Medical Coverage Policy

Effective Date.....**10/15/2019**
Next Review Date..... **9/15/2020**
Coverage Policy Number **0531**

Surgical Treatments for Lymphedema and Lipedema

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Overview

This Coverage Policy addresses surgical treatments for lymphedema and lipedema.

Coverage Policy

The following surgical treatments for lymphedema are considered experimental, investigational or unproven:

- excisional procedures (e.g., debulking and liposuction)
- microsurgical treatment (e.g., microsurgical lymphatico-venous anastomosis, lymphatic- capsular-venous anastomosis, lymphovenous bypass)
- vascularized lymph node transfer
- tissue transfer (e.g., omental or mesenteric flap)

Liposuction for the treatment of lipedema is considered experimental, investigational or unproven.

General Background

Lymphedema

Lymphedema is a chronic condition that develops over months to years of an increasing lymphatic load that exceeds the lymphatic system's transport capacity. Impairment of lymphatic transport leads to interstitial accumulation of a protein-rich fluid that are normally transported by the lymphatic system from the interstitium into the circulation. Lymphedema can an affect any body part including trunk, limbs, head/neck, and genitals. Lymphedema is classified into primary and secondary forms. Primary lymphedema occurs when the lymphatic system does not mature properly during fetal development. It can be familial, genetic, or hereditary. Secondary lymphedema occurs secondary to a disruption or obstruction of the lymphatic system caused by: filariasis (primary cause worldwide), lymph node surgery/radiation due to cancer (primary cause in the United States) or by another cause such as chronic venous insufficiency (CVI), deep vein thrombosis (DVT), infection, surgery/trauma, lipedema, and obesity (Fort, 2019; Bello, et al., 2017).

Lymphedema may be clinically apparent but imaging is required for confirmation and to rule out other conditions that may confound the clinical presentation. Imaging technologies to confirm lymphedema or plan surgery include lymphoscintigraphy, or indocyanine green lymphangiography, possibly complemented by magnetic resonance imaging (Hayes, 2017; International Society of Lymphology [ISL], 2013).

Once diagnosed, lymphedema may be staged by severity. There are 2 main staging methods—the International Society of Lymphology (ISL) scale and the Campisi scale. The International Society of Lymphology (ISL) staging guidelines for lymphedema states (Mehrara, 2019; Bello, et al., 2017; Hayes, 2017; ISL, 2013):

- Stage 0: Latent or Subclinical
  - impaired lymphatic transport
  - no evident edema, subtle changes in tissue fluid/composition
  - changes in subjective symptoms
  - may last months or years before progression
- Stage I: Spontaneously Reversible
  - early accumulation of protein-rich fluid
  - pitting edema
  - subsides with elevation
- Stage II: Spontaneously Irreversible
  - accumulation of protein-rich fluid
  - pitting edema may progress to nonpitting as excess fat and fibrosis develop
  - does not resolve with elevation alone
- Stage III: Lymphostatic Elephantiasis
  - nonpitting
  - significant fibrosis
  - trophic skin changes

The Campisi staging system for lymphedema:

- Stage IA: Latent lymphedema without clinical evidence of edema, but with impaired lymph transport capacity (provable by lymphoscintigraphy) and with initial immune-histochemical alterations of lymph nodes, lymph vessels, and extracellular matrix.
- Stage IB: Initial lymphedema, totally or partially decreasing by rest and draining position, with worsening impairment of lymph transport capacity and of immune-histochemical alterations of lymph collectors, nodes, and extracellular matrix.
- Stage IIA: Increasing lymphedema, with vanishing lymph transport capacity, relapsing lymphangitic 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 IIIA: Properly called elephantitis, with scleroindurative pachydermatitis, papillomatous lymphostatic verrucosis, no lymph transport capacity, and life-threatening disability.
- Stage IIIB: Extreme elephantitis with total disability.

Nonsurgical or conservative treatment options for lymphedema are primarily physical and include elevation, exercise, skin care (to prevent drying, cracking, and infection), limb elevation, elastic stockings or other pressure garments or bandages, physical therapy, manual lymph drainage, massage therapy, and pneumatic compression devices; these are often used in combination such as with complex decongestive therapy (CDT) or intermittent pneumatic compression therapy. CDT, also known as complex lymphedema therapy (CLT) or complete decongestive physiotherapy (CDP) is a noninvasive treatment that is considered a standard of care for lymphedema. The main goal of treatment of lymphedema is volume reduction of the affected limb, improvement in patient symptoms as well as a reduction of or elimination of any recurrent infections (Garza, et al., 2017; Hayes, 2017; Lasinski and Boris, 2002; Macdonald, et al., 2003).

Nonsurgical treatments can be intensive and may require extensive, and time-consuming, ongoing intervention. For some individuals the nonsurgical treatments yield inadequate lymphedema control. Lymphedema surgery has been proposed to reduce limb size and improve quality of life (QOL) and function when conservative nonsurgical management yields inadequate results. The goals of surgical management of lymphedema are to retain or restore function, alleviate pain and discomfort, reduce the risk of infection, prevent disease progression, improve cosmesis, and limit deformity. There is no consensus regarding the role of surgery, the optimal surgical approach, or the timing of an operative procedure for extremity lymphedema. Conservative or nonsurgical treatment options are often resumed after surgery to maintain surgical benefits (Mehrara, 2019, Bello, et al., 2017; Garza, et al., 2017; Hayes, 2017).

Operations for lymphedema are classified in two main categories: excisional operations and lymphatic reconstruction. Surgical management of lymphedema is categorized into two general approaches: physiologic techniques and reductive/ablative techniques. Physiologic procedures are proposed for individuals with early stage lymphedema prior to deposition of excess fat and extensive tissue fibrosis. Reductive/ablative techniques are proposed for individuals who present with more advanced lymphedema after fat deposition and tissue fibrosis has occurred. Individuals with more advanced lymphedema have been treated with physiologic techniques, however, the results are variable, and only limited numbers of patients have been analyzed (Mehrara, 2019).

The issue in monitoring success of surgical interventions is that there is no set standard for measuring degree of lymphedema and no standardized conservative treatment protocol before or after surgery. Additionally, presently there is no uniformity in the literature with regards to a protocol for diagnosing and monitoring lymphedema. Providers who follow these patients have reported objective and subjective improvements in the majority of lymphedema patients who have undergone surgical intervention. Most studies that report on the surgical management of lymphedema monitor limb circumference, volume reduction, and incidence of cellulitis as their endpoints. Recently, patient self-reported quality of life outcome tools specific for lymphedema have been included as an additional end point. The most commonly performed surgical procedures for lymphedema are lymphaticovenular anastomosis and vascularized lymph node transfer (Garz, et al., 2017).

A textbook review of the surgical treatment of lymphedema concluded that lymphatic microsurgery continues to be promising but it requires extensive microsurgical training. Long-term patency rates associated with documented clinical and functional improvement must be reproduced in a larger numbers of patients and several medical centers before this operation can be recommended for routine treatment or as an alternative to conservative measures (Trinidad-Hernandez and Gloviczki, 2013).

Multiple ongoing clinical trials for the surgical treatment of lymphedema can be found on the ClinicalTrials.gov database.

Physiologic Techniques
The surgical approaches include lymphatic bypass procedures, flap transposition procedures, and vascularized lymph node transfers. The lymphatic bypass procedures are the most commonly used of the physiological

techniques. These procedures require a high level of technical skill, and it is recommended that performance of these procedures be reserved for those surgeons who have expertise in microvascular surgery (Mehrara, 2019).

Lymphatic bypass procedures: The lymphatic bypass procedures are categorized as lymphatic-lymphatic bypass and lymphovenous bypass procedures. Lymphaticovenular bypass procedures are a variation of the lymphovenous approach. There are several methods used to perform a bypass procedure. There is no consensus for the specific type of lymphatic bypass procedure to be performed; these decisions are made based on surgeon preference and experience. To help identify the lymphatic vessels, prior to making an incision, isosulfan blue dye is injected into the subcutaneous tissue distal to the operative site. The most common approaches are described as follows (Mehrara, 2019; Garza, et al., 2017):

- **Lymphatic-lymphatic bypass:** Lympholymphatic bypass transfers soft tissue resected from an unaffected site to a site that is proximal to that affected by lymphedema and followed by a direct anastomosis of the lymphatic vessels.
- **Lymphovenous bypass:** Lymphovenous bypass is an alternative to the lymphatic-lymphatic technique. A vein interposition graft is used to connect the distal lymphatic vessels with vessels proximal to the obstruction. Proximal vessels used in this technique include lymphatic vessels, adjacent veins, or deeper and larger veins. Multiple lymphatic vessels can be anastomosed to the vein graft.
- **Lymphaticovenular anastomosis (LVA):** This is a super microsurgical technique used to anastomose distal subdermal lymphatic vessels and adjacent venules less than 0.8 mm in diameter. Distal subdermal lymphatics are less affected by lymphedema and are more readily available for a bypass procedure than deeper lymphatic channels.
- **Vascularized lymph node transfer (VLNT):** This approach utilizes microsurgical techniques to transfer lymph nodes from an unaffected site to the affected limb with the intent of restoring lymphatic function and promoting lymph drainage. A limiting factor of this approach is that lymphedema can develop in the donor extremity.
- **Flap/tissue transfer:** Due to the risk of donor site lymphedema, clinicians have sought out other sources of vascularized lymphatic tissue. The omentum's function as lymphatic organ and mesenteric lymph nodes have both been explored for possible applications in lymphedema management. Results from these approaches have yet to be fully validated.

Reductive/Ablative Techniques
Reductive techniques, also called ablative techniques, remove fibrofatty tissue that has formed from sustained lymphatic fluid stasis. Reductive techniques include direct excision and liposuction (Mehrara, 2019; Hayes, 2017; Trinidad-Hernandez and Gloviczki, 2013):

- **Direct excision:** A variety of direct excision procedures have been described for the treatment of extremity and genital lymphedema. Excisional operations remove excess subcutaneous tissue to decrease the volume of the extremity. Lymphedematous tissues are excised together, including the skin and soft tissues. The resulting defects are covered either with tissue flaps (e.g., Sistrunk, Homans, Thompson procedures) or with skin grafts (e.g., Charles procedure). Prolonged hospitalization, poor wound healing, large surgical scars, sensory nerve damage, and residual edema of the foot and ankle are reported problems. These common complications limit such procedures to individuals with disabling, advanced or end-stage lymphedema that is not responding to maximal medical therapy.
- **Liposuction:** This ablative surgery removes fatty and fibrotic depositions through multiple small incisions of the affected limb in patients with more advanced lymphedema. It is sometimes called suction-assisted lipectomy. It is proposed for patients with stage II or III lymphedema. Postoperative placement of compression garments prevents swelling recurrence, must be refitted regularly, and may be required for life to maintain surgical benefits.

U.S. Food and Drug Administration (FDA)
The FDA does not regulate surgical procedures. Any medical devices, drugs, biologics, or tests used as a part of this procedure may be subject to FDA regulation.

Literature Review

Lymphatic bypass procedures: In a prospective cohort study, Salgarello et al. (2018) reported the outcomes of patients' health-related quality of life (HRQoL) after super microsurgical lymphaticovenular anastomosis (LVA) for lower and upper extremities lymphedema (ULL or LLL) (n=70). Forty-four patients (62.8%) were affected by ULL and 26 (37.1%) were affected by LLL. Five patients (7.1%) had a primary lymphedema, while 65 patients (92.9%) were affected by secondary lymphedema. The study included Caucasian patients with ULL and LLL. The intervention was super microsurgical lymphaticovenular anastomosis (LVA). There was no comparator. Quality of life (QoL) was assessed by lymphedema QoL questionnaire (LyMQoL), which is a validated disease-specific instrument to measure the impact of lymphedema on patient's lives, covering four domains: function, body image, symptoms, and mood. There was a mean follow-up of 8.5 months (range: 2–21 months). Additionally, the episodes of lymphangitis and the need for conservative therapy before and after surgery was evaluated. Among the sample, 61 patients (87.1%) underwent physical therapy or a rehabilitation program preoperatively. Postoperatively, the number of subjects who needed physical therapy, including manual compression, lymphatic massage, bandaging, or compression garments, remained stable, but 58.6% of the patients had a reduction in the number of sessions and/or compressive classes necessary to their well-being, difference in which was also significant ($p<0.01$). The average for overall QoL score before surgery was 5.5 for the upper limb group and 5.7 for the lower limb group. After a mean follow-up ranging from 8.5 months, there was an average increase for the global QoL score of 2.3 for upper limb and 2.6 for lower limb. The QoL average observed postoperatively was 7.9 for upper limb and 8.3 for lower limb ($p<0.001$). A statistically significant improvement in all four domains ($p<0.01$) was reported after surgery, being present from the first postoperative months for both upper and lower extremities. No adverse events were reported. The authors concluded that lymphaticovenular anastomosis improves HRQoL in patients affected by ULL and LLL. Additionally, both a reduction of episodes of lymphangitis and a decrease in the need of conservative therapy were observed in this cohort of patients. This study was limited by lack of a comparator group and short-term follow-up.

In a retrospective study, Engel et al. (2018) investigated the outcome of lymphedema microsurgery with or without microsurgical breast reconstruction for breast cancer-related lymphedema (BCRL) (n=124). Patients with BCRL who underwent three treatment modalities without or with microsurgical breast reconstruction were included in this study as groups I and II. (Cheng grading: grade I: n = 56; grade II: n = 45; grade III: n = 20; grade IV: n = 3). Patients were offered the lymphedema microsurgery depending on the availability of patent lymphatic ducts on indocyanine green lymphography if they failed to complete decongestive therapy. Patients who underwent simultaneous lymphovenous anastomosis and vascularized lymph node flap transfer were excluded from this study. Group I consisted of 87 patients who did not receive microsurgical breast reconstruction, and 30 (group Ia), 23 patients (group Ib), and 34 patients (group Ic) were treated with complete decongestive therapy, lymphovenous anastomosis, and vascularized lymph node flap transfer, respectively. Of the 37 patients in group II who underwent microsurgical breast reconstruction, 22 were treated with complete decongestive therapy (group IIa), 4 received a lymphovenous anastomosis (group IIb), and 11 were treated by vascularized lymph node flap transfer (group IIc). The circumferential difference, reduction rate, and episodes of cellulitis were used to evaluate the outcome of treatments. Mean follow-up period was 19.1 +/- 5.3 months (range 5.7-62.8 months). Improvements in the circumferential difference (12.8±4.2% vs 11.5±5.3%), the reduction rate (20.4±5.1% vs 14.7±6%), and episodes of cellulitis (1.7±1.1 vs 2.1±2.4times/yr) did not significantly differ between groups I and II ($p=0.06$, 0.07, and 0.06, respectively). In both groups, vascularized lymph node flap transfer was significantly superior to lymphovenous anastomosis or complete decongestive therapy in terms of improvements in the circumferential difference, reduction rate and episodes of cellulitis ($p=0.04$, 0.04, and 0.06, respectively). The re-exploration rate was 16.9% (n=21), and the overall complication rate was 8.1% (n=10). Flap losses did not occur. One (in group II) of 18 patients who underwent vascularized groin lymph node flap transfer developed right lower limb lymphedema, which was successfully treated with a lymphovenous anastomosis in the ankle one year after surgery. None of the 27 patients who received vascularized submental lymph node flaps developed face lymphedema. The authors concluded that microsurgical breast reconstruction did not improve the outcome of BCRL. Improvements in BCRL were better for lymphatic microsurgery than complete decongestive therapy. Vascularized lymph node flap transfer provided greater improvements in the BCRL than lymphovenous anastomosis.

In a prospective cohort study, Poumellec et al. (2017) analyzed the results of lymphaticovenous anastomoses (LVA) on 31 patients and reviewed the existing literature. This study comprised 31 female patients presenting lymphedema of the upper limb following treatment for breast cancer for which surgical treatment was given by microsurgery consisting of three stepped LVA performed in an outpatient setting. The post-LVA arm

circumference was measured at three levels (wrist, forearm, and arm) in 31 female patients. Mean follow-up time was 12.8 months. Reduction in the circumference was 22.5, 21.32, and 30.2%, respectively, in the wrist, forearm, and arm. Functional improvement was observed in the majority (84%) of patients ranging from moderate to substantial. Only two patients had no result. The only patients to experience recurrence were those with a high level of lymphedema. The review of the current literature and the present study revealed modest results in terms of decreased excess volume, although a major improvement in function points to LVA as a useful technique in this indication. Progress in imaging techniques has enhanced the results achieved with this procedure, although further studies on recurrence rates are needed with a follow-up greater than one year.

In a prospective study, Cornelissen et al. (2017) analyzed the effect of lymphaticovenous anastomosis (LVA) on quality of life (n=20). Inclusion criteria consisted of an evidenced upper limb lymphedema secondary to breast cancer in stage 1 or 2A according to the International Society of Lymphology (ISL) classification, patent lymphatic ducts seen by indocyanine green (ICG) lymphangiography and an absence of skin infections and complex decongestive therapy for at least three months. Quality of life was considered as the primary outcome, measured by the Lymphedema international classification of functioning (Lymph-ICF) questionnaire. Secondary outcomes were the use of compressive stockings and arm volume changes according to the Upper Extremity Lymphedema index (UEL-index). Measurements were obtained preoperatively and at one, three, six and 12 months postoperatively. The mean follow-up was 7.8 ± 1.5 months. Statistically significant improvement in quality of life was achieved in the total score and for all the quality of life domains after one year of follow-up ($p<0.05$). The discontinuation rate in compressive stockings use was 85%. The mean relative volume difference in UEL between a healthy and lymphoedematous arm preoperatively was 14.92 ± 8.01 and postoperatively 12.99 ± 7.47. The difference did not reach statistical significance ($p=0.582$). This study is limited by small sample size, lack of a comparator and short-term follow-up.

Cornelissen et al. (2018) conducted a systematic review to assess the clinical effects (improvement in arm circumference and quality of life) of lymphaticovenous anastomosis (LVA) in treating breast cancer-related lymphedema (BCRL). A total of 15 studies, 11 prospective and four retrospective studies, were included. All studies reported on BCRL in terms of volume or circumference reduction. Study population consisted of 268 patients; 263 patients presented with BCRL, one patient with upper limb lymphedema after an elbow fracture, and four patients with primary upper limb lymphedema. A control group was provided in two articles. One study included a control group where the patients who only received continuous bandaging were compared with those who underwent the intervention and continuous bandaging. Another study included several groups to compare the effect of different interventions, including LVA and lymph node transfers in combination with or without microvascular breast reconstruction, to groups only receiving decongestive therapy. The average follow-up was 20 months, ranging from two months to eight years. Thirteen out of the included studies reported a positive surgical effect on reduction in volume or circumference. Twelve articles mentioned qualitative measures, being symptom improvement and improvement in quality of life. The number of patients who experienced symptoms relief ranged from 50%-100% in the studies. Adverse events were not reported. Many limitations were reported. The volume and level of evidence of the studies on the effects of LVA in this specific patient population were low. No randomized controlled trial could be included, which displays the lack of solid evidence on this topic. The follow-up time in some studies was too short, with follow-up ranging from two months to six years. It remains unknown whether this reduction was maintained over a period of time. A broad variety in the years from onset till the LVA contributed to the heterogeneity of our study population. The way the outcomes were described varied enormously between studies. Some reported in terms of absolute or relative volume reduction while others mentioned circumference reduction. The authors concluded that heterogeneous results of LVA in the volume/circumference reduction for the treatment of BCRL were reported among studies. Improvement of the subjective symptoms was presented in most of the studies. This review showed that LVA may be particularly useful to improve quality of life in breast cancer-related lymphedema, in particular, in early-stage lymphedema in the distal arm. Further prospective, randomized controlled studies are required to confirm the effectiveness of LVA and to determine the appropriate candidates for this procedure.

Basta et al. (2014) conducted a systematic review and meta-analysis to quantify the efficacy and safety of microsurgery for lymphedema. Studies meeting criteria for inclusion were rated on methodologic quality based on the American Society of Plastic Surgeons levels of evidence. Demographic information, cause of lymphedema, and surgical technique were recorded. Quantitative change in lymphedema and perioperative complications were noted. A total of 27 studies were included, with 24 level IV evidence and three level III

evidence. Overall, the study population consisted of 1619 patients, with a female-to-male ratio of approximately 3:2. The vast majority of patients suffered from postsurgical lymphedema associated with oncologic conditions, including breast cancer and various gynecologic cancers. The staging system of lymphedema was inconsistent across studies. Lymphovenous shunt procedures were performed in 22 studies and lymph node transplantation was performed in five studies. Excess circumference was reduced by 48.8 ± 6.0%, and absolute circumference was reduced by 3.31 ± 0.73 cm. Studies reporting change in volume demonstrated reduction in excess volume by 56.6 ± 9.1%, and absolute volume was reduced by 23.6 ± 2.1%. The incidence of no improvement in lymphedema postoperatively was 11.8% and 91.2% of patients reported subjective improvement. Approximately 64.8% of patients discontinued compression garments at follow-up. Complications included operative-site infection (4.7%), lymphorrhea (7.7%), reexploration for flap congestion (2.7%), and additional procedures (22.6%). Limitations of this study are: heterogeneity of the patient population; assessment modalities; and inconsistent reporting of complications. The authors concluded that lymph node transplantation may provide better outcomes compared with lymphovenous shunt, but well-designed head-to-head comparisons are needed to evaluate this further.

Scaglioni et al. (2017) conducted a systematic review on the topic of lymphovenous anastomosis (LVA), assessing both objective and subjective improvements in lymphedema of extremities. The primary endpoint was the objective of a subjective postoperative lymphedema reduction. Ten of the observational cohort studies were retrospective and eight prospectively designed totally 939 patients. No randomized controlled trials were available for inclusion. The number of patients per study ranged from 5-154. The duration of lymphedema prior to surgery ranged from 22 days to 29 years, although not all studies revealed this data. The studies included in this review describe significant variations in surgical techniques, number of anastomoses and supplementary interventions. All studies reported objective reductions in circumference measurements. Subjective symptom relief was found in 50-100% of the patients as well as a reduction in the number of cellulitis episodes in all investigated cases. In 11 out of 18 studies, additional compressive therapy was reported. The studies included in this review showed great heterogeneity. The authors concluded that the time of follow-up in the vast majority of the included studies was too short to make a reliable statement about sustained benefits of LVA surgery. Additionally, the deficiency of comparative designed studies and uniform outcome measurements continues to prevents drawing evidence based conclusions.

In a 2019 UptoDate topic on surgical treatment of primary and secondary lymphedema the author states that “outcome data for physiologic techniques are from retrospective reviews of mostly lymphatic bypass procedures. Lymphatic bypass procedures result in highly variable responses, ranging from a complete response to none. The variability of results among the different studies is likely due to a number of factors including differences in assessing volume or circumference, length of follow-up, variable use of postoperative compression garments and/or physical therapy, and the use of non-standardized or non-validated questionnaires for subjective analysis. There has been no standardization of assessing volume of lymphedematous limb, and numerous techniques are reported to approximate volume changes following an operative procedure. Few studies report the use of complimentary techniques (e.g., volume measurements and bioimpedance or lymphoscintigraphy) to corroborate measurements. Other caveats include mixed series of patients, either based upon etiology (e.g., primary congenital conditions, or secondary lymphedema following nodal resections, trauma, or filariasis); location of lymphedema (e.g., upper or lower extremity); and/or variable criteria for patient selection, selection of procedures, timing of intervention, and identification of suitable lymphatic vessels for bypass surgery” (Mehrara, 2019).

In a Hayes Medical Technology Directory Report on Surgical Treatment of Lymphedema: A Review of Reviews, the authors summarized the overall quality of the evidence for LVA was low-quality. Among 12 studies reviewed, 3074 patients were treated with LVA for upper extremity lymphedema (n=310), lower extremity lymphedema (n=164), or a mix that could not be differentiated (n=2600). No studies directly comparing LVA with nonsurgical treatment for lymphedema were identified. Of the nine studies noting lymphedema staging schemes, both the International Society of Lymphology (ISL) scheme and the Campisi lymphedema staging scheme were used. The duration of follow-up ranged from 3-120 months, but most studies reported 12-32 months of follow-up. In the studies reviewed, information on the performance of LVA itself was limited. Most studies were characterized as using LVA, but one study also implemented lymphaticovenous implantation, and one used lymph vessel transplantation. An average absolute circumference reduction of 5.8% (95% CI, 0.07-11.5%) in three studies with 33 patients, an average excess circumference reduction of 16.1% (95% CI, 2.6-29.6%) in four studies with 69

patients, and an average excess volume reduction of 33.1% (95% CI, 14.4-51.9%) in four studies involving 172 patients. The studies reviewed did not report QOL using standard instruments; five studies reported related outcomes. A majority of patients responded positively in terms of QOL. One study reported 91.7% symptom improvement and two other studies reported mean satisfaction of 94.5%. Two other studies reported 50% patients with subjective improvement. Two studies reported an overall complication rate of 5.9%, consisting of partial skin ulceration in one patient and wound dehiscence in one patient. After surgery, in 10 of 11 studies that reported additional interventions, the patients used compression garments. Of those, three reported additional interventions such as physical therapy or manual drainage. One study used physical therapy alone for postoperative care. The authors reported that although the meta-analyses of various limb-reduction measures were statistically significant when studies were combined, the average reductions in limb circumference were modest, particularly when the lower CI is considered. Not all studies reported statistically significant limb size reduction, although power may have been an issue. QOL was generally not assessed using a standard instrument, which decreases the overall quality of this outcome; however, available results suggest most patients had satisfactory improvement (Hayes 2017, reviewed 2018, 2019).

Vascularized Lymph Node Transfer (VLNT): In a case series study, Ciudad et al. (2019) described the clinical and patient reported outcomes of combining a physiologic (dual gastroepiploic VLNTs) and an excisional procedure (the modified radical reduction with preservation of perforators [RRPP]) in patients with extremity lymphedema stage III, as defined by the International Society of Lymphology (ISL). Diagnosis was based on past medical history, clinical examination, and lymphoscintigraphy using technetium-99m. All patients had failed at least six months of conservative treatment. Patients with prior history of abdominal surgery were excluded. The intervention was double gastroepiploic VLNT with laparoscopic harvest in combination with RRPP. There was no comparator group. Demographics, outcomes including circumference reduction rates, preoperative and postoperative lymphoscintigraphy, complications, and responses to the Lymphedema Quality of Life (LYMQOL) questionnaire were analyzed. The mean follow-up period was 14.2 months (range, 12-19). The mean circumference reduction rate was 74.5% ± 6.9% for the upper limb and 68.0% ± 4.2% for the lower limb. LYMQOL showed a 2.7-fold quality-of-life improvement ($p<0.01$). Postoperative lymphoscintigraphy showed improved lymphatic drainage in all cases. There were no major complications. Minor complications, including numbness and hyperesthesia, were treated conservatively. The study was limited by lack of a comparator and small sample size. The authors concluded that combination of VLNT with modified RRPP in a one stage procedure is safe and reliable and provides optimal outcomes for patients with advanced extremity lymphedema. Larger series using this technique are required to standardize the combined approach and offer better and more efficient outcomes.

In a comparative study, Maruccia et al. (2019) retrospectively evaluated and compared surgical and patient-related outcomes in women affected by stage II and III post mastectomy upper limb lymphedema by two approaches: a combined physiological procedure of lymph node flap transfer and release of the axillary scar with fat graft versus only the lymph node transfer. Inclusion criteria was history of breast cancer treated with either mastectomy or breast-conserving therapy and axillary lymph node dissection; Stage II and III (International Society of Lymphology staging system) breast cancer-related upper limb lymphedema exclusively treated by combined lymph node transfer to distal site and axillary scar release with fat graft or just with lymph node transfer to the distal site. Patients were excluded if they underwent the ancillary excisional procedure to treat lymphedema. Group A was combined procedure (VLNT + fat graft) (n=18); Group B had VLNT only (n=21). The primary outcome measure was the reduction rate (RR) of upper limb circumference (above elbow and below elbow). The secondary outcome was incidence of cellulitis and the specific quality of life parameters. An average follow-up time to lymphodynamic evaluation was 29 months (range, 24–38 months) for Group A and 32 months (range 28–44) for Group B. Flap survival rate was 100%, with no donor site morbidity in all patients. A statistically significant difference between the circumference reduction rates (RR) at above elbow level was observed at 3 and 6 months of follow-up comparing the two groups ($p < 0.00001$), with higher values in Group A than in Group B. No significant difference was detected comparing RR values at above and below elbow at 12 and 24 months postoperatively. LYMQOL metrics showed significantly better scores ($p<0.0001$) in all domains at all follow-up appointments in Group A. No adverse events were reported. This study was limited by small sample size. The authors advocate further larger research to corroborate and expand the results of the study.

In a retrospective observational study, Leppäpuska et al. (2019) reported results of chronic lymphedema patients (n=21) who have undergone lymph node transfer and liposuction simultaneously in one operation and compared

the results with patients who have undergone lymph node transfer without liposuction. Lymphangiogenesis associated growth factor (VEGF-C, VEGF-D) concentrations in the wound fluids of these patients was analyzed. The study included post mastectomy patients and one Hodgkin's lymphoma patient. All patients had a long history (range between 12 and 185 months, average 52 months) of chronic lymphedema with nonpitting edema and deposition of fat and fibrotic tissue after axillary lymphadenectomy and radiation therapy. Indications for procedure included clinically diagnosed lymphedema with more than 500mL of nonpitting edema compared with contralateral arm and reduced lymphatic function in lymphoscintigraphy. A total of 11 patients underwent lymph node transfer combined with liposuction (LIPO) of the affected arm and 10 patients underwent simultaneous breast reconstruction and lymph node transfer combined with liposuction of the affected arm. Compression therapy was started immediately after the operation and the patients used compression 24 hours/day at least six months postoperatively. Changes in clinical parameters (number of erysipelas infections, pain), arm volume, transport indexes calculated form lymphoscintigraphy images, and daily usage of compression garments were compared preoperatively and postoperatively and between groups (combined technique vs lymph node transfer). Mean follow-up time was 48.9 ± 15.4 months. In the combined technique group, the average arm volume excess decreased postoperatively 87.7%, and in 7 of 10 patients, the edema volume did not increase even without compression. Seventeen of 21 patients were able to reduce the use of compression garment. Lymphoscintigraphy results were improved in 12 of 15 patients and the improvement was significantly greater in the combined technique group than in the lymph node transfer group (p=0.01). The number of erysipelas infections was decreased in seven of 10 patients and the decrease was significantly greater in the combined technique group than in the lymph node transfer group (p=0.02). In the lymph node transfer group, the average excess volume decreased postoperatively 27.5%. Fourteen of 27 patients were able to reduce the use of compression garments. Lymphoscintigraphy results were improved in 8 of 19 patients, and the number of erysipelas infections was decreased in one of three patients. There were no complications of the liposuction arm. Nine of 21 patients had minor complications (postoperative numbness, wound infection, limited skin necrosis, seroma) of the flap donor or recipient area. One patient needed a reoperation because of a thrombosis of the arterial anastomosis on the first postoperative day (wet liposuction technique). The authors concluded that liposuction can safely be performed with lymph node transfer in one operation to achieve optimal results in patients with chronic lymphedema. The combined technique provides immediate volume reduction and further regenerative effects on the lymphatic circulation. The significantly greater reduction in lymphoscintigraphy values and erysipelas infections suggests that the combined technique might be better for late-stage lymphedema patients than lymph node transfer alone. Limitations of this study include the retrospective nature of the data gathering and the small number of patients. A randomized controlled trial for stage II lymphedema patients comparing lymph node transfer, liposuction with controlled compression therapy, and the combination of these two techniques in the future would be feasible to compare these techniques in the same patient material.

In a case series study, Liu et al. (2018) evaluated the outcome of vascularized groin lymph node (VGLN) transfer using axilla as a recipient site in patients with breast cancer-related lymphedema (BCRL) and reported on radiological evidence of lymphangiogenesis in VLNT. A total of 30 patients with BCRL were included in this study with a mean age of 60. All 30 patients had axillary dissection. Twenty-seven patients received adjuvant radiotherapy. One patient had stage I lymphedema, 25 patients had stage II disease, and four patients had late stage II disease and 28 received chemotherapy. The mean duration of lymphedema was six years. All patients received preoperative decongestive physiotherapy. None of the patients had received prior surgery for lymphedema. Patients with active axillary disease (i.e., axillary lymph node metastasis or documented deep vein thrombosis of the axillary vessels), were excluded from this study. A skinless VGLN flap nourished by the superficial circumflex iliac vessels was transferred to the axillary region of the lymphedematous limb. Mean follow-up was 22.11 ± 7.83 months (range, 12-34 months). The outcomes were assessed clinically with limb circumference measurement and radiologically with lymphoscintigraphy. No patient developed increase in limb circumference, 9 (30%) patients had no limb circumference reduction, and 21 (70%) patients had limb circumference reduction. The mean circumference reduction rate of the lymphedematous limb was 47.06% ± 27.92% (range, 0% to 100%). Eleven (37%) patients showed radiological improvement in postoperative lymphoscintigraphy that included seven cases of faster contrast transport and four cases of visualization of transplanted lymph node. No adverse events were reported. The authors concluded that the effectiveness of VGLN flap transfer in the treatment of BRCL is supported by limb circumference reduction and improvements in lymphoscintigraphy parameters. This study was limited by small sample size and lack of a comparator.

In a prospective study, Maronado et al. (2017) evaluated the flap and the donor site morbidity of the supraclavicular (SC) VLNT. A review of a prospective database was performed for patients who had undergone SC VLNT to treat upper or lower extremity lymphedema. Flap and donor site complications were registered for each patient. One hundred consecutive patients with lower or upper extremity lymphedema underwent SC VLNT (84% from the right side) with a mean of 11-months follow-up (range 3-19 months). There were no flap loss but three flaps (3%) required re-exploration due to venous congestion of the skin paddle. Two patients had local infection and three patients developed chyle leak (3%) at the donor site but resolved spontaneously. No donor site secondary lymphedema was noted. This study focused on donor site. No limb size reduction outcomes were reported.

In a prospective study, Gratzon et al. (2017) evaluated the clinical, psychosocial, and functional outcomes of patients who underwent VLNT to the axilla for the treatment of upper extremity lymphedema after breast cancer therapy (n=50). Patients were evaluated preoperatively and postoperatively at one-, three-, six-, nine-, and 12-month intervals by circumferential measurements, pain/heaviness scales, and lymphedema quality of life (LYMQOL) questionnaires. Preliminary results showed a decrease in arm volumes by 34.57 % at one month, 52.03 % at three months, 42.34 % at six months, 65.23 % at nine months, and 58.68 % at 12 months. Pain and heaviness consistently decreased over time at 12 months. Overall quality of life scores steadily improved at 12 months. There was a significant decrease in the number of infections of the affected arm postoperatively and a decreased need for physiotherapy. Complications occurred in 17 patients and consisted mainly of minor wound complications. The authors reported that a consensus of surgical and postoperative protocols for VLNT is needed among studies to assess adequately its utility in the treatment of lymphedema. Although preliminary results are promising, larger studies with longer follow-up are needed to evaluate the efficacy and safety of this procedure.

In a randomized prospective control study, Dionyssiou et al. (2016) evaluated the effectiveness of free vascularized lymph node transfer (LNT) in stage II breast cancer-related lymphedema patients in comparison with non-surgical management. A total of 36 cases were included in this study and randomly divided in two groups: group A patients (n=18) underwent microsurgical LNT; followed by six months of physiotherapy and compression, while group B patients (n=18) were managed by physiotherapy and compression alone for six months. Patients of both groups removed their elastic garments after six months and were re-examined one year later. Limb volume reduction was observed in both groups; mean reduction was greater in group A (57%) than in group B (18%). Infection episodes in group A were significantly reduced compared to those in group B patients. All group A patients reported painless and feeling of heaviness-free extremities with overall functional improvement, while the corresponding changes in group B patients were no more than marginal. This study is limited by small sample size and short-term follow-up.

In a case series study, Saaristo et al. (2012) describe a modified breast reconstruction flap containing lymph nodes from the groin area to reconstruct both the missing breast and the lymphatic network anatomy in the operated axilla. Breast reconstruction was completed in 87 patients. For all patients with lymphedema symptoms (n=9), a modified lower abdominal reconstruction flap containing lymph nodes and lymphatic vessels surrounding the superficial circumflex vessel pedicle was performed. Operation time, donor site morbidity, and postoperative recovery between the two groups (lymphedema breast reconstruction and breast reconstruction) were compared. The effect on the postoperative lymphatic vessel function was examined. The average operation time was 426 minutes in the lymphedema breast reconstruction group and 391 minutes in the breast reconstruction group. The postoperative abdominal seroma formation was increased in patients with lymphedema. Postoperative lymphoscintigraphy demonstrated at least some improvement in lymphatic vessel function in five of six patients with lymphedema. The upper limb perimeter decreased in seven of nine patients. Physiotherapy and compression was no longer needed in three of nine patients. No edema problems were detected in the lymph node donor area. None of the operated patients with lymphedema reported pain, hernias, or edema symptoms in the donor area (low abdominal wall or lower limb). A total of three of nine patients with lymphedema have discontinued the use of compression and physiotherapy eight months to two years after the breast reconstruction and lymph node transfer. The authors reported that the lymph node transfer is still considered an experimental surgery and this study is the third report on the efficacy of the lymph node transfer in the treatment of lymphedema.

In a case series study, Gharb et al. (2011) reported the outcome of vascularized lymph node transfer with hilar perforators compared with the conventional technique. A total of 21 patients affected by early stage II upper limb lymphedema were included in the study. A total of 11 patients received a free groin flap containing lymph nodes, and 10 patients received vascularized inguinal lymph nodes with hilar perforators. Mean follow-up was 46 and 40 months, respectively. Complications, secondary procedures, circumference of the limb, and subjective symptomatology were registered. There was no statistical difference in the limb circumference measurements between the two groups preoperatively. Differences between preoperative and postoperative measurements were statistically significant only in the perforator-based group at the levels below elbow, wrist, and midpalm ($p=0.004$, 0.002, 0.007, respectively). All the other differences were not statistically significant. The number of secondary procedures was significantly higher in the standard group ($p=0.03$). There were two cases of partial flap loss and donor site lymphorrhea in the standard group. In both the groups, visual analog scale scores improved after the operation.

In a case series study, Lin et al. (2009) evaluated the outcome of vascularized groin lymph node transfer using the wrist as a recipient site in patients with post-mastectomy upper extremity lymphedema. A total of 13 consecutive patients underwent vascularized groin lymph node transfer for post-mastectomy upper extremity lymphedema. A vascularized groin lymph node nourished by the superficial circumflex iliac vessels was harvested and transferred to the dorsal wrist of the lymphedematous limb. The superficial radial artery and the cephalic vein were used as the recipient vessels. Outcome was assessed by upper limb girth, incidence of cellulitis, and lymphoscintigraphy. All flaps survived, and one flap required re-exploration, with successful salvage. No donor-site morbidity was encountered. At a mean follow-up of 56.31 ± 27.12 months, the mean reduction rate (50.55±19.26%) of the lymphedematous limb was statistically significant between the preoperative and postoperative groups ($p<0.01$). The incidence of cellulitis was decreased in 11 patients. Postoperative lymphoscintigraphy indicated improved lymph drainage of the affected arm, revealing decreased lymph stasis and rapid lymphatic clearance.

In an initial report of this surgery which was performed in France, Becker et al. (2006) reported on retrospective data collected on 24 patients treated with inguinal lymph node transfers to the axillary region. Patients with lymphedema for more than five years underwent lymph node transplantation. In this case series, upper limb perimeter returned to normal in 10 cases, decreased in 12 cases, and remained unchanged in two cases. The 10 cases in which upper limb perimeter returned to normal were described as being “cured.” The authors reported that “no current gold standard for evaluation of lymphedema exists; hence, evaluating results of treatments remains difficult and appears controversial”. Long-term results were evaluated according to skin elasticity and existence of infectious disease, decrease or disappearance of the lymphedema assessed by measurements, effects observed on isotopic lymphangiography, and ability to stop or to discontinue physiotherapy after six months. Long-term results were also evaluated according to the duration of the lymphedema before surgery and occurrence of downstaging after surgery. Physiotherapy was discontinued after six months in 14 patients and after 12 months in one patient. In the nine other patients, physiotherapy remained necessary and was performed once weekly in seven patients. Physiotherapy was thus discontinued in 15 patients (62.5%). No results were reported after 12 months.

In a review of the literature, Pappalardo et al. (2019) concluded that vascularized lymph node (VLN) transfer has become a promising treatment for moderate and advanced stages of extremity lymphedema. Consensus among the experts regarding most of the current issues, including the mechanism of VLN transfer, staging system or donor and recipient sites, is needed to provide more predictable outcomes. Patient selection criteria, careful preoperative evaluation of donor site and recipient site and mastering anatomy and surgical skills are key factors for successful treatment of lymphedema of the extremities.

In a review of the literature, Scaglioni et al. (2018) evaluated outcomes and complications of vascularized lymph node transfer (VLNT) for the treatment of lymphedema. A total 24 studies encompassing 271 vascularized lymph node transfers were included. There were 260 free vascularized lymph node transfers performed, and 11 pedicle lymph node flaps. Measurements reported were heterogeneous. The follow-up time ranged from 1 to 96 months. The inguinal nodes were the most commonly used donor site followed by the lateral thoracic lymph nodes. The lateral thoracic lymph nodes were the least effective and had the highest complication rates (27.5%) compared to other lymph node donor sites (inguinal: 10.3% and supraclavicular: 5.6%). Upper extremity lymphedema responded better compared to lower extremity (74.2 vs. 53.2%), but there was no difference in placing the lymph

nodes more proximally versus distally on the extremity (proximal: 76.9% vs. distal: 80.4%). The number and degree of improvement following VNLT was not thoroughly or consistently documented in the majority of studies. Twenty-five patients underwent additional adjuvant debulking procedures secondary to the lymph node transfers. The authors reported that more structured, prospective research to document outcomes in a more objective fashion is needed to know which donor and recipient site is best. Many of the studies included in the current analysis did not specify these details. Standardization in the parameters used to measure lymphedema following surgical intervention is needed.

In a Hayes Medical Technology Directory Report on Surgical Treatment of Lymphedema: A Review of Reviews, the authors summarized the overall quality of the evidence for vascularized lymph node transfer (VLNT) was low-quality. Among 10 studies enrolling 111 patients with upper limb lymphedema and 74 with lower limb lymphedema of stage IIa to III reported average absolute circumference limb reduction at follow-up of 39.5% (95% CI, 36.0-43.0%) in four studies with 69 patients, an average absolute volume reduction of –4.04% (95% CI, –23.6-15.5%) in two studies with 32 patients, and an average excess volume reduction of 26.4% (95% CI, –7.98-60.8%) in four studies with 77 patients. Although the average circumference reduction was statistically significant, the average absolute and excess volume reductions were not. Quality of life (QOL) measured on standard instruments was not reported, but patients in four studies reported improved function, appearance, and mood, as well as decreased pain. Seven studies reported an overall rate of complications of 30%, including cellulitis, wound infection, lymphocele, donor site pain, seroma, and lymphedema. The authors reported that "Some uncertainties about the safety and efficacy of VLNT remain. Outcomes did not consistently indicate that VLNT was successful for the treatment of lymphedema; however, some evidence suggests that many patients were satisfied with their surgery. Benefits over conservative care are suggested by the results of a single randomized controlled trial (RCT) of patients who had been treated for breast cancer. More complications were reported for VLNT than for other surgeries" (Hayes, 2017, reviewed 2018, 2019).

Raju et al. (2014) completed a review of the literature for VLNT with updates and comparisons on current application, techniques, results, studies and possible future implications. The authors concluded that "Although the results with the use of VLNT for treatment of lymphedema have been largely positive, further exploration into standardized protocols for diagnosis, treatment optimization, and patient outcomes assessment is needed".

Flap/Tissue Transfer: In a prospective study, Nguyen et al. (2017) report the long-term outcomes of the minimally invasive free vascularized omental lymphatic flap for the treatment of lymphedema. All consecutive patients with advanced lymphedema undergoing minimally invasive free vascularized omental lymphatic flap transfer were included (n=42). Perioperative evaluation included qualitative assessments, lymphoscintigraphy, and volumetric measurements with a mean follow-up of 14 (3–32) months. Subjective improvements were noted in 83% of patients. Mean volumetric improvement was 22%. Complications occurred in 16% (n=7) of patients. There was one episode of pancreatitis and one flap loss. Postoperative imaging revealed viable lymphatic transfers. Cellulitis history was present in 74% (n=31) patients with post-operative cellulitis occurring in 5% (n=2) patients. The collection of quality of life outcomes measures was incomplete.

Reductive/Ablative Techniques: In a prospective registry study, Hoffner et al. (2018) evaluated the five-year results after liposuction in combination with controlled compression therapy (CCT). Between 1993 and 2012, a total of 127 consecutive women were operated on. Twenty-two could not be followed for five years: 18 died before the last follow-up (10 because of breast cancer and eight of other causes), one had recurrence of breast cancer, one stopped using CCT, one moved abroad, and in one case, data from the therapist was missing. A total of 105 women with non-pitting lymphedema remained in the study. Inclusion criteria was: diagnosis of secondary arm lymphedema following breast cancer treatment; a significant excess volume, that is the volume of the affected arm was at least 10% larger than that of the unaffected arm and concomitant subjective discomfort; inability of previous conservative treatment to reduce the excess volume completely; no or minimal pitting (<5mm) as a sign of adipose tissue hypertrophy; and accustomed to the use of compression garments preoperatively. Exclusion criteria included active cancer, wounds, or infections and patients unwilling to undergo continuous postoperative CCT. Power-assisted liposuction was used during the period 1993–1997, the "dry technique". During the period 1997–2012, a tourniquet was utilized in combination with the tumescence technique to minimize blood loss. There was no comparator. The primary outcome was excess volume reduction. Standardized forms were used to collect pre-, peri-, and postoperative data. Patients were followed up regularly at 0.5, one, three, six, nine months and at one year after surgery, and then every year. If complete

reduction was not reached at one year, three-month visits were scheduled. Patients with complete reduction at two years were followed up by their previous lymph therapist, who reported arm volumes yearly. Total aspirate mean volume was 1,831 ± 599 ml (range, 650–3,780) for all patients (n=105). Postoperative mean reduction five years postoperatively was 117% ± 26% as compared with the healthy arm. No adverse events were reported. The authors concluded that liposuction combined with CCT is an effective and safe method for treatment of chronic, nonpitting arm lymphedema resistant to conservative treatment. A mean reduction of 117% was achieved, and such normalization can be anticipated in patients with an excess volume of around 3,000 ml. This study is limited by small sample size and no comparator.

In a cohort study, Lamprou et al. (2017) reported the long-term results of circumferential suction-assisted lipectomy (CSAL) in end-stage primary and secondary lymphedema of the leg. Patients were treated with CSAL for unilateral chronic irreversible lymphedema of the leg (n=88). Compression therapy was resumed after surgery. Leg volumes were measured before surgery, and at one, six, 12 and 24 months after the procedure. A total of 47 patients with primary lymphedema had a median preoperative volume difference between affected and unaffected legs of 3686 (interquartile range [IQR]), 2851 to 5121) ml. Two years after surgery, this volume difference was reduced to 761 ml, a 79% reduction. In the 41 patients treated for secondary lymphedema, the median preoperative volume difference was 3320 (IQR 2533-4783) ml, decreasing after two years to -38 ml indicating a 100% reduction in excess volume on average. The preoperative volume difference and the sex of the patient significantly influenced the final outcome after two years. The outcome was not related to body mass index (BMI) or other patient characteristics. Subsequent continuous compression, weight control, physical exercise, and lifestyle alterations are still needed to achieve the maximum effect.

In a cohort study, Hoffner et al. (2017) assessed liposuction plus controlled compression therapy in patients with lymphedema of an arm secondary to breast cancer treatment. The aim of the study is to test the hypothesis that liposuction improves health-related quality of life (HRQoL). Sixty female patients with arm lymphedema were followed for a one-year period after surgery. The 36-item short-form health survey (SF-36) was used to assess HRQoL. Patients completed the SF-36 questionnaire before liposuction, and after one, three, six, and 12 months. They reported a mean difference between affected and unaffected limbs of 1365 mL (standard error of the mean [SEM] 73) at baseline, which declined to 75 mL (SEM 35) at one month, –26 mL (SEM 40) at three months, –133 mL (SEM 40) at six months, and –213 mL (SEM 35) at one year, indicating > 100% reduction in excess volume on average. They reported that 82% (49 of 60) patients had complete resolution of their lymphedema. The adipose tissue volume removed at surgery was 1373 – 56mL. One month after liposuction, better scores were found in mental health. After three months, an increase in physical functioning, bodily pain, and vitality was detected. After one year, an increase was also seen for social functioning. The physical component score was higher at three months and thereafter, while the mental component score was improved at three and 12 months. Limitation of this study include: a lack of control or comparator group; observational study; insufficient length of follow-up to determine long-term outcomes.

In a 2019 UptoDate topic on surgical treatment of primary and secondary lymphedema the author states that most of the outcome data for reductive/ablative techniques for the treatment of lymphedema are from retrospective reviews, small case series and case reports. At this time there are no randomized trials to determine the optimal reductive procedure to treat lymphedema (Mehrara, 2019).

In a Hayes Medical Technology Directory Report on Surgical Treatment of Lymphedema: A Review of Reviews, the authors summarized the evidence for excision to treat late-stage lymphedema of the extremities. There is limited, low-quality evidence from five cohort studies. A total of 65 patients with lower extremity lymphedema and 11 with upper extremity lymphedema that was stage IIb or higher in each study found consistent improvements, including reductions in absolute circumference ranging from 12-16%, and a 52% reduction in excess circumference. Duration of follow-up ranged from 13-48 months. Two out of five studies reported quality of life results stating improvements in well-being and function. There was a moderate incidence of complications. Four of the five studies reported on complications and those experienced by 2-4 patients in total included prolonged numbness, cellulitis, wound breakdown, and need for additional grafting. Other complications experienced by one patient each included infection, seroma, hematoma, and hyperesthesia. In all studies reviewed, patients were encouraged to wear compression garments to maintain surgical benefits (Hayes, 2017, reviewed 2018, 2019).

The Hayes Medical Technology Directory Report on Surgical Treatment of Lymphedema: A Review of Reviews, summarized the evidence for liposuction. There is low-quality evidence from four studies enrolling 111 patients with upper extremity lymphedema and 74 with lower extremity lymphedema. Of the two studies that reported on stage, one reported ISL stage II-III and the other reported stage II. Three studies reported follow-up of 12 months and the fourth reported a mean follow-up of 38.4 months. Details of the liposuction or suction assisted lipectomy procedures was not reported in the studies. Reported weighted mean excess volume reduction (compared with the contralateral side) of 96.6% (95% CI, 86.2% to 107%) for a meta-analysis of three studies with 70 patients. Three studies followed patients for 12 months and the fourth for a mean of 38.4 months. All three studies reporting quality of life (QOL) found improved well-being and decreased depression and anxiety. It is unclear whether standard instruments were used to assess QOL. No perioperative complications were reported. In all studies, patients were encouraged to wear compression garments to maintain surgical benefits (Hayes, 2017, reviewed 2018, 2019).

Systematic Reviews: Markkula et al. (2019) conducted a Cochrane systematic review to assess and compare the efficacy of surgical interventions for the prevention of the development of lymphedema (LE) in the arm after breast cancer treatment and to assess and compare the efficacy of surgical interventions for the treatment of established LE in the arm after breast cancer treatment. The authors considered any surgical intervention for the treatment or prevention of secondary LE of the arm after breast cancer treatment. Both reductive and reconstructive techniques were considered including, but not limited to: liposuction; lymphaticovenular anastomoses; lymphatico-lymphatic bypass; lymph node transfer. All randomized controlled trials (RCTs) that compared a surgical intervention for the treatment or prevention of LE in the arm after breast cancer treatment to either standard intervention (conservative measures such as compression garments, lymphatic massage, bandaging, and intermittent pneumatic compression), placebo intervention (surgery performed without the critical surgical step), or another surgical intervention were included in this review. Three studies (n=131) were included: two studies reported on the effectiveness of lymphaticovenular anastomosis as part of preventive management protocols in the prevention of breast cancer-related lymphedema and one study reported on the effectiveness of vascularized lymph node transfer in the treatment of established breast cancer-related lymphedema. The author conclusions state that there is currently not enough evidence to support the widespread adoption of lymphaticovenular anastomosis or vascularized lymph node transfer techniques. This review has shown that when these techniques are applied by well-trained surgeons who are expert in its use, there is potential to make a real impact in outcomes for breast cancer patients but there is currently not enough evidence to support the widespread adoption of lymphaticovenular anastomosis or vascularized lymph node transfer techniques.

In a systematic review (SR), Carl et al. (2017) reviewed the literature to develop a treatment algorithm based on highest-quality lymphedema research. The SR addressed lymphovenous anastomosis (LVAs), vascularized lymph node transfer (VLNT), liposuction, excision, and multiple/combination surgical approaches for the treatment of lymphedema. The inclusion criteria was surgical therapy of extremity lymphedema studies with ≥ eight patients. A total of 69 articles met inclusion criteria and were assigned Methodological Index for Nonrandomized Studies (MINORS) scores with a maximum score of 16 or 24 for noncomparative or comparative studies, respectively. The average MINORS scores using noncomparative criteria were 12.1 for excision, 13.2 for liposuction, 12.6 for LVA, 13.1 for VLNT, and 13.5 for combined/multiple approaches. Loss to follow-up was the most common cause of low scores. A total of 39/69 cohort studies rated as high quality by MINORS instrument were included in the review: LVA (12), VLNT (10), excision (5), liposuction (4), combined/multiple approaches (8). The sample size was 8-2600. Follow-up 6-120 months. In studies measuring excess volume reduction, the mean reduction was 96.6% for liposuction, 33.1% for LVA, and 26.4% for VLNT. Included excision articles did not report excess volume reduction. The authors stated that further studies with a particular focus on patient follow-up will improve the validity of lymphedema surgery research. The authors also noted that the biggest drawback of this study was the heterogeneity of the included studies in terms of lymphedema stage and etiology, method of assessing surgical outcomes, and inconsistent reporting of complications and quality of life outcomes. Additionally, to better delineate indications for LVA versus VLNT and validate their proposed algorithm, more head-to-head comparative studies that adopt an accepted staging system, such as the ISL system, are needed. Randomized controlled trials with homogeneous patient populations in term of etiology and stage that compare surgical treatments to conservative therapies would help further define the most appropriate interventions for patients according to their clinical stage.

In a systematic review, Cormier et al. (2012) evalutated the surgical treatment of lymphedema. A total of 20 retrospective and prospective studies met inclusion criteria; procedures were categorized as excisional procedures (e.g., debulking, amputation, and liposuction) (n=8), lymphatic reconstruction (n=8), and tissue transfer (e.g., lymph node transplantation, pedicled omentum, bone marrow stromal cell transplantation). (n=4). The reported incidence of volume reduction of lymphedema in these studies varied from 118% reduction to a 13% increase over the follow-up intervals ranging from six months to 15 years. The largest reported reductions were noted after excisional procedures (91.1%), lymphatic reconstruction (54.9%), and tissue transfer procedures (47.6%). Procedure complications were rarely reported. The authors concluded that most of these reports are based on small numbers of patients, use non-standardized or inconsistent measurement techniques, and lack long-term follow-up. In addition, although these surgical techniques have shown promising results, nearly all note that the procedures do not obviate the need for continued use of conventional therapies, including compression, for long-term maintenance.

In a Hayes Medical Technology Directory Report on Surgical Treatment of Lymphedema: A Review of Reviews, the authors summarized the evidence for lymphedema surgery stating that “Lymphedema surgery is relatively safe and may be efficacious for many patients, although not all findings were consistent across the studies of the various surgeries. The results of lymphedema surgery are related to the selection of the appropriate therapy according to lymphedema severity. Finally, for some surgeries, limitations of the body of evidence preclude the drawing of firm conclusions. The literature should be monitored for additional evidence on a greater total number of patients, safety and long-term outcomes, and data on quality of life (QOL) and function measured by validated instruments, which may increase the strength of the evidence” (Hayes 2017, reviewed 2018, 2019).

Professional Societies/Organizations

National Cancer Institute (NCI): The NCI Health Professional Version [Physician Data Query (PDQ®)] on lymphedema states that “Surgery is rarely performed on patients who have cancer-related lymphedema. The primary surgical method for treating lymphedema consists of removing the subcutaneous fat and fibrous tissue with or without creation of a dermal flap within the muscle to encourage superficial-to-deep lymphatic anastomoses. These methods have not been evaluated in prospective trials, with adequate results for only 30% of patients in one retrospective review. In addition, many patients face complications such as skin necrosis, infection, and sensory abnormalities. The oncology patient is usually not a candidate for these procedures. Other surgical options include the following: Microsurgical lymphaticovenous anastomoses in which the lymph is drained into the venous circulation or the lymphatic collectors above the area of lymphatic obstruction; liposuction; superficial lymphangiectomy; fasciotomy” (NCI, 2015; 2019).

National Comprehensive Cancer Network Guidelines™ (NCCN®): The National Comprehensive Cancer Network Guidelines™ (NCCN Guidelines™) on Breast Cancer (Version 3.2019) does not specifically mention surgical treatments for lymphedema. The guideline recommends educating patients on lymphedema, monitoring for lymphedema and referring for lymphedema management as needed (NCCN, 2019).

National Lymphedema Network (NLN): The NLN published a position paper on the diagnosis and treatment of lymphedema in 2011. The summary on surgical treatment states: “In general, surgical treatment is associated with significant risks, may result in reduced swelling for an unknown time, and is done by very few surgeons with experience in lymphedema. Surgical management of lymphedema should always be done in conjunction with complete decongestive therapy (CDT) and does not stop the need for compression garments and Phase II maintenance. Since CDT, and other adjunctive therapies such as advanced garments and intermittent pneumatic compression therapy (IPC), can usually produce good management in compliant patients, surgery is rarely a necessary consideration”.

Use Outside of the US

National Institute for Health and Care Excellence (NICE): NICE issued clinical guidance addressing the use of liposuction for chronic lymphedema in 2017 (NICE, 2017). The guidance reviewed the evidence and concluded that current evidence on the safety and efficacy of liposuction for chronic lymphedema is adequate to support the use of this procedure provided that standard arrangements are in place for clinical governance, consent and audit. Patient selection should only be done by a multidisciplinary team as part of a lymphedema service.

International Society of Lymphology (ISL): In 2013 the ISL published an updated consensus document regarding the diagnosis and treatment of peripheral lymphedema (ISL, 2013). The document makes the following comments regarding operative treatment of lymphedema:

- Treatment of peripheral lymphedema is divided into conservative (i.e., nonoperative methods) and operative methods. Both methods include an understanding that meticulous skin hygiene and care is of extreme importance to the success of all treatment approaches.
- Operations designed to alleviate peripheral lymphedema by enhancing lymph return have gained increased acceptance worldwide, but usually require combined physiotherapy or other compression after the procedure to maintain edema reduction and ensure vascular/shunt patency.

Lipedema

Lipedema is a rare disorder of adipose tissue that primarily affects females and is often misdiagnosed as obesity or lymphedema. There are numerous synonyms to refer to this condition (e.g. adipositas dolorosa, lipomatosis dolorosa, painful lipohypertrophy). The disorder is well-known in Europe but is largely unrecognized and underdiagnosed in the United States. Lipedema is a distinct entity that must be differentiated from obesity and lymphedema, although it may progress to involve the venous and lymphatic systems, which increases the difficulty of its diagnosis. In contrast to primary lymphedema, the lymphatic system remains unimpaired in the initial stages of lipedema and can keep up with the increased amount of interstitial fluid. In the majority of the cases, lipedema is located in lower limbs with the feet unaffected. There is usually minimal pitting edema. The typical presentation is of a woman with bilateral “stovepipe” enlargement of the legs and without involvement of the feet with a sharp demarcation between normal and abnormal tissue at the ankle, referred to as the “cuff sign.” This is often combined with a symmetrical involvement of arms, particularly the upper arms, with sparing of hands. Lipedema may be isolated to the arms without involvement of the legs, but this is extremely rare. The pathogenesis is unknown and no curative treatment is available. Patients may complain of tenderness and pain and sustain easy bruising. Elevating the limbs has no effect on the involved limbs. Advanced lipedema may progress into lymphedema. When lipedema remains untreated, increased lymphatic load continually exceeds lymphatic transport capacity resulting in the decompensation of the lymphatic system therefore, uni-, or much more typically, bilateral lymphedema can develop. The pressure of the fat tissue itself causes obstruction of the lymphatic vessels resulting in secondary lymphedema. Additionally, the deposition of protein-rich edema causes fibrosis of the tissue, further impairing lymphatic drainage. The combination of lymphatic insufficiency and lipedema is called lipolymphedema or lympho-lipedema. Concomitant severe venous insufficiency is rare; however, varicosity is often seen among lipedematous patients. Diagnosis of lipedema is generally made on the basis of clinical features (See Appendix A). Usually, the medical history and clinical examination are enough to suspect the diagnosis. The most common comorbidities associated with lipedema include: hypertension, obestity (BMI ≥ 35), hypothyreosis, atopic diseases, osteoporosis, lymphedema, varicose veins of leg, depression and anxiety (Sandhofer, et al., 2019; Shavit, et al., 2018; Mehrara, 2018; Canning, et al., 2018; Dadras, et al., 2017; Forner-Cordero, et al., 2012; Stutz, et al., 2009).

There are currently four reported stages of lipedema: Stage 1 involves an even skin surface with an enlarged hypodermis; Stage 2 involves an uneven skin pattern with the development of a nodular or mass-like appearance of subcutaneous fat, lipomas, and/or angiolipomas; Stage 3 involves large growths of nodular fat causing severe contour deformity of the thighs and around the knee; and Stage 4 involves the presence of lipolymphedema (Buck, et al., 2016).

The standard conservative therapy for lipedema significantly differs from that of lymphedema. Management of lipedema is complex and distinct from lymphedema. The proposed main conservative treatment is complete or complex decongestive therapy (CDT). (Please refer to Medical Coverage Policy Complex Lymphedema Therapy [Complete Decongestive Therapy]). CDT combines several approaches including manual lymph drainage (a massage technique), compression therapy, and physical mobilization. Manual lymphatic drainage, compression stockings, intermittent pneumatic compression, skin care and exercise are often used to control pain and symptoms. Diet is also used to prevent or treat obesity associated with lipedema. It is suggested that lipedema patients avoid weight gain. Obesity and “yo-yo” dieting have been shown to exacerbate lipedema. Even with conservative and supportive treatments, the disease may progress and further treatment may be necessary. Surgical options are proposed in patients who are resistant to conservative treatment. Proposed surgical options include liposuction using specialized techniques for lipedema (e.g., water jet-assisted liposuction) and excision (surgical removal of large deposits of affected tissue). Often, multiple sessions of liposuction are necessary to

adequately treat the extremities circumferentially and along their entire length. Liposuction can only reduce the amount of fatty tissue, but not completely remove it. Many patients often require ongoing conservative treatment postoperatively to maintain results. Additionally, the avoidance of postoperative weight gain is essential in order to maintain the results of surgery (Sandhofer, et al., 2019; Hayes, 2019; National Institute of Heatlh [NIH], 2019; Wollina, 2019; Dadras, et al., 2017; Warren and Kappos, 2016; Buck and Herbst, 2016).

Literature Review: There is a paucity of evidence in the peer-reviewed literature addressing liposuction for the treatment of lipedema. Studies are mainly case series with no comparator group. There is a lack of consistent criteria to determine the ideal time or patient characteristics for liposuction in the treatment of lipedema.

A February 2019 Hayes Evidence Analysis Research Brief on liposuction for the treatment of lipedema concluded that "There is insufficient published evidence to assess the safety and/or impact on health outcomes or patient management for the use of liposuction for the treatment of lipedema". The available published literature addressing liposuction for the treatment of lipedema is sparse and of low quality. A search of the peer-reviewed literature yielded a paucity of research reporting outcomes in patients treated with liposuction for lipedema. A total of 13 abstracts were retrieved, including one pretest/posttest study (Wollina, et al., 2019, n=111); five survey studies (Baumgartner et al. [2016], n=85; Rapprich et al. [2015], n=85; Dadras et al. [2014], n=25; Rapprich et al. [2011], n=25; Schmeller et al. [2012], n=112) with potential overlapping patient groups, three systematic review articles (Halk et al., [2017]; Reich-Schupke et al. [2017] and Forner-Cordero et al. [2012]), one case series (Wollina et al. [2014], n=3); and three review articles (Wollina [2018]; Bellini et al., [2017], Okhovat et al. [2015]).

In a case series study, Wollina, et al. (2019) analyzed 111 patients with lipedema not responding to complex decongestive Therapy (CDT). The patients underwent a total of 334 liposuctions. Comorbidities were recorded. The study included patients with a diagnosis of lipedema. All were females aged 20–81 years of age (median ± standard deviation: 44 ± 16.8 years). They had been treated by CDT for at least six months without improvement or experienced deterioration of pain sensations and/or leg volume. The study included seven patients with lipedema Stage I, 50 patients with Stage II, and 48 patients with Stage III. All patients had an involvement of the legs including 108 patients with a dominance of the upper legs and two with a more pronounced involvement of the lower legs. Twenty-seven patients also had an involvement of the arms (24%). The delay of diagnosis was between 1 and 21 years. Eighty percent of patients had at least one comorbidity (e.g., obesity, lymphedema, and diabetes). The intervention was micro-cannular liposuction in tumescent anesthesia (TA) with the classical mechanical liposuction, some patients had a 980 nm-diode laser-assisted liposuction. The primary outcomes were reduction of limb circumferences, pain (on a 10-point visual analogue scale [VAS]), bruising, improvement of mobility and adverse events. The median follow up was 2.0 ± 2.1 years. A follow up between five and seven years was available in 18 patients. The median total amount of lipoaspirate was 4,700 ml, with a range of 950–14,250 ml. The median reduction of limb circumference was 6 cm. The median pain level before treatment was 7.8 and 2.2 at the end of the treatment. An improvement of mobility could be achieved in all patients and bruising was reduced. None of these patients had a relapse of lipedema. Serious adverse events were observed in 1.2% of procedures, the infection rate was 0% and the bleeding rate was 0.3%. In 4.5% of patients with most advanced disease, other surgical procedures had been performed after completion of liposuction, such as thigh or arm lift, laser lipolysis, or debulking surgery to obtain best results. Limitations of this study include the lack of a comparator group, small patient population and loss of patients to long-term follow-up.

In a case series study, Schmeller et al. (2006) reported the efficacy and safety of surgery (liposuction) concerning appearance and associated complaints. Twenty-eight patients, who had undergone conservative therapy over a period of years, were treated by liposuction under tumescent local anesthesia with vibrating microcannulas. Twenty-one could be reevaluated after an average of 12.2 (1–26) months. From 28 patients, 15 were operated on once, eight twice, two three times, and three four times. The average amount of fat removed per session was 3017 mL, with a range of 1060 to 5500 mL depending on the size and number of operated areas. The authors reported that all patients showed improvement, with normalization of body proportions. Spontaneous pain, sensitivity to pressure, and bruising either disappeared completely or improved. Other than minor swelling for a few days, no complications could be observed following surgery. All patients reported an increase in their quality of life. Physical therapy had to be continued to a much lower degree. Limitations of the study include the lack of a comparator group, small sample size and short-term follow-up.

Forner-Cordero 2012 reported in a systematic review of the literature that there is a lack of knowledge and little evidence about lipedema, especially among obesity experts. Treatment protocols are stated to be comprised of conservative (decongestive lymphatic therapy) and surgical (liposuction) approaches. The authors concluded that current knowledge about lipedema as a hidden epidemic is scarce, but the scientific interest is increasing. More studies are required to know the real prevalence and to reach an earlier diagnosis of this disorder. Diagnosis and treatment should be made as early as possible to prevent complications associated with increased functional and cosmetic morbidity.

Professional Societies/Organizations
No evidence-based clinical practice guidelines were located for lipedema.

Centers for Medicare & Medicaid Services (CMS)
- National Coverage Determinations (NCDs): No NCDs found.
- Local Coverage Determinations (LCDs): No LCDs found.

Use Outside of the US
In June 2019, the Canadian Agency for Drug and Technologies in Health (CADTH) published a Rapid Response Report: Summary with Critical Appraisal on Liposuction for the Treatment of Lipedema-A Review of Clinical Effectiveness and Guidelines. The key research questions were: what is the clinical effectiveness of liposuction for the treatment of lipedema and what are the evidence-based guidelines regarding the use of liposuction for the treatment of lipedema? The authors' conclusions state that "information about the clinical effectiveness of liposuction for the treatment of lipedema was sourced from five uncontrolled before-and-after studies (Dadras, et al., 2017; Wollina, et al., 2019; Schmeller, et al., 2012, Rapprich, et al., 2011; Baumgartner, et al., 2016). Data from the studies indicated that in patients with lipedema, treatment with liposuction resulted in a significant improvement of pain, sensitivity to pressure, edema, bruising, feeling of tension, and quality of life. The patients also experienced significant reductions in size extremities and restriction of movement, and the need for conservative therapy for lipedema. The benefits of liposuction remained up to 88 months follow-up assessments. Liposuction was generally well tolerated; most adverse events occurred in <5% of patients. However, the quality of the evidence was limited, with sources of uncertainty such as systematic biases due to lack of randomization, and the use of instruments that have not been validated for the collection of data and assessment in lipedema-related complaints. Studies to validate tools to assess lipedema-related outcomes and define a minimally clinically important difference for the condition may also be necessary to put the benefit of liposuction for the treatment of lipedema in a clinical perspective".

Revised guidelines on lipedema were developed under the auspices of and funded by the German Society of Phlebology (DGP) (Reich-Schupke, et al., 2017). The recommendations are based on a systematic literature search and the consensus of eight medical societies and working groups. The guidelines stated that the diagnosis of lipedema is established on the basis of medical history and clinical findings and is characterized by localized, symmetrical increase in subcutaneous adipose tissue in arms and legs in marked disproportion to the trunk. In addition edema, easy bruising, and increased tenderness may be seen. Further diagnostic tests are typically reserved for special cases that require additional workup. Lipedema is a chronic, progressive disorder with individual variability and unpredictability of its clinical course. Treatment consists of four therapeutic mainstays that may be combined as necessary to address current clinical symptoms. These four treatments include: complex physical therapy (manual lymphatic drainage, compression therapy, exercise therapy, and skin care), liposuction and plastic surgery, diet, and physical activity, as well as psychotherapy if necessary. According to the Society, surgical procedures may be indicated if, despite thorough conservative treatment, symptoms persist, or if there is progression of clinical findings and/or symptoms.

Halk and Damastra (2017), in a systematic review of the literature to June 2013, reported on Dutch guidelines for lipedema. In 2011, the Dutch Society of Dermatology and Venereology organized a task force to create guidelines on lipedema, using the International Classification of Functioning, Disability and Health of the World Health Organization. Clinical questions on significant issues in lipedema care were proposed, involving making the diagnosis of lipedema; clinimetric measurements for early detection and adequate follow-up; and treatment. The authors concluded that there is little consistent information about the diagnosis or therapy of lipedema in the literature and indicate lipedema is frequently misdiagnosed as only an aesthetic problem and therefore under- or mis-treated. Treatment is divided into conservative and surgical treatment. The guideline recommendations state

"To ensure early detection and an individually outlined follow-up, the committee advises the use of a minimum data set of (repeated) measurements of waist circumference, circumference of involved limbs, body mass index and scoring of the level of daily practice and psychosocial distress. Promotion of a healthy lifestyle with individually adjusted weight control measures, graded activity training programs, edema reduction, and other supportive measures are pillars of conservative therapy. Tumescent liposuction is the treatment of choice for patients with a suitable health profile and/or inadequate response to conservative and supportive measures". The authors reported that consistent criteria to determine the ideal time or patient characteristics for liposuction are not available. The strength of the recommendations in this clinical guideline and the links to supporting evidence were not provided.

Appendix A

Differential diagnosis of lymphedema and lipedema (Shavit, et al., 2018)

Characterstics	Lipedema	Lymphedema
Pathophysiology	Genetic, primary	Defects in lymph vessels, primary or secondary
Disproportion	Yes	No
Age of onset	Puberty	Any age
Gender	Female	Both genders
Skin consistency	Firm	Soft
Skin color	Normal, sometimes ecchymosis	Brown, warty, sclerotic
Extent of involvement	Bilateral, mainly legs	Unilateral or bilateral most commonly on legs and arms
Symmetry	Symmetric	May be asymmetric
Clinical cues	"Cuff sign" ankle pad fatty retromalleolar sulcus or lack of Achilles tendon definition	Verruca papillomatosis pebbly stone skin positive stemmer sign*
Involvement of feet	No	Yes
Response to compression therapy	No	Yes
Common associations	Anxiety, depression, hypermobility	Venous disease, recurrent cellulitis
Easy bruising	Yes	No

* A positive Stemmer sign is the inability to pinch the fold of skin at the base of the second toe or finger, indicating the presence of lymphedema

Coding/Billing Information

Note: 1) This list of codes may not be all-inclusive.
2) Deleted codes and codes which are not effective at the time the service is rendered may not be eligible for reimbursement.

Considered Experimental/Investigational/Unproven:

CPT®* Codes	Description
15832	Excision, excessive skin and subcutaneous tissue (includes lipectomy); thigh
15833	Excision, excessive skin and subcutaneous tissue (includes lipectomy); leg
15836	Excision, excessive skin and subcutaneous tissue (includes lipectomy); arm
15839	Excision, excessive skin and subcutaneous tissue (includes lipectomy); other area
15876	Suction assisted lipectomy; head and neck

15877	Suction assisted lipectomy; trunk
15878	Suction assisted lipectomy; upper extremity
15879	Suction assisted lipectomy; lower extremity
38308	Lymphangiotomy or other operations on lymphatic channels
49904	Omental flap, extra-abdominal (eg, for reconstruction of sternal and chest wall defects)
49905	Omental flap, intra-abdominal (List separately in addition to code for primary procedure)
49906	Free omental flap with microvascular anastomosis

Considered Experimental/Investigational/Unproven when used to report any surgical treatment indicated in this coverage policy as experimental, investigational or unproven:

CPT®* Codes	Description
38589	Unlisted laparoscopy procedure, lymphatic system
38999	Unlisted procedure, hemic or lymphatic system

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