



PHYSIOTHERAPEUTIC ROLE IN LYMPHEDEMA- GUIDANCE TO MEDICAL PROFESSIONALS

Physiotherapy & Rehabilitation

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ABSTRACT

Lymphedema is associated with feelings of discomfort and heaviness, functional limitation, disfigurement, psychological distress, and an elevated risk of recurrent infection. It has a negative effect on quality of life. There is no consensus on one single specific treatment for lymphedema but an association of therapies is recommended. These therapies include manual and mechanical lymph drainage, exercising and myolymphokinetic activities, compression garments and bandages, care with hygiene and with daily tasks, and psychological support.

KEYWORDS

Lymphedema, Physiotherapy, Pneumatic Compression, Lymphatic Drainage

The lymphatic vasculature is a second network of vessels, adjacent to the blood vasculature. It plays a crucial role in normal physiology.^{1,2} The dynamics of blood pressure and oncotic pressure drive a continuous filtration of blood plasma from blood capillaries into the interstitial space. Excess fluid and macromolecules are taken up from the interstitial space into the initial lymphatics through a permeable endothelial cell layer.^{1,3}

The blind-ended lymphatic capillaries take up lymphatic fluid, which is then transported through a hierarchy of lymphatic vessels throughout the body.^{1,4} Ultimately, lymphatic fluid is returned back into the vessels of the cardiovascular system via the thoracic duct. Initial protein concentration of the lymphatic fluid is around 3–4%. Once it reaches the blood stream, protein concentration is believed to be higher. It reaches levels similar to blood plasma ($\approx 6\%$).^{1,5} It is estimated that approximately eight liters of lymphatic fluid are generated every day. Due to reabsorption processes within the lymph nodes, the post-nodal flow rate is about four liters per day.⁶

Any dysfunction within the lymphatic vasculature can lead to the accumulation of fluid within the tissue. This occurs due to an imbalance of plasma filtration and transport capacity of the vessels, resulting in different pathological conditions, such as lymphedema. Lymphedema is characterized by a chronic, progressive and disfiguring form of regional swelling. The disease is usually diagnosed in peripheral extremities. The amount of fluid accumulated can reach up to 5–15 L.^{6,7,8}

Lymphedema is associated with feelings of discomfort and heaviness, functional limitation, disfigurement, psychological distress, and an elevated risk of recurrent infection. The hemodynamic factors at the site of lymphedema may also play a role in its development.⁹ Affected person can experience pain, swelling, tightness, heaviness in the affected part, and recurrent skin infections. If left untreated, lymphedema may predispose the affected limb to the development of other secondary complications like recurrent bouts of cellulitis or lymphangitis, axillary vein thrombosis, severe functional impairment, cosmetic embracement, and lymphangiosarcoma.¹⁰

According to the International Society of Lymphology, lymphoedema has to be treated with Combined Physical Therapy. This is a two-stage treatment program. During the first or intensive phase, the lymphoedema has to be maximally reduced. This phase consists of skin care, Manual Lymphatic Drainage, exercises and multi-layer bandaging. The second or maintenance phase aims to conserve and optimize the result obtained in the first phase. It consists of skin care, exercises, compression by a low-stretch elastic sleeve and Manual Lymphatic Drainage when needed.¹¹

Currently there is no cure or permanent remedy for lymphedema. If it is left untreated, lymphedema will gradually progress through its stages. Zuther and Norton defined the stages of lymphedema as: "The latency stage is characterized as having no swelling. Stage 0, or subclinical stage, is characterized as having a reduced transport capacity (TC) and normal tissue consistency. Stage 1, the reversible stage, is characterized as having soft, pitting edema, no secondary tissue changes, and elevation can assist in reducing the swelling. Stage 2,

spontaneously irreversible stage, is characterized as having lymphostatic fibrosis, hardening of the tissue, no pitting, positive Stemmer sign, and having frequent infections. Stage 3, also known as lymphostatic elephantiasis, is characterized as extreme increase in volume and tissue texture with typical skin changes (papillomas, deep skinfolds, etc.) and positive Stemmer sign."¹²

There is no consensus on one single specific treatment for lymphedema but an association of therapies is recommended. These therapies include manual and mechanical lymph drainage, exercising and myolymphokinetic activities, compression garments and bandages, care with hygiene and with daily tasks, and psychological support.¹³ However, no definite cure is currently available. Physical therapy in the form of complete decongestive therapy (CDT) can assist in reducing symptoms. CDT lasts for several weeks and is a multicomponent therapy program with the primary aim to reduce volume and to prevent disease progression.¹ There are several methods of therapy used in CDT, with the two therapy types that encompass most techniques and technology including positive and negative pressure. Historically, CDT treatments have predominated via treatments that offer positive pressure.¹⁴

Positive pressure modalities include any treatment that exerts a pushing force onto the tissues whereby external tissue pressure becomes higher than internal tissue pressure. Studies have shown that mechanically this results in decreased lymphatic load through reduced oedema formation following compression of blood vessels causing decreased venous pressure.¹⁵

The recent improved descriptions of the Revised Starling's principle reinforce that the lymphatics are responsible for reabsorption of tissue fluid, with both arterial and venous blood vessels being biased towards filtration. If blood capillary filtration forces are reduced then lymphatic load will be reduced. Compression bandaging, pressure garments, including wraps and chip bags, massage including fascial releases and manual lymphatic drainage, pneumatic compression devices and exercise are examples of positive pressure technology, or therapy, that aims to directly or indirectly impact the lymphatics by positive pressure forces. Exercise for example, indirectly offers a positive pressure force through muscular contraction and increased arterial pulsation resulting in compression of lymphatic vessels.^{16,17}

Negative pressure on the other hand, representing an advancement in CDT treatment capability, works by the opposite means to positive pressure whereby a pulling or opening force is applied to the tissues. The technology aims to make local external tissue pressure lower than internal tissue pressure and, therefore, offers a treatment that a manual therapists hands alone cannot deliver. Kinesiological tape, deep breathing, cupping and medical negative pressure devices, are examples of negative pressure technology or therapies that aim to directly or indirectly impact the lymphatics by utilising negative pressure forces.¹⁴

The following techniques are available in physiotherapy clinical practice for the management of lymphedema :-

1. CDT contains the 4 following components: manual lymphatic drainage (MLD), bandaging, exercises, and skin care practices.¹⁸

a) Manual Lymphatic Drainage is a gentle massage technique and stimulates the lymphatic flow and the formation of lympholymphatic and axilloaxillary anastomoses. MLD is carried out by a trained MLD therapist, who uses specialized and gentle hand movement to give a pumping action on the skin without oils. This technique is a type of skin massage, which improves lymph flow and reabsorption without increasing capillary filtration. As a result, MLD reduces the tissue swelling and softening fibrosis in the affected body part. MLD can not only be implemented alone, but can also be implemented with other therapies, or as a part of Complete Decongestive Therapy (CDT).^{18,19}

b) Bandaging involves a compression bandage, which aims to reduce swelling by reducing of fluid formation and the amount of lymph reflux. A multi-layer bandage counterbalances the elastic insufficiency of the connective tissue of the subcutis and increases the tissue pressure to enhance lymph flow. A compression sleeve protects the arm against wounds and bites and helps to maintain the lymphoedema reduction reached during the intensive phase.¹⁹

c) Skin Care- Physiotherapists teach skin care exercises to avoid skin infection. The aim of skin care in lymphoedema management is to improve or maintain the condition and integrity of the skin, and to prevent skin injury, trauma and infection.¹⁹

d) Exercises combine compression with active and repetitive movements in the affected area of the body, which can promote lymph flow and reduce swelling. Long-term exercises can lead to improved lymph flow by increased sympathetic outflow, increased muscular contractions and increased ventilation. **Myolymphokinetic exercises** cause muscle movements that increase veno-lymphatic return which, in turn, leads to a reduction in the volume of the lymphedema however for these exercises to be effective they must comply with biomechanical principles. Frequently the increase in volume of the affected limb reduces the amplitude of movements, increases the body mass index and makes exercising, and consequently rehabilitation of the limb, more difficult. Thus exercising is a technique that potentially can be used in the treatment of lymphedema. Apparatuses can be used to control movements in the rehabilitation of limbs thereby improving the amplitude of joint movement and posture of the spine and reducing limb size.¹³

2. Kinesiology taping is an example of technology whereby the mechanics of action are not well understood. It is theorised that negative pressure is created indirectly through tissue movement creating skin stretch from adhesive tape pulling on the skin. As superficial tissues are pulled, more space is created between the dermis and fascia, pulling on lymphatic anchor capillaries, which attach the skin and drawing fluid into superficial lymphatic vessels.¹⁴

3. Deep breathing is another example of a therapy that aims indirectly to create a central negative pressure force on the lymphatic system. Changes in intraabdominal pressure create negative pressure within the thoracic duct. Within the literature deep breathing and simple exercise alone has been shown to reduce arm lymphoedema volume and is generally regarded as a standard component of CDT.^{19,20}

4. Cupping is the primitive form of local negative pressure devices, being used in Chinese alternative medicine since the second century AD and continuing to be used in contemporary Chinese medicine. It involves the application of warm, negative pressure, which can change the permeability of local capillaries, causing them to rupture and release histamine, serotonin, and other substances. It mobilizes the immune system, and enhances local tolerance and body resistance to disease. The level of negative pressure at the tissue interface cannot be controlled accurately and as bruising and swelling is a common side effect of this modality, cupping is not used to treat lymphoedema in initial phase due to the risk of further harm.^{21,14}

5. Negative Pressure massage Therapy (NPMT) is ideal for use by lymphatic therapists as the therapist can determine which body areas to target the negative pressure treatment towards. Large body areas can be treated with therapy targeted directly over scars, areas of radiation induced fibrosis, fibrosis from lymphoedema, areas of oedema, around wounds or around sensitive or fragile skin areas. The units are designed for multiple patient use, which also means that they may be a more cost viable option.¹⁴

The first medical NPMT device described in medical literature was

LPG's Endermologie® device. Designed over 30 years ago in France, this technology is used widely in the international cosmetology market. The device uses a central vacuum unit to create the negative pressure with different patented treatment heads that include both rollers and sequential suction to mobilise tissues. A body suit, LPG endermowear®, is required to reduce the potential for skin debris being collected in to the vacuum unit. **Endermologie** is a machine-assisted massage system that allows positive pressure rolling, in conjunction with applied negative pressure to the skin and subcutaneous tissues. It involves the use of a motorized device with two adjustable rollers and controlled suction, which creates a symmetrical skin-fold allowing for smooth and regulated deep tissue mobilization. It was originally developed to soften scars but now it is widely used as an alternative method for altering fat distribution in the subcutaneous plane. Lymphedema treatment remains a problem even with modern treatment modalities, since clear therapeutic protocols do not exist.²²

6. Intermittent Pneumatic Compression (IPC) is a multi-chamber device that inflates sequentially from distal to proximal, pushing the liquid ahead by its inflation. IPC devices consist of pneumatic cuffs that are incorporated into a compression garment, which is connected to a pump and applied to the limb. It involves a device that allowed the administration of gradual pressure gradients on lymph vessels and improves the lymph flow. This tool could apply pressures between 0 and 300 mmHg pressure, but pressures between 30 and 60 mmHg are generally preferred. Multiple-chamber garments typically provide sequential compression in an ascending pattern up the limb. Pumps vary in timing cycles and amount of pressure produced, ranging from low-pressure, slow-inflation to high-pressure, rapid-inflation devices. IPC pumps have used sequential cycles to provide a peristaltic massaging effect along the limb towards its root. This, however, does not mimic the MLD process, which starts with the unaffected lymph nodes and region of the body and moves proximally to distally. A negative aspect of IPC is its contraindication in patients with cardiac problems.^{19,20}

7. Electrical stimulation has been used in clinical practice to reduce the edema as, by producing muscle contractions and relaxation, it increases the venous and lymphatic flow. Among different electrical current forms, **High-Voltage Electrical Stimulation (HVES)** is clinically indicated for acute and chronic pain, to increase the speed of tissue regeneration, neuromuscular reeducation, to increase the venous blood flow and absorb the edema. Assuming that muscle pumping helps in the edema absorption process, HVES is being used to activate the muscles around an affected body part. A theoretical hypothesis exists that the electrical current creates a potential electrical field that can induce. HVES applied negative-polarity current with motor-level intensity. The reduced capillary permeability to plasma protein, the effect of muscle pumping and repulsion of loads (negative current and negative proteins) can explain its results laser therapy for lymphedema reduction indicated the following hypotheses for its effects: restored axillary lymphatic drainage by the stimulation of new lymph conduits, softening of fibrous tissue and surgical scar, systemic effects related to the extracellular fluid volume and reduction of accumulated tissue fluids by blood flow changes.²³

8. Faradic current is a short-duration interrupted direct current with a pulse duration ranging from 0.1 to 1 ms with a frequency of 50 to 100 Hz. Faradic current is surged to produce tetanic contraction and relaxation of the muscle. Treatment with faradic current also known as faradism. **Faradism under pressure** method is used in the treatment of edema to increase the venous and lymphatic drainage from the edematous area. The faradic current is applied along with an elastic bandage such as elastocrepe bandage and body part, which is to be treated, is kept elevated during treatment. Applied for 15 to 20 minutes only.²⁴

9. Laser refers to the production of a ray of light radiation, characterized by monochromaticity, coherence and collimation. It is produced by emitting a large quantity of identical photons, using appropriate energized material. After its production, the radiation can be reflected on the surface or penetrate the tissues, depending on the wavelength, nature of tissue surface and incidence angle. This resource is used in physiotherapy based on its anti-inflammatory, analgesic and regenerative effects. It can promote the inhibition of prostaglandin, the formation of new blood vessels, and also normalize cell membrane activity, regenerate nerve fibers and lymph vessels and accelerate the

healing process by stimulating fibroblasts. The most used laser types in clinical practice are Helium-Neon (HeNe) and Gallium Arsenate (AsGa). It is believed that, to treat lymphedema, the laser can stimulate lymphangiogenesis, lymph activity, lymphatic movement, macrophages and the immune system, reduce fibrosis and also exerts analgesic effects.²³

Lymphedema-associated signs and symptoms are increased limb diameter, skin tensioning with risk of breakdown and infection, stiffness and decreased range of movement (ROM) of affected limb joints, sensory disorders in the hand and reduced use of the limb for functional tasks. Consequently, it can result in esthetic deformities, decreased functional ability, physical discomfort, episodes of erysipelas and psychological stress. Lymphedema treatment using CDT, which is widely used, consists of two phases: intensive phase and maintenance phase. In the first phase, which aims to achieve maximum limb volume reduction with esthetic and functional improvement, MLD, functional compression bandaging and exercises are applied. In the second, self-massage, exercises and sleeve use (elastic containment) are applied. Its goal is to maintain the reductions achieved in the intensive phase for the longest time possible. Daily skin care is necessary in both phases.

Isolated techniques were insufficient to reduce the lymphedema. Exercise modes and Pressure therapy without any associations may not be beneficial, as the lymphatic system needs to be unblocked first, which will then be maintained by the action of muscle contraction and the use of compressive bandaging and positive pneumatic pressure. MLD alone is not effective for lymphedema treatment either, and the best results are achieved when associated with compression and exercises. Compressive bandaging not only maintains but also increases lymphatic absorption and, together with kinesiotherapy, stimulates lymphatic functioning. Combined techniques produce the most beneficial effects and, depending on the physiopathology of the lymphedema, the physiotherapist should select the best combination, based on a detailed assessment of individual cases.

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