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RESEARCH PAPER

# Lymphedema surgery: the current state of the art

**Jay W. Granzow**[1]

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## Abstract

**Background/purpose** Lymphedema surgery, when integrated into a comprehensive lymphedema treatment program for patients, can provide effective and long-term improvements that non-surgical management alone cannot achieve. Such a treatment program can provide significant improvement for many issues such as recurring cellulitis infections, inability to wear clothing appropriate for the rest of their body size, loss of function of arm or leg, and desire to decrease the amount of lymphedema therapy and compression garment use.

**Methods** The fluid predominant portion of lymphedema may be treated effectively with surgeries that involve transplantation of lymphatic tissue, called vascularized lymph node transfer (VLNT), or involve direct connections from the lymphatic system to the veins, called lymphaticovenous anastomoses (LVA). VLNT and LVA are microsurgical procedures that can improve the patient's own physiologic drainage of the lymphatic fluid, and we have seen the complete elimination for the need of compression garments in some of our patients. These procedures tend to have better results when performed when a patient's lymphatic system has less damage. The stiff, solid-predominant swelling often found in later stages of lymphedema can be treated effectively with a surgery called suction-assisted protein lipectomy (SAPL). SAPL surgeries allow removal of lymphatic solids and fatty deposits that are otherwise poorly treated by conservative lymphedema therapy, VLNT or LVA surgeries.

**Conclusion** Overall, multiple effective surgical options for lymphedema exist. Surgical treatments should not be seen as a "quick fix", and should be pursued in the framework of continuing lymphedema therapy and treatment to optimize each patient's outcome. When performed by an experienced lymphedema surgeon as part of an integrated system with expert lymphedema therapy, safe, consistent and long-term improvements can be achieved.

**Keywords** Lymphedema surgery · VLNT · LVA · SAPL · Lymph node transfer

Lymphedema surgery, when integrated into a comprehensive lymphedema treatment program for patients, can provide effective and long-term improvements that non-surgical management alone cannot achieve. Such a treatment program can provide significant improvement for many issues such as recurring cellulitis infections, inability to wear clothing appropriate for the rest of their body size, loss of function of arm or leg, and desire to decrease the amount of lymphedema therapy and compression garment use.

At first, lymphedema swelling is composed mostly of lymphatic fluid. In this early stage, the swelling still may still respond to conservative treatment. Over time, the inflammatory lymphatic fluid damages the natural lymphatic drainage pathways and surrounding tissues. It can bring about permanent deposits of solids in the tissues that are more difficult to treat. Lymphedema swelling also greatly increases the risk of dangerous infections, called cellulitis, which can be severe in patients with lymphedema. Arm or leg swelling can often progress to cause functional impairments that interfere with work and activities of daily living.

Effective lymphedema surgeries have existed for many years and continue to be refined and improved. The best results are achieved when surgery is performed as part of a

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✉ Jay W. Granzow
drjay@lymphedemasurgeon.com

[1] Harbor-UCLA Division of Plastic Surgery, Torrance, CA, USA

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comprehensive treatment system incorporating specialized lymphedema therapy before and after surgery. The success of lymphedema surgeries very much highly depends on the training, experience, and relevant expertise of the lymphedema surgeon and lymphedema therapist.

Lymphedema surgeries have been shown to produce significant and lasting reductions both in the size of the affected arm or leg and also the amount of therapy and compression garment use required for treatment. No single technique is optimal for all presentations. Rather, careful patient selection after a complete course of conservative lymphedema therapy has been completed is critical. Individualized lymphedema therapy integrated into the treatment plan before and after surgery also is essential in achieving excellent results.

The fluid predominant portion of lymphedema may be treated effectively with surgeries that involve transplantation of lymphatic tissue, called vascularized lymph node transfer (VLNT), or involve direct connections from the lymphatic system to the veins, called lymphaticovenous anastomoses (LVA). VLNT and LVA are microsurgical procedures that can improve the patient's own physiologic drainage of the lymphatic fluid, and we have seen the complete elimination for the need of compression garments in some of our patients. These procedures tend to have better results when performed when a patient's lymphatic system has less damage. Therefore, the best candidates for LVA or VLNT surgeries are patients with early stage lymphedema. Poor candidates for LVA and VLNT surgeries are patients with more advanced disease with significant amounts of solid present because VLNT and LVA procedures cannot remove the permanently accumulated lymphedema solids.

Some studies have shown variable results when VLNT or LVA are used to reduce volume. We find better results using conservative therapy and compression first to reduce the excess fluid volume, and then using VLNT or LVA to reduce the amount of compression and therapy needed to maintain the volume reduction.

Lymphedema therapy that is carefully integrated into any surgical treatment plan is indispensible. A lymphedema surgeon and lymphedema therapist must closely work together to insure the best lymphedema therapy course is given both before and after any surgical procedure. This is especially true for the SAPL procedure, where pre- and postoperative planning, measurements, and lymphedema therapy are critical for a successful outcome. We prefer long-term lymphedema therapy to be administered by the patient's local lymphedema therapist under the direction of the lymphedema surgeon or surgical lymphedema therapist.

Obesity and morbid obesity generally lead to poor surgical outcomes and the same applies with lymphedema surgeries. Meaningful weight loss through a coordinated program that may include behavioral, dietary and psychosocial counseling and possibly weight reduction surgery, should be concluded prior to consideration for lymphedema surgery. The lymphedema in many obese individuals may be permanent even after significant weight loss has taken place.

VLNT surgery involves the microsurgical transfer of a small number of lymph nodes and surrounding tissue from another part of the body, called a donor site, to the area affected by lymphedema. Multiple donor sites have been reported and include the groin, torso, supraclavicular area (near the neck above the collar bone), and submental areas (underneath the chin).

VLNT surgery repeatedly has been shown in well-established medical literature to be effective in reducing the swelling, symptoms and associated problems with lymphedema. The need for ongoing lymphedema therapy and compression garment use can be decreased significantly (Fig. 1). The incidence of cellulitis and infection in the affected extremity has also been shown to decrease.

Safety and surgical expertise are critical to minimize the rare risk of lymphedema occurring at the donor site. The use of reverse lymphatic mapping also can minimize this risk by mapping the lymph nodes draining the arm or leg closest to the lymph node flap donor site using a radioactive tracer similar to that used in lymphoscintigraphy, or using specialized blue dye taken up by the peripheral lymphatics. During the dissection of the lymph node-containing flap, the lymph nodes draining the arm or leg are thus identified and preserved and only a small number of peripheral lymph nodes are harvested.

It is important to perform physiologic procedures such as VLNT or LVA while the patients are still in the fluid

**Fig. 1** Patient with lymphedema of the right arm and hand after axillary lymph node dissection and radiation therapy for breast cancer treatment. Photos before and after VLNT surgery to the axilla. Following surgery, patient has no additional swelling and no longer requires use of compression garment. Most patients significantly decrease compression garment use after VLNT if VLNT is used to address the fluid rather than then solid component of lymphedema

phase of their condition, before the deposition of excess solids occurs. A delay in conservative or surgical lymphedema treatment may allow solids to accumulate and may require patients to undergo SAPL treatment instead to remove the solids. VLNT and LVA may also be used as a second stage surgery after a SAPL surgery has been performed and healing has occurred. The second stage VLNT and/or LVA can decrease the amount of compression garment use and therapy required and produce better results than can be achieved with either procedure alone.

LVA surgery involves the direct connection of lymphatic vessels to nearby venules. These lymphatic connections as very small, usually much < 1 mm in diameter, and require supermicrosurgical expertise (Fig. 2).

In the peripheral parts of the arm or leg, closer to the hands or feet, single or multiple superficial lymphatics are connected to veins. In the proximal areas, closer to the armpit or groin, the lymphatics are larger and fewer, larger connections typically are performed. The location and types of connections can vary considerably from patient to patient and are dependent on the patient anatomy, surgeon experience, and the progression of the lymphedema disease itself. Since no donor site is required and only a fraction of the lymphatic vessels in the affected arm or leg are connected, LVAs tend to be the least invasive and have the lowest overall surgical risk and recovery among any of the lymphedema surgeries.

The stiff, solid-predominant swelling often found in later stages of lymphedema can be treated effectively with a surgery called suction-assisted protein lipectomy (SAPL). SAPL surgeries allow removal of lymphatic solids and fatty deposits that are otherwise poorly treated by conservative lymphedema therapy, VLNT or LVA surgeries.

SAPL continues to be an effective and long-term solution for lymphedema in many patients. The procedure is different from standard cosmetic liposuction, which is not suitable to treat lymphedema. SAPL has been described using various names including circumferential suction assisted lipectomy (CSAL), liposuction in lymphedema and lympho-liposuction. First introduced by Brorson in 1987, SAPL techniques have been improved and have produced significant objective benefit in clinical trials with long-term follow-up.

SAPL greatly decreases the incidence of severe extremity cellulitis and hospitalizations requiring intravenous antibiotics to treat such infections. Medical literature overwhelmingly supports the safety and efficacy of this surgical treatment, and we know of no studies or reports which have shown the procedure to be ineffective or harmful to patients if performed properly by an experienced surgeon with close coordination and post surgery monitoring by a lymphedema therapist.

In our own published series, we have reported average infection reductions of about 80% and excess volume reductions of 111% in arms and 86% in legs (Figs. 3, 4). Statistically significant reductions in lymphedema impact on daily activities, work abilities, improved limb function, reduced lymphedema-specific emotional distress, and a clear improvement in patient quality of life have also been shown.

The safety of SAPL surgery has been studied in medical literature, which found the function of the lymphatics to be unaffected by the surgery. In our experience, SAPL surgery appears also to improve the lymphatic drainage in the arm or leg after healing has occurred, and we have had no

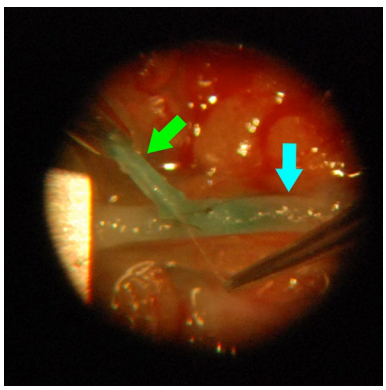

**Fig. 2** LVA seen through an operating microscope. The lymphatic vessel (green arrow) has been connected to the side of a small vein (blue arrow). Isosulfan blue dye can be seen draining from the lymphatic vessel to the vein. (Color figure online)

**Fig. 3** Patient with a 19-year history of solid predominant lymphedema of the right arm following axillary lymph node dissection and radiation therapy for lymphedema. Cellulitis infections were frequent and the patient required daily prophylactic antibiotics to decrease the rate of infections. Photos before SAPL and 18 months after SAPL. Volume excess prior to SAPL was 898 cc. Patient had a decrease in volume excess of 104% after SAPL, had no postoperative cellulitis and required no further antibiotic prophylaxis

**Fig. 4** Patient with 46 year history of chronic, congenital, solid predominant lymphedema of the left leg with prior attempt at direct surgical debulking (Sistrunk procedure) with long residual scar at inner aspect of entire left leg. Photos before surgery and 21 months following SAPL. After SAPL, she has a stable 86% reduction in volume excess, improved range of motion and decreased lymphedema swelling and symptoms

cases in which the patient's lymphedema has worsened from the procedure.

Lymphedema therapy required before and after the SAPL procedure is intense and cannot be substituted with a simple set of postoperative written instructions to the patient or therapist. Again we reiterate that SAPL is very different from cosmetic liposuction in many ways including the type and amount of lymphedema therapy required, the way the procedure is performed, the length of the surgery and solid materials removed and need for progressively smaller, specialized, custom-fitting garments after surgery. Lymphedema therapy performed by a specialized lymphedema therapist with specific experience with the SAPL is also essential to proper outcome following the procedure and cannot be substituted with a simple set of postoperative written instructions to the patient or therapist.

Proper patient selection is vital to the success of the surgery because the different lymphedema surgeries address different aspects of lymphedema swelling. LVA and VLNT best address the fluid portion of lymphedema swelling which predominates during the early stages of the disease process. SAPL removes the otherwise permanent solid component of the swelling, usually found in later, chronic cases. For example, an arm or leg affected by late-stage, chronic lymphedema which never reduces in size to even close to that of the opposite, unaffected side even on a patient's best day with maximum lymphedema therapy is very likely to be characterized by solid, rather than fluid swelling. In such a case, significant volume reduction is much less likely with LVA or VLNT, and much more likely with SAPL.

However, LVA and/or VLNT intended to decrease the amount of compression garment use and therapy required (rather than to decrease excess volume) could be performed after SAPL removes the stagnant lymphedema solids first.

The best candidates for lymphedema surgery are patients who have tried and failed a properly planned and administered lymphedema therapy regimen that usually includes of manual lymphatic drainage (MLD), fitted compression garment use and bandaging. One or more courses of complete decongestive therapy (CDT) usually have been performed.

Even though it is often possible to reduce the therapy and compression garment requirements after a successful surgery, patients should be willing to continue with lymphedema therapy before and after any surgical procedure. Patients that have not or are unwilling to have lymphedema therapy, are looking for a "magic bullet" type of procedure, or who are greatly overweight are not good candidates.

Different types of surgery can complement each other and produce better results in properly selected patients. Physiologic procedures such as VLNT and LVA can be combined during the same operation or in sequential operations for increased effectiveness. Staged procedures can also be used to treat both solid and then fluid components of lymphedema separately. For instance, VLNT/LVA can be performed after healing after the SAPL surgery is complete to help address the reaccumulation of lymphatic fluid. We consistently see significant reductions both in excess limb volume and also in the requirement for postoperative garment use in medical literature with the staged SAPL and VLNT/LVA procedures.

Overall, multiple effective surgical options for lymphedema exist. Surgical treatments should not be seen as a "quick fix", and should be pursued in the framework of continuing lymphedema therapy and treatment to optimize each patient's outcome. When performed by an experienced lymphedema surgeon as part of an integrated system with expert lymphedema therapy, safe, consistent and long-term improvements can be achieved.

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