

2018

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Recommended Citation

Chang EI, Masià J, Smith ML. Combining Autologous Breast Reconstruction and Vascularized Lymph Node Transfer. . 2018 Jan 01; 32(1):Article 4152 [p.]. Available from: <https://academicworks.medicine.hofstra.edu/publications/4152>. Free full text article.

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Combining Autologous Breast Reconstruction and Vascularized Lymph Node Transfer

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Semin Plast Surg 2018;32:36–41.

Abstract

Keywords

- ▶ vascularized lymph node transfer
- ▶ breast reconstruction and lymph node transfer
- ▶ breast free flap and lymphedema surgery
- ▶ DIEP flap and lymph node transfer

Breast cancer patients are at risk for developing postmastectomy lymphedema syndrome of the ipsilateral upper extremity following treatment for breast cancer in the setting of an axillary dissection, postoperative radiation, and chemotherapy. For patients suffering from lymphedema who are also seeking breast reconstruction, combining an autologous abdominal free flap with a vascularized inguinal lymph node transfer provides patients the opportunity to have an aesthetic breast reconstruction as well as the potential to improve their lymphedema in a single operation. The present article aims to provide a description of the salient features of this approach including the preoperative preparation, the surgical technique, the postoperative management and complications, and a summary of the outcomes.

Lymphedema is an unfortunate debilitating consequence that plagues several patients who have undergone treatment for breast cancer. While the greatest risk factor for developing lymphedema comes from an axillary lymph node dissection, there are several risk factors that have been found to predispose patients to lymphedema.^{1,2} In fact, 3 to 8% of patients who have only had a sentinel node biopsy will develop lymphedema, and patients who have had chemotherapy and radiation therapy are also at significantly increased risks of developing lymphedema. The final factor that has been linked to lymphedema is obesity as patients with a higher body mass index are also at greater risks.^{1–4}

The field of lymphedema surgery has witnessed tremendous advancements in recent years, in particular with the advances in microscope optics and imaging technology, which have really propelled the field of super microsurgery to the forefront of lymphedema treatment.^{5–7} Historic approaches, including the Charles' procedure where the soft tissue is excised directly, have become obsolete in the management of lymphedema except in the most severe cases. The new

approaches are physiologic solutions aimed to improve the drainage of fluid from the affected arm, and long-term studies are available confirming their efficacy. The use of a lympho-venous bypass (LVB) or lymphaticovenular anastomosis (LVA) has proven to be remarkably effective in earlier stages of post mastectomy lymphedema syndrome and will be described in another article.^{8,9} The second physiologic option is the vascularized lymph node transfer (VLNT) which has traditionally been reserved for patients with more advanced lymphedema who are not candidates for a LVB/LVA. The concept is based on the premise that lymph nodes can be harvested from alternate sites and then transferred on a vascular pedicle to the arm to improve the drainage from the affected extremity. In animal studies, the transferred lymph nodes stimulate lymphangiogenesis promoting the growth of new lymphatic channels that improve the drainage from the arm.^{10,11} An alternative hypothesis is that inosculation occurs between the native remaining lymphatic channels and those arising from the transferred lymph nodes.^{12–14} Regardless, studies have confirmed there are communications that form between the

Issue Theme Lymphedema Management; Guest Editors: Edward I. Chang, MD, FACS, Mark V. Schaverien, MBChB, MD, MSc, MEd, FRCS (Plast), and Jesse C. Selber, MD, MPH, FACS

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Tel: +1(212) 584-4662.

DOI <https://doi.org/10.1055/s-0038-1632402>.
ISSN 1535-2188.

transferred nodes and surrounding tissue allowing fluid to be absorbed into the nodes, which then drains into the pedicle vein of the lymph nodes that is connected to the systemic circulation using microvascular techniques. The use of VLNT for the treatment of lymphedema will also be discussed further in another article.

Combined Breast Reconstruction and VLNT

There are several potential donor sites that can be used for the VLNT, and currently, there is no clear consensus as to which lymph node basin represents the ideal donor site.¹⁵ This remains an area of active research, but the most popular lymph nodes have been the supraclavicular nodes,^{16–18} the submental nodes,^{19,20} the lateral thoracic nodes,²¹ the inguinal nodes,²² the omentum,^{23,24} and more recently the mesenteric lymph nodes.²⁵ Comparisons between the different lymph nodes and donor sites have not demonstrated significant differences, except the lateral thoracic nodes seem to have a higher risk of donor site complications compared with the other lymph nodes.^{15,26,27} However, in patients suffering from post-mastectomy lymphedema syndrome, the inguinal nodes can be transferred at the time of autologous breast reconstruction, coupling the inguinal nodes to a deep inferior epigastric artery perforator (DIEP) flap or a muscle-sparing transverse rectus abdominis myocutaneous (MS-TRAM) flap to reconstruct the patient's breast while simultaneously addressing the patient's lymphedema in one operation.²⁸

This approach was first described by Saaristo et al with promising outcomes in nine patients.²⁹ A follow-up study by Nguyen et al demonstrated similar findings in patients who underwent a simultaneous abdominal free flap coupled to a chimeric vascularized inguinal node transfer. Further, the study presented an algorithm for the design of the free flap taking into consideration the recipient vessels for the free flap and the lymph nodes as well as the donor site for lymph nodes.²⁸ This technique has grown in popularity and again has been found to be an effective, reproducible means of providing patients with post mastectomy lymphedema syndrome an aesthetic, durable breast reconstruction and improving patients' lymphedema in one operation.

One study compared the benefits of performing a simultaneous autologous breast reconstruction with the inguinal node transfer to performing an isolated inguinal lymph node transfer and found that patients who underwent the simultaneous VLNT with the breast free flap had superior outcomes compared with the VLNT alone.³⁰ This suggests that there are added benefits to transferring healthy vascularized tissue into the mastectomy site that has often been radiated in addition to performing the lymph node transfer. However, another recent study examining the benefits of lymphedema surgery in breast cancer patients demonstrated that patients who received a VLNT with their breast reconstruction had better outcomes with greater improvement of their lymphedema than had patients receiving a LVB or anastomosis in terms of circumference reduction, volume reduction, and episodes cellulitis. When the authors analyzed the impact of

breast reconstruction on lymphedema, they did not demonstrate any benefits coupling breast reconstruction to either the LVB/LVA or the VLNT.³¹

Preoperative Imaging

For autologous free flap breast reconstruction, the use of different preoperative imaging modalities has become the standard of care for many reconstructive microsurgeons. However, whether one decides to obtain a preoperative computed tomography angiogram (CTA), laser Doppler imaging, or magnetic resonance angiogram (MRA) is entirely surgeon dependent.^{32–35} The true utility of these imaging modalities for perforator mapping is an area of tremendous debate; however, preoperative imaging is a vital component for planning when combining autologous breast reconstruction with simultaneous VLNTs. Patients should undergo mapping of the sentinel nodes in the inguinal region to identify which critical nodes may predispose patients to lymphedema of the leg if those nodes are disrupted or harvested. This is considered the standard of care for all VLNTs and is also important while performing a combined simultaneous DIEP flap breast reconstruction with a vascularized inguinal node transfer. In the early inception of inguinal node harvest, anatomic landmarks were used to guide the harvest of nodes to avoid injury to the sentinel nodes.³⁶ Typically, the nodes that can be safely harvested are located between the superficial inferior epigastric vein and the superficial circumflex vein. The nodes should be above the level of the inguinal ligament and lateral to the femoral vessels.³⁷ In the author's practice, the use of lymphoscintigraphy has also proven to be a remarkably useful tool in the identification of the sentinel nodes draining the lower extremities, which aids in guiding flap design and lymph node harvest.

Surgical Technique

The patient should be imaged using indocyanine green (ICG) prior to the incision to map the lymphatics in the affected extremity. Preoperative lymphoscintigraphy is useful in localizing the sentinel nodes of the leg so they can be protected during the lymph node harvest. Injection of lymphazurin or isosulfan blue into the webspaces of the feet should also be performed and will aid in visualization of the sentinel nodes in the groin, which should be protected to minimize the risks of donor site lymphedema from the inguinal node harvest. Typically, the inferior incision is made first, and dissection proceeds to identify the superficial inferior epigastric vessels and the superficial circumflex iliac vessels. Ideally, the superficial circumflex iliac vessels should be used for the VLNT; however, in certain circumstances, the vessels are not available or have not been included in the flap design. Once the superficial vessels have been identified, a wide based adipofascial pedicle is created centered over the superficial system, and then dissection proceeds toward the takeoff of the vessels. The adipofascial pedicle is tapered as one approaches the origin of the vessels, which is typically

where the superficial nodes are located. Careful attention must be paid again to avoid dissection in any area where lymphazurin or blue dye is seen, and the lymph nodes harvested should always be above the level of the inguinal ligament and lateral to the femoral vessels to avoid injuring the lymphatic system draining the lower extremity. The lymph nodes should not be visualized directly or skeletonized, as this will devascularize the lymph nodes. Once the lymph nodes have been harvested, the superficial vessels are traced to their origin maximizing the length of the vessels for the microvascular anastomosis. After the lymph nodes have been harvested, the DIEP flap is harvested in the usual fashion. Closure of the abdominal donor site can present some challenges as the harvest of the inguinal nodes can leave a hollowing and concavity in the groin. Some have advocated the use of an abdominal flap based on the superior edge of the donor incision to fill in the lymph node donor site.³⁸

The anastomosis of the DIEP flap should ideally be performed to the internal mammary vessels; however, vessels in the axilla can also be used as described. In general, the dissection for recipient vessels in the axilla accomplishes two objectives, the obvious is identifying recipient vessels for the lymph node transfer, but the second critical aspect is the scar release in the axilla. This is a vital component to the operation and can provide patients with an immediate improvement not simply in the severity of the lymphedema, but also in the patient's range of motion and shoulder and arm mobility. The selection of recipient vessels also presents challenges to the reconstructive surgeon. Following an axillary dissection, often the lateral thoracic vessels have been ligated and are not available to serve as recipient vessels. The thoracodorsal vessels may even have been divided during the node dissection, but if they have been preserved, they are reliable vessels that can be used to perfuse the lymph nodes. However, in the setting that the DIEP flap fails, and the thoracodorsal vessels have been ligated for the lymph node transfer, a pedicle latissimus dorsi flap is no longer an option for breast reconstruction. The serratus branch often offers a suitable size match for the arterial anastomosis, but the vein is typically too small to accommodate the superficial circumflex iliac vein or the superficial inferior epigastric vein.

Performing an additional anastomosis for the lymph nodes is an area of considerable debate. Often harvesting the flap in conjunction with the DIEP provides adequate perfusion of the lymph nodes that should be confirmed with intravascular ICG angiography. In the setting that the nodes are perfused well without signs of arterial insufficiency or venous congestion, perhaps an additional anastomosis is not necessary. While some routinely perform an additional arterial and venous anastomosis to maximize perfusion to the lymph nodes, others do not. Some believe only an additional venous anastomosis is necessary as the fluid absorbed by the lymph nodes is returned to the systemic circulation via the pedicle vein. Outcomes on whether an additional set of anastomoses are needed to maximize a patient's post-operative lymphedema remain to be elucidated.

Complications

As with any microvascular breast reconstruction, there are always risks for complications with the microvascular anastomoses and perfusion to the free flaps as well the donor site.^{39,40} However, there are unique risks to a VLNT from nearly every donor site. While donor site lymphedema has not been reported with a submental or omental transfer, there are significant risks of developing lymphedema of the legs following an inguinal lymph node harvest.^{15,41} However, while patients may not necessarily develop lymphedema following a lymph node harvest, there are studies that have demonstrated alterations in lymphatic function following a lymph node harvest.⁴² Aside from lymphedema, patients should also be cautioned on the possibility of a seroma or lymphocele, which may require prolonged duration of drains, repeat aspiration, or percutaneous drainage.

Outcomes

Overall, the outcomes following simultaneous breast reconstruction and a vascularized inguinal node transfer have been remarkably promising. The earliest reports of this approach in nine patients demonstrated a profound improvement in all patients undergoing this approach. Saariisto et al demonstrated a reduction in circumferential measurements in seven of their nine patients, three of whom were able to discontinue the use of their compression sleeves entirely.²⁹ Nguyen et al expanded on these findings in 29 patients, 23 of whom reported sustained subjective improvements in their lymphedema with reduced heaviness, decreased dependence on compression sleeves, pneumatic compression and conservative therapy, and episodes of cellulitis. On average, patients had a 10% reduction in volumetric measurements 12 months following the operation.²⁸ Neither study reported any patients who developed donor site lymphedema following inguinal node harvest. Other smaller studies and earlier reports have reported similar findings.^{43,44} In particular, patients have a significant improvement in their quality of life following this approach combining autologous free flap breast reconstruction with a VLNT. In 22 patients utilizing this approach, all but one patient reported a significant improvement in her quality of life, and at least half the patients reported fewer infections and were able to discontinue compression therapy with average follow-up of 29 months.⁴⁵

Discussion

The field of lymphedema surgery is rapidly advancing, and given the number of patients who are anticipated to develop lymphedema as a result of breast cancer treatment, plastic surgeons will certainly see patients who are suffering from post mastectomy lymphedema syndrome and also seeking breast reconstruction. The approach of performing a simultaneous abdominal free flap to reconstruct the breast in conjunction with a chimeric vascularized inguinal lymph node transfer is able to achieve both objectives in a single

operation. Early results have demonstrated remarkable outcomes which have had a dramatic impact on patients' quality of life with both subjective and objective improvements.

While this is the most commonly performed approach for combining breast reconstruction with a lymph node transfer, this is not the only approach available. There have also been reports of using a pedicle latissimus dorsi myocutaneous flap coupled with lateral thoracic lymph nodes for the treatment of lymphedema along with breast reconstruction.⁴⁶ This represents another approach for combining breast reconstruction with lymphedema surgery; however, this approach may not always be feasible as often the lateral thoracic nodes have been removed during the axillary dissection. The contralateral latissimus dorsi myocutaneous flap can also be harvested as a free flap in conjunction with the lateral thoracic nodes and transferred to the index breast in the setting that the lateral thoracic nodes on the index breast were removed.⁴⁷ Similar to the combined abdominal free flap and lymph node approach, combining the pedicle latissimus dorsi flap with the lateral thoracic nodes has proven to be efficacious in improving patients' lymphedema symptoms, but larger studies are needed to decipher whether one modality is superior to the other.

As with any surgical procedure, there are always associated risks and potential complications, the most dreaded of which is donor site lymphedema. Harvesting the inguinal nodes with the DIEP flap must be done cautiously paying careful attention to avoid the sentinel nodes of the leg which can be inadvertently harvested with the flap. These are one of the fine nuances of this technique and why it should only be performed by skilled microsurgeons. Prior to proceeding with this approach, it is critical to obtain a localization study to identify which nodes can be harvested. However, some centers have started implementing a similar concept in preventing lymphedema. Reverse lymphatic mapping can be utilized to identify the sentinel nodes in the groin, but can also be used to identify which nodes preferentially drain the upper extremity to distinguish them from the lymph nodes draining the breast. Nodes that are draining the arm are preserved while only the nodes that drain the breast are removed as part of the axillary dissection.⁴⁸⁻⁵¹ Several studies have demonstrated reduced risks of lymphedema using reverse lymphatic mapping; however, there are still conflicting results preventing its widespread adoption as the standard of care.

While most reconstructive microsurgeons can perform autologous breast reconstruction safely and efficiently, combining breast reconstruction with lymphedema surgery is a unique operation that requires additional training and experience to provide patients with the most optimal outcomes. Lymphedema patients seeking breast reconstruction are often the most challenging cohort of patients as they typically have all had an axillary dissection coupled with chemotherapy and radiation making the dissection for recipient vessels a formidable task. Further as many patients also tend to be obese, the harvest of the flaps is also often more tedious. When taking into account the need to address their lymphedema, which is often their primary complaint, these

patients by definition add an additional level of complexity to their preoperative workup, operative time, post-operative management, and follow-up. Further, while losing a free flap is a rare occurrence, it is not life threatening, and other options are available to reconstruct the breast in the setting of a flap loss. However, complications arising from the lymph node harvest can have severe consequences for patients further compromising their quality of life and is much more severe than the loss of a free flap. Hopefully with further advancements in our understanding of lymphedema, the available technology to assist in these operations, and dissemination of the technique and training to perform these surgeries safely and effectively, patients will hopefully have the best outcome possible where reconstructive surgeons cannot only restore their breasts, but also treat their lymphedema as well.

Conclusion

Autologous free abdominal flap breast reconstruction can be performed safely and reliably with high success rates at most institution, and coupling the inguinal lymph nodes with the abdominal flap affords many patients the best option for achieving an aesthetic, natural breast reconstruction as well as addressing their lymphedema in a single operation. However, maximizing outcomes while minimizing complications is still dependent on appropriate planning and preparation, skill and training, and meticulous technique and experience.

Conflict of Interest

None.

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