Lymphedema

Number: 0069

Policy

*Please see amendment for Pennsylvania Medicaid at the end of this CPB.

Diagnosis

Bioimpedance Devices for Detection of Lymphedema:

Aetna considers bioimpedance devices (e.g., L-Dex U400) experimental and investigational for the diagnosis or management of lymphedema because their effectiveness for these indications has not been established.

Treatments

Complex Decongestive Physiotherapy:

Aetna considers a course of complex decongestive physiotherapy (CDP), also called manual lymphoid drainage, medically necessary when both of the following criteria are met:

1. The member has any of the following conditions:

Policy History

Last Review 03/30/2018
Effective: 10/23/1995
Next Review: 01/24/2019

Review History

Definitions

Additional Information

Clinical Policy Bulletin Notes
A. Evidence of ulceration due to lymphedema; or
B. Intractable lymphedema of the extremities, unrelieved by elevation; or
C. One or more previous admissions to treat complications of intractable lymphedema (i.e., cellulitis, ulceration); and

II. The member has shown a past record of compliance and the member or his/her caregiver is capable of following the instructions associated with CDP.

Lymphedema Pumps:

Aetna considers lymphedema pumps (pneumatic compression devices) medically necessary durable medical equipment (DME) for home use according to the following criteria:

Pneumatic Compression Device Without Calibrated Gradient Pressure

Aetna considers home use of a non-segmented (unicompartmental) device or segmented (multicompartmental) pneumatic compression device without manual control of the pressure in each chamber medically necessary for members with chronic and severe lymphedema when all of the following requirements are met:

I. The member has a diagnosis of lymphedema; and
II. The member has persistence of chronic and severe lymphedema as identified by the documented presence of at least one of the following clinical findings:

A. Marked hyperkeratosis with hyperplasia and hyperpigmentation,
B. Papillomatosis cutis lymphostatica,
C. Deformity of elephantiasis,
D. Skin breakdown with persisting lymphorrhea, or
E. Detailed measurements over time confirming the persistence of the lymphedema with a history evidencing a likely etiology; and
III. In addition to this documented persistence, the lymphedema is then documented to be unresponsive to other clinical treatment over the course of a required four-week trial of conservative therapy that must include all of the following:

A. Regular and compliant use of an appropriate compression bandage system or compression garment to provide adequate graduated compression:

1. Adequate compression is defined as (i) sufficient pressure at the lowest pressure point to cause fluid movement and (ii) sufficient pressure across the gradient (from highest to lowest pressure point) to move fluid from distal to proximal. The compression used must not create a tourniquet effect at any point.
2. The garment may be prefabricated or custom-fabricated but must provide adequate graduated compression starting with a minimum of 30 mmHg distally; and

B. Regular exercise; and
C. Elevation of the limb.

When available, manual lymphatic drainage is a key component of conservative treatment as is appropriate medication treatment when there is concurrent congestive failure.

At the end of the 4-week trial, if there has been improvement, then a pneumatic compression device is considered not medically necessary. Where improvement has occurred, the trial of conservative therapy must be continued with subsequent reassessment at intervals at least 1 week apart. Only when no significant improvement has occurred in the most recent 4 weeks and the medical necessity criteria above are still met, may the lymphedema be considered unresponsive to conservative therapy, and a pneumatic compression device without calibrated gradient pressure would be considered
medically necessary.

At a minimum, re-assessments conducted for a trial must include detailed measurements, obtained in the same manner and with reference to the same anatomic landmarks, prior to and at the conclusion of the various trials and therapy, with bilateral comparisons where appropriate.

Pneumatic Compression Device With Calibrated Gradient Pressure
Aetna considers home use of a segmented pneumatic compression device with manual control of the pressure in each chamber medically necessary for the treatment of lymphedema extending onto the chest, trunk and/or abdomen when all of the following are met:

I. The member has the diagnosis of lymphedema; and
II. The member meets medical necessity criteria for a pneumatic compression device as described above; and
III. The member has lymphedema extending onto the chest, trunk and/or abdomen that extends past the limits of a standard compression sleeve, and the chest, trunk and/or abdominal lymphedema has failed to improve with a four-week trial demonstrating failed response to treatment with a pneumatic compression device without calibrated gradient pressure is required. The four-week trial of conservative therapy must include all of the following:

A. At least 4 weeks of regular, daily, multiple-hour home usage of a pneumatic compression device without calibrated gradient pressure after careful, in-person fitting, training and supervision by a technician who is skilled in and who regularly and successfully uses the appliance provided; and
B. Compliant use of an appropriate compression bandage system or compression garment to provide adequate graduated compression:

1. Adequate compression is defined as (i) sufficient pressure at the lowest pressure point to cause fluid
movement and (ii) sufficient pressure across the gradient (from highest to lowest pressure point) to move fluid from distal to proximal. The compression used must not create a tourniquet effect at any point;

2. The garment may be prefabricated or custom-fabricated but must provide adequate graduated compression starting with a minimum of 30 mmHg distally; and

C. Regular exercise; and
D. Elevation where appropriate; and
E. Manual lymphatic drainage (where available) and self-manual lymphatic drainage (MLD) for at least 30 minutes per day; and
F. Evaluation of diet and implementation of any necessary change; and
G. Medications as appropriate (e.g. diuretics and/or other treatment of congestive failure, etc.); and
H. Correction (where possible) of anemia and/or hypoprotenemia.

At the end of the 4-week trial, if there has been improvement of the lymphedema extending onto the chest, trunk and/or abdomen, then a pneumatic compression device with calibrated gradient pressure is considered not medically necessary. Where improvement has occurred, the trial of conservative therapy must be continued with subsequent reassessment at intervals at least 1 week apart. When and only when no significant improvement has occurred in the most recent 4 weeks and the medical necessity criteria above are still met, a pneumatic compression device with calibrated gradient pressure is considered medically necessary.

A pneumatic compression device with calibrated gradient pressure used to treat lymphedema not extending onto the chest, trunk and/or abdomen is considered experimental and investigational.
Aetna considers trunk or chest appliances/use of a lymphedema pump to the trunk or chest experimental and investigational.

Note: For members without DME benefits, lymphedema pumps are only covered for members with arm lymphedema due to mastectomy for breast cancer who meet the criteria for a lymphedema pump stated above.*

A 2-phase lymph preparation and drainage therapy device (e.g., Flexitouch Device, Tactile Systems Technology, Minneapolis, MN; LymphaPress Optimal, Lympha Press USA, Manalapan, NJ) is considered equally effective to standard segmented pneumatic compression devices with calibrated gradient pressure.

Aetna considers the ACTitouch Adaptive Compression Therapy System equally effective to standard segmented pneumatic compression devices without calibrated gradient pressure.

For Aetna’s clinical policy on pneumatic compression devices for chronic venous insufficiency, see CPB 0500 - Intermittent Pneumatic Compression Devices (../500_599/0500.html).

Note: Although the literature suggests that the use of lymphedema pumps is commonly initiated in the hospital, there is no medical necessity for this practice unless the member has other complications of lymphedema (i.e., cellulitis) that would require hospitalization. The use of lymphedema pumps can be initiated in the clinic or in the home setting.

Static Compression Sleeves:

Aetna considers static compression sleeves (e.g., the ReidSleeve, ArmAssist) to be medically necessary supplies for members with intractable lymphedema of the arms. Note: 2 pairs of static compression sleeves and/or gloves per affected arm are considered medically necessary in the initial purchase (the 2nd pair is for use while the 1st pair is in the laundry); and
no more than 2 replacements per affected arm every 6 months is considered medically necessary. (Sleeves and gloves are separate items; as such, if both should be required for treatment, two gloves and two sleeves would be considered medically necessary initially, with two additional of each in subsequent 6 months, if needed.) For members whose plans exclude coverage of supplies, static compression sleeves are only covered for intractable lymphedema of the arms due to mastectomy for breast cancer. * See also CPB 0482 - Compression Garments for the Legs (../400_499/0482.html).

**Compression Garments for the Abdomen, Chest, Genitals, Trunk, Head or Neck:**

Aetna considers compression garments for the abdomen, chest, genitals, trunk, head or neck experimental and investigational. There is a lack of peer-reviewed published literature evaluating the clinical utility of compression garments for these anatomical sites.

Aetna considers compression bras for post-mastectomy lymphedema experimental and investigational because their effectiveness for this indication has not been established.

**Microsurgical Treatments:**

Aetna considers microsurgical treatments (microsurgical lymphatico-venous anastomosis, lymphatic-capsular-venous anastomosis, lymphovenous bypass) experimental and investigational for the treatment of members with chronic obstructive lymphedema because the long-term effectiveness of this procedure has not been established by the peer-reviewed medical literature.

**Lymph Node Transfer:**

Aetna considers lymph node transfer (also known as vascularized lymph node transfer) for the treatment of lymphedema due to cervical cancer, post-mastectomy lymphedema experimental and investigational because its
effectiveness has not been established.

Whole Body Vibration:

Aetna considers whole body vibration for the treatment of lymphedema experimental and investigational because its effectiveness has not been established.

Tissue Transfers (e.g., Omental Flap):

Aetna considers tissue transfers (e.g., omental flap) for the treatment of lymphedema experimental and investigational because its effectiveness has not been established.

Excisional Procedures (Debulking, Liposuction):

Aetna considers excisional procedures (debulking, liposuction including suction-assisted protein lipectomy (SAPL); also known as suction lipectomy) for the treatment of lymphedema experimental and investigational because its effectiveness has not been established.

Reverse Lymphatic Mapping:

Aetna considers reverse lymphatic mapping experimental and investigational because its effectiveness has not been established.

Low-Level Light Therapy (Low-Level Laser Therapy / Photo-Bio-Modulation Therapy):

Aetna considers low-level light therapy (also known as low-level laser therapy and photo-bio-modulation therapy experimental and investigational because its effectiveness has not been established.

Matrix Rhythm Therapy:

Aetna considers matrix rhythm therapy experimental and investigational because its effectiveness has not been established.
Platelet-Rich Plasma:

Aetna considers platelet-rich plasma experimental and investigational because its effectiveness has not been established.

Aquatic Therapy / Aqua Lymphatic Therapy:

Aetna considers aquatic therapy / aqua lymphatic therapy experimental and investigational for the treatment of lymphedema because its effectiveness for this indication has not been established.

Combined Adipose-Derived Stem Cell and Vascularized Lymph Node Transfer:

Aetna considers combined adipose-derived stem cell and vascularized lymph node transfer for treatment of secondary lymphedema experimental and investigational because the effectiveness of this approach has not been established.

*Note: HR 4328 (Public Law 105-277) requires individual and employer group health plans (including indemnity, PPO, POS and HMOs), that provide medical and surgical benefits with respect to a mastectomy, to provide coverage for lymphedema treatment in a manner determined in consultation with the attending physician and the member for a participant or beneficiary who is receiving benefits for a mastectomy and who elects breast reconstruction after the mastectomy. Therapy is subject to annual deductibles and co-insurance provisions for physical therapy. Therapy is not subject to visit limitation provisions for physical therapy.

Also see CPB 0097 - External Breast Prosthesis (0097.html).

Background

Lymphedema refers to edema (i.e., swelling) due to inadequate lymphatic circulation related to either (i) defective development
of the lymphatics (primary lymphedema); or (ii) destruction or obliteration of the lymphatic system (secondary lymphedema) due to either trauma, wounds, surgery, radiation therapy, or infection with a tropical filarial parasite. Primary lymphedema typically involves the lower extremities and typically afflicts females.; When it arises at birth it is called lymphedema congenita, before the age of 35 it is called lymphedema praecox, and when arising later in life it is called lymphedema tarda. Secondary lymphedema occurs most commonly after lymph node dissections. For example, 10 to 20 % of women with breast cancer who have undergone axillary dissection will experience lymphedema. Leg edema can result after groin dissection, most typically for melanoma. Lymphedema results in a feeling of heaviness, aching or tightness. In severe cases, mobility can be impaired. Development of angiosarcoma, known as the Stewart-Trewes syndrome, is a very rare complication of long standing severe lymphedema.

Lymphedema, as discussed below, is just one group of conditions that can be a cause of accumulation of fluid in the tissue. Lymphedema arises from disorders of the lymphatic system. It is essential to rule out other causes of edema in order to diagnose lymphedema. Edema from other causes is not classified as lymphedema for purposes of Medicare reimbursement for PCDs (E0650-E0652).

**Primary lymphedema:**

Primary lymphedema is a disorder of the lymphatic system that occurs on its own. It is inherited and uncommon. Examples (not all-inclusive) are:

- Congenital lymphedema due to lymphatic aplasia or hypoplasia
- Milroy's disease, an autosomal dominant familial form of congenital lymphedema
- Lymphedema praecox
- Lymphedema tarda
Secondary lymphedema:

Secondary lymphedema is a disorder of lymphatic flow that is caused by some other disease or condition. It is more common than primary lymphedema. It is most commonly caused by surgery (especially lymph node dissection, such as for breast cancer), radiation therapy (especially axillary or inguinal), trauma, lymphatic obstruction by tumor, and, in developing countries, lymphatic filariasis. Secondary lymphedema may also result from compression of the lymphatic and venous channels resulting from leakage of fluid into interstitial tissues in patients with chronic venous insufficiency. (See below)

Lymphedema is usually staged by observing a patient's physical condition. The International Society of Lymphology uses the following 3-stage scale for classification of a lymphedematous limb:

Stage 1: Early accumulation of fluid relatively high in protein content (e.g., in comparison with "venous" edema) that subsides with limb elevation. Pitting may occur.

Stage II: Limb elevation alone rarely reduces tissue swelling and pitting may or may not occur as tissue fibrosis develops.

Stage III: Lymphostatic elephantiasis. Pitting is absent and trophic skin changes such as acanthosis, fat deposits, and warty overgrowths develop.

An increasing number of lymphologists recognize an earlier stage of lymphedema, termed Stage 0, which refers to a latent or subclinical condition where swelling is not evident despite impaired lymphatic transport. Stage 0 may exist for months or years before the onset of overt lymphedema.

Cormeir and associates (2010) performed a systematic review and meta-analysis of the oncology-related literature excluding breast cancer to derive estimates of lymphedema incidence and to identify potential risk factors among various malignancies.
The authors systematically reviewed 3 major medical indices (MEDLINE, Cochrane Library databases, and Scopus) to identify studies (1972 to 2008) that included a prospective assessment of lymphedema after cancer treatment. Studies were categorized according to malignancy, and data included treatment, complications, lymphedema measurement criteria, lymphedema incidence, and follow-up interval. A quality assessment of individual studies was performed using established criteria for systematic reviews. Bayesian meta-analytic techniques were applied to derive summary estimates when sufficient data were available. A total of 47 studies (7,779 cancer survivors) met inclusion criteria: melanoma (n = 15), gynecological malignancies (n = 22), genito-urinary cancers (n = 8), head/neck cancers (n = 1), and sarcomas (n = 1). The overall incidence of lymphedema was 15.5% and varied by malignancy (p < 0.001): melanoma = 16% (upper extremity, 5%; lower extremity, 28%); gynecological = 20%; genito-urinary = 10%; head/neck = 4%; and sarcoma = 30%. Increased lymphedema risk was also noted for patients undergoing pelvic dissections (22%) and radiation therapy (31%). Objective measurement methods and longer follow-up were both associated with increased lymphedema incidence. The authors concluded that lymphedema is a common condition affecting cancer survivors with various malignancies. The incidence of lymphedema is related to the type and extent of treatment, anatomical location, heterogeneity of assessment methods, and length of follow-up.

Lymphedema is diagnosed based upon the patients history and physical examination. The most widely accepted measure of lymphedema is limb circumference compared with that of the unaffected limb or compared with that of the same limb before the interventions or events that led to lymphedema. Imaging is usually not necessary unless an obstructive cause of the lymphedema is suspected (e.g., tumor).

Bioimpedance is a non-invasive method for estimating body composition based on the electrical conductive properties of various tissues. It is thought that bioimpedance devices can
detect developing lymphedema before any clinical signs are visible. Devices using bioimpedance have been proposed as a diagnostic test of subclinical lymphedema (Stage 0) for the early identification of patients at risk of developing lymphedema. Proponents who support the approach to diagnose subclinical disease believe that early treatment of subclinical lymphedema will result in less severe chronic disease. One bioimpedance device is the ImpediMed LDex™ U400 (ImpediMed Limited, San Diego, CA), cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process in 2008. Thus, the manufacturer was not required to provide the evidence of clinical efficacy that is necessary to support a premarket approval (PMA). According to the FDA clearance letter, the device is “to aid in the clinical assessment of unilateral lymphedema of the arm in women.” The FDA labeling states that the device is "not intended to diagnose or predict lymphedema of an extremity." ImediMed's L-Dex technology utilizes the characteristics of frequency dependent current flow to quantify changes in extracellular fluid in the patient's limb.

Czerniec and colleagues (2010) reported on measurement of lymphedema to determine the relationship between physical methods of measuring lymphedema and self-reported swelling. Lymphedema in women with (n = 33) and without (n = 18) unilateral arm lymphedema secondary to breast cancer was measured by self-report, bioimpedance spectroscopy, perometer, and the truncated cone method. The physical measurement tools were highly reliable (ICC((2,1)): 0.94 to 1.00) with high concordance (r(c): 0.89 to 0.99). Self-report correlated moderately with physical measurements (r = 0.65 to 0.71) and was moderately reliable (ICC((2,1)): 0.70). The authors concluded that lymphedema assessment methods are concordant and reliable but not interchangeable.

There is a lack of reliable evidence that intervention in the subclinical stage of lymphedema detected by bioimpedance improves outcomes over close monitoring and intervention when lymphedema becomes clinically evident by standard measures (e.g., limb volume measurement).
study by Stout Gergich et al (2008) has been cited to support initiation of lymphedema treatment at a subclinical stage. The study by Stout Gergich, et al. (2008) is not an National Institute of Health clinical practice guideline or clinical practice recommendation, but is a report of a case-control study to investigate the efficacy of a different technology, perometry, in the diagnosis and management of subclinical lymphedema in patients with early-stage breast cancer. Stout Gergich, et al. (2008) states that “The views expressed in this article are those of the author(s) and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government.” The article states that “further research is needed” to validate bioimpedance in the context of a surveillance tool.

In the study by Stout Gergich, et al. (2008), lymphedema was identified in 43 of 196 women who participated in a prospective breast cancer morbidity trial. This study used another method of measurement, perometry, to detect lymphedema at an early stage. Limb volume was measured pre-operatively and at 3-month intervals after surgery. If an increase of greater than 3% in upper limb volume developed compared with the preoperative volume, then a diagnosis of lymphedema was made, and a compression garment intervention was prescribed for 4 weeks. Upon reduction of lymphedema, garment wear was continued only during strenuous activity, with symptoms of heaviness, or with visible swelling. Statistical analysis was a repeated-measures analysis of variance by time and limb (p less than or equal to 0.001) comparing the lymphedema cohort with an age-matched control group. The investigators reported that the time to onset of lymphedema averaged 6.9 months post-operatively. The mean (± standard deviation) affected limb volume increase was 83 ml (± 119 ml; 6.5% ± 9.9%) at lymphedema onset (p = 0.005) compared with baseline. After the intervention, a statistically significant mean 48 ml (± 103 ml; 4.1% ± 8.8%) volume decrease was realized (p less than 0.0001). The mean duration of the intervention was 4.4 weeks (± 2.9 weeks). Volume reduction was maintained at an average follow-up of 4.8 months (± 4.1 months) after the
intervention. The study did not provide evidence, however, that clinical outcomes were improved by initiating lymphedema treatment at the subclinical stage versus initiating lymphedema treatment at the earliest stage where lymphedema becomes clinically apparent using standard measurements (e.g., limb circumference measurements).

An assessment by the Australia and New Zealand Horizon Scanning Network (2008) concluded: "The Impedimed Imp™ SFB7 device appears to be effective for diagnosis of lymphoedema, although the studies were small in nature and lacked high quality design. Larger studies in which the device is directly compared with the standard methods for lymphoedema diagnosis are required. Additionally, varied stages of lymphoedema manifestation should be included."

An ad hoc group organized by the Avon Foundation for Women (2011) organized to discuss advances in the early detection and intervention of lymphedema recommended perometry or bioimpedance in the early detection of lymphedema. A reading of the full text of the recommendation reveals that the primary support for use of perometry or bioimpedance spectroscopy is the study by Stout Gergich, et al. (2008); the limitations of this study are summarized above.

The 2011 National Accreditation Program for Breast Centers (NAPBC) Standards lists lymphedema management and risk reduction practices among breast center supportive services. The NAPBC Standards lists the National Lymphedema Network resource center as a recommended resource on this topic. However, the NAPBC standards include no discussion of bioimpedance, or requirement for bioimpedance as a requirement for accreditation.

“bioelectrical spectroscopy (BIS) or infrared perometry are suggested as alternative or adjunctive methods to circumferential measurement.”

A technology assessment of the diagnosis and management of secondary lymphedema prepared for the Agency for Healthcare Research and Quality (Oremus et al, 2010) concluded: "There is consistent evidence to indicate that lymphedema can be reliably measured using circumferential measures or volume displacement ... There is too little evidence to draw conclusions about the reliability of other tests such as tonometry, ultrasound, lymphoscintigraphy, or bioimpedance."

The Northern Ireland CREST Committee guidelines for lymphedema (2008) recommend circumferential limb volume measurement for assessing limb volume. Bioimpedance measurement is described as promising, noting that it should be considered over the next 5 years. The CREST guideline development group identified continued research into the reliability and validity of diagnostic methods such as bioimpedance analysis among priorities for future research in Northern Ireland.

The National Cancer Institute Physician Data Query (PDQ) on lymphedema (NCI, 2011) states that circumferential upper-extremity measurement is the most widely used method to diagnose upper-extremity lymphedema. Bioimpedance is listed among several other options for evaluating limb volume. The PDQ also stated that a study comparing various methods of assessing upper-limb lymphedema did not show any superiority of any one method; for support, the PDQ cited a study by Ridner, et al. (2007) comparing circumferential limb measurements to bioimpedance and perometry.

Several other guidelines that have been cited for support of bioimpedance spectroscopy make no recommendation for use of this technology. A report of an Institute of Medicine workshop (Hewitt, et al., 2006) includes no recommendation for, or reference to, bioimpedance
spectroscopy for lymphedema. The workshop report identifies
evaluations of the value of lymphedema prevention, early
diagnosis, and surveillance as areas in need of further
research. A 2009 consensus document on diagnosis and
treatment of peripheral lymphedema, from the International
Society of Lymphology makes no reference to or
recommendation for bioimpedance spectroscopy. Canadian
guidelines on the care and treatment of lymphedema (Harris, et
al., 2001) make no recommendation for bioimpedance
spectroscopy. The guidelines recommend circumferential
measurements and state that other methods “are being
evaluated in research settings.”

The federal Women’s Health and Cancer Rights Act of 1998
requires health insurance policies that cover mastectomy to
also provide coverage for reconstructive surgery, prostheses,
and physical complications of mastectomy, including
lymphedema. However, the Act does not require health
insurers to cover bioimpedance spectroscopy or other
interventions of unproven value.

Results of available studies do not provide consistent evidence
that bioimpedance is any more reliable than current methods
for detection of lymphedema. In addition, there is a lack
of clinical studies demonstrating that incorporation of
bioimpedance into lymphedema management improves clinical
outcomes. Long-term studies demonstrating the effectiveness
of bioimpedance testing over conventional monitoring
techniques for lymphedema are needed.

Conservative treatment of lymphedema focuses on a
combination of physical therapies: elevation of the arm or leg,
manual physical therapy, wearing of various types of
compression stockings/bandages, or pneumatic pumps.

The use of elastic stockings is considered a valuable component
of lymphedema therapy, and appears to be critical to the long
term success of treatment. Compliance with elastic stocking
may be problematic since they are frequently hot,
uncomfortable, and considered unsightly by some. Lack of compliance may result in requests for further treatment, such as pneumatic pumps or complex decongestive physiotherapy. However, elastic garments are a component of all treatments of lymphedema and compliance has a major impact on the success of any treatment of lymphedema.

PCDs consist of an inflatable garment for the arm or leg and an electrical pneumatic pump that fills the garment with compressed air. The garment is intermittently inflated and deflated with cycle times and pressures that vary between devices.

A non-segmented pneumatic compressor (E0650) is a device which has a single outflow port on the compressor. The fact that the air from the single tube may be transmitted to a sleeve/appliance with multiple compartments or segments (E0671-E0673) does not affect the coding of the compressor.

A segmented pneumatic compressor (E0651, E0652) is a device which has multiple outflow ports on the compressor which lead to distinct segments on the appliance which inflate sequentially. A segmented device without calibrated gradient pressure (E0651) is one in which either (a) the same pressure is present in each segment or (b) there is a predetermined pressure gradient in successive segments but no ability to individually set or adjust pressures in each of several segments. In an E0651 device the pressure is usually set by a single control on the distal segment. A segmented device with calibrated gradient pressure (E0652) is characterized by a manual control on at least three outflow ports which can deliver an individually determined pressure to each segmental unit. The fact that the tubing and/or appliance are capable of achieving a pressure gradient does not classify the compressor as E0652 because this is not a calibrated gradient pressure.

Segmental gradient pressure pneumatic appliances (E0671-E0673) are appliances/sleeves which are used with a non-segmented pneumatic compressor (E0650) but which achieve a
pressure gradient through the design of the tubing and/or air chambers.

Pneumatic pumps can consist either of static uni-compartmental pumps where an equal amount of pressure is applied throughout the edematous limb, or a sequential pump which essentially attempts to “wring out” the edema by graded compression from distal to proximal. Due to the short cycles of pressure, higher pressures can be applied compared to the static pumps. Pressures higher than the systolic blood pressure are avoided; pressures up to 80 to 90 mm Hg are typical. At this point sequential pumps (such as the Lymphapress or the Wright linear sequential pump) appear to be more commonly used than static pumps. The Lymphapress device is composed of a series of overlapping cells that apply a sequential pattern of compression moving distally to proximally along the affected limb. Using this strategy, higher levels of pressure can be applied compared to other uni-compartmental devices which apply the same degree of pressure along the entire limb. The Lymphapress device seems to be effective in acutely decreasing lymphedema, and many patients have purchased this device for home use.

Newer, advanced pneumatic compression devices with additional features that the more "traditional" type of pumps do not offer have been developed. A two-stage multichamber programmable pneumatic compression device operates in two separate phases. These devices are proposed to be based on the principles of manual lymph drainage (treat the proximal areas first, which is theorized to prepare the distal areas for drainage). The first phase is a "preparatory" phase, followed by the treatment or drainage phase, which utilizes light variable pressure to drain the fluid/blood from the distal treatment areas. The second phase may be controlled by multiple programmable options. Examples of this type of pump include, but may not be limited to, the Flexitouch or LymphaPress Optimal.

The Flexitouch Device (Tactile Systems Technology, Minneapolis,
MN) is a 2-phase lymph preparation and drainage therapy device. The device consists of an electronic controller unit and garments which are worn on the trunk and upper and lower affected extremities and connected to the controller unit by tubing harnesses. The garment consists of 32 inflatable chambers that sequentially inflate and deflate at 1 to 3 second intervals, according to 1 of the 13 pre-programmed treatment patterns selected. Chamber pressure and treatment times can be adjusted. The manufacturer states that device’s sequential action evacuates lymph from the trunk and extremities and drains it into the venous system. The garments are made from stretch material and are fitted with Velcro enclosures, so custom fitting of garments is not required. There are no published studies comparing the effectiveness of this 2-phase lymph preparation and drainage therapy device to standard segmented pneumatic compression devices.

The ACTitouch Adaptive Compression therapy system is another more recently developed pump device. It combines intermittent pneumatic compression with a sustained gradient pressure. It may be used when stationary or when ambulating (walking).

Drug therapy with benzopyrone can also result in slow reduction of lymphedema. This drug is a proteolytic agent that acts by activating macrophages, which then break down the protein-rich lymphedema fluid, thus decreasing its viscosity and thereby facilitating its flow.

A technique developed in Germany, complex decongestive physiotherapy (CDP), has been introduced in the United States. It is most frequently offered in specialized clinics. Patients attend the clinics for 1 to 4 weeks; CDP consists of 4 basic components as follows:

1. **Meticulous skin and nail care** The protein rich lymphedema fluid is highly susceptible to infection which can then further damage the lymphatics resulting in a vicious cycle. Thus meticulous skin and nail care is required. Emollients are
often used to prevent drying and cracking of the skin and all fungal infections must be treated promptly.

2. **Manual lymphatic drainage (MLD)** This massage technique seems to be the unique component of this multi-disciplinary approach and is based on the concept that the lymphatic system is subdivided into individual lymphotomes which communicate through collateral channels. The idea behind MLD is to increase the collateral circulation between these lymphotomes, such that the lymphedema fluid can be shunted from an inadequately draining lymphotome into a normal one. Thus, unlike other massage techniques, MLD begins with massage of the contralateral truncal lymphotome and then progresses toward the edematous extremity. Theoretically, in this way the collateral circulation is opened and dilated and the lymphatic drainage is “decongested.” There is no specific description of the technique of MLD, or theories as to how this technique can open and dilate collateral channels. Patients enrolled in the CDP clinic may undergo 1 to 2 such MLD sessions (about 45 mins each) each day.

3. **Bandaging** After the MLD session, the lymphedematous limb is wrapped with a pure cotton, minimally elastic bandages in order to provide adequate tissue pressure which in turn prevents re-accumulation of lymphedema.

4. **Remedial Exercises** During the clinical sessions the patients receive additional counseling in various aspects of self management, such as skin care, nutrition, weight control, etc. Prior to discharge from the clinic, the patient is fitted with an elastic support garment. It is recommended that this garment be worn as much as possible, and even at night. Some clinics may recommend wearing the bandages at night, and the compressive garment during the day. The use of these garments can be gradually reduced as the patient improves; however, typically, the patient will need to continue wearing the compressive garment at least part time. An initial course of CDP may require 30 days, or in the case of lower extremity care, 45 days.

No conservative treatment is entirely curative and all require a
committed physical therapy team and a committed and compliant patient.

Surgery, though not curative and rarely performed, has been suggested as a treatment for those with refractory lymphedema who have not improved with conservative management. Lymphedema surgery may be classified as reconstructive or excisional. Excisional surgical procedures for lymphedema include, but may not be limited to, debulking and liposuction. Excisional surgical procedures involve resection of the redundant tissue that may develop in long-standing severe lymphedema and elephantiasis. Reconstructive surgical procedures include, but may not be limited to, microsurgical treatment (e.g., microsurgical lymphatico-venous anastomosis, lymphatic-capsular-venous anastomosis, lymphovenous bypass), lymph node transfer (also known as vascularized lymph node transfer) and tissue transfers. Reconstructive (physiologic) surgical procedures attempt to provide or enhance lymphatic drainage with either anastomoses between lymphatic systems (i.e., linking subcutaneous tissues with the deep lymphatics), creating lymphovenous anastomoses or creation of artificial lymph channels. These surgical techniques are controversial and rarely used.

Damstra and colleagues (2009) prospectively determined the effect of lympho-venous anastomosis (LVA) on breast cancer related lymphedema (BCRL) and reviewed the current literature. A total of 10 patients who were previously treated for breast cancer by surgery, radiotherapy, and chemotherapy, and were unresponsive to 12-weeks of non-operative treatment, underwent an LVA procedure. Objective measurements were gathered for circumferential measurement and water volumetry, and quality of life. Various types of lympho-scintigraphy were performed pre-operatively and post-operatively at 3 and 12 months. Treatment was embedded in a multi-disciplinary setting. Post-operative volume measurements initially showed a 4.8 % reduction of lymphedema at 3 months and a 2 % reduction after 1 year. Various scintigraphic parameters showed some improvement.
Quality of life questionnaires reported minimal improvement. Reviewing the literature, only retrospective studies were found; these reported varying results for LVA procedures. The selection of patients, classification of lymphedema, indications and types of LVA, and additional therapeutic options were heterogeneous, not comparable, and lacked a validated method of effect-assessment. The authors concluded that their findings showed a minimal reduction in volume of lymphedema following LVA; in the literature, there was no convincing evidence of the success of LVA. They noted that non-operative treatment and elastic stockings are still preferred by most patients with lymphedema, especially in early stages with few irreversible changes.

In a randomized, single-blinded, controlled trial, Devoogdt et al (2011) determined the preventive effect of manual lymph drainage on the development of lymphedema related to breast cancer. A total of 160 consecutive patients with breast cancer and unilateral axillary lymph node dissection were included in this study. The randomization was stratified for body mass index (BMI) and axillary irradiation and treatment allocation was concealed. Randomization was done independently from recruitment and treatment. Baseline characteristics were comparable between the groups. For 6 months, the intervention group (n = 79) performed a treatment program consisting of guidelines about the prevention of lymphedema, exercise therapy, and manual lymph drainage. The control group (n = 81) performed the same program without manual lymph drainage. Main outcome measures included cumulative incidence of arm lymphedema and time to develop arm lymphedema, defined as an increase in arm volume of 200 ml or more in the value before surgery. Four patients in the intervention group and 2 in the control group were lost to follow-up. At 12 months after surgery, the cumulative incidence rate for arm lymphedema was comparable between the intervention group (24 %) and control group (19 %) (odds ratio 1.3, 95 % confidence interval [CI]: 0.6 to 2.9; p = 0.45). The time to develop arm lymphedema was comparable between the 2 group during the 1st year after surgery (hazard
ratio 1.3, 0.6 to 2.5; \( p = 0.49 \)). The sample size calculation was based on a presumed odds ratio of 0.3, which is not included in the 95 % CI. This odds ratio was calculated as (presumed cumulative incidence of lymphedema in intervention group/presumed cumulative incidence of no lymphedema in intervention group) \times (presumed cumulative incidence of no lymphedema in control group/presumed cumulative incidence of lymphedema in control group) or \((10/90) \times (70/30)\). The authors concluded that manual lymph drainage in addition to guidelines and exercise therapy after axillary lymph node dissection for breast cancer is unlikely to have a medium to large effect in reducing the incidence of arm lymphedema in the short-term.

**Vascularized Lymph Node Transfer**

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. Between January of 1997 and June of 2005, 13 consecutive patients with a mean age of 50.69 +/- 11.25 years 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 lympho-scintigraphy. All flaps survived, and 1 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 pre-operative and post-operative groups (\( p < 0.01 \)). The incidence of cellulitis was decreased in 11 patients. Post-operative lympho-scintigraphy indicated improved lymph drainage of the affected arm, revealing decreased lymph stasis and rapid lymphatic clearance. A hypothesis was proposed that the vascularized groin lymph node transfer might act as an
internal pump and suction pathway for lymphatic clearance of lymphedematous limb. The authors concluded that vascularized groin lymph node transfer using the wrist as a recipient site is a novel and reliable procedure that significantly improves post-mastectomy upper extremity lymphedema. Drawback of this study included small sample size and lack of a control group.

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 this study. Of them, 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. The differences were evaluated statistically. The limb circumferences decreased significantly in the new group. The number of secondary procedures was significantly higher in the standard group. There were 2 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. The authors concluded that transfer of vascularized inguinal lymph nodes based on the hilar perforators improves the outcomes in the treatment of early lymphedema of the upper extremity. Drawback of this study included small sample size and lack of a control group.

Cormier and colleagues (2012) performed a systematic review of the literature to examine contemporary peer-reviewed literature (2004 to 2010) evaluating the surgical treatment of lymphedema. A comprehensive search of 11 major medical indices was performed. Selected articles were sorted to identify those related to the surgical treatment of lymphedema. Extracted data included the number of patients, specific surgical procedure performed, length of follow-up, criteria for defining lymphedema, measurement methods, volume or circumference reduction, and reported
complications. A total of 20 studies met inclusion criteria; procedures were categorized as excisional procedures (n = 8), lymphatic reconstruction (n = 8), and tissue transfer (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 6 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 a number of surgical approaches have demonstrated beneficial effects for select patients with lymphedema. Most of these reports, however, were based on small numbers of patients, use non-standardized or inconsistent measurement techniques, and lack long-term follow-up. The proposed benefits of any surgical approach should be evaluated in the context of the potential morbidity to the individual patient and the availability of surgical expertise. 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.

Also, an UpToDate review on "Operative management of primary and secondary lymphedema" (Mehrara, 2012) stated that "similar to flap transfers, lymph node transfers are not commonly performed. Although these procedures may hold some promise, additional studies are required to evaluate their efficacy and to identify patient populations that are most likely to benefit .... Outcome data for lymph node transfer procedures are based upon small series of patients. Effective engraftment of non-vascularized transfer of lymph node grafts has not been clearly demonstrated. Harvesting of lymph nodes for transfer may cause lymphedema in the donor extremity".

An UpToDate review on "Lymphedema: Prevention and treatment" (Mohler and Mondry, 2012) did not mention the use of whole body vibration as a management toll.
Dylke et al (2014) examined if bioimpedance spectroscopy was suitable for detection of hand lymphedema. The hands of 50 participants without a history of lymphedema were measured with perometry and bioimpedance spectroscopy after positioning 2 ways for 3 minutes: (i) both hands rested at heart height; and (ii) the dominant hand at heart height and the non-dominant hand at head height. In addition, 10 women with secondary hand lymphedema were also measured. Impedance and volume measurements were found to be strongly related (dominant hand \( r = -0.794 \)). Both measurements were reliable (\( \text{ICC}(2,1) = 0.900 \) to 0.967 and 0.988 to 0.996, respectively). Impedance was more sensitive to small changes in hand volume due to the postural change (position \( \times \) device interaction: \( F = 23.9, p < 0.001 \)). Finally, impedance measurements had better discrimination of women with lymphedema than volume measurements. The authors concluded that bioimpedance spectroscopy is a promising tool for the detection of secondary hand lymphedema.

Cheng et al (2013) noted that vascularized groin lymph node flap transfer is an emerging approach to the treatment of post-mastectomy upper limb lymphedema. These investigators described the pertinent flap anatomy, surgical technique including different recipient sites, and outcome of this technique. A total of 10 cadaveric dissections were performed to clarify the vascular supply of the superficial groin lymph nodes; and 10 patients underwent vascularized groin lymph node flap transfer for post-mastectomy upper limb lymphedema using the wrist (\( n = 8 \)) or elbow (\( n = 2 \)) as a recipient site; and 10 patients who chose to undergo physical therapy (PT) were used as controls. Intra-operatively, indocyanine green (ICG) was injected subcutaneously on the flap margin to observe the lymph drainage. Outcomes were assessed using improvement of circumferential differentiation, reduction rate, and decreased number of episodes of cellulitis. A mean 6.2 ± 1.3 groin lymph nodes with consistent pedicles were identified in the cadaveric dissections. After ICG injection, the fluorescence was drained from the flap edge into the donor vein, followed by the recipient vein. At a mean follow-up of
39.1 ± 15.7 months, the mean improvement of circumferential differentiation was 7.3 ± 2.7 % and the reduction rate was 40.4 ± 16.1 % in the vascularized groin lymph node group, which were statistically greater than those of the PT group (1.7 ± 4.6 % and 8.3 ± 34.7 %, respectively; p < 0.01 and p = 0.02, respectively). The authors concluded that the superficial groin lymph nodes were confirmed as vascularized with reliable arterial perfusion. They stated that vascularized groin lymph node flap transfer using the wrist or elbow as a recipient site is an effective approach to treating post-mastectomy upper limb lymphedema. The findings of this small study need to be validated by well-designed studies.

UpToDate reviews on “Management of locally advanced cervical cancer” (De Los Santos and Straughn, 2014), and “Management of recurrent or metastatic cervical cancer” (Wright, 2014) do not mention vascularized lymph node transfer as a management tool.

Furthermore, NCCN’s clinical practice guideline on “Cervical cancer” (Version 2.2015) does not mention vascularized lymph node transfer as a management tool.

Ketterer (2014) noted that surgical options for treating lymphedema have expanded in recent years. For many years the only treatment options were conservative non-surgical therapies and excisional surgeries. Advances in microsurgery have made it possible to reconstruct lymphatic function. Reconstructive surgical options include lymphatico-venular bypass, lymphatico-lymphatic bypass, and vascularized lymph node transfer (VLNT). The authors concluded that currently, there is no consensus on how or when to surgically treat lymphedema, and more studies are needed to evaluate the risks and effectiveness of each of these techniques.

Basta et al (2014) quantified the safety and effectiveness of microsurgery for lymphedema through a systematic meta-analysis. A literature search was conducted to identify all articles involving microsurgical treatment of 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 as well as peri-operative complications were noted. A total of 27 studies were included, with 24 offering level IV evidence and 3 offering level III evidence. Lympho-venous shunt procedures were performed in 22 studies and lymph node transplantation was performed in 5. 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 a 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 post-operatively 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 %), re-exploration for flap congestion (2.7 %), and additional procedures (22.6 %). The authors concluded that operative interventions for peripheral lymphedema appear to provide consistent quantitative improvements post-operatively, with a relatively wide safety margin. Lymph node transplantation may provide better outcomes compared with lympho-venous shunt, but well-designed head-to-head comparisons are needed to evaluate this further.

Raju and Chang (2015) performed a comprehensive literature review of VLNT with updates and comparisons on current application, techniques, results, studies and possible future implications. The review was conducted over major medical indices (PubMed-MEDLINE, Factiva, Scopus, Sciencedirect, EMBASE). Search terms were focused on vascularized, lymph node transfer (also autologous, lymph node transplant) to cover both human and animal studies. Each study was verified for the nature of the procedure; a free microsurgical flap containing lymph nodes for the purpose of relieving lymphedema. There were human and animal studies that individually reported clear benefits, but because of methodological shortcomings
comparative studies with uniform patient selection and monitoring were lacking. 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.

In a systematic review, Ozturk and colleagues (2016) evaluated the current evidence on VLNT and examined if there is objective data concerning improved outcomes. These researchers performed a literature search of PubMed, Embase and CENTRAL electronic databases to identify articles written in the English language on VLNT for treatment of lymphedema. Publications were selected according to inclusion criteria. Papers reporting adjunct techniques and those that did not describe outcomes were excluded. Data including patient demographics, surgical technique, complications and outcomes were extracted. A quality score was calculated for each article. A total of 18 studies were included with an overall study population of 305 patients. Mean quality score of articles was 5.3 with levels of evidence range from II to IV. Among 182 patients who underwent limb circumference assessment, 165 (91%) showed post-operative improvement. Reduction of limb volume was noted in 98 of 114 (86%) patients; 92 patients underwent lymphoscintigraphy/lymphangiography and 55 (60%) demonstrated moderate or significant improvement of flow. Patient satisfaction was questioned in 105 patients and with exception of 7 patients, all reported a high satisfaction level with significant relief in symptoms and improved quality of life (QOL). Publications also reported a reduction in infectious episodes. The authors concluded that VLNT appeared to provide improvement in lymphedema. However, they stated that more studies with standardized methods for reporting outcomes and uniform patient selection are needed to evaluate this technique thoroughly.

Scaglioni and associates (2016) evaluated outcomes and complications of VLNT. Several early preliminary studies have reported promising outcomes, but they were limited by small
numbers, short follow-up, and were inconsistent in addressing the origin and recipient site of the transferred lymph nodes as well as the donor site morbidity. These investigators performed a review of literature using PubMed-Medline, Embase for key words VLNT (also autologous, lymph node transplant); only human studies were included. A total of 24 studies encompassing 271 VLNTs were included. 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 versus 53.2 %), but there was no difference in placing the lymph nodes more proximally versus distally on the extremity (proximal: 76.9 % versus distal: 80.4 %). The authors concluded that VLNT for lymphedema treatment is a promising operative technique showing beneficial results in early but also in advanced stage lymphedema.

Cornelissen and co-workers (2017) stated that lymph node transfer has been performed to treat lymphedema for several years. The goal of this procedure is to provide a bridge between the lymphatic system distal and proximal to the lymph node dissection. There is a lack of consensus about the necessity of an additional vascular anastomosis for the transplanted lymph nodes. These investigators performed a systematic literature search in Cochrane Library database CENTRAL, Medline, and Embase of animal studies using lymph node transplantation with and without additional vascularization in March 2016. The strategy used for the search was: ("Models, Animal"[Mesh]) and ("Lymphedema"[Mesh]) or "Lymph Nodes"[Mesh]) or "Lymph Node Excision"[Mesh]) and (vascularized lymph node transfer) or (non-vascularized lymph node transfer) or lymph node graft). The primary outcomes were: survival of transplanted lymph node and lymphatic vessel regeneration. A total of 16 studies were included; vascularization and the use of growth factors were significantly associated with lymph node survival; and lymphatic
vessels regeneration was independent from vascularization. The authors concluded that according to the findings of this study, additional vascular anastomosis might improve the transplanted lymph node survival. Moreover, they stated that further studies in both experimental and clinical setting are needed in order to support it.

Carl and colleagues (2017) noted that although conservative management of lymphedema remains the 1st-line approach, surgery is effective in select patients. These investigators reviewed the literature and developed a treatment algorithm based on the highest quality lymphedema research. They performed a systematic literature review to examine the surgical treatments for lymphedema. Studies were categorized into 5 groups: (i) excision, (ii) liposuction, (iii) LVA, (iv) VLNT, and (v) combined/multiple approaches. Studies were scored for methodological quality using the methodological index for non-randomized studies (MINORS) scoring system. A total of 69 articles met inclusion criteria and were assigned MINORS scores with a maximum score of 16 or 24 for non-comparative or comparative studies, respectively. The average MINORS scores using non-comparative 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; 39 studies scoring greater than 12/16 or greater than 19/24 were considered high quality. In studies measuring excess volume reduction, the mean reduction was 96.6 % (95 % CI: 86.2 to 107 %) for liposuction, 33.1 % (95 % CI: 14.4 to 51.9 %) for LVA, and 26.4 % (95 % CI: -7.98 to 60.8 %) for VLNT. Included excision articles did not report excess volume reduction. The authors concluded that although the overall quality of lymphedema literature was fair, the MINORS scoring system was an effective method to isolate high-quality studies. These studies were used to develop an evidence-based algorithm to guide clinical practice. They stated that further studies with a particular focus on patient follow-up will improve the validity of lymphedema surgery research. The mean excess volume reduction with VLNT was 26.4 %, which was less than for the other procedures included in the review.
(liposuction, LVA). Furthermore, for VLNT, the 95 % CI crossed zero, meaning that the mean excess volume reduction failed to reach statistical significance. The authors also noted that the biggest drawback of this study was the heterogeneity of the included studies in terms of patients’ lymphedema stage and etiology, method of assessing surgical outcomes, and inconsistent reporting of complications and quality of life outcomes. They also stated that 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. Also, RCTs 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. Furthermore, additional studies with a particular focus on patient follow-up would help improve the validity of lymphedema surgery research.

**Microsurgical Lymphatico-Venous Anastomosis:**

Cancer Care Ontario (2015) noted that there is limited evidence regarding the effectiveness of surgical interventions for the treatment of breast cancer-related lymphedema. A small prospective study among 10 patients who were unresponsive to 12-weeks of non-operative treatment and were treated with lympho-venous anastomosis demonstrated a 4.8 % reduction of lymphedema at 3 months and a 2 % reduction after 1 year. Improvement in reported quality of life was minimal. The LYMPHA technique (lymphatic-venous anastomoses at the time of axillary dissection) was prospectively compared to axillary dissection alone in 46 women with breast cancer. At 6 months, lymphedema occurred in 1 patient in the treatment group (4.34 %) versus 7 patients (30.43 %) in the control group; no statistically significant differences in the arm volume were observed in the treatment group during follow-up, while the arm volume in the control group showed a significant increase after 1, 3, and 6 months from operation. There was significant difference between the 2 groups in the volume changes with
respect to baseline after 1, 3, 6, 12, and 18 months after surgery (every timing p value < 0.01). Despite these promising results, prospective randomized controlled trial (RCT) data are lacking and there is a large variation in the selection of patients, classification of lymphedema, and indications and types of anastomosis procedures described in retrospective studies. Additional research is needed to better understand the effectiveness of surgery as a treatment modality for breast cancer survivors with lymphedema.

Jorgensen and colleagues (2017) noted that lymphedema is one of the most dreaded side effects to any cancer treatment involving lymphadenectomy. Progressed lymphedema is adversely complex and currently there is no widely acknowledged curative treatment. Thus, recent focus has shifted to risk reduction and prevention. It has been hypothesized that bypassing lymphatic vessels to veins prophylactically, could minimize the lymphatic dysfunction seen following lymphadenectomy. In a systematic review and meta-analysis, these investigators examined this possible future treatment modality by reviewing studies that treated patients with prophylactic lympho-venous anastomosis (LVA) for the prevention of secondary lymphedema following lymphadenectomy. A systematic search yielded 12 articles included in the qualitative analysis and 4 of these were further eligible to be included in the quantitative analysis. These researchers found that patients treated with prophylactic LVA had a significant reduction in lymphedema incidence (relative risk [RR]: 0.33, 95 % CI: 0.19 to 0.56) when compared to patients receiving no prophylactic treatment (p < 0.0001). The authors concluded that prophylactic LVA in relation to lymphadenectomy showed promising results, however because of the low number of eligible studies and method heterogeneity between studies, there is an urgent need for uniformly high quality studies, before the treatment can be concluded effective.

Omental Flap for the Treatment of Lymphedema:
Abbas and Seitz (2011) stated that inguinal nodes dissection is associated with high rates of morbidity, lymphedema in particular is a chronic disabling condition which is a common complication following this operation. Prevention or minimization of this condition is an important aim when considering this procedure. Many technical modifications have been suggested for this purpose. This systematic review aimed at assessing the effectiveness of the available strategies to reduce the risk and severity of leg lymphedema. For this review, MEDLINE and EMBASE were searched to identify studies that reported surgical strategies designed to reduce complications of groin dissection and in particular leg lymphedema. Studies that reported outcome of long saphenous vein sparing, fascia preserving dissection, microvascular surgery, sartorius transposition and omental pedicle flap were located. Data were collected using predefined inclusion and exclusion criteria. A combined odds ratio (OR) was calculated combining studies suitable for meta-analysis using the random effect model. The search result defined few studies that reported results of saphenous vein sparing technique; some of those studies were found suitable for meta-analysis based on the Newcastle-Ottawa scale for non-randomized studies. The meta-analysis showed significant reduction of lymphedema (OR 0.24, 95 % CI: 0.11 to 0.53) and other complications of inguinal node dissection. There were no randomized studies to address this problem; there were also isolated studies that reported benefits of other techniques but none of them was suitable for meta-analysis. The authors concluded that meta-analysis of the reported studies on sparing the long saphenous vein in inguinal nodes dissection suggested a reduced rate of lymphedema and other post-operative complications. Other methods that may be beneficial are fascia preserving dissection, pedicled omental flap and microsurgery; however sartorius transposition has not been shown to reduce the rate of complications. They stated that randomized controlled trials (RCTs) are needed to prove the benefits of various technical modifications.

Nguyen and Suami (2015) noted that advances in microsurgery
have displayed promising results for the treatment of lymphedema. The use of vascularized lymph node transfers has increased in popularity but incurs the potential risk for donor-site lymphedema. The omentum has been previously described for the treatment of lymphedema but has been overlooked because of presumed high morbidity, including the need for celiotomy and pedicled complications. The authors presented a novel technique and early results of the laparoscopic free omental lymphatic flap for the management of lymphedema. The minimally invasive harvest avoided both the previously associated morbidity of this flap and the risk of iatrogenic lymphedema to the donor site.

**Reverse Lymphatic Mapping:**

The technique of reverse lymphatic mapping appears to be used for vascularized lymph node transfer.

Ochoa et al (2014) hypothesized that mapping the lymphatic drainage of the arm with blue dye (axillary reverse mapping [ARM]) during axillary lymphadenectomy decreases the likelihood of disruption of lymphatics and subsequent lymphedema. This institutional review board-approved study involved 360 patients undergoing sentinel lymph node biopsy (SLNB) and/or axillary lymph node dissection (ALND) from May 2006 to October 2011. Technetium sulfur colloid (4 ml) was injected sub-areolarly, and 5 ml of blue dye was injected subcutaneously in the volar surface ipsilateral upper extremity (ARM). Data were collected on variations in lymphatic drainage, successful identification and protection of arm lymphatics, cross-over, and occurrence of lymphedema. A group of 360 patients underwent SLNB and/or ALND, 348 of whom underwent a SLNB. Of those, 237 (68.1 %) had a SLNB only, and 111 (31.9 %) went on to an ALND owing to a positive axilla. An additional 12 of 360 (3.3 %) axilla had ALND owing to a clinically positive axilla/pre-operative core needle biopsy. In 96 % of patients with SLNB (334/348), breast SLNs were hot but not blue; cross-over (SLN hot and blue) was seen in 14 of 348 patients (4 %). Blue lymphatics were identified in 80 of 237 SLN
incisions (33.7 %) and in 93 of 123 ALND (75.4 %). Average follow-up was 12 months (range of 3 to 48) and resulted in a SLNB lymphedema rate of 1.7 % (4/237) and ALND of 2.4 % (3/123). The authors concluded that ARM identified substantial lymphatic variations draining the upper extremities and facilitated preservation. Metastases in ARM-identified lymph nodes were acceptably low, indicating that ARM is safe. They stated that ARM added to present-day ALND and SLNB may be useful to lesser rates of lymphedema.

Seyednejad et al (2014) stated that ARM is a surgical technique that was first described in 2007 as a method for preserving the lymphatic drainage of the arm during sentinel lymph node biopsy (SLNB) or axillary lymph node dissection (ALND) for breast cancer. These researchers found that the ARM technique had several limitations that include a poor success rate for identification of arm lymph nodes (ARM nodes) and lymphatics. The occurrence of common lymphatic drainage pathways of the arm and the breast in a subset of patients also raised concerns regarding its oncological soundness. Furthermore, the effectiveness of the ARM procedure in reducing lymphedema risk in breast cancer patients that undergo a variety of treatments has yet to be clearly defined.

Dayan et al (2015) introduced the technique of reverse lymphatic mapping for vascularized lymph node transfer. This physiologic technique allows one to identify which lymph nodes drain the trunk as opposed to the extremity, to minimize the risk of iatrogenic lymphedema. These investigators performed a prospective study of patients undergoing vascularized lymph node transfer using the reverse lymphatic mapping technique. Patients received technetium injections in the first and second web-spaces of the foot and intra-dermal indo-cyanine green (ICG) injections in the lower abdomen. Lymphatic vessels were traced to the lymph nodes draining the lower abdomen that were harvested; a gamma probe was used to localize lymph nodes draining the lower extremity, which were avoided. In cases of vascularized axillary lymph node transfer, technetium was injected into the hand and ICG was injected into the back
and lateral chest. Ten-second counts were recorded of the lymph node flap and the sentinel node draining the extremity for comparison. A total of 35 patients underwent vascularized lymph node transfer (19 groin and 16 axillary lymph node transfers) guided by reverse lymphatic mapping. Follow-up time was 1 to 30 months. Mean 10-second count using the gamma probe for all lymph node flaps was 88.6 (SD, 123; median of 39); mean 10-second count of extremity sentinel nodes was 2,462 (SD, 2,115; median of 2,000). On average, 10-second signal strength of the lymph node flap was 6.0% that of the extremity sentinel node. The authors concluded that reverse lymphatic mapping guides vascularized lymph node flap harvest based on physiologic drainage patterns of the trunk and limb that may minimize the risk of iatrogenic lymphedema. The findings of this small study need to be validated by well-designed studies.

Yue and colleagues (2015) noted that ARM procedure can distinguish lymphatics draining the arm from those draining the breast. It has been proposed to preserve lymphatic drainage of the upper limbs and reduce the incidence of upper limb lymphedema during breast cancer surgery. These researchers evaluated the feasibility of ARM in modified radical mastectomy and to evaluate its effect on prevention of lymphedema. From January 2012 to March 2014, a prospective study was performed in 265 breast cancer patients who underwent modified radical mastectomy. Patients were divided into 2 groups: (i) 127 patients (47.93%, control group) received a traditional ALND, and (ii) 138 patients (52.07%, experimental group) received ARM preservation of the nodes and lymphatics during ALND. Radioactive tracer and methylene blue were used for ARM of the nodes and lymphatics. All of the identified ARM nodes were diagnosed using fine needle aspiration cytology for assessment of metastatic status. All resected axillary lymph nodes were conducted in a pathology examination to evaluate tumor metastasis. Data were collected on variations in identification of the ARM nodes and lymphatics, the metastasis of ARM nodes, and the occurrence of lymphedema. In the experimental group, the ARM procedure was successfully
conducted in 129 cases (93.48%); ARM nodes metastasis occurred in 11 patients (8.53%). The median follow-up time was 20 months, at the last evaluation there were 42 patients who developed upper limb lymphedema in the control group (33.07%), and in the experimental group the incidence of lymphedema was 5.93% (7/118; p < 0.001). None of the patients had nodal relapses during the follow-up time. The authors concluded that ARM appears to be a feasible technique with which to identify upper arm nodes and lymphatics during the modified radical mastectomy procedure. This was a feasibility study.

An UpToDate review on “Technique of axillary lymph node dissection” (Margenthaler, 2015) states that “Axillary reverse mapping -- Axillary reverse mapping (ARM) is an experimental technique, being investigated as a method of preserving the upper extremity lymphatics during ALND in an attempt to reduce the risk of postoperative lymphedema. Blue dye is injected in the upper inner ipsilateral arm and blue lymphatics and nodes are avoided during ALND. In two studies of 23 patients each, metastases were present in the nodes related to ARM sampling in 14 and 60% of patients, respectively. Thus, further studies are needed to determine the long-term oncologic outcomes of this novel technique, which should not be used outside of a clinical trial”.

Also, National Comprehensive Cancer Network’s clinical practice guideline on “Breast cancer” (Version 2.2015) does not mention reverse lymphatic mapping as a management tool.

Furthermore, there is an ongoing phase I/II clinical trial – “VST-1001 (Dilute Fluorescein) for Lymphatic Mapping & Localization of Lymph Nodes in Patients with Breast Cancer” that is still recruiting subjects (Last verified November 2014).

Gebruers and Tjalma (2016) stated that breast cancer is the most common malignancy in women worldwide. Fortunately, the overall survival is good. Therefore it is important to focus on the morbidities related to breast cancer treatment. One of
the most dreaded morbidities is lymphedema. In 2007 the axillary reverse mapping (ARM) was introduced to limit the invasiveness in the axilla during breast cancer surgery. It is hypothesized that ARM is able to limit the incidence of breast cancer related lymphedema (BCRL) considerably. This systematic review aimed to answer the following research questions: (i) which approaches for ARM are described? (ii) is ARM surgical feasible and oncological safe? and (iii) does ARM decrease the incidence of lymphedema after sentinel lymph node biopsy (SLNB) and axillary lymph node dissection (ALND)?

A total of 27 papers were retrieved using 4 electronic databases (PubMed, Web of Science, Medline and Cochrane clinical trials; assessed until May 13, 2015). The level of evidence of these studies was low (mostly level 3). The authors concluded that the ARM procedure is feasible although ARM-node rates have a broad range. Additionally, from a theoretical point there is a clear benefit from ARM in terms of lymphedema prevention. However, from a practical point there is little scientific data to support this due to the lack of studies; and especially because of the different methods and definitions for lymphedema used in the different studies.

Beek and colleagues (2016) noted that ARM is a technique by which the lymphatic drainage of the upper extremity that traverses the axillary region can be differentiated from the lymphatic drainage of the breast during ALND. Adding this procedure to ALND may reduce upper extremity lymphedema by preserving upper extremity drainage. These investigators reviewed the current literature on the ARM procedure and discussed the feasibility, safety and relevance of this technique. A PubMed literature search was performed until August 12, 2015. A total of 31 studies were included in this review. The studies indicated that the ARM procedure adequately identified the upper extremity lymph nodes and lymphatics in the axillary basin using blue dye or fluorescence. Preservation of ARM lymph nodes and corresponding lymphatics was proven to be oncologically safe in clinically node-negative breast cancer patients with metastatic lymph node involvement in the SLN who are advised to undergo a completion ALND. The authors
concluded that the ARM procedure is technically feasible with a high visualization rate using blue dye or fluorescence; ALND combined with ARM can be regarded as a promising surgical refinement in order to reduce the incidence of upper extremity lymphedema in selected groups of patients.

**Suction-Assisted Protein Lipectomy (SAPL) for the Treatment of Lymphedema:**

Granzow et al (2014a) noted that surgical treatment of chronic lymphedema has seen significant advances. Suction-assisted protein lipectomy (SAPL) has been shown to safely and effectively reduce the solid component of swelling in chronic lymphedema. However, these patients must continuously use compression garments to control and prevent recurrence. Microsurgery procedures, including lymphatico-venous anastomosis (LVA) and vascularized lymph node transfer (VLNT), have been shown to be effective in the management of the fluid component of lymphedema and allow for decreased garment use. SAPL and VLNT were applied together in a 2-stage approach in 2 patients with chronic lymphedema after treatment for breast cancer. SAPL was used first to remove the chronic, solid component of the soft tissue excess. Volume excess in these patients' arms was reduced an average of approximately 83 % and 110 % after SAPL surgery. After the arms had sufficiently healed and the volume reductions had stabilized, VLNT was performed to reduce the need for continuous compression and reduce fluid re-accumulation. Following the VLNT procedures, the patients were able to remove their compression garments consistently during the day and still maintain their volume reductions. Neither patient had any post-operative episodes of cellulitis. SAPL and VLNT can be combined to achieve optimal outcomes in patients with chronic lymphedema.

Granzow et al (2014b) stated that effective surgical treatments for lymphedema now can address the fluid and solid phases of the disease process. Microsurgical procedures, including LVA and VLNT, target the fluid component that predominates at
earlier stages of the disease. Suction-assisted protein lipectomy addresses the solid component that typically presents later as chronic, non-pitting lymphedema of an extremity. These researchers assessed the outcomes of patients who underwent selective application of these 3 surgical procedures as part of an effective system to treat lymphedema. This was a retrospective chart review of patients with lymphedema who underwent complete decongestive therapy followed by surgical treatment with SAPL, LVA, or VLNT. The primary outcomes measured were post-operative volume reduction (SAPL), daily requirement for compression garments and lymphedema therapy (VLNT and LVA), and the incidence of severe cellulitis. A total of 26 patients were included in the study, of which 10 underwent SAPL and 16 underwent LVA or VLNT. The average reduction of excess volume by SAPL was 3,212 ml in legs and 943 ml in arms, or a volume reduction of 87 % and 111 %, respectively, when compared with the unaffected, opposite sides. Microsurgical procedures (VLNT and LVA) significantly reduced the need for both compression garment use (p = 0.003) and lymphedema therapy (p < 0.0001). The overall rate of cellulitis decreased from 58 % before surgery to 15 % after surgery (p < 0.0001). The authors concluded that when applied appropriately to properly selected patients, surgical procedures used in the treatment of lymphedema are effective and safe. This was a small (n = 10 for SAPL), retrospective study; its findings need to be validated by well-designed studies.

Low-Level Light / Laser Therapy:

In a narrative non-systematic review, Zecha and associates (2016a) stated that there is evidence supporting the effectiveness of low level laser therapy (LLLT), also known as photo-bio-modulation therapy (PBMT), for the management of oral mucositis (OM) in patients undergoing radiotherapy for head and neck cancer (HNC). Recent advances in PBMT technology, together with a better understanding of mechanisms involved, may expand the applications for PBMT in the management of other complications associated with HNC treatment. These researchers described PBMT mechanisms of
action, dosimetry, and safety aspects and provided a basis for a companion paper (part 2) which described the potential breadth of potential applications of PBMT in the management of side-effects of chemo-radiation therapy (CRT) in patients being treated for HNC and proposed PBMT parameters. These investigators reviewed PBMT mechanisms of action and dosimetric considerations. Virtually, all conditions modulated by PBMT (e.g., ulceration, inflammation, lymphedema, pain, fibrosis, neurological and muscular injury) are thought to be involved in the pathogenesis of CRT-induced complications in patients treated for HNC. The impact of PBMT on tumor behavior and tumor response to treatment has been insufficiently studied. In-vitro studies assessing the effect of PBMT on tumor cells reported conflicting results, perhaps attributable to inconsistencies of PBMT power and dose.

Nonetheless, the biological bases for the broad clinical activities ascribed to PBMT have also been noted to be similar to those activities and pathways associated with negative tumor behaviors and impeded response to treatment. While there are no anecdotal descriptions of poor tumor outcomes in patients treated with PBMT, confirming its neutrality with respect to cancer responsiveness is a critical priority. The authors concluded that based on its therapeutic effects, PBMT may have utility in a broad range of oral, oropharyngeal, facial, and neck complications of HNC treatment. They stated that although evidence suggested that PBMT using LLLT is safe in HNC patients, more research is imperative and vigilance remains warranted to detect any potential adverse effects of PBMT on cancer treatment outcomes and survival.

Zecha and associates (2016b) stated that PBMT may have potential applications in the management of a broad range of side effects of CRT in patients being treated for HNC. For OM management, optimal PBMT parameters identified were as follows: wavelength, typically between 633 and 685 nm or 780 to 830 nm; energy density, laser or light-emitting diode (LED) output between 10 and 150 mW; dose, 2 to 3 J (J/cm²), and no more than 6 J/cm² on the tissue surface treated; treatment schedule, 2 to 3 times a week up to daily; emission
type, pulsed (less than 100 Hz); and route of delivery, intra-orally and/or transcutaneously. To facilitate further studies, these researchers proposed potentially effective PBMT parameters for prophylactic and therapeutic use in supportive care for dermatitis, dysphagia, dry mouth, dysgeusia, trismus, necrosis, lymphedema, and voice/speech alterations. The authors concluded that PBMT may have a role in supportive care for a broad range of complications associated with the treatment of HNC with CRT. The suggested PBMT irradiation and dosimetric parameters, which are potentially effective for these complications, are intended to provide guidance for well-designed future studies. It is imperative that such studies include elucidating the effects of PBMT on oncology treatment outcomes.

Robijns and colleagues (2016) noted that breast cancer and its treatments can bring along serious side effects such as fatigue, skin toxicity, lymphedema, pain, and nausea. These can substantially affect the patients' QOL. Thus, supportive care for breast cancer patients is an essential mainstay in the treatment. Low-level light therapy also named PBMT is a non-invasive, therapeutic option used to stimulate wound healing and reduce inflammation, edema, and pain. It is used in different medical settings ranging from dermatology, physiotherapy, and neurology to dentistry. In the last 20 years, LLLT is becoming a new treatment modality in supportive care for breast cancer. In this review, all existing literature concerning the use of LLLT for breast cancer was used to provide evidence in the following domains: OM, radio-dermatitis (RD), lymphedema, chemotherapy-induced peripheral neuropathy (CIPN), and osteonecrosis of the jaw (ONJ). The authors concluded that the findings of this review suggested that LLLT is a promising option for the management of breast cancer treatment-related side effects. However, they stated that it still remains important to define appropriate treatment and irradiation parameters for each condition in order to ensure the effectiveness of LLLT.

Matrix Rhythm Therapy:
Narin and colleagues (2016) noted that primary lymphedema occurs because of genetic predisposition and developmental insufficiency of the lymphatic system. Matrix rhythm therapy (MRT) was developed as an external and dynamic method that supplies rhythmic mobilization of the fluids in tissues. These researchers examined the effects of MRT in primary lymphedema. A 36-year old female with left lower limb lymphedema was evaluated. Leg circumference was measured before and at the end of treatment, and 1 and 3 months later. The circumferences were converted to volumetric values; 20 sessions of MRT (5 days/week) were applied to the affected leg, spine, and abdominal regions. Patient satisfaction was assessed with the Global Rating of Change scale. Volumetric values were 1,573.28 ml before treatment, 1,573.13 ml at the end of treatment, 1,516.70 ml 1 month later, and 1,441.61 ml 3 months later. At the end of treatment, the volumetric reduction was not significant; however, when compared with baseline, measurements at 1 and 3 months decreased by 3.59 % and 8.36 %, respectively; and the Global Rating of Change score was 2. The authors concluded that MRT could not reduce lymphedema when used alone, but long-term treatment may show positive effects.

Platelet-Rich Plasma:

Akgul and associates (2016) stated that platelet-rich plasma (PRP) is an autologous concentrated preparation of human platelets contained in a small volume of plasma that is characterized by hemostatic and tissue-repairing effects. Being enriched by various kinds of growth factors, and their tissue-repairing effects have made them the focus of attention for use in tissue regeneration. These researchers noted that PRP has been safely used and documented in many different fields, including orthopedics, sports injuries, dental and periodontal surgery, and cosmetic, plastic, cardiovascular, general, and maxillofacial surgery. The current evidence obtained from in-vitro and animal studies pointed out that PRP may potentially be used to regenerate injured lymphatic vessels to treat or prevent lymphedema. Thus, these investigators reviewed
existing literature on the clinical uses of PRP in lymphedema and examined if there is enough evidence to support the use of PRP in clinical practice as a therapeutic option. In contrast to in-vitro and animal models, there is no clinical trial regarding the use of PRP in lymphedema treatment. Only 2 animal studies matched to this research area yielded positive and promising results in terms of the potential role of PRP for lymphedema therapies in the future. The authors concluded that it is clear that this is an important issue that should be studied in greater depth to clarify the effectiveness of PRP in the management of lymphedema.

**Diagnosis of Upper-Quadrant Lymphedema Secondary to Cancer:**

The clinical practice guideline from the oncology section of the American Physical Therapy Association (APTA) (Levenhagen et al, 2017) stated that “There are emerging diagnostic methods that detect tissue quality, visualize edema, or evaluate structural lymphatic transport capacity. These methods include 3D camera, tissue dielectric constant (TDC), dual-energy x-ray absorptiometry (DXA), MRI, CT, lymphoscintigraphy, lymphography, and tonometry. Because of lack of evidence, high costs, or the invasive nature for some of these tests, these methods are not recommended to be incorporated into general clinical practice for diagnosing secondary upper-quadrant lymphedema (SUQL) at this time. Lymphatic system imaging, including lymphoscintigraphy and lymphography, can be useful in determining the full extent of lymphatic system impairment, and the results may assist the clinician when traditional interventions are not successful. Another emerging area is the diagnosis and assessment of lymphedema in patients treated for head and neck cancer. A combined approach of head and neck external lymphedema and fibrosis (HN-ELAF), circumferential measurement at the upper neck point, and TDC may be useful for diagnostic purposes. Little research is currently available to guide the diagnosis of hand, trunk, and breast lymphedema. Moreover, they stated that the bulk of the evidence includes patients with upper-extremity lymphedema.
due to breast cancer treatments. Further research is needed for diagnosing lymphedema both in the trunk and in the head and neck region. Furthermore, they noted that early diagnosis is crucial to maintain QOL and minimize upper-quadrant morbidity for patients at risk for SUQL; thus, there is a need for research to determine appropriate pre-operative measurements and prospective monitoring protocols.

Aquatic Therapy / Aqua Lymphatic Therapy for the Treatment of Lymphedema:

Yeung and colleagues (2017) stated that aquatic therapy has several proposed benefits for people with lymphedema. These researchers performed a systematic review of the evidence for aquatic therapy in lymphedema management. Five electronic databases were searched to identify RCTs of people with lymphedema, which compared aquatic therapy with other lymphedema interventions. Qualitative analysis was undertaken where quantitative analysis was not possible. Study quality was assessed using physiotherapy evidence database (PEDro) scores. The strength of evidence was evaluated using the Grades of Recommendations Assessment, Development and Evaluation (GRADE) approach; 4 RCTs of moderate quality (average PEDro score of 6.5/10) were included in the review; 2 studies provided results for inclusion in meta-analysis. There was moderate-level evidence of no significant short-term differences in lymphedema status (as measured by lymphedema relative volume) between patients who completed aqua lymphatic therapy (ALT) compared to land-based standard care (standardized mean difference [SMD]: 0.14; 95 % CI: -0.37 to 0.64, I² = 0 %, p = 0.59); and low-quality evidence of no significant difference between ALT and standard care for improving upper limb (UL) physical function (SMD -0.27, 95 % CI: -0.78 to 0.23, I² = 0 %, p = 0.29). No adverse events (AEs) were reported. The authors concluded that current evidence indicated no significant benefit of ALT over standard land-based care for improving lymphedema status or physical function in people with UL lymphedema. Moreover, they stated that further research is needed to strengthen the
evidence from 4 studies in people with UL lymphedema, and to establish the effectiveness of this intervention in people with lower limb lymphedema.

Combined Adipose-Derived Stem Cells and Vascularized Lymph Node Transfers for the Treatment of Secondary Lymphedema:

Hayashida and colleagues (2017) noted that secondary lymphedema is often observed in post-malignancy treatment of the breast and the gynecologic organs, but effective therapies have not been established in chronic cases even with advanced physiologic operations. Currently, reconstructive surgery with novel approaches has been attempted. In this experimental study, the hind-limbs of 10-week-old male C57BL/6J mice, after 30-Gy x-irradiation, surgical lymph node dissection, and 5-mm gap creation, were divided into 4 groups, with vascularized lymph node transfer abdominal flap and 1.0 × 10 adipose-derived stem cells. Lymphatic flow assessment, a water-displacement plethysmometer paw volumetry test, tissue quantification of lymphatic vessels, and functional analysis of lymphatic vessels and nodes were performed. Photodynamic eye images, using indocyanine green fluorescence, demonstrated immediate staining in sub-iliac lymph nodes, and linear pattern imaging of the proximal region was observed with the combined treatment of adipose-derived stem cells and vascularized lymph node transfer. Both percentage improvement and percentage deterioration with the combined treatment of adipose-derived stem cells and vascularized lymph node transfer were significantly better than with other treatments (p < 0.05). The numbers of lymphatic vessels with LYVE-1 immunoreactivity significantly increased in mice treated with adipose-derived stem cells (p < 0.05), and B16 melanoma cells were metastasized in groups treated with vascularized lymph node transfers by day 28. The authors concluded that adipose-derived stem cells increased the number of lymphatic vessels and vascularized lymph node transfers induced the lymphatic flow drainage to the circulatory system. They stated that combined adipose-derived stem cell and vascularized
lymph node transfer treatment in secondary lymphedema may effectively decrease edema volume and restore lymphatic function by lymphangiogenesis and the lymphatic-to-venous circulation route. These preliminary findings need to be validated by well-designed studies.

**CPT Codes / HCPCS Codes / ICD-10 Codes**

*Information in the [brackets] below has been added for clarification purposes. Codes requiring a 7th character are represented by “+”:

<table>
<thead>
<tr>
<th>Code</th>
<th>Code Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPT codes covered if selection criteria are met:</strong></td>
<td></td>
</tr>
<tr>
<td>97016</td>
<td>Application of modality to 1 or more areas; vasopneumatic devices</td>
</tr>
<tr>
<td>97140</td>
<td>Manual therapy techniques (e.g., mobilization/manipulation, manual lymphatic drainage, manual traction), one or more regions, each 15 minutes</td>
</tr>
<tr>
<td><strong>CPT codes not covered for indications listed in the CPB:</strong></td>
<td></td>
</tr>
<tr>
<td>0232T</td>
<td>Injection(s), platelet rich plasma, any site, including image guidance, harvesting and preparation when performed</td>
</tr>
<tr>
<td>14000 - 14350</td>
<td>Tissue transfer</td>
</tr>
<tr>
<td>15876 - 15879</td>
<td>Suction assisted lipectomy; head and neck, trunk, upper or lower extremity</td>
</tr>
<tr>
<td>38308</td>
<td>Lymphangiotomy or other operations on lymphatic channels [lymphatic-capsular-venous anastomosis, lymphovenous bypass, or lymph node transfer]</td>
</tr>
<tr>
<td>49904</td>
<td>Omental flap, extra-abdominal (eg, for reconstruction of sternal and chest wall defects)</td>
</tr>
<tr>
<td>Code</td>
<td>Code Description</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>49905</td>
<td>Omental flap, intra-abdominal (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td>49906</td>
<td>Free omental flap with microvascular anastomosis</td>
</tr>
<tr>
<td>78195</td>
<td>Lymphatics and lymph nodes imaging [reverse lymphatic mapping]</td>
</tr>
<tr>
<td>93702</td>
<td>Bioimpedance spectroscopy (BIS), extracellular fluid analysis for lymphedema assessment(s)</td>
</tr>
<tr>
<td></td>
<td><strong>CPT codes related to the CPB:</strong></td>
</tr>
<tr>
<td>29583</td>
<td>Application of multi-layer compression system; upper arm and forearm</td>
</tr>
<tr>
<td>29584</td>
<td>upper arm, forearm, hand, and fingers</td>
</tr>
<tr>
<td></td>
<td><strong>HCPCS codes covered if selection criteria are met:</strong></td>
</tr>
<tr>
<td>A4465</td>
<td>Non-elastic binder for extremity</td>
</tr>
<tr>
<td>E0650</td>
<td>Pneumatic compressor, non-segmental home model</td>
</tr>
<tr>
<td>E0651</td>
<td>Pneumatic compressor, segmental home model without calibrated gradient pressure</td>
</tr>
<tr>
<td>E0652</td>
<td>Pneumatic compressor, segmental home model with calibrated gradient pressure</td>
</tr>
<tr>
<td>E0655</td>
<td>Non-segmental pneumatic appliance for use with pneumatic compressor, half arm</td>
</tr>
<tr>
<td>E0660</td>
<td>Non-segmental pneumatic appliance for use with pneumatic compressor, full leg</td>
</tr>
<tr>
<td>E0665</td>
<td>Non-segmental pneumatic appliance for use with pneumatic compressor, full arm</td>
</tr>
<tr>
<td>E0666</td>
<td>Non-segmental pneumatic appliance for use with pneumatic compressor, half leg</td>
</tr>
<tr>
<td>Code</td>
<td>Code Description</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>E0667</td>
<td>Segmental pneumatic appliance for use with pneumatic compressor, full leg</td>
</tr>
<tr>
<td>E0668</td>
<td>Segmental pneumatic appliance for use with pneumatic compressor, full arm</td>
</tr>
<tr>
<td>E0669</td>
<td>Segmental pneumatic appliance for use with pneumatic compressor, half leg</td>
</tr>
<tr>
<td>E0671</td>
<td>Segmental gradient pressure pneumatic appliance, full leg</td>
</tr>
<tr>
<td>E0672</td>
<td>Segmental gradient pressure pneumatic appliance, full arm</td>
</tr>
<tr>
<td>E0673</td>
<td>Segmental gradient pressure pneumatic appliance, half leg</td>
</tr>
<tr>
<td>E0676</td>
<td>Intermittent limb compression device (includes all accessories), not otherwise specified</td>
</tr>
<tr>
<td>S8420 - S8428</td>
<td>Gradient pressure aids (sleeves, gloves, gauntlets)</td>
</tr>
<tr>
<td>S8950</td>
<td>Complex lymphedema therapy, each 15 minutes</td>
</tr>
</tbody>
</table>

**HCPCS codes not covered for indications listed in the CPB:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Code Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E0656</td>
<td>Segmental pneumatic appliance for use with pneumatic compressor, trunk</td>
</tr>
<tr>
<td>E0657</td>
<td>Segmental pneumatic appliance for use with pneumatic compressor, chest</td>
</tr>
<tr>
<td>E0670</td>
<td>Segmental pneumatic appliance for use with pneumatic compressor; integrated, 2 full legs and trunk</td>
</tr>
<tr>
<td>G0460</td>
<td>Autologous platelet rich plasma for chronic wounds/ulcers, including phlebotomy, centrifugation, and all other preparatory procedures, administration and dressings, per treatment</td>
</tr>
<tr>
<td>Code</td>
<td>Code Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>P9020</td>
<td>Platelet rich plasma, each unit</td>
</tr>
</tbody>
</table>

**Other HCPCS codes related to the CPB:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Code Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A6530</td>
<td>Gradient compression stockings</td>
</tr>
<tr>
<td>A6549</td>
<td></td>
</tr>
</tbody>
</table>

**ICD-10 codes covered if selection criteria are met:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Code Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I89.0</td>
<td>Other noninfective disorders of lymphatic vessels and lymph nodes [intractable lymphedema]</td>
</tr>
<tr>
<td>I89.9</td>
<td></td>
</tr>
<tr>
<td>I97.2</td>
<td>Postmastectomy lymphedema syndrome [vascularized lymph node transfer not covered for the treatment of post-mastectomy lymphedema or for the treatment of lymphedema due to cervical cancer]</td>
</tr>
</tbody>
</table>

Q82.0  | Hereditary lymphedema

The above policy is based on the following references:


17. Szuba A, Cooke JP, Yousuf S, Rockson SG. Decongestive lymphatic therapy for patients with cancer-related or


33. Partsch H, Flour M, Smith PC; International Compression Club. Indications for compression therapy in venous and lymphatic disease consensus based on experimental data and scientific evidence. Under the auspices of the IUP. Int


37. Mohler ER, Mondry TE. Lymphedema: Etiology, clinical manifestations, and diagnosis. UpToDate [online serial]. Waltham, MA: UpToDate; 2010.


50. Australia and New Zealand Horizon Scanning Network (ANZHSN). Impedimed Imp for the diagnosis of lymphoedema. Horizon Scanning Technology Prioritising Summary. Canberra, ACT: Department of Health and


65. Mehrara B. Operative management of primary and secondary lymphedema. UpToDate [online serial]. Waltham, MA. Last reviewed September 2012.


70. Wright JD. Management of recurrent or metastatic cervical cancer. UpToDate Inc., Waltham, MA. Last reviewed September 2014.


83. Margenthaler J. Technique of axillary lymph node dissection. UpToDate Inc., Waltham, MA. Last reviewed November 2015.


AETNA BETTER HEALTH® OF PENNSYLVANIA

Amendment to
Aetna Clinical Policy Bulletin Number: 0069 Lymphedema

There are no amendments for Medicaid.