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REVIEW ARTICLE

Surgical treatment of breast cancer-related lymphedema: an updated review

Tratamiento quirúrgico del linfedema secundario al cáncer de mama: revisión actualizada

Alejandro Maciel-Miranda[1,2], Kelvin Jasso-García[2], Eduardo Montag[3], Pedro Ciudad[4,5], Jesús Escrivá-Machado[6], and Nicolás Pereira[7,8]*

[1]*Plastic Surgery Service, Instituto Oncológico Nacional, Zapopan, Jalisco, Mexico;* [2]*The Breast and Body Center, Hospital Puerta de Hierro Andares, Zapopan, Jalisco, Mexico;* [3]*Plastic Surgery Service, Institute of Cancer of the State of São Paulo, São Paulo, SP, Brazil;* [4]*Breast Unit, Clínica Internacional, Lima, Peru;* [5]*Department of Plastic, Reconstructive, and Burn Surgery, Hospital Nacional Arzobispo, Lima, Peru;* [6]*Clínica Escrivá, Bucerías, Nayarit, Mexico;* [7]*Centro Especializado en Linfedema y Lipedema (ceLL), Clínica Nea, Santiago, Chile;* [8]*Department of Plastic Surgery, Hospital del Trabajador, Santiago, Chile*

Abstract

Breast cancer-related lymphedema is a common complication after axillary lymph node dissection and radiotherapy, significantly affecting patients' quality of life. This review aims to outline the latest surgical advances for his management, highlighting current techniques and their role in prevention and treatment at various stages of the disease. An extensive literature review was performed in major databases (PubMed, Scopus, Web of Science), focusing on original studies, systematic reviews, and metaanalyses addressing surgical techniques for the management of breast cancer-related lymphedema. Articles published in the last [10] years were included. Several surgical approaches are described, including lymphaticovenous anastomosis, vascularized lymph node transfer, immediate lymphatic reconstruction, and liposuction. The choice of procedure depends on the clinical stage of lymphedema, the availability of expertise and micro-surgical equipment. Current evidence shows that early surgical management can reduce disease progression, improve quality of life, and lower the incidence of infectious episodes. Lymphatic surgery offers promising outcomes in both prevention and treatment of breast cancer-related lymphedema. Although significant advances—such as supermicrosurgery and immediate prophylactic procedures—have been made, there is still a need for randomized clinical trials to strengthen clinical recommendations. An interdisciplinary approach and careful patient selection are critical to optimizing outcomes.

Keywords: *Lymphedema. Breast cancer. Lymphatic reconstruction. Lymphaticovenous anastomosis. Supermicrosurgery.*

Resumen

El linfedema secundario al cáncer de mama es una complicación frecuente tras la disección ganglionar y la radioterapia, con un impacto negativo en la calidad de vida de las pacientes. El objetivo de esta revisión es presentar los avances en el tratamiento quirúrgico del linfedema relacionado con cáncer de mama, destacando las técnicas más recientes y su papel en la prevención y el manejo en distintas etapas de la enfermedad. Se llevó a cabo una revisión exhaustiva de la literatura disponible en bases de datos internacionales (PubMed, Scopus, Web of Science), enfocada en estudios originales, revisiones sistemáticas y metaanálisis que abordaran las técnicas quirúrgicas para el manejo del linfedema secundario al cáncer de mama. En la revisión se incluyeron artículos publicados en los últimos [10] años. Se describen distintas estrategias quirúrgicas,

***Correspondence:**
Alejandro Maciel-Miranda
E-mail: maciel.alejandro@gmail.com

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como la anastomosis linfático-venosa, la transferencia de ganglios linfáticos vascularizados, la reconstrucción linfática inmediata y la liposucción. La elección de la técnica depende de la etapa clínica del linfedema, de la disponibilidad de equipos y de la experiencia en microcirugía. La evidencia actual indica que el tratamiento quirúrgico temprano puede disminuir la progresión del linfedema, mejorar la calidad de vida y reducir el número de episodios infecciosos. La cirugía linfática ofrece resultados prometedores en la prevención y el tratamiento del linfedema secundario al cáncer de mama. Aunque se han logrado avances significativos —incluida la supermicrocirugía y los procedimientos de prevención inmediata— persiste la necesidad de ensayos clínicos aleatorizados que aporten mayor solidez a las recomendaciones. Un abordaje interdisciplinario y la selección adecuada de las pacientes son cruciales para optimizar los resultados.

Palabras clave: *Linfedema. Cáncer de mama. Reconstrucción linfática. Anastomosis linfático-venosa. Supermicrocirugía.*

Introduction

Lymphedema is a complex clinical condition characterized by insufficiency of the lymphatic system, manifesting as abnormal accumulation of protein-rich fluid in the interstitial space of the upper and lower extremities.

Breast cancer-related lymphedema occurs after disruption of the lymphatic system by axillary lymph node dissection, radiation, or taxane therapy. It is estimated to affect 1 in 5 patients with breast cancer, producing significant psychosocial, emotional, and economic impacts[1,2]. This dysfunction in lymphatic transport typically leads to chronic swelling of the affected limb, followed by progressive fibrosis, hypertrophy of fatty tissue, structural damage to lymphatic vessels, and significant impairment in quality of life[3-5]. Management of lymphedema requires an interdisciplinary approach involving collaboration among multiple specialties, including plastic surgery, surgical oncology, breast surgery, radiology, and physical therapy specialized in lymphedema, among others[6]. Each discipline contributes expertise to optimize patient outcomes.

Among the risk factors, obesity has been identified as a significant determinant in the development of postoperative lymphedema in breast cancer patients, underscoring the importance of implementing strategies directed at weight control and loss in those at risk of developing secondary lymphedema[6,7].

Although lymphedema has no cure, conservative management—based on complete decongestive therapy or manual lymphatic drainage, along with compression, exercise, and skin care—represents the reference method for prevention and for improving local condition in early stages.

Surgical treatment is reserved for specific cases, mainly when conservative treatment fails. Its objectives include preventing disease progression, reducing the frequency of infectious or inflammatory episodes, and improving both aesthetics and function of affected areas.

Lymphatic surgery plays an increasingly important role in breast cancer patients, serving both preventive and therapeutic purposes in early and advanced stages. Despite significant advances in this field, including the development of supermicrosurgical techniques and growing emphasis on prevention in recent years, high-quality evidence remains limited due to the scarcity of randomized clinical trials[8,9].

Staging of lymphedema

The staging system of the International Society of Lymphology is based on physical examination, clinical signs, measurements, and imaging modalities[8,9] (Table 1). In some centers, modified systems are used that combine symptom severity, circumferential differences, and imaging findings, categorizing lymphedema from mild to very severe[10].

Bioimpedance is a noninvasive technique used to measure the body's electrical resistance to a low-intensity current. In the context of lymphedema diagnosis, bioimpedance is used to evaluate and monitor fluid accumulation in tissues and changes in body composition. The electrical current passes through the body, and resistance varies according to water and electrolyte content in the tissues. Lymphatic fluid accumulated in lymphedema alters this resistance, as tissues with higher water content conduct electricity better. This technique can detect differences between affected and unaffected limbs and monitor changes in a limb over time. It has the advantage of identifying lymphedema in its early stages, before visible data appear; in addition, it is noninvasive, results are obtained within minutes, and it allows precise measurement of fluid volume changes[11-13].

Currently, the use of indocyanine green lymphography has broadened the understanding of lymphatic

Table 1. Clinical staging of lymphedema according to the International Society of Lymphology

Stage	Description
Stage 0 (latent)	Subclinical lymphedema, no edema, but with evidence of impaired lymphatic function. May exist months or years before edema occurs
Stage 1	Pitting edema, reversible. No palpable fibrosis
Stage 2	Pitting edema that does not respond to elevation
Stage 2b	Non-pitting edema due to severe fibrosis
Stage 3 (lymphostatic elephantiasis)	Severe swelling, fibrosis, and tissue thickening. Acanthosis (hyperpigmentation), hyperkeratosis, and papillomatosis (wart-like growths)

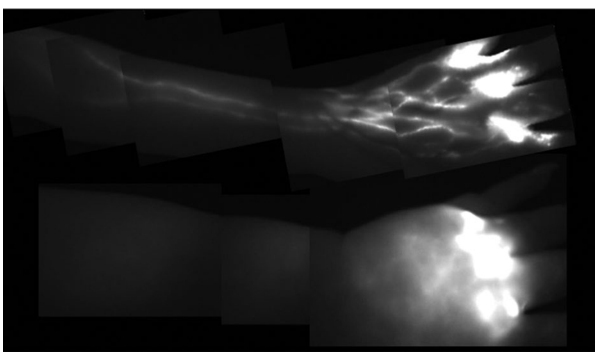

Figure 1. *Indocyanine green lymphography. Upper image: normal limb with linear lymphatic channels. Lower image: limb with lymphedema showing dermal reflux and contrast stasis.*

physiology, allowing in vivo visualization of patent lymphatic channels (Fig. 1).

Studies suggest the use of the MD Anderson Cancer Center (MDACC) classification system (Table 2), which guides treatment decisions, consisting essentially of lymphaticovenous anastomosis when visible channels are present[14,16].

In addition to the MDACC classification, several institutions have implemented treatment algorithms that integrate a multidisciplinary approach for prevention and management of breast cancer–related lymphedema. Cho et al[17] have proposed an algorithmic approach based on MDACC staging and lymphedema severity, prioritizing the use of lymphaticovenous anastomosis in early stages and vascularized lymph node transfer in advanced stages. This algorithm emphasizes early monitorization, interdisciplinary collaboration, and the use of immediate lymphatic reconstruction (preventive microsurgical approach for lymphatic restoration [LYMPHA, lymphatic microsurgical preventive healing approach], prophylactic lymphaticovenous bypass, and immediate inguinal lymphatic reconstruction) in patients undergoing axillary lymph node dissection, with strict postoperative 24-month follow-up[17].

Other additional techniques include lymph-MRI and magnetic resonance lymphangiography, described by Pons et al.[18] consisting of intradermal gadolinium injection and subsequent MRI imaging that allows identification of deep lymphatic channels, an integral view of lymphatic anatomy, and the possibility of locating channels for future bypass[18,19]. (Fig. 2).

Surgical techniques in the current treatment of lymphedema

Surgical treatment of lymphedema is categorized into 2 main approaches:

- Physiologic therapy: focused on restoration or reconstruction of lymphatic drainage.
- Excisional therapy: including procedures such as liposuction and resective techniques with skin grafting, such as the Charles procedure.

Immediate lymphatic reconstruction

The LYMPHA technique is attributed to Boccardo, published in 2011, which marked the beginning of the concept of immediate lymphatic reconstruction. Its objective is to perform a lymphaticovenous bypass during the same surgery in which lymphatic flow is interrupted by axillary lymph node dissection[20-22].

Initially, the technique consisted of introducing several lymphatic vessels “en bloc” into an axillary tributary vein, but over time variants have refined the procedure, including removal of fat at the anastomosis site, since its presence has been associated with higher failure rates. Additional refinements include the “octopus” technique[23] and the use of an interpositional venous graft to avoid tension at the anastomosis[24]. (Fig. 3).

Currently, this technique is known as immediate reconstruction or prophylactic lymphaticovenous bypass. Its objective is to prevent the development of breast cancer–related lymphedema by restoring lymphatic drainage interrupted after axillary lymph node dissection.

Published studies report that the use of this technique reduces the risk of lymphedema from 40% down to 8%. Moreover, meta-analyses have demonstrated its effectiveness and cost-effectiveness[25-27], and several international groups are working on

Table 2. MD Anderson Cancer Center lymphedema classification system

Stage	Management recommendation
Stage 0 No dermal backflow	Active monitorization with regular monitoring by bioimpedance and indocyanine green (ICG) lymphography. Preventive measures such as physiotherapy and follow-up with lymphedema specialists. Consideration of immediate lymphatic reconstruction (inguinal immediate lymphatic reconstruction, LYMPHA, prophylactic lymphaticovenous bypass) in patients undergoing axillary lymph node dissection.
Stage 1 Patent lymphatic vessels and minimal dermal backflow	Complete decongestive therapy including manual lymphatic drainage, compression, exercise, and skin care. Lymphaticovenous anastomosis (LVA) recommended, as functional lymphatic vessels are still present.
Stage 2 Moderate number of patent lymphatic vessels and segmental dermal backflow	LVA feasible if functional lymphatic vessels are identified with ICG. Complete decongestive therapy.
Stage 3 Few patent lymphatic vessels with extensive dermal backflow	Combination of LVA and vascularized lymph node transfer (VLNT) in selected cases. Compression therapy and physiotherapy as postoperative support.
Stage 4 Dermal backflow involving the hand	VLNT is the primary surgical option when fibrosis prevents the performance of lymphaticovenous anastomosis. In these cases, intensified complete decongestive therapy with advanced compression measures and manual lymphatic drainage is also recommended as part of the management strategy.
Stage 5 ICG does not migrate proximally from the injection site	VLNT with resection of fibrotic tissue when necessary. Liposuction in cases of advanced lymphedema with significant fatty hypertrophy. Complete decongestive therapy as adjunctive treatment to maintain volume reduction.

LYMPHA: lymphatic microsurgical preventive healing approach (preventive microsurgical approach for lymphatic restoration).

Figure 2. *Magnetic resonance lymphangiography with intradermal gadolinium administration. Linear lymphatic channels are visible in the forearm.*

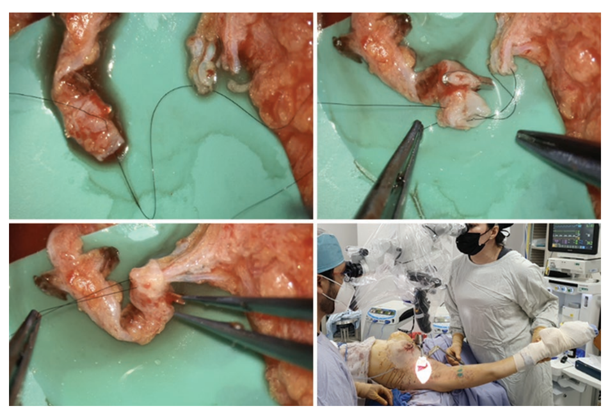

Figure 3. *Immediate lymphatic reconstruction. "Octopus" technique: multiple invaginating sutures. Arm in abduction to confirm absence of tension.*

generating high-level evidence to establish clinical recommendations[3,28,29].

Immediate lymphatic reconstruction has been used not only in breast cancer but also in melanoma and gynecologic cancers. Morotti et al.[30] described immediate inguinal lymphatic reconstruction in 12 lower limbs after inguinal lymph node dissection, reporting only 1 case of mild lymphedema (8.3%).

Surgical considerations

Although lymphaticovenous bypass is conceptually simple, its execution in the operating room is challenging. For example, in cases of standard en bloc lymphadenectomy, it may be difficult to find a recipient vein of adequate length and caliber.

The learning curve varies according to the surgeon's specialty:

- For the resective surgeon, the challenge lies in identifying and preserving adequate recipient veins during nodal dissection. In Mexico, this procedure is generally performed by a surgical oncologist with experience in breast surgery, including axillary lymphatic dissection of levels I and II.
- For the reconstructive surgeon, the difficulty lies in in-depth knowledge of venous and lymphatic anatomy, reliable identification of target lymphatic channels, and appropriate selection of recipient veins, in addition to mastering microvascular anastomosis techniques.

Physiologic treatment

Lymphaticovenous anastomosis and lymphaticovenous bypass

The first experimental lymphaticovenous anastomosis was reported by Jacobson in a canine model in 1962. Subsequently, Yamada performed the first clinical application in a patient with obstructive lymphedema in 1967. During the 1970s, O'Brien and his team implemented the technique in humans, while several others attempted refinements without achieving satisfactory results.[31]

In 2000, Koshima introduced a supermicrosurgical approach in which subdermal lymphatic vessels are connected to adjacent subdermal venules measuring less than 0.8 mm in diameter [31]. This procedure, known as lymphaticovenous anastomosis (LVA), allows diversion of lymphatic flow into the venous system, its natural physiologic destination at the junction of the thoracic duct with the venous circulation at the level of the subclavian vein. By redirecting lymphatic flow into small venules, obstruction of the lymphatic system is avoided.

Studies have demonstrated that LVA is highly effective in the early stages of lymphedema, and its application is currently being investigated even in advanced cases (stage III). This technique is particularly effective when functional lymphatic vessels are still present and the surrounding tissue has not developed severe fibrosis. A significant proportion of patients undergoing this procedure have been able to discontinue compression garments, even with long-term follow-up[32].

Surgical procedure

In the preoperative evaluation, lymphatic mapping with indocyanine green lymphography is performed, which enables identification of functional lymphatic vessels and adjacent venules.

The procedure can be performed under general anesthesia or local anesthesia with sedation. Incisions of 1 to 2 cm are performed at the previously marked sites, after which the lymphatic vessels and venules are carefully identified and dissected with the aid of a surgical microscope.

The connection between the lymphatic vessel and venule is achieved using supermicrosurgical techniques with ultrafine sutures (11-0 or 12-0). Anastomosis configurations may be end-to-end, end-to-side, or combinations of both.

To verify anastomotic patency, the passage of a dye such as indocyanine green or patent blue is observed.

Since infrared imaging can be integrated into the surgical microscope, real-time intraoperative assessment of LVA patency is possible. However, one of the main limitations of this technique is the low penetration of the light used to stimulate dye fluorescence, which reaches only up to 2 cm beneath the skin (Fig. 4).

Postoperative care and complications

In the postoperative period, continuous use of compression garments is required to maintain adequate lymphatic flow and prevent fluid accumulation. Regular clinical follow-up is performed to monitor for possible complications such as infections, persistent edema, or anastomotic failure.

Most published series on lymphatic bypass surgery report low complication rates. The most common adverse events include minor wound-healing problems, episodes of cellulitis, and lymphatic fistulas[33,34].

Vascularized lymph node transfer

Vascularized lymph node transfer (VLNT) is a modern and promising surgical technique for the treatment

Figure 4. *Gastroepiploic lymph node flap transfer to the arm.* **A:** *simultaneous team approach, laparoscopic harvest of gastroepiploic nodes and preparation of the recipient site.* **B:** *gastroepiploic lymph node flap divided into 2.* **C:** *in situ flaps.* **D:** *immediate postoperative appearance.*

of lymphedema, particularly in advanced-stage patients in whom lymphaticovenous anastomosis is not viable due to severe fibrosis or irreversible lymphatic vessel damage. It is also indicated in cases refractory to conservative treatments and in patients with recurrent episodes of cellulitis. In some cases, VLNT can be combined with lymphaticovenous anastomosis to improve outcomes[35].

Initially described and popularized by Becker et al.[36] this technique prompted the search for lymph node donor sites that minimize morbidity at the donor region, thereby avoiding lymphedema in that area. Preservation of vascular supply during transfer has been shown to significantly improve the degree of lymphedema and lymphatic function[37].

Mechanisms of action

There are 2 main mechanisms by which transfer of healthy lymph nodes contributes to restoring lymphatic flow:

- "Sponge" function: vascularized tissue in the affected area—often damaged by fibrosis and radiotherapy—absorbs interstitial fluid and drains it through the venous anastomosis of the flap.
- "Pump" function: transplanted functional lymph nodes facilitate lymphatic circulation in the recipient site.

In addition, transplanted lymph nodes promote the release of lymphangiogenic growth factors, stimulating lymphangiogenesis, that is, the formation of new lymphatic connections between the flap and recipient lymphatic vessels[38].

Donor sites and surgical technique

The preferred donor sites currently include the submental, supraclavicular, thoracodorsal, inguinal, and gastroepiploic regions (Fig. 5).

The inguinal flap is an evolution of the superficial circumflex iliac artery perforator flap, harvested from the lateral portion of the inguinal area to reduce the

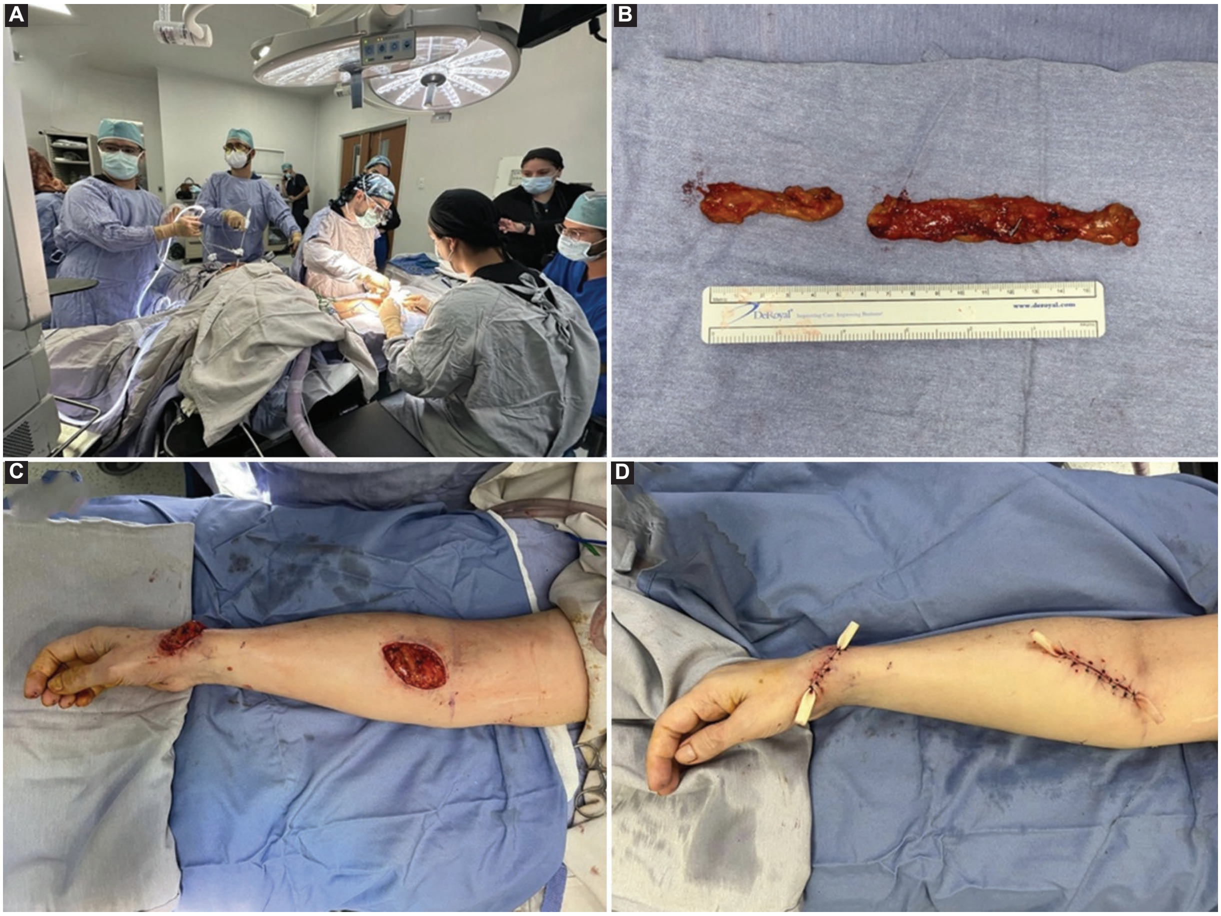

Figure 5. *Lymphaticovenous anastomosis.* **A:** *localization of lymphatic channels with indocyanine green lymphography and infrared camera.* **B:** *overall view of surgical setup under microscope.* **C:** *close-up, subcutaneous incisions approximately 2 cm long.* **D:** *lymphaticovenous anastomosis in situ. Contrast grid 1 mm per square.*

risk of donor-site lymphedema. To optimize procedural safety, reverse lymphatic mapping is employed, using a dual technique to identify nodes draining the donor limb (Fig. 6).

If the recipient site (axilla, ankle, or groin) has undergone prior surgery or radiotherapy, a wide excision of scar tissue is performed to prepare an adequate bed for the flap. Apparently, there is no difference in outcome whether the flap is positioned in a distal area (wrist) or in a proximal area (axilla)[39].

Women requiring simultaneous breast reconstruction and lymphedema treatment may be ideal candidates for breast reconstruction with lower abdominal flaps, including inguinal lymph nodes. In these cases, the thoracodorsal vessels are often selected as recipient vessels, allowing placement of lymphatic tissue in the axillary space[40]. (Fig. 7)

Complications

Although vascularized lymph node transfer has generally proven to be a safe procedure, complications may occur, including flap loss, donor-site lymphedema, seroma, lymphocele, infection, and wound-healing problems[41].

Interposition of flaps with functional lymphatic channels

The use of lymphatic imaging modalities, such as indocyanine green, has enabled the transfer of lymphatic channel flaps with precise anatomic orientation, functioning as a “bridge” in damaged areas such as the axilla. This procedure facilitates reconnection of healthy lymphatic channels and restoration of lymphatic flow in the affected region.

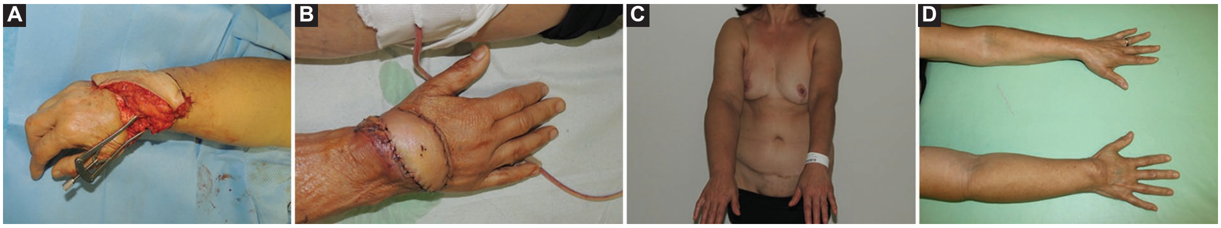

Figure 6. *Inguinal lymph node flap.* **A:** *flap inset at the wrist.* **B:** *immediate postoperative flap.* **C:** *preoperative lymphedema.* **D:** *postoperative follow-up with lymphedema improvement.*

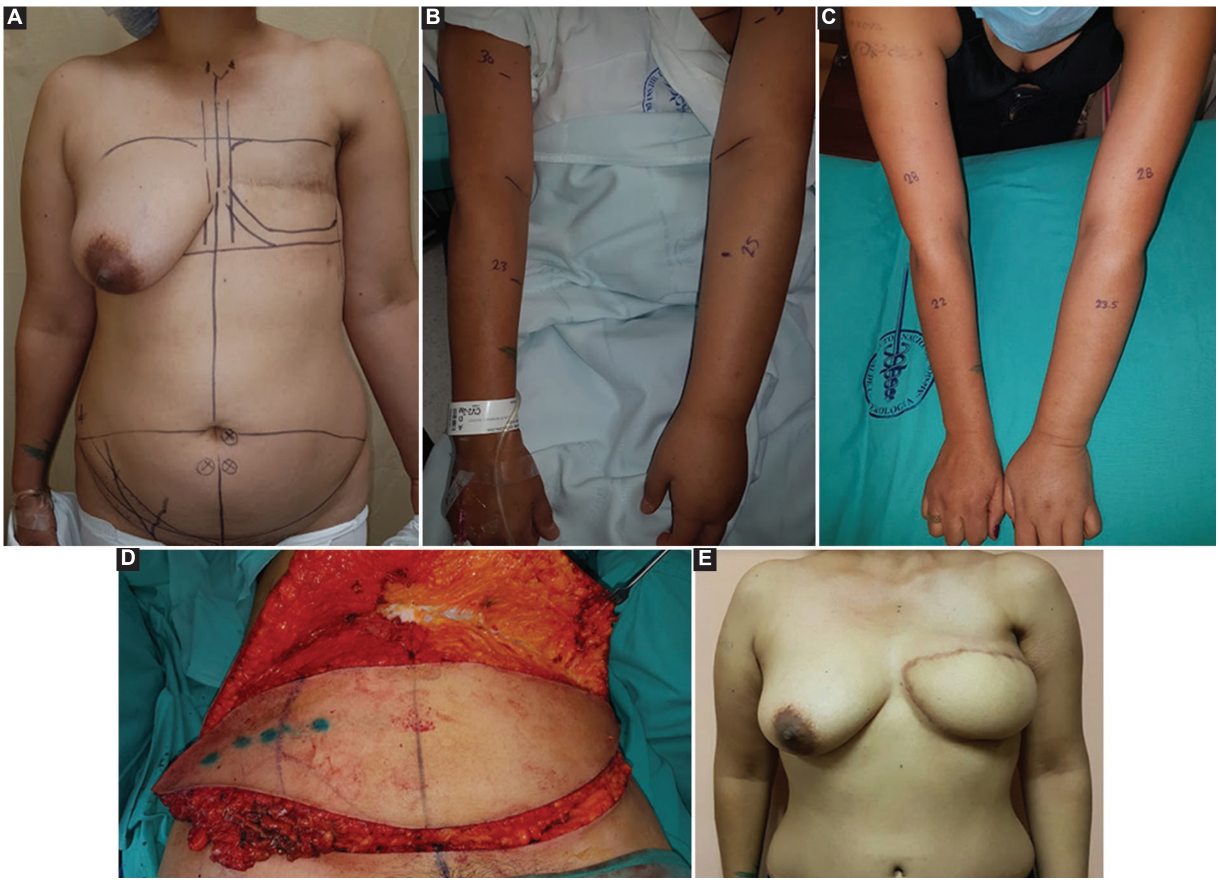

Figure 7. *Deep inferior epigastric perforator (DIEP) flap combined with inguinal lymph nodes.* **A:** *preoperative absence of breast.* **B:** *preoperative left arm lymphedema.* **C:** *postoperative improvement of left arm lymphedema and reduced circumference.* **D:** *DIEP flap including inguinal lymph nodes.* **E:** *postoperative reconstructed breast and treated lymphedema.*

In the LIFT technique (lymphatic interpositional flap transfer), a perforator flap including lymphatic vessels is transferred to a recipient site to "bridge" the interruption caused by tumor ablation and connect proximal and distal lymphatic stumps[42].

Excisional treatment

Liposuction

Accumulation of lymphatic fluid in the extremities causes increased deposition and hypertrophy of adipose tissue. Liposuction, a procedure that uses a fenestrated metal cannula connected to a vacuum suction system, allows aspiration of subcutaneous fat and reduction of limb volume. However, one possible risk of this technique is additional damage to the remaining lymphatic vessels[43]. To minimize this risk, longitudinal liposuction is preferred because it better preserves the integrity of lymphatic vessels, which is why it has been described as "lymphatic vessel-preserving." On the other hand, circumferential liposuction can be an appropriate option when a more uniform cosmetic result is sought, provided it is performed carefully.

Table 3. Overview of applications and outcomes of the main surgical techniques in lymphedema treatment

Technique	Most suitable lymphedema stage	Indications	Limitations	Complications	Volume reduction (%)
LYMPHA	Prevention of lymphedema	Patients undergoing axillary lymph node dissection	Ongoing debate on efficacy; randomized trials in progress	None reported	Reduces risk of lymphedema from 40% to 9% of cases
Lymphaticovenous anastomosis (LVA)	Early stages with functional lymphatic vessels	Patients with early lymphedema, partial lymphatic transport	Requires fluorescence equipment and microsurgical skills	Lymphatic fistulas, minor infections	Up to 44-55%; improvement in 73% of cases
Vascularized lymph node transfer (VLNT)	Advanced stages with fibrosis or irreversible lymphatic vessel damage	Patients with advanced lymphedema or unsuitable for LVA	Risk of donor-site lymphedema; complex microsurgical technique	Donor-site lymphedema, seroma, infection, flap loss	Up to 47%; improved when combined with LVA
LIFT (lymphatic interpositional flap transfer)	Stages II and III	Areas of lymphatic flow interruption such as wounds or scars	Requires fluorescence equipment and microsurgical skills	Donor-site lymphedema, seroma, infection, flap loss	
Liposuction	Advanced stages with fibrosis and significant fat hypertrophy	Volume reduction in cases refractory to compression therapy	Continuous use of compression garments; risk of damage to lymphatic vessels	Cellulitis, lymphatic injury, minor paresthesias	20-23% (up to [10]6% when combined with compression therapy)
Direct excision with skin grafts	Severe and refractory cases with major functional disability	Extreme cases in which daily activities are severely impaired	High morbidity, poor cosmetic outcome, invasive technique	Scarring, chronic infections, contour irregularities	Variable; used only in extreme cases

LIFT: lymphatic interpositional flap transfer; LYMPHA: lymphatic microsurgical preventive healing approach.

Brorson[44] described liposuction performed under ischemia, which allows extraction of adipose tissue with significantly reduced blood loss. After fat removal, excess redundant skin can be resected in the same procedure.

The main disadvantage of liposuction is the need for continuous (24-hour) use of compression garments after surgery to maintain the achieved balance. Interruption of this regimen can lead to recurrence of lymphedema due to reaccumulation of lymphatic fluid. Therefore, liposuction is a reductive procedure that does not improve lymphatic function.

Direct excision

Although direct excision is reserved for severe cases of lymphedema because of its high morbidity, in some cases radical excision may be the only option to restore function.

Among the described techniques is the Charles procedure, characterized by complete resection of skin and subcutaneous tissue while preserving the deep fascia and plantar surface of the foot, with defect coverage using skin grafts harvested from the resected tissue[45].

Other techniques have been developed to restore connection between the deep and superficial lymphatic systems, including resection of skin and soft tissue through an elliptical incision along the medial aspect of the arm combined with wide excision of the deep fascia, and the use of de-epithelialized skin flaps positioned along the neurovascular bundle throughout the incision length to promote lymphatic communication between the 2 systems[46]. (Table 3).

Robotic surgery

The use of robotic surgery in lymphedema treatment represents a significant advancement in reconstructive supermicrosurgery. This technology has expanded surgical possibilities by improving precision, providing enhanced visualization, and

Table 4. Advantages and challenges of robotic surgery in lymphatic reconstruction

Advantages	
Extreme precision	Greater accuracy due to robotic instruments, which can move within ranges beyond the capabilities of human hands
Minimization of trauma	Controlled robot movements reduce the risk of damage to surrounding tissues, which is crucial in small and delicate lymphatic structures
Improved visualization	Robotic systems offer enhanced three-dimensional visualization, facilitating identification of tiny lymphatic vessels and veins
Surgeon ergonomics	The robotic platform reduces surgeon fatigue during prolonged procedures, thus improving intervention quality
Potentially better outcomes	Greater precision may translate into improved lymphatic drainage, symptom reduction, and faster patient recovery
Challenges and considerations	
High cost	Systems are expensive, both in terms of acquisition and maintenance, which may limit accessibility
Learning curve	Extensive training is required for surgeons
Specific indications	Not all patients with lymphedema are ideal candidates for robotic surgery. Its use should be considered case by case, based on lymphedema severity, viability of lymphatic structures, and other factors
Procedure duration	Although precision is greater, robotic procedures may be longer, especially during the initial adoption phase
Clinical evidence	Although preliminary results are promising, larger and long-term studies are needed to establish the definitive superiority of robotic surgery over traditional techniques

reducing tremor, which is particularly beneficial in lymphaticovenous anastomosis techniques. Its advantages and disadvantages are summarized in table 4.

Conclusions

Lymphatic surgery offers promising results in the prevention and treatment of breast cancer–related lymphedema. Although significant advances have been achieved, such as supermicrosurgery and immediate preventive procedures, there remains a need for randomized clinical trials to strengthen recommendations. An interdisciplinary approach and appropriate patient selection are crucial to optimizing outcomes.

Robotic surgery holds great potential in surgical management of lymphedema, especially in microsurgical procedures such as lymphaticovenous anastomosis and vascularized lymph node transfer. However, its implementation must be considered in relation to available resources, surgical team expertise, and careful patient selection. With ongoing technological advancement and specialized training, this modality will likely become standard in the surgical management of lymphedema at specialized centers.

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Conflicts of interest

The authors declared no conflicts of interest whatsoever.

Ethical considerations

Protection of persons and animals. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality, informed consent, and ethical approval. The authors followed their institution's confidentiality protocols, obtained informed consent from patients, and obtained approval from the Ethics Committee. The recommendations of the SAGER guidelines were followed according to the nature of the study.

Statement on the use of artificial intelligence. The authors declare that they did not use generative artificial intelligence for the writing of this manuscript.

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