap based on superior thyroid vessels has been recently used, which does not risk donor site lymphedema (Babak Mehrara, pers. comm., October 2014). The omentum has

also been revisited because there is no risk of extremity lymphedema.

The groin is one of the most commonly used donor sites because of familiar anatomy, abundant tissue, and a discrete scar. However, it has a short pedicle (typically 1–2 cm) and a vessel caliber usually between 1–1.5 mm with a risk of lower extremity lymphedema.

The axillary flap based on the thoracodorsal or lateral thoracic vessels has a larger and longer pedicle with the option for including a large skin paddle and muscle if needed. We commonly use this as a buried flap in the calf for lower extremity lymphedema or as a composite lymph node – TDAP flap if skin is required to resurface a severely radiated and contracted axilla for upper limb lymphedema.

The supraclavicular flap provides a relatively small amount of soft tissue and small skin paddle, but a longer pedicle than the groin. However, it is technically more challenging as the phrenic nerve, spinal accessory nerve, lung, right lymphatic duct or thoracic duct, and a variable pedicle must be negotiated.[64] There is also a risk of upper extremity lymphedema. If it is used to treat upper limb lymphedema, it should be harvested from the contralateral side as the major lymphatic collectors from the upper limb may pass near or through these lymph nodes.

The submandibular or submental flap described by Ming-Huei Cheng has a major advantage of avoiding any risk of limb lymphedema.[67] However, there is a possibility of injuring the marginal mandibular nerve with subsequent lower lip weakness and a scar beneath the mandibular border.

RECIPIENT SITE

There has yet to be conclusive data regarding the ideal recipient site for a lymph node transfer. Two competing theories regarding mechanism and, consequently, rationale for recipient site selection are the lymphovenous shunting hypothesis proposed by Chen, and the lymphatic bridge proposed by Becker. Becker advocates for burying lymph nodes in the axilla following complete removal of any existing scar, aiming to restore lymphatic continuity across the lymphadenectomy site.[65,66] Indeed, lymphoscintigraphy studies and MRL studies have confirmed reconstitution of afferent and efferent lymphatics into the VLNT in some, but not all patients. In our own series, while at least two-thirds of patients experienced improvement, only one-third demonstrated uptake of the proximal lymph node transfer on lymphoscintigraphy. The axillary recipient site is also cosmetically desirable and allows the surgeon to address other issues such as scar contracture, axillary vein stenosis, or pain syndromes from neuroma or entrapped nerves.

Cheng makes a compelling case for placing the lymph nodes in the most dependent area at the wrist with a skin paddle which has yielded the best results in his series.[72–77] Cheng has confirmed shunting of lymph from the lymph node flap into the vein that drains the flap both in animal and human studies. This is possible through interconnections between the lymphatic sinuses and venules within the lymph node itself where the circulation interacts with the lymphatic system. If the patient does not want a visible flap on the wrist, the forearm is used as a recipient site, although the wrist provided the greatest limb reduction in Chen's reported experience.[72]

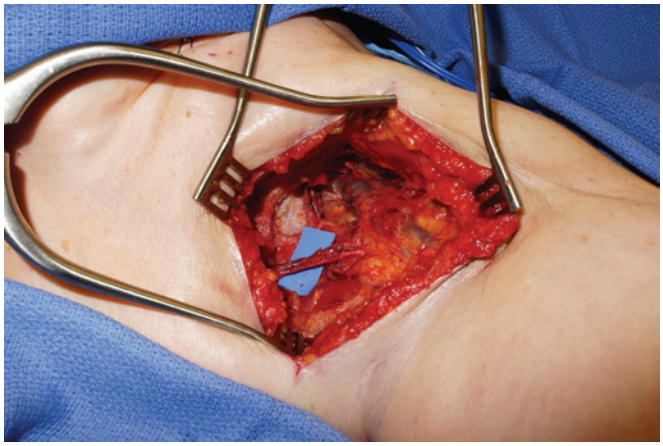

Figure 8.8 Axillary recipient site following complete scar excision down to the axillary vein with exposed of the thoracodorsal vessels shown over the blue background.

We have used all three recipient sites with varying degrees of success, but there are no data at this point comparing the axillary donor site to more distal donor sites. In general, our first choice is burying the flap in the axilla as we can remove a scar, and address axillary vein stenosis if present, as well as avoid a noticeable wrist flap, which our patient population is sometimes averse to.

PREPARATION OF THE AXILLARY RECIPIENT SITE

If a prior axillary scar is present, this is typically used for the approach. Subcutaneous flaps are elevated to expose the axillary scar, the anterior border of the latissimus muscle, the pectoralis major muscle, and the axillary vein. This dissection can be treacherous in patients with severe radiation change, causing distortion of the brachial plexus, axillary vein, and recipient thoracodorsal vessels. Once the thoracodorsal vessels are identified, the axillary scar is completely removed from the axillary vein and lateral chest wall to the proximal upper limb until normal fat is exposed (Fig. 8.8). The inflow of the thoracodorsal vessels is carefully confirmed and often requires more proximal division. If the thoracodorsal vessels are unavailable, then the circumflex scapular vessels or posterior humeral circumflex vessels can be used. If the lymph node transfer to the axilla is ultimately unsuccessful or the axilla is too hostile a recipient site, we have also performed lymph node transfer to the forearm using the recurrent radial vessels as recipients. This typically requires a small skin paddle, but can be buried in some cases.

VASCULARIZED GROIN LYMPH NODE TRANSFER WITH REVERSE LYMPHATIC MAPPING

ANATOMY AND FLAP DESIGN

The target lymph nodes for vascularized groin lymph node transfer are the superficial inguinal nodes most commonly