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Surgical Options for Lymphedema Following Breast Cancer Treatment

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Surgical options for treating lymphedema have expanded in recent years. For many years the only treatment options were conservative nonsurgical therapies and excisional surgeries. Advances in microsurgery have made it possible to reconstruct lymphatic function. Reconstructive surgical options include lymphaticovenular bypass, lymphaticolymphatic bypass, and vascularized lymph node transfer. Currently, there is no consensus on how or when to surgically treat lymphedema, and more studies are needed to evaluate the efficacy and risks of each of these techniques.

The lymphatic system is an important component of the circulatory system and is primarily responsible for the regulation of interstitial fluid. Normally, venous capillaries absorb 90% of fluid in tissues, and lymphatic vessels absorb the remaining 10% (Tawari, Coriddi, & Lamp, 2012). Lymphedema occurs when the architecture of the lymphatic system is disturbed and fluid transport is prevented. Protein-rich interstitial fluid accumulates, which can result in swelling, production of fatty tissue, and fibrosis. Breast cancer treatment is a well-recognized cause for upper extremity lymphedema. Reports on the incidence of lymphedema following breast cancer treatment vary widely with 24%–49% following mastectomy and 4%–28% following lumpectomy (Becker, 2013). Axillary lymph node dissection, radiation therapy to the axillary region, postoperative seroma, and obesity are major risk factors for development of lymphedema (Suami & Chang, 2010). Lymphedema can be a debilitating condition, causing pain, body image disturbances, frequent infections, restrictions in range of motion, and greatly decrease a person's quality of life. Until recently lymphedema has been viewed as incurable, but exciting new surgical techniques are developing to treat lymphedema and restore lymphatic function.

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CONSERVATIVE TREATMENT

Conservative treatment of lymphedema includes lymphatic-specific massage techniques, exercise, and external compression and is considered the gold standard. The goal of these modalities is to manually compress tissue and remove the retained interstitial fluid. Once edema has reduced, fitted garments are required to prevent the reaccumulation of fluid. These interventions are time-consuming, expensive, uncomfortable, and patients are expected to continue these measures for their entire lives (Tawari, Coriddi, Salani, & Povoski, 2013). Conservative treatment has proven to be beneficial in patients with mild to moderate lymphedema. Because these modalities depend strongly on patient compliance, success rates vary widely (Doscher, Herman, & Garfein, 2012).

SURGICAL MANAGEMENT

Candidates for surgical intervention are patients who have failed conservative treatment and have impaired function of the affected extremity. Surgical treatments for lymphedema can be classified into two categories: excisional techniques and reconstructive techniques. Excisional surgery includes debulking and liposuction. Reconstructive techniques include lymphaticovenular bypass, lymphaticolymphatic bypass, and vascularized lymph node transfer. After extensive review of the literature, no surgical protocol was found for the treatment of lymphedema. Although various surgical procedures have been performed, it is debatable which technique is the most effective.

Debulking is a technique that has been around since the early 1900s and is known as the Charles procedure. This technique involves removing the skin and subcutaneous tissue down to the fascia, followed by primary closure or skin grafting. Debulking has been rarely used in the past 50 years because of high complication rates and poor aesthetic results. Recent literature indicates that modifications to this technique may have minimal complications and could be beneficial for certain patients. Debulking is only appropriate with prolonged lymphedema, when the damage to the lymphatics is irreversible. Because debulking destroys any functioning lymphatic vessels, this technique is not appropriate for early-stage lymphedema (Doscher et al., 2012).

Liposuction is a more recent technique used to reduce lymphedematous volume. As with debulking, liposuction should only be done with late-stage lymphedema when the excess volume of the extremity is dominated by adipose tissue, not lymph fluid. In the beginning stages of lymphedema, the excess volume of the extremity is predominantly lymph fluid and should be treated with conservative therapies or reconstructive surgery. Continued impaired clearance of lipids causes the excess volume to change to adipose tissue. When the swelling of a lymphedematous extremity is due to excess fluid, pitting edema can be observed. When the excess volume is due to adipose tissue, pitting edema will be minimal or absent (Brorson, 2012).

Risks of excisional techniques for lymphedema include hematoma, skin/flap necrosis, infection, chronic wounds and delayed wound healing, deep vein thrombosis, scarring, destruction of functioning lymphatic vessels, loss of limb function, and recurrence of lymphedema (Cormier, Rourke, Crosby, Chang, & Armer, 2011). Both debulking and liposuction require postoperative compression therapy to prevent the reaccumulation of fluid (Doscher et al., 2012).

Advances in microsurgery have made lymphaticovenular bypass possible. The aim is to allow lymph fluid to bypass the natural route of traveling through lymph vessels to the subclavian veins and entering the bloodstream. During lymphaticovenular bypass, functioning lymphatic vessels are connected directly to veins in the area affected by lymphedema. With the use of high-power microscopy, lymph vessels can be connected to subdermal venules less than 0.8 mm in diameter. The size of the venule is important to prevent venous reflux and anastomosis site thrombosis; the pressure in the lymphatic system must remain higher than the pressure in the venule. Smaller subdermal venules have lower pressure so that venous reflux is minimized (Tawari et al., 2013). This technique requires small incisions and can be done under local anesthesia (Cormier et al., 2011). In general, postoperative compression therapy is required, but in some cases lymph drainage function has recovered to a normal level and postoperative compression has not been necessary. Lymphaticovenular bypass is more effective early after the onset of edema. This technique has also been suggested as a prophylactic treatment at the time of lymphadenectomy (Koshima, Narushima, & Lida, 2012).

Lymphaticolymphatic bypass is another approach for treating lymphedema. This technique involves harvesting healthy lymphatic vessels from an area of the body unaffected by lymphedema and transferring them to the area of disrupted lymph flow, creating a bypass. One specific method that has been investigated is the use of lymphatic grafts from the medial thigh area. The lymphatic grafts are transferred to the anterior shoulder of the affected extremity where the grafts are placed in the subcutaneous tissue and anastomosed to lymph vessels in the upper arm and in the neck. This technique restores lymphatic function and patients have reported long-term improvement. Despite this success, lymphaticolymphatic bypass is not a widely accepted technique. The procedure is extremely difficult, requiring delicately removing 25–30 cm lymphatic vessels. Lymphaticolymphatic bypass creates a long scar at the donor site and carries the risk of lymphedema in the donor leg (Felmerer, Sattler, Lohrmann, & Tobbia, 2012).

Another advancing surgical technique is autologous lymph node transplantation. Free tissue transfer is a standard technique in plastic surgery that involves harvesting an autologous tissue flap from a distant donor site, transferring it to the recipient site, and anastomosing veins and arteries of the flap to veins and arteries of the recipient site. Lymph node transplantation is performed the same way and transfers composite soft tissue that contains lymph nodes from an unaffected groin, axilla, or cervical/neck to the affected area of lymphedema (Becker, 2013).

Becker, Assouad, Riquet, & Hidden (2006) retrospectively reviewed data of 24 patients who received autologous lymph node transfers between 1991 and 1997. All of the patients in this review had inguinal lymph nodes transplanted to the axillary region. Seven of the patients had incomplete results in the forearm and required a second lymph node transfer with lymph nodes harvested from the contralateral inguinal region and transplanted at the level of the elbow. Ten of the patients in this study were considered cured with the upper arm returning to normal size. Six were not considered cured, but the size of their upper extremity decreased by 50% or more. Another six had improvement of 50% or less and the remaining two patients had no improvement (Becker et al., 2006).

The theory behind autologous lymph node transplantation is that new lymph vessels are thought to sprout from the transplanted lymph nodes and drain the region of lymph fluid. This is only a theory and currently there is no data to prove this (Suami & Chang, 2010). Lymph node transfer has been found to alleviate upper extremity lymphedema, but the degree of improvement varies, with different studies using different postsurgical evaluation methods.

Saaristo et al. (2012) studied the effects of combined lymph node transfer with lower abdominal free flaps, including deep inferior epigastric perforator flaps and muscle-sparing transverse rectus abdominis myocutaneous flaps. The study observed nine postmastectomy patients who had radiation and lymphadenectomy and reported symptoms of lymphedema. The surgical technique in this study involved harvesting a dual lymph node and breast reconstruction flap. The flap included tissue from the lower abdomen to reconstruct the breast and an adjoining lymphatic flap from the groin. The groin flaps

TABLE 1 Current Lymphedema Staging Systems

ISL system[a]	Campisi score[b]
Stage 0: Latent or subclinical conditions where swelling is not evident despite impaired lymph transport	
Stage I: Early accumulation of fluid relatively high in protein content that subsides with limb elevation. Pitting may occur	Stage IA: "Latent" lymphedema, without clinical evidence of edema, but with impaired lymph transport capacity (provable by lymphoscintigraphy) and with initial immunohistochemical alterations of lymph nodes, lymph vessels, and extracellular matrix
	Stage IB: "Initial" lymphedema, totally or partially decreased by rest and draining positions, with worsening impairment of lymph transport capacity and of immunohystochemical alterations of lymph collectors, nodes, and extracellular matrix
Stage II: Pitting may or may not occur as tissue fibrosis develops. Limb elevation alone rarely reduces tissue swelling	Stage IIA: "Increased lymphedema" with vanishing lymph transport capacity, relapsing lymphangitis attacks, fibroindurative skin changes, and developing disability
	Stage IIB: "Column-shaped" limb fibrolymphedema, with lymphostatic skin changes, suppressed lymph transport capacity, and worsening disability
Stage III: Lymphostatic elephantiasis where pitting is absent. Trophic skin changes, such as acanthosis, fat deposits, and warty overgrowths, often develop	Stage IIIA: Properly called "elephantiasis," with scleroindurative pachydermitis, papillomatous lymphostatic verrucosis, no lymph transport capacity, and life-threatening disability
	Stage IIIB: "Extreme elephantiasis" with total disability

Note. *ISL = International Society of Lymphology.*
[a]*Warren, Brorson, Borud, & Slavin (2007).*
[b]*Campisi, Accogli, & Boccardo (2010).*

contained lymph nodes, lymphatic vessels, and fat surrounding the superficial circumflex iliac vessels or its perforators. The inferior epigastric vessels were anastomosed to the thoracodorsal vessels. The abdominal flap was shaped to form the reconstructed breast, and the groin flap was placed in the axilla. The lymphatic anastomoses were expected to form spontaneously and were not done surgically. Postoperatively, lymphoscintigraphy demonstrated improvement in lymph drainage in five of the six patients. Seven of the nine patients had a reduction in limb circumference.

Some patients with lymphedema have experienced significant improvement following delayed breast reconstruction with autologous tissue, both latissimus dorsi and free flaps; currently, there are few studies addressing the relationship between delayed breast reconstruction with autologous tissue and lymphedema. One report describes a woman who had a modified radical mastectomy with postoperative radiation. Lymphedema developed in her left hand 4 years later and gradually progressed to affect her entire left arm. Twelve years after her mastectomy, the patient had left breast reconstruction with an extended latissimus dorsi myocutaneous flap. Lymphedema symptoms began to improve 2 months after surgery, and at 3 years the volume of the two arms was nearly equal. This was only a single case, and more studies are needed to understand the relationship between latissimus dorsi breast reconstruction and lymphedema. This case suggests that even though the latissimus dorsi flap does require dissecting the axillary area, it should not be excluded from the options for delayed breast reconstruction when lymphedema aggravation is a concern (Lee et al., 2012).

DISCUSSION

Currently, there is no consensus on the staging of lymphedema, which makes it difficult to review study results. The Campisi score and the International Society of Lymphology (ISL) system are two commonly used staging systems (Table 1). In addition, Lee and Bergan (2005) developed a staging system utilizing two separate systems: clinical staging and laboratory staging. The clinical stages expand on the ISL system with various additional systemic factors. The laboratory stages address lymphoscintigraphic findings. A universal staging system to assess lymphedema is needed to improve data review.

Between the years of 1975 and 2009, the overall 5-year survival rate of breast cancer increased from 74.8% to 90.3% (Howlader et al., 2012). Subsequently there are now more people living with lymphedema. Lymphedema currently remains a problem without a definitive solution. The best surgical technique is debatable, and perhaps a combination of these techniques would be best. Many studies suggest higher success rates with early intervention, but the indications for surgery remain controversial. One of the biggest struggles of lymphedema treatment is achieving satisfactory long-term results. More studies are needed to evaluate the efficacy and risks of each current technique for alleviating lymphedema.

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