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IDEAS AND INNOVATIONS

Reconstructive

Immediate Lymphatic Reconstruction with Vascularized Omentum Lymph Node Transplant: Reducing the Risk of Both Painful Contracture and Lymphedema

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Summary: Patients undergoing extensive lymph node dissection and radiation are at high risk for not only lymphedema but also painful contracture. In a standard lymphadenectomy, immediate lymphatic reconstruction using a lymphovenous bypass is effective in reconstructing the lymphatic defect. However, a more aggressive nodal clearance leaves the patient with a large cavity and skeletonized neurovascular structures, often resulting in severe contracture, pain, cosmetic deformity, and venous stricture. Adjuvant radiotherapy to the nodal bed can lead to severe and permanent disability despite physical therapy. Typically, these patients are referred to us after the fact, where surgery will rarely restore the patient to normal function. In an effort to avoid lymphedema *and* contracture, we have been reconstructing both the lymphatic and soft tissue defect during lymphadenectomy, using vascularized omentum lymphatic transplant (VOLT). A total of 13 patients underwent immediate reconstruction with VOLT at the time of axillary (n = 8; 61.5%) or groin (n = 5; 38.5%) dissection. No postoperative complications were observed. The mean follow-up time was 15.1 ± 12.5 months. Only one lower extremity patient developed mild lymphedema (11% volume differential), with excellent scores in validated patient-reported outcomes. All patients maintained full range of motion with no pain. None of the 13 patients required a compression garment. Immediate lymphatic reconstruction with VOLT is a promising procedure for minimizing the risk of lymphedema and contracture in the highest risk patients undergoing particularly extensive lymph node dissection and radiotherapy. *(Plast Reconstr Surg Glob Open 2024; 12:e5747; doi: 10.1097/GOX.0000000000005747; Published online 19 April 2024.)*

BACKGROUND

The authors began performing immediate lymphatic reconstruction (ILR) with vascularized omentum lymphatic transplant (VOLT) during axillary or inguinal lymphadenectomy in 2016. These were exceptionally high-risk patients referred preoperatively by their surgical oncologists who were almost certain the extensive dissection and radiotherapy would result in severe lymphedema and contracture (Fig. 1). These patients required the most aggressive forms of nodal clearance—most commonly the result of bulky disease, recurrence, prior radiotherapy, or reoperation (Fig. 2). Patients with a body mass index greater than 40 were not included.

The omentum was harvested as a free flap using a previously described open technique through a 6- to 8-cm incision in the epigastric midline.[1,2] This allowed for the use of bipolar cautery and finer instruments compared with laparoscopic or robotic platforms. The omentum was isolated on the right gastroepiploic vessels and transplanted

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Fig. 1. A young woman who underwent mastectomies, left axillary dissection, and extensive radiotherapy. She not only developed lymphedema but severe painful axillary contracture. Despite 1 year of intensive physical therapy, this is the highest she can raise her arm.

Takeaways

Question: How can we prevent lymphedema and severe contracture, pain, cosmetic deformity, and venous stricture in patients undergoing extensive lymph node dissection and radiotherapy?

Findings: We have been reconstructing both the lymphatic and soft-tissue defect at the time of lymphadenectomy, using vascularized omentum lymphatic transplant. Thirteen patients were included. Only one patient developed mild lymphedema with excellent scores in patient-reported outcomes. All patients maintained full range of motion with no pain. None required a compression garment.

Meaning: Vascularized omentum lymphatic transplant is a promising procedure for minimizing the risk of lymphedema and contracture in the highest risk patients undergoing, particularly extensive lymph node dissection and radiotherapy.

to the axilla or groin during nodal dissection. The VOLT relies on lymphangiogenesis induced by VEGF-C in the transplanted lymph node; no direct lymphatic reconstruction is performed.

The thoracodorsal or circumflex scapular vessels were the most common recipient vessels in the axilla. In the groin, the most common recipients were the deep inferior epigastric vessels or the superficial femoral artery and the superficial circumflex iliac vein.[1,2] A second venous anastomosis to the distal gastroepiploic vein was commonly performed to avoid venous hypertension.

Outcomes were assessed using manual limb volume measurements, bioimpedance scores (L-DEX scores), and the validated Lymphedema Life Impact Scale.[1,3–5] Thirteen patients underwent immediate reconstruction with VOLT at the time of lymphadenectomy, of whom 11 were women and two were men. The average age was 54.9 ± 13.1 years with a mean BMI of 26.0 ± 4.8 kg per m^2. Two patients had both pain and contracture preoperatively; none of the patients had lymphedema or required any compression garment preoperatively. Eight patients (61.5%) underwent a vascularized omentum transplant to the axilla, and five patients (38.5%) underwent omentum transplant to the groin. No postoperative complications were observed. The mean follow-up time was 15.1 ± 12.5 months. All patients received neoadjuvant chemotherapy and extensive adjuvant radiotherapy (40% of them to the nodal basin). Lymphedema, defined as volume differential more than 10% or LDEX more than 6.5, developed in one lower extremity patient 15 months after surgery. (**See table, Supplemental Digital Content 1,** which displays demographic, clinical information, and main outcomes of

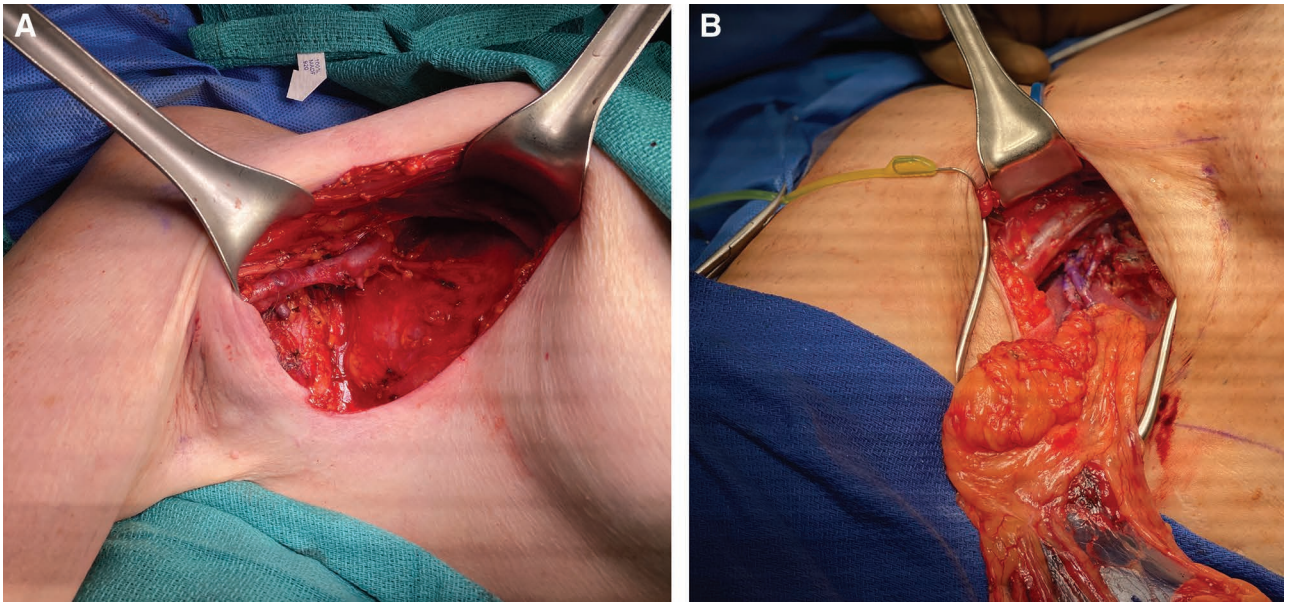

Fig. 2. A, Extensive axillary dissection with denuded axillary vein, nerve structures, and large dead space. B, Immediate axillary reconstruction with omentum before final inset.

Fig. 3. Patient with locally advanced breast cancer who underwent neoadjuvant chemotherapy, modified radical mastectomy, and immediate VOLT/DIEP flap reconstruction. Adjuvant radiotherapy was dosed to the chest, axilla, supraclavicular fossa, and internal mammary chain placing her at high risk for disability. At 15 months postoperative, she had full ROM, no lymphedema, and no hollowing of the axilla.

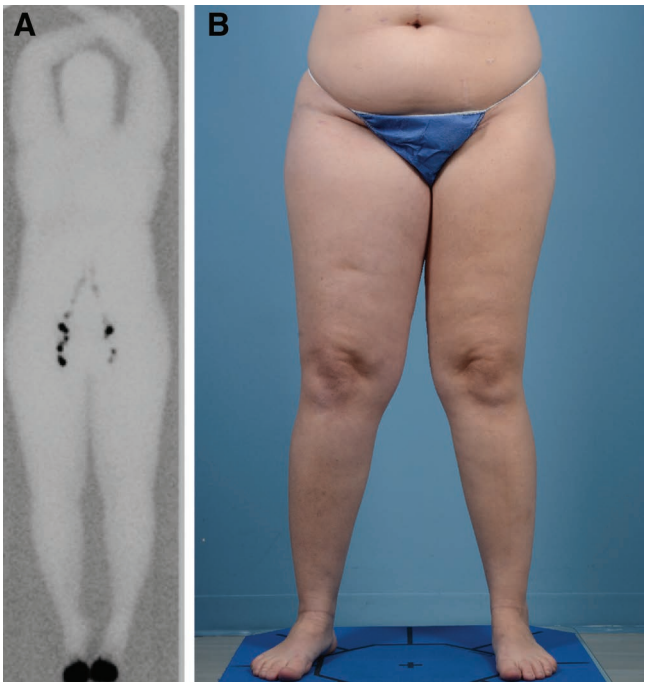

Fig. 4. A 27-year-old woman with locally advanced vulvar squamous cell carcinoma underwent left inguinal lymphadenectomy, ILR with omentum, and adjuvant radiotherapy. At 8 months postoperative there was no limb swelling. Her lymphoscintigraphy at 8 months postoperative (A) confirmed lymphatic continuity across the omentum. Eighteen months postoperatively, she developed a recurrence in the contralateral right inguinal lymph node basin. After right lymphadenectomy without lymphatic reconstruction, she developed intractable lymphedema. In contrast, at 2 years postoperative, (B) the left lower extremity with omentum remained compression free without swelling or recurrence.

patients who underwent immediate reconstruction with VOLT. **http://links.lww.com/PRSGO/D168**.) However, this case was mild, with 11% volume differential and excellent quality-of-life scores. There were two patients with preexisting severe contracture presenting with bulky recurrence who reported dramatic improvement in both ROM and resolution of pain. All other patients (11) maintained full range of motion (ROM). Two patients experienced one episode of cellulitis (15.4%), 4 months and 18 months after surgery, respectively. None of the patients in this series required a compression garment. All patients had satisfactory cosmetic contour without a radiated and hollowed out appearance (Figs. 3 and 4).

DISCUSSION

Although lymphedema causes significant morbidity, painful contracture is also common and can be functionally devastating.[6–8] Not all lymph node dissections are the same—some patients undergo radical clearance with bare neurovascular structures covered only by thin skin. These patients commonly have pain, contracture, cosmetic deformity, and venous stricture, compounding their lymphedema. Wound healing can also be a challenge with a large dead space, especially in the groin. These patients are commonly sent to us long after their surgery. Surgical intervention after the fact comes with greater risk and recovery and rarely results in a normal outcome. It is not uncommon for us to see intrinsic contracture of the brachial plexus where the shoulder cannot be fully abducted without risking plexus avulsion. Despite its significant prevalence, painful contracture is under-reported with no literature on prevention and treatment. In our own prospective series, 41% of patients undergoing lymph node transplant had limited ROM frequently associated with pain.

Although ILR using LVB is appropriate in patients who have adequate soft tissue remaining after the nodal dissection, it will not address the contracture risk in more extensive dissections. An extensive nodal clearance with denuded neurovascular structures will require soft tissue replacement to fill the defect and prevent overlying skin adherence. Placing lympho-fatty tissue protects these structures and also minimizes any cosmetic deformity, mitigating the effects of radiation.[6] Additionally, LVB may also not be possible in such a vessel-depleted field. In our prospective ILR trial using LVB, 12.6% of all cases were aborted because of inadequate lymphatics or technical limitations. In contrast, there were no such cases using a VOLT where standard microsurgical anastomosis was not possible. In extreme cases where skin replacement is required, the authors most commonly use a thoracodorsal artery perforator or latissimus flap with vascularized lymph nodes.

In summary, the results in this pilot study are promising for prophylactic VOLT in the prevention of painful contracture and lymphedema. The outcomes were better than the authors expected, given that these were the highest risk patients who underwent the most aggressive nodal clearances and wide field radiotherapy. This patient cohort did not experience pain, contracture, or cosmetic deformity. Although only one patient out of 12 presented with mild lymphedema at a mean follow-up of 16 months,

a longer follow-up period is needed to better assess lymphedema outcomes. Additional limitations of this study are its retrospective nature; a prospective protocol with long-term outcomes is needed and in progress. Given the severe potential morbidity, immediate soft tissue reconstruction using omentum may be a worthwhile consideration in the highest-risk patient groups.

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DISCLOSURES

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REFERENCES

1. Brown S, Mehrara BJ, Coriddi M, et al. A prospective study on the safety and efficacy of vascularized lymph node transplant. *Ann Surg*. 2022;276:635–653.
2. Kenworthy EO, Nelson JA, Verma R, et al. Double vascularized omentum lymphatic transplant (VOLT) for the treatment of lymphedema. *J Surg Oncol*. 2018;117:1413–1419.
3. Laidley A, Anglin B. The Impact of L-Dex measurements in assessing breast cancer-related lymphedema as part of routine clinical practice. *Front Oncol*. 2016;6:192.
4. Coriddi M, Kim L, McGrath L, et al. Accuracy, sensitivity, and specificity of the LLIS and ULL27 in detecting breast cancer-related lymphedema. *Ann Surg Oncol*. 2022;29:438–445.
5. Weiss J, Daniel T. Validation of the lymphedema life impact scale (LLIS): a condition-specific measurement tool for persons with lymphedema. *Lymphology*. 2015;48:128–138.
6. Belmonte R, Messaggi-Sartor M, Ferrer M, et al. Prospective study of shoulder strength, shoulder range of motion, and lymphedema in breast cancer patients from pre-surgery to 5 years after ALND or SLNB. *Support Care Cancer*. 2018;26:3277–3287.
7. DiSipio T, Rye S, Newman B, et al. Incidence of unilateral arm lymphoedema after breast cancer: a systematic review and meta-analysis. *Lancet Oncol*. 2013;14:500–515.
8. Kootstra JJ, Hoekstra-Weebers JE, Rietman JS, et al. A longitudinal comparison of arm morbidity in stage I–II breast cancer patients treated with sentinel lymph node biopsy, sentinel lymph node biopsy followed by completion lymph node dissection, or axillary lymph node dissection. *Ann Surg Oncol*. 2010;17:2384–2394.