Simulated Manual Lymph Drainage Therapy in Home Treatment of Lymphedema

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ABSTRACT

Background Lymphedema is a chronic, debilitating disease of the lymphatic system that results in swelling of the trunk and/or one or more extremities. Lymphedema is often seen in patients who have undergone surgery and/or radiation related to cancer treatment. Lymphedema has also been seen in patients with a genetic predisposition to the disease, traumatic injury, tumor growth, filariasis, or other infection.[1] The standard treatment for lymphedema is complete decongestive therapy (CDT). A key element of CDT is manual lymph drainage (MLD), an expensive and time-consuming therapy delivered in a clinic setting. Self-administered MLD is one aspect of ongoing home care following in-clinic therapy. Self-administered MLD can pose various drawbacks including poor compliance and inconsistent or ineffective technique.[2,3] A recent technology offers patients a method to self-administer therapy using an in-home medical device that operates based on the principles of MLD.

Introduction

The two primary functions of the lymphatic system are to help protect the body from infection and disease, and to collect lymph fluid from the tissues and return it to the bloodstream.[4] Excess water, proteins, bacteria, viruses and waste products are carried through the lymph vessels to the lymph nodes where these materials are filtered. The filtered lymph fluid then rejoins the circulatory system at the venous angles just below the collar bones.[5]

Lymphedema can result from genetic anomalies, infections, after surgery, radiation, or traumatic injury to the lymphatic system. Blockage or damage to the lymphatic system interrupts the ability of this system to move lymphatic fluid. The fluid then stagnates in the affected limb, causing progressive swelling.[6] Currently, the most common cause of lymphedema in the United States is the treatment for cancer.

Lymphedema is a serious and debilitating condition that can affect nearly every aspect of a person's life. Moderate lymphedema can increase the size of a patient's limb to several times that of a normal limb. This results in greatly decreased dexterity and range of motion, and inhibits patients from being able to perform basic activities of daily living. Many complications are common in lymphedema patients including:

- Severe pain
- Loss of mobility
- Tissue changes that can harden the skin of the affected limb (fibrosis)
- Life-threatening infections (cellulitis, lymphangitis)
- Muscle atrophy
- Impaired wound healing
- Reduced quality of life

Severe lymphedema can also result in lymphatic fluid weeping from the skin and, in the most severe cases, amputation.

Currently, there is no cure for lymphedema. Daily treatment of lymphedema is necessary to reduce swelling and complications. Effective long-term management of lymphedema generally requires in-clinic treatment followed by daily home maintenance therapy for the remainder of the patient's life.

In-Clinic CDT

CDT is used in the clinic setting to treat the symptoms of lymphedema. CDT uses a combination of four components to return an edematous limb to near normal size: MLD, bandaging and pressure garments, light exercises, and meticulous skin care. All four components of CDT are performed and emphasized during in-clinic therapy.

Although all four components of CDT play an important role, this paper focuses on the self-administered MLD aspect of therapy. Within the complete CDT regimen, the primary purpose of the MLD component is to move lymph fluid from an affected trunk region and limb to functional adjacent

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lymph node groups. These functional lymph groups can then accept the additional fluid from the affected limb and move the fluid into the circulatory system.

As used by a therapist during in-clinic treatment, MLD is a highly skilled therapeutic application that follows accepted anatomical and physiological principles of the lymphatic system. MLD therapy consists of light and specific manual techniques using four types of gentle manual strokes. Each stroke uses a working and a resting phase. In the working phase of the stroke, the skin is stretched such that lymph capillaries and smooth musculature of the lymph angions are manipulated. The working phase of each stroke lasts about one second, and is then released. The work-and-release process is repeated a number of times in the same area.[7] The directional pressure during the work-and-release phase moves lymph fluid toward the functioning lymph regions. The pressure should be enough to stretch the skin to its elastic capacity. To deliver these techniques effectively, MLD requires specialized training.[8]

By performing the mild stimulation techniques of MLD, therapists make use of functioning lymph nodes and vessels near the non-functioning regions. MLD helps the therapist achieve therapy goals by:

- increasing the frequency of lymph vessel contraction,
- increasing the amount of lymph fluid moved,
- increasing pressure in the lymph collector vessels,
- improving the lymph transport capacity to transport fluid, and
- reversing the directional flow of lymph fluid from natural flow patterns toward collateral vessels, anastomoses, and uninvolved lymph nodes.[9]

First, specific techniques are applied to decongest the trunk in the non-functioning lymph node region and to stimulate the passages to allow blocked fluid to exit. Stimulation in this phase moves from the contralateral trunk area to the congested area.[10] This creates a suction effect to help move lymph fluid from the affected area.[11] Next, the therapist focuses on moving fluid from the congested region to the functioning lymph areas. The precise areas that are treated depend upon the patient's specific condition. Generally, the patient is required to lie down, and his or her trunk, neck, and limb(s) are treated.

To achieve a reduction in the size of the limb or trunk, CDT treatment can involve daily clinic visits for three to six weeks[12], depending upon the location, duration, and severity of the patient's lymphedema. Once in-clinic therapy is completed, the patient continues to apply CDT at home. This requires that the patient and family take a significant part in lymphedema management. Continuing CDT at home can reduce the risk factors for developing cellulitis.[13]

Home Maintenance Therapy

As a lymphedema patient goes through in-clinic treatment, therapists educate the patient on a home maintenance strategy. Maintaining the benefits of in-clinic therapy requires that the patient understand and consistently use all four components of CDT, including self-administered MLD therapy. To be effective, MLD must be performed regularly and with proper technique, focusing on preparing and draining the trunk and extremity.

Barriers to Treatment Effectiveness

Patient compliance with CDT is crucial for long-term successful management of lymphedema symptoms.[14] Although not the only obstacle, compliance with self-administered MLD is a significant obstacle to maintaining in-clinic therapy benefits. MLD technique administered by an inexperienced individual poses another potential barrier to the success of MLD therapy.[15] Without the specialized training and skills required for MLD, patients and caregivers may have difficulty administering consistent and effective MLD therapy. Improper therapy technique reduces home therapy results, which often leads to a reduced compliance with home therapy.

Self-administering MLD therapy can be very difficult. Therapists are challenged with the task of training lay people in proper MLD technique. MLD requires precise applications of pressure, directional movements, and hand techniques. In addition, MLD requires that the patient be in a horizontal position, which can inhibit the patient from reaching all areas of the body for therapy. Applying too much pressure can worsen lymphedema symptoms. Therefore,

therapists must decide carefully which patients appear able to participate in MLD self-management.[16] The ability of patients and caregivers to apply MLD consistently depends a great deal on energy and skill level.

Outcomes of ineffective or infrequent home therapy can include infections that require antibiotic use or hospitalization, tissue hardening or fibrosis, the necessity for additional in-clinic therapy sessions, return of pain, reduced mobility, and loss of functional status and ability.

Lymphedema Treatment Using Flexitouch

The Flexitouch® 2-Phase Lymph Preparation and Drainage™ System is a recent technology designed for use in the home setting as part of continued lymphedema therapy maintenance. Consisting of an electronic controller unit and garments, Flexitouch therapy takes the place of self-administered MLD. Flexitouch simulates MLD using important design and therapy process innovations that differ from previously available technologies:

- Flexitouch patented therapy process prepares and drains the trunk and limb.
- Flexitouch garments use a proprietary composite of laminated materials that deliver a variable stretch during inflation. This stretch creates variable pressure against the skin that simulates a therapist's hand movements during in-clinic MLD.
- Patented Flexitouch garments include separate trunk and limb garments that when combined, consist of up to thirty-two separate chambers. The curved chambers of the Flexitouch trunk garment help optimize the redirection of fluid flow by lying perpendicular to lymphatic pathways. This directs lymph fluid to follow anatomical pathways away from the affected limb toward unaffected lymph node regions. Each individual chamber is a narrow 1.5 inches (3.75 cm) wide, based on research indicating that chambers should be as narrow as possible to maximize flow from regions that have been compressed.[17]
- Flexitouch delivers brief applications of mild pressure, each lasting one to three seconds, in a continuously moving rhythmic work-and-release action that is repeated multiple times in each section. These short pressure applications, along with the release phase, help lymph fluid absorb and move. No two Flexitouch chambers are fully inflated at the same time.

Table 1. Therapy Process Similarities: MLD and Flexitouch

MLD	Flexitouch
1. The MLD process first decongests the trunk.	Flexitouch starts at the trunk with a preparation phase.
2. Each MLD stroke stretches the skin to manipulate lymph capillaries and smooth musculature of the lymph angions.	Flexitouch delivers a variable stretch against the skin during inflation using patented garment structure and proprietary materials.
3. The working phase of each MLD stroke lasts about one second and is repeated.[18]	Flexitouch repeatedly delivers 1-3 second applications of mild pressure.
4. MLD therapy moves lymph fluid from an affected trunk and limb to functional adjacent lymph node groups.	Flexitouch garments use up to 32 curved chambers to redirect fluid from the congested area to the functional adjacent lymph node groups.
5. MLD prepares and drains the trunk and affected extremity.	Flexitouch uses a patented 2-Phase Preparation and Drainage process.

Flexitouch requires no patient training in the MLD technique and minimal patient activity. Because Flexitouch delivers consistent therapy for the patient, patient or caregiver skill level in delivering MLD is not an issue. Flexitouch reduces many issues with patient compliance. The majority of Flexitouch patients report maintaining the use of their Flexitouch seven days a week. Similarly, over 90% of patients describe themselves as "extremely and/or somewhat satisfied" with the Flexitouch therapeutic intervention.[19] Patients and therapists report significant reduction in edematous limbs when Flexitouch is used for 60 minutes, twice a day.[20]

Home Treatment Alternatives

Historically, the primary home treatment alternative to self-administered MLD therapy has been therapy delivered by a compression pump. Compression pumps are mechanical devices that move compressed air into a sleeve worn on the affected limb. The air pressure moves fluid deep into the limb and nearby areas.[21] Compression pumps consist of a pneumatic pump and garments that typically contain one to twelve chambers and deliver cycling pressure applications up to 30 seconds in length. Compression pumps operate using the assumption that applying

static pressure will move lymph fluid to functioning lymph nodes. In operation, each chamber in the compression pump garments inflates in sequence until all chambers are fully inflated and actively applying pressure against the entire limb. Compression pumps have been shown to work primarily by moving fluid into blood capillaries.[22] Some compression pumps may allow for manual adjustment in pressure, frequency and duration, requiring that precautions be taken to monitor any patient adjustment of settings. Patients may set the pressure too high, which is difficult to monitor in the home setting.[23] When a pump exerts too much pressure, there is risk of damage to functioning lymph vessels.[24]

Compression Pump Debate

There has been significant disagreement over the use of compression pumps in the treatment of lymphedema. The design and function of compression pumps are not consistent with anatomy, physiology, and pathophysiology of the lymphatic system.[25] Compression pumps put pressure on the limb such that fluid is pressed into the limb rather than being moved out through natural pathways.[26] Concerns have been raised over whether compression pumps are able to move protein-rich lymph fluid, or if they are effective at moving only water that can quickly return once compression stops.[27] If only water is removed from the affected limb, the lymphedema fluid protein concentration builds up, creating a negative effect.[28] The use of compression pumps has been associated with discomfort and pain, skin irritation, and a higher risk of cellulitis or lymphangitis.[29] Genital edema is also a significant concern for patients being treated with a compression pump for lower extremity edema. The onset of genital edema has serious consequences to the patient's quality of life, including symptoms such as severe depression. Genital edema responds poorly to treatment and is often irreversible.[30] The risk of side affects associated with compression pumps must be considered by both clinicians and patients.

In a survey of short-term and long-term users of compression pumps, of the 56 patients responding to the survey who once had used a pump, only 10 continued to do so. The low rate of compliance was attributed to a variety of factors such as little or no reduction in edema, fear of negative physical effects, and doctor recommendations to stop pump therapy. Many patients in the survey said they had experienced negative side affects they associated with pumping, including pain, relocation of the swelling, increase in swelling, and cellulitis.[31] Flexitouch differs from compression pumps in key areas of design:

Table 2. Design Differences: Flexitouch vs. Compression Pumps

Flexitouch	Compression Pumps
1. Flexitouch uses a patented 2-Phase Preparation and Drainage process.	Compression pumps provide a single therapy process.
2. Flexitouch delivers a variable stretch during inflation using patented garment structure and proprietary materials.	Compression pump garment materials are not constructed of stretchable fabrics.
3. Flexitouch uses up to 32 chambers. The narrow chambers optimize flow from the affected regions.	Compression pumps have one to twelve chambers to cover the affected extremity.
4. The curved chambers of the Flexitouch trunk garment redirect fluid from the congested area to the functioning lymph node groups.	Compression pump garments cease at the point the limb meets the trunk.
5. Flexitouch repeatedly delivers brief 1-3 second applications of mild pressure. No two chambers are inflated at the same time.	Compression pumps deliver static pressure applications up to 30 seconds in length. Multiple chambers are inflated simultaneously.

Conclusion

The Flexitouch® 2-Phase Lymph Preparation and Drainage™ System is a recent technology that administers therapy using the well-established methods and principles of MLD. Flexitouch offers patients a consistent and effective in-home alternative to self-administered MLD therapy as part of their daily lymphedema care regimen. The Flexitouch mechanized therapy application ensures consistent therapy delivery that is not affected by the skill or energy level of the patient or caregiver. Patients and healthcare providers report remarkable results with the Flexitouch system.

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