



Research Article

Effectiveness of Lymphatic Drainage Pump Massage Machines in Patients with 1st and 2nd Degree Lower Extremity Lymphedema

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Abstract

Introduction: Lymphedema is tissue swelling caused by an accumulation of proteinaceous fluid usually drained through the body's lymphatic system. It most commonly affects the arms or legs, but it can also affect the chest wall, abdomen, neck, and even genitals. Any issue that blocks the drainage of lymph fluid can cause lymphedema. A treatment cuff uses air chambers (3, 4, 6, 8) that are filled with air one after the other during a compression cycle, starting distally. Each chamber remains inflated until the final one reaches the desired pressure. A new principle involves overlapping the pressure chambers. This avoids the accumulation of fluid or the formation of blisters.

Methods: We have issued more than 550 such devices here to test the efficacy of the 8-chamber system, we included only patients with more than three months of regular use. We initiated this study for internal quality control of the clinic, but mainly to estimate the benefit for patients with mild leg edema regardless of gender, all are adult patients, regardless of socioeconomic circumstances. At the end of the three months, we conducted telephone interviews with 448 patients. After a brief introduction, we started with our open question, e.g. what would you say about the swelling in the leg and the pain sensation there. So we could see exciting and significant improvements in these two primary symptoms.

Results: In the telephone survey of 448 patients who had already been diagnosed with mild to moderate lymphedema, i.e., 1st or 2nd degree lower extremities lymphedema, 417 (93.08%) patients reported that swelling had decreased after three months of regular use, 388 (86.60%) said that pain symptoms had been reduced in 307 cases, and, notably, 298 (66.51%) patients reported improvement in both symptoms. Apart from this, several patients reported additional improvements, including stress relief, easier urination than before, improved leg movements.

Introduction

Lymphedema is a common and progressive disease that worsens patients' quality of life, and there is still no standard treatment [1]. New approaches for the treatment of lymphedema are to be presented. These studies show that using the mechanical lymphatic drainage device to treat lower and upper limb lymphedema significantly aids both treatment and maintenance. Another point regarding these devices is that

automatic lymphatic drainage as monotherapy reduces edema, though compression mechanisms combine better results. Since chronic lymphedema leads to fibrosis and end-organ failure even with average circulation, redirecting lymphatic drainage to the systemic atrium with low pressure would be a mile stone [2] in case of such treatments may be a valuable alternative for treating devastating complications as protein less enteropathy and plastic bronchitis can be minimized. It may prevent or reduce the development of end-organ fibrosis

or failure. Lymphedema is a chronic peripheral swelling caused by a dysfunction of the lymphatic system, resulting in discomfort and restricted movement of the limbs [3]. The accessory lymphatics are believed to be the drainage pathways in the affected arm, which prevents the progression of edema to the final stage. Understanding the accessory lymphatic ways in lymphedema patients may lead to new insights into the pathophysiology of lymphedema [4]. Therefore, we hope to switch such paths by applying the Lymphatic drainage pump massage machines to the legs.

Advantages in general and future concepts (Figure 1)

Lymphedema is the result of impaired lymphatic transport with increased limb volume. Lymphedema is divided into primary and secondary forms. Primary lymphedema occurs sporadically, rarely familial or associated with complex malformations or genetic disorders. The diagnosis of lymphedema is mainly made clinically, although lymph scintigraphy is helpful in the primary form to accurately assess the lymphatic function of both limbs. The most important complication is erysipelas (cellulitis), but psychological or functional complaints may also occur with lymphedema. The primary differential diagnosis is lipedema, which is defined as abnormal fat accumulation from the hip to the ankle. Treatment of lymphedema is based on complete decongestive therapy, with reduction of lymphedema volume in the first phase of treatment [5].

Method and pathomechanical mechanics

Much to the chagrin of patients, the positive effect of decongestive therapy is often underestimated; in contrast, wound healing may be delayed or remains unsuccessful and costs increase due to the long treatment times.

In addition, the indications for peristaltic lymphatic drainage therapy have been expanded in recent years. The indications range from cellulite to lymphoedema, pre-operative preparation (decongestion of the future surgical area), post-operative treatment (rapid regression of oedema in the wound area and improvement of O₂ transport in the tissue), post-ischaemic and decubital lymphoedema and as part of apoplexy treatment.



Figure 1: Eight-chamber system for peristaltic lymphatic drainage with overlapping sections.

Efficiency

Most patients report that after 20 minutes of treatment, they need to resolve water - this is an immediate and direct effect of decongestive therapy. Therefore, it may be possible to reduce or completely stop diuretics and pain therapy medication. People with mobility disorders - e.g. in old people's homes, overweight people, but also athletes can benefit from the therapy! This therapy is also ideally suited for relaxation at home or for the feeling of "tired legs" that you often have in the evening after work. The popular term "tired legs" actually corresponds to class I to II lymphoedema. The reason for this is often undiagnosed venous insufficiency. Experience has shown that a professional angiological examination usually reveals the cause of the symptoms.

Substitution of compression stockings - many patients do not like or cannot put on class II support stockings (weakness, rheumatism) or wear them (summer heat). In such cases, peristaltic lymphatic drainage at the end of a working day is a complete replacement for compression stockings. The legs are completely decongested and refreshed after just 20 minutes.

Cost-benefit ratio - peristaltic lymphatic drainage is significantly cheaper than manual lymphatic drainage - a single application of manual lymphatic drainage pays for the device in full.

Experience has shown that with regular use (minimum 1 x day) it is possible to lose up to 35 kg of water after a certain time (weeks and months)! Such results cannot be achieved with medication or manual therapy [6].

Introduction of our further works and significances

By applying our so-called Lymphatic drainage pump massage machine before or together with causal treatment methods, we can better avoid than treat the known edema complications. Nevertheless, only a few works deal with the role of the lymphatic system. We are also investigating the possibility of correcting the lymphatic circulation in venous pathology. We are very interested in continuing to work on this.

In patients with breast cancer, lymphatic abnormalities precede the development of lymphedema. In younger women, obesity appears to be the main factor in developing lymphedema, whereas in older women, improving muscle strength through active exercise can prevent lymphedema. Manual lymphatic drainage is as safe and effective as vigorous exercise in rehabilitation after breast cancer surgery [7]. The shunt lymphedema model simulates the volume response, histopathology, and lymphographic features of human acquired lymphedema. Because of these similarities to human lymphedema, this refinement of a mouse model of acquired lymphedema provides a promising platform for studying lymphatic vascular insufficiency and evaluating new therapeutic modalities [8]. Our observations found that even with the application of such an Lymphatic drainage pump massage machine in the early stages, such stalls can be delayed or even stopped. The sequential programs and high



pressure resulted in faster lymphatic flow compared to other modes. The results suggest that a more significant treatment effect could be achieved by adjusting the treatment mode and pressure of intermittent pneumatic compression [9]. As we mentioned earlier, our devices are minimally limited by patient age (all are adult Patients), gender, and socioeconomic status. Therefore, patients with gynecological conditions or obesity benefited significantly from our methods (Table 1).

It is our pleasure to position ourselves as a “Center of Excellence” in the field of lymphology. We successfully work in the field of lymphology and its complications. Lymphology and drainage therapy is an interdisciplinary field with versatile applications. The positive effect of decongestive therapy is often underestimated – often to the chagrin of patients. On the contrary, wound healing is delayed or unsuccessful, and costs increase due to long treatment times. We have expanded the peristaltic lymphatic drainage therapy indications during the last seven years. From cellulite to lymphedema, the preoperative preparation (decongestion of the future surgical area), the postoperative treatment (rapid regression of edema in the wound area and improvement of O₂ transport in the tissue), post-ischemic, decubital lymphedema and in the context of apoplexy treatment.

Lymphatic drainage pump massager therapy has many positive effects – weight loss, pain relief, stress reduction, and a positive feeling at the end of the application. From your experience, many patients report that after 20 minutes of application, they feel the need to urinate – this is the immediate and direct effect of decongestive therapy. For this reason, it is possible to reduce or altogether discontinue diuretic medications and painkillers. Especially people with mobility disorders – e.g., older adults’ homes, overweight people, and top athletes – can benefit from the therapy! The therapy is also very suitable for relaxation at home or for “tired legs”, which one often has in the evening after work. The term “tired legs” corresponds to lymphedema class I to II. The reason for this is often undiagnosed venous insufficiency.

Substitution of compression stockings – many patients do not want to or cannot put on class II support stockings (due to weakness, rheumatism) or do not wear them (due to summer heat). Then peristaltic lymphatic drainage at the end of a working day proves to be a complete substitute for compression stockings. With a 20-minute application, the legs are entirely decongested and refreshed. Our systems are Cost-effective – peristaltic lymphatic drainage is significantly less expensive than manual lymphatic drainage. We also have other pumps applicable in the leg, arm, and body.

A 2016 French study examined total lower limb volume and decreased induced by a pulsatile suit versus Intermittent Pneumatic Compression (IPC) during five days of complex decongestive physical therapy (CPD), using a 65 mm Hg compression pump. The researchers’ promising results pave the way for more extensive clinical trials addressing maintenance and moderate lymphedema in the outpatient setting. Tidal volume (TV) reduction was more pronounced in the Stendo group than in the IPC group when adjusted for baseline TV; TV reduction was 14.2 L (11.2%) in the Stendo group, 11.0 L (8.8%) in the IPC group ($p = 0.052$ – %TV change $p = 0.08$). Quality of life tended to improve in favor of the Stendo group compared to the IPC groups (14.2% [SD: 23.4%] and 6.7% [SD: 31.5%], respectively). No adverse events related to the Stendo device were reported [10].

The setting, the study participants, and the interventions

In this case, we are a leader in the region, and some of the patients even call our clinic by nicknames like “Bein Klinik” in German and “Clinique de la jambe” in French to emphasize the global sense of our expertise. Moreover, we are keen on treating patients worldwide, and we have clinicians and scientists with different talents. To ensure the effectiveness of the treatment, we constantly undergo internal and external quality control. From the patients’ side, we receive at least ten positive feedbacks every day. Although we discuss various diseases in the treatment perspective in this article, we have mainly focused on the concept expressed in the title (Figure 2).

Even in the present, treating patients with trophic and inflammatory diseases of the lower limb veins in outpatient clinics is poorly developed.

No tactical approaches and effective methods for treating this group of patients exists. Implementing that Lymphatic drainage pump massager practice of polyclinical treatment of patients with this pathology will significantly reduce economic costs, shorten the duration of therapy, increase treatment efficiency and reduce patient disability (Figure 3).

Lymphatic drainage in patients with various forms of venous insufficiency of the lower limbs using the Lymphatic drainage pump massager instrument system is our future vision. Analysis of results and clinical evaluation of lymphatic therapy in complex treatment of patients with chronic venous insufficiency complicated by inflammatory and trophic processes in soft tissues. Several health authorities have developed an algorithm for the complex polyclinical treatment

Table 1: Application of Lymphatic drainage system.

Medical field	Benefits
Surgery	Preoperative preparation for surgery; postoperative treatment of wound edema
Traumatology	Post-traumatic edema, in patients with lack of exercise
Cardiology	Oedema in heart failure
Urology and Nephrology	Facilitate or ease urination
Venous system	Prophylaxis, post-thrombotic syndrome, impending leg ulcer, chronic venous insufficiency
Arterial system	Peripheral arterial occlusive disease - PAVD (shop window disease)
Lymphatic	Lymphedema, lipedema, mixed forms of edema
Rheumatology	pain relief in arthritis, knee pain in osteoarthritis
Neurology	Paralytic and post paralytic edema, disorders in hemiplegia
Gynaecology	pregnancy, leg edema, fast convalescence time after delivery
Psychiatry	Psychiatry during therapy with psychotropic drugs
Aesthetics	Cellulitis, slimming, Massage



Figure 2: 2 2 pictures from our archive of 2 patients in 2021.

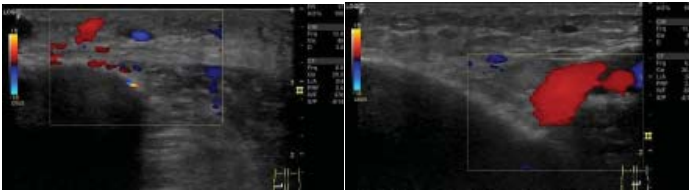


Figure 3: Pain and swelling reduction by increasing venous blood flow.

of patients with complicated forms of Chronic Venous Insufficiency (CVI).

Results

While we studied the benefits of sequential therapy with the peristaltic lymphatic drainage system in patients with 1st and 2nd degree lymphedema in our department, we investigated the results of lymphatic drainage disorders in patients with lower limb edema-related pathologies, which were particularly pronounced in patients with trophic disorders. Our study revealed pathophysiological mechanisms that we can influence with Massaging device using a lymphatic drainage pump therapy to prove its effectiveness in this category of patients with light degrees of Leg edema. In the telephone survey of 448 patients who had already been diagnosed with mild to moderate lymphedema, i.e., lower extremity lymphedema of 1st or 2nd degree (Figure 4). Those Grade of lower extremity lymphedema, 417 (93.08%) of patients reported that swelling had decreased after three months of regular use, 388 (86.60%) said that pain symptoms had been reduced in 307 cases, and, more remarkably, 298 (66.51%) of patients reported that both of the above symptoms had improved. In addition, several patients in this group reported other improvements, such as relief from stress, easier urination than before, improved leg movements.

Discussion

Several conditions cause lower extremity oedema, including deep venous thrombosis, cellulitis, venous congestion, and congestive heart failure [11]. Lymphedema is characterised by several pathophysiologic events, including lymphatic congestion, remodelling and dysfunction of lymphatic vessels, inflammation, deposition of fatty tissue, and fibrosis. Lymphedema treatment may be based on low-stretch bandaging and wearing elastic compression garments in

combination with skincare, exercises and, as needed, manual lymphatic drainage [12]. The idea of flushing the remaining lymphatic fluid was curiously received and even emphasised because there is very little scientific data on the occlusion pressure of the superficial lymphatic vessels. Considering its importance in determining the transport capacity of lymphatic vessels, it is crucial to know its value [13]. However, the exact sequence of these events and their interplay in the development and progression of lymphedema are far from adequately described [14]. According to the 2017 studies by Ayman A Grada et al., there are no standard guidelines for diagnosing lymphedema. There is no cure for lymphedema yet, and the goal of treatment is to limit the progression of the disease and prevent complications [15]. For this case, we have a simple but effective solution. Compression pneumatic therapy effectively addresses chronic vascular conditions such as lymphedema, venous insufficiency, and arterial insufficiency. Lymphedema is the result of inadequate lymphatic drainage and typically affects the extremities. Recent studies have shown that obesity is another cause of extremity lymphedema. The options for conservative treatment of patients with elephantiasis lymphedema of the lower extremities is limited and often inadequate [16]. There is a growing trend of evidence supporting the use of pneumatic compression for all three conditions. A national reimbursement decision for the benefit of pneumatic compression therapy for lymphedema and chronic venous insufficiency after conservative treatment has not given sufficient favourable effects. Stimulation of the lymphatic and venous drainage system and along with improved blood flow in the microcirculatory system and the formation of a positive endothelial response [17]. The cause of swelling of the extremities is due to a lack of contraction of the lymphatic vessels rather than an anatomical abnormality, and compression and manual lymphatic drainage may be effective treatments [18]. Clinical practitioners also report success in reimbursement for high-pressure pneumatic compression therapy for peripheral arterial disease. Research studies now support treatment approaches and Parameters that were previously based solely on expert opinion. Considering the current evidence base, there appears to be a role for using pneumatic compression judiciously.

Lymphedema of the extremities is a common, complex, and debilitating disease whose biology is still incompletely understood. Although many of these patients experience

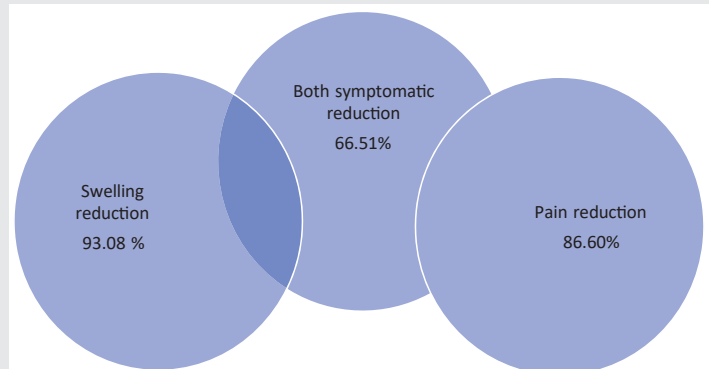


Figure 4: Lower extremity lymphedema of 1st or 2nd degree.



a degree of medical neglect, increasing interest in and understanding this disease has improved diagnostic evaluation and therapeutic intervention methods. It is anticipated that further exploration of the cellular mechanisms of lymphedema will lead to increasingly elegant refinements in the control of this disease [19]. Finally, we referred to an article claiming that such pumps Lymphatic drainage massage device may reduce cancer cells via playing a role in the lymphatic system. They have shown differences in sentinel lymph node sampling patterns for lower extremity melanoma below and above the knee. Biopsy for deep inguinal lymph nodes can be delayed once preoperative lymph scintigraphy shows concomitant drainage into the superficial inguinal pelvis [20].

In our particular study all of the above patients were monitored clinically and remotely with the same clinical examination after the Lymphatic drainage massage device application during the three months from 01/09/2021 to 01/12/2021. Thus, we were able to show that the system we used and our internal therapy rhythm with this instrumentation (8-chamber system) have proven therapeutic benefits in terms of pain reduction and reduction of swelling in patients with lower limb edema. Indeed, the applicability of lymphatic drainage in post-surgical recovery and its ability to serve as a means of stress reduction and relaxation explain its holistic nature. Though the results are impressive, some methodological limitations were pointed out that may have affected the generalizability of the results, such as recruitment bias, participant dropout, and inconsistent adherence to the procedures used, which require further investigation. Also recognized in the study was the possibility of improving the technology so that even a 12-chamber press therapy system could be used for more complicated or severe stages of lymphedema. Additional studies should include randomized controlled trials with even more patients to confirm these data and expand the application of the indicated system. These advancements offer the opportunity to effectively change the treatment of lymphedema and other related diseases and to develop appropriate solutions for different patient groups.

In this work, due to the complexity and broad meaning of such therapy, we have only considered pain reduction and swelling reduction as the simplified aim of the work.

Conclusion

This study confirms the feasibility of an eight-chamber sequential peristaltic lymphatic drainage system as an effective approach for the treatment of mild to moderate lymphedema. Not only was this system equivalent or superior to conventional therapies in terms of mobility restoration, fluid reduction and kinetic stability, but it also provided equivalent benefits as an alternative to conventional physical therapy, as demonstrated by the consistent and measurable results. Its ability to be used in the treatment of a wide range of conditions makes it a holistic form of therapy. Sustained technological breakthroughs and global implementation strategies could complement the capabilities of healthcare organizations so that quality care is possible and the desired results are achieved everywhere.

Ethical declarations

Competing interests: This study was exempt from ethical approval since it investigated the effect of a specific type of equipment, details of which were provided to the author by the hospital's internal supervisors.

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