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Clinical Outcomes of Shochwave Therapy in Lipedema

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Abstract

Background: Lipedema is a chronic condition whose public awareness and detection is constantly growing, yet without strongly validated therapeutic opportunities. **Objectives**: Given the need to direct lipedema patients toward appropriate management approaches and the demand for new studies and methods, this invetigation aimed to assess the effects of a combined treatment consisting of extracorporeal shock wave therapy (ESWT), manual lymphatic drainage (MLD), intermittent pneumatic compression (IPC), and lifestyle recommendations compared to a 5-week control period prior to treatment in patients with lipedema. **Methods**: Retrospective evaluation of patients undergoing a 5-week control period with lifestyle recommendations followed by a 5-week treatment period (10 sessions) with a standardized protocol including ESWT, MLD and IPC. Circumference measurements at three designated points on the lower extremities were recorded at the start and end of the control period, and before and after treatment. **Results**: Data from 55 female patients (age: 46.9 ± 11.9 years, body mass index [BMI]: 29.54 ± 7.33 kg/m²) who completed both the control and treatment periods were included. Analysis of measurement changes over time showed significant improvements in 3 of 6 measured points during the control period, with no significant changes at other levels. In contrast, significant improvements were observed at all levels after treatment ($p < 0.01$). **Conclusion**: The combined use of ESWT, MLD, IPC, and lifestyle recommendations was found to be an effective method for managing lipedema treatment. Further studies on the relative impact of each and everyone of these 3 therapeutic components are encouraged.

Keywords: lipedema; extracorporeal shock wave therapy; manual lymphatic drainage; intermittent pneumatic compression; lifestyle recommendations

1. Introduction

Lipedema is a chronic, progressive lymphatic disorder characterized by disproportionate subcutaneous fat accumulation [1–3]. Although its etiology remains unclear, hormones, genetic factors, inflammation, and dilated blood and lymphatic vessels are considered potential contributors to its pathogenesis [4]. This subcutaneous fat expansion, accompanied by lipid hypertrophy, is responsible for immune cell accumulation and extracellular matrix remodeling. These events trigger inflammation and pathogenic changes in vascular and lymphatic function, leading to interstitial fluid accumulation and expansion of the interstitial space [5].

Lipedema almost exclusively affects women, with a global prevalence ranging from 10% to 15% [1]. Initial symptoms and exacerbations often occur during hormonal transition periods [6].

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In lipedema, the hands, feet, head, neck, and trunk are typically spared, while symmetrical involvement is observed in the lower abdomen, hips, and lower and upper extremities [1]. This results in visually apparent body disproportion [5]. Pain is a hallmark symptom of lipedema. It may manifest superficially and/or subcutaneously during palpation. Although pain in lipedema is understudied and lacks a clearly defined pattern in the literature, pressure pain, spontaneous pain, tension, and heaviness are among the most frequently reported symptoms. Patients often exhibit hypersensitivity to touch and a tendency to bruise easily [6].

Due to the unclear pathophysiology of lipedema, no etiological treatment exists. Current approaches focus on symptom relief and complication prevention. Management typically involves surgical and conservative treatments [7,8], including patient education, complex decongestive therapy (manual lymphatic drainage, compression therapy, exercise, skin care), physical activity, liposuction, plastic surgery, diet, and psychotherapy. Additional approaches include shock wave therapy, deep oscillation therapy, intermittent pneumatic compression, aquatic therapy, pharmacological treatment, and kinesiotaping [7,9].

Exercise is known to significantly impact adipose tissue in lipedema patients. Increased adipose tissue leads to macrophage infiltration, causing chronic low-grade systemic inflammation. Conversely, moderate exercise has anti-inflammatory effects and stimulates lipolysis by enhancing fat oxidation. Moderate aerobic exercise increases opioid production, which is crucial for pain modulation, thereby reducing its levels. Exercise may also reduce edema in lipedema patients. Thus, increasing physical activity and establishing exercise habits are critical in lipedema management [9].

Weight gain consistently increases limb volume, but pain symptoms are not directly related to disproportion. However, diet can positively or negatively influence this condition. Concurrent obesity can reduce mobility and lead to comorbidities, worsening the overall condition. High insulin levels promote lipogenesis, sodium and water retention, and proinflammatory effects. Based on the hypothesis that pro- and anti-inflammatory factors may influence lipedema symptoms, some authors focus on inflammation management and recommend anti-inflammatory and/or ketogenic diets [7].

Manual lymphatic drainage (MLD) is a low-pressure, gentle, pumping, and circular massage technique designed to stimulate superficial lymphatic pathways. It is an effective method for reducing limb volume, alleviating lymphatic stasis, enhancing protein resorption, and opening lymphatic collaterals in lipedema patients [10,11].

Intermittent pneumatic compression (IPC) is a mechanical massage method using air-inflated cuffs to mimic MLD techniques and enhance lymphatic flow. Its effectiveness in reducing edema, pain, and capillary fragility in lipedema has been demonstrated in clinical practice and case series. One study reported that IPC reduced limb volume and improved painful symptoms [6]. Another study showed that IPC, when added to complex decongestive therapy, is a reliable and effective method for lipedema treatment [11].

Extracorporeal shock wave therapy (ESWT), used in lipedema for its lipid mobilization and lipolysis effects, is an easy-to-apply, non-invasive, side-effect-free local treatment. Its ability to reduce pain and inflammation in musculoskeletal conditions, support lymphatic flow through anti-inflammatory and antifibrotic properties, and smooth the skin by stimulating lipid mobilization and lipolysis supports its use in lipedema treatment. These effects are related to increased local perfusion via neoangiogenesis, enhanced blood flow and new cell delivery, improved local oxygenation, tissue trophism, and metabolic waste drainage [12].

Patient self-management skills are essential for effective lipedema management, as with other chronic conditions. Effective self-management plays a role in slowing the progression of the disease, improves symptoms, and enhances quality of life. Comprehensive patient education plays a critical role in disease management [13,14].

Based on this, the herein presents study aimed to investigate the effects of a comprehensive conservative approach—including ESWT, MLD, IPC, and lifestyle recommendations—compared to a 5-week control period with only lifestyle recommendations for proper disease management in lipedema patients.

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2. Materials and Methods

This study was approved by the Institutional Ethics Committee of the Faculty of Physical Therapy and Rehabilitation, Hacettepe University (Approval No: FTREK25/21/22.05.2025), and was conducted in accordance with the Declaration of Helsinki (1975, revised in 2013). Written informed consent was obtained from all participants.

The study population consisted of retrospective data from 55 female patients aged 18-60 years (46.9 ±11.9 years) who visited our unit between October 23, 2023, and February 21, 2025, diagnosed with lipedema, and completed the control period and combined treatment described below. Data from patients who did not complete the treatment were excluded. Patients with cardiovascular, renal, or pulmonary diseases, neoplastic conditions, chemotherapy, or recent surgical history were excluded.

At the start of the control period, patients were advised to increase physical activity levels and adopt an active lifestyle to address symptoms such as fatigue and muscle strength loss, and to support general health and weight control [5]. Using the Talk Test, patients were instructed on performing daily moderate-intensity physical activity/aerobic exercise (walking at a pace where conversation causes breathlessness) [15]. Patients were also educated on adopting a lipedema-appropriate diet and weight management to reduce body composition, pain, inflammation, and other lipedema-related symptoms. Although no specific, scientifically supported diet exists for lipedema, the goal is to reduce body weight with a hypocaloric diet and prevent systemic inflammation using antioxidant and anti-inflammatory foods. Compliance was closely monitored through regular follow-up visits and patient self-reporting. The primary expectation of patients presenting to the clinic is often a significant reduction in the circumference of their legs. Therefore, to avoid disappointment, patients were informed that the primary goal of dietary management is to alleviate symptoms such as pressure pain, hypersensitivity, and tension, rather than improving limb appearance [10,16]. Additional water consumption, beyond its basic functions, was explained to increase lipolysis and energy expenditure via sympathetic activation and thermogenesis, improving body composition [16]. Based on this, patients were advised to consume the recommended daily water intake of 30–40 mL/kg [17]. Compression garments, such as lipedema leggings, were recommended to enhance venous and lymphatic flow, minimize capillary filtration, support limb shape, increase mobility and functionality, facilitate movement, and reduce pain through anti-inflammatory effects [18]. These recommendations were communicated verbally to the patients, and they were encouraged to incorporate them into their daily lives through verbal reinforcement. Adherence to these recommendations was not assessed. They were invited for a follow-up after 5 weeks before starting the treatment protocol. This period has been used as a control period to be able make a comparison the effect of only diet and exercise and treatment protocol.

Circumference measurements of both lower extremities were taken at three points—proximal to the malleolar level, 10 cm distal to the inferior border of the patella, and 10 cm proximal to the superior border of the patella—at the start and end of the control period [10]. Measurements were taken using a non-elastic tape measure while the patient was in the supine position and recorded. All the measurements were performed by same physiotherapist.

After completing the control period, patients underwent a triple combined treatment protocol, consisting of 10 sessions over 5 weeks (twice weekly). Only cases completing both periods were included in the study. Treatment was administered in an outpatient setting without anesthesia or topical medications. The first phase, ESWT, used focused shock wave therapy (Modus ESWT Focused Shockwave Therapy, Ankara, Türkiye). Lower extremities were divided into anterior and posterior sections by an imaginary line. In one session, 6000 pulses were applied to the anterior section, and in the next session to the posterior section, at a frequency of 4 pulses/second, equivalent to 25 min sessions, with an average intensity of 0.23 mJ/mm² for the thigh and 0.18 mJ/mm² for the lower leg [12]. Subsequently, certified and an experienced physiotherapist applied MLD to the lower extremities for approximately 30 minutes using Földi techniques [19]. Patients then underwent 20

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minutes of IPC at a pressure setting of 50 mmHg (MK400L Intermittent Pneumatic Compression System, Republic of South Korea) [18].

Circumference measurements were taken and recorded at the same points before and after treatment, as done during the control period.

All these interventions are routinely provided to lipedema patients visiting the clinic.

After reviewing patient files, data from patients meeting the study criteria—age, height, pre- and post-treatment body weight, BMI, and lower extremity circumference measurements—were recorded in a data collection form. In accordance with data protection principles, no personally identifiable information such as patient names was recorded.

Statistical Analysis

Categorical data were reported as counts and percentages, while continuous data were described using means, standard deviations, medians, and minimum–maximum values. The paired t-test was used to assess mean differences between pre- and post-treatment measurements. Statistical significance was set at $p < 0.05$. Data analysis was performed using IBM SPSS 25 statistical software.

3. Results

The control and treatment outcomes of 55 female patients who met the study criteria were compared. Of these patients, 36 were diagnosed with stage II and 19 with stage III lipedema, all classified as type II or type III. The staging and typing were performed according to the S2K Guidelines of the German Society of Phlebology and Lymphology [20].

Evaluation of changes in body weight (kg) over time during the control and treatment periods showed statistically significant reductions in both body weight and BMI for both periods ($p < 0.001$) (Table 1).

Table 1. Evaluation of Body Weight Over Time During Control and Treatment Periods.

	Initial Control Mean±SD	Second Control Mean±SD	Pre-Treatment Mean±SD	Post-Treatment Mean±SD	p value*
Body weight (kg)	77.64±21.03	75.43±20.49	76.1±21.6	74.4±20.3	< 0.001

*Repeated ANOVA test, $p < 0.05$ significant, SD: Standard Deviation.

Analysis of lower extremity circumference measurements (cm) over time showed significant changes in 3 of 6 measured points during the control period, while significant improvements were observed at all points during the treatment period. Differences at all levels are presented in Table 2.

Table 2. Evaluation of Differences in Lower Extremity Circumference Measurements Over Time.

Level	Initial Control Mean±SD	Second Control Mean±SD	Pre-Treatment Mean±SD	Post-Treatment Mean±SD	p-value*	p-value† (1vs2, 3vs4)
Right Ankle (cm)	24.58 ± 3.35	24.64 ± 3.41	24.99 ± 3.13	24.34 ± 3.02	<0.001	0.99; 0.001
Left Ankle (cm)	24.86 ± 3.31	24.85 ± 3.44	25.32 ± 3.29	24.59 ± 3.06	<0.001	0.99; 0.001
Right Below Knee (cm)	43.46 ± 7.99	42.53 ± 7.92	42.74 ± 7.05	41.42 ± 6.91	0.002	0.001; 0.001
Left Below Knee (cm)	43.72 ± 8.06	41.89 ± 9.39	42.88 ± 6.89	41.49 ± 6.74	0.02	0.09; 0.001
Right Above Knee (cm)	55.31 ± 8.91	53.14 ± 9.11	51.53 ± 9.63	49.72 ± 9.41	<0.001	0.001; 0.001

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Left Above Knee (cm)	55.40 ± 8.59	53.53 ± 8.87	51.42 ± 9.65	49.72 ± 9.62	<0.001	0.001; 0.001

*Repeated ANOVA test, †Post-hoc test Bonferroni, $p < 0.05$ significant, SD: Standard Deviation, 1: Initial Control, 2: Second Control, 3: Pre-Treatment, 4: Post-Treatment. Ankle: Proximal to the malleolar level (cm). Below Knee: 10 cm distal to the inferior border of the patella (cm). Above Knee: 10 cm proximal to the superior border of the patella (cm).

Additionally, all patients subjectively reported a significant reduction in pre-treatment pain and sensitivity post-treatment. However, these were not evaluated objectively. They described their legs as feeling lighter, improved mobility, and reduced wavy appearance, particularly in the thighs. No treatment-related side effects were reported during the treatment period.

4. Discussion

This study found that the control period, which involved only lifestyle recommendations, significantly improved BMI but did not result in significant differences in lower extremity circumference measurements at all levels.

In contrast, the combined treatment—consisting of ESWT, MLD, IPC, and lifestyle recommendations—demonstrated positive improvements in both BMI and all measured circumference levels.

Although lipedema lacks a definitive treatment and is considered incurable by some authors, the primary goal of treatment is to improve psychosocial status, reduce symptoms, enhance quality of life, and prevent secondary complications [9,21]. Adipose tissue in lipedema is known to be resistant to exercise and diet. While exercise and dietary adjustments are crucial in lipedema management, they are often insufficient alone [9]. Our study demonstrated that lifestyle recommendations alone (exercise, diet, compression garments) resulted in less improvement compared to the combined treatment incorporating ESWT, MLD, and IPC.

ESWT is reported as a method to address resistant adipose tissue due to its lipid mobilization and lipolysis effects. Numerous studies have reported its analgesic and anti-inflammatory effects, which result from increased local perfusion via neoangiogenesis, improving tissue trophism, local oxygenation, and metabolic waste drainage. Siemes et al. (2005) first demonstrated the antifibrosclerotic effects of ESWT in lipedema patients, showing improved biomechanical skin properties. Both human and animal studies have confirmed ESWT's effects on adipose tissue. In lipedema, ESWT is used to target adipose tissue, reduce pain and inflammation, and smooth and improve skin appearance [12].

Given the slowed lymphatic flow in lipedema, compression therapies are another essential component of treatment [14] MLD is a specialized manual therapy designed to accelerate and direct lymphatic flow, potentially reducing pressure sensitivity and pain in lipedema patients [22]. IPC, which produces similar outcomes to MLD, regulates lymphatic flow [11].

Patient education is a critical component of managing chronic conditions. Adequate education on disease onset, progression, and factors exacerbating or alleviating symptoms enables better disease control and improved quality of life [13,14]. The literature contains few studies on combined and comprehensive approaches to lipedema treatment [9,10,12,19]. This pilot study investigated the efficacy of a combination of treatment approaches and demonstrated its effectiveness. According to patients' verbal feedback, the intensive protocol itself enhances their motivation to adhere to the given recommendations and contributes to the development of self-discipline.

Volkan-Yazıcı et al. (2021) examined the effects of complex decongestive therapy (CDT) and IPC on lower extremity circumference and volume in lipedema patients. They also incorporated walking and post-treatment medical compression stockings. Their study found significant differences in lower extremity circumference and volume measurements. However, as these interventions are superficial, additional methods are needed to mobilize lipedema tissue more deeply. In this context, ESWT, with

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its deeper penetration, is a safe method for reducing fibrotic restrictions and improving the interstitial space [19].

Michelini et al. (2023) investigated the effects of a combined treatment involving shock wave therapy, mesotherapy, and kinesiotaping in lipedema patients. The study found significant improvements in lower extremity circumference and subcutaneous adipose tissue ultrasound thickness, with a positive correlation between these measurements, confirming the treatment's effect on adipose tissue. Additionally, pain reduction highlighted ESWT's desensitization effect. Patients were reassessed after 6 months to observe long-term effects [12]. Similarly, we planned to evaluate the long-term effects of our study.

An example of ESWT use in lipedema is Bruno et al.'s (2025) study, which, unlike our study, used ESWT post-surgery, focusing on postoperative fibrous tissue. They reported significant improvements in pain, fibrosis severity, and patient satisfaction [23].

Physical activity and dietary patterns applied in individuals with lipedema are known to produce varying effects on lower extremity circumferential measurements. A limitation of our retrospective analysis is the inability to control patients' adherence to lifestyle recommendations, such as physical activity and diet, as well as symptoms such as pain and tenderness. However, the study's contribution of an effective treatment combination to the literature is significant. Although a satisfaction survey was not conducted due to the retrospective design, all patients reported satisfaction with the treatment at the end of the sessions and noted improvements in pain and sensitivity.

Surgical interventions such as liposuction, commonly employed in the treatment of lipedema, are associated with high costs and are not reimbursed by public health insurance systems in most countries [24]. Furthermore, the evidence regarding the long-term efficacy of liposuction remains limited and heterogeneous, with no clear consensus on its sustained clinical benefit. In contrast, the therapeutic approach utilized in our study is characterized by its non-invasive nature, low complication risk, and comparatively more accessible cost [12]. Moreover, extracorporeal shock wave therapy (ESWT) has also been reported to be effective in reducing postoperative pain, fibrosis, and edema following liposuction procedures [23]. These findings support the consideration of ESWT not only as a component of conservative treatment strategies but also as a cost-effective complementary modality in the multidisciplinary management of lipedema. In addition to this, bariatric treatment is not recommended for patients not meeting specific criteria due to potential risks, increasing interest in conservative approaches. However, the literature also lacks sufficient data on the effects of conservative approaches [7].

This study has several limitations inherent to its retrospective and observational nature. First, although some patients reported symptomatic relief such as pain reduction, pain-related outcomes were not systematically recorded, as the study was initially designed to evaluate circumferential changes rather than subjective parameters. Second, although the combined protocol included ESWT, manual lymphatic drainage (MLD), and intermittent pneumatic compression (IPC), it was not possible to isolate the individual effects of each modality. Future randomized trials should consider evaluating these modalities separately or in varying combinations.

Third, although patients were given specific instructions on diet, fluid intake, and activity during the lifestyle modification phase, the degree of adherence to all components was not objectively documented in a standardized manner. However, dietary compliance was closely monitored through follow-up and verbal confirmation.

Finally, the short-term follow-up period limits the ability to assess long-term outcomes such as recurrence, tissue fibrosis, or quality-of-life changes. Prospective studies with extended follow-up and validated patient-reported outcome measures (PROMs) are warranted to build on the preliminary findings presented here.

Our study is significant as it is, to our knowledge, the first to examine the effects of a comprehensive conservative treatment approach (ESWT, MLD, IPC, and lifestyle recommendations) in lipedema. This method is easy to apply, non-invasive, conservative, side-effect-free, and

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multidisciplinary. However, given lipedema's chronic nature, treatment options should be reassessed based on clinical progression, emphasizing its increasingly recognized psychosocial aspects. Conducting the study with a controlled diet and exercise program and objectively monitoring symptoms could further clarify ESWT's role. Further a prospective multicenter, larger cohort, and longer follow up study are needed.

5. Conclusions

The results of our study indicate that a comprehensive combined treatment protocol consisting of ESWT, MLD, IPC, and lifestyle recommendations is an effective method for managing lipedema.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Research Ethics Committee of the Faculty of Physical Therapy and Rehabilitation, Hacettepe University (FTREK25/21).

Informed Consent Statement: Not applicable.

Data Availability Statement: The datasets generated during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

BMI	Body Mass Index
cm	Centimeter
ESWT	Extracorporeal Shock Wave Therapy
IPC	Intermittent Pneumatic Compression
m	Meter
mJ	Millijoule
mL	Milliliter
MLD	Manual Lymphatic Drainage
mm	Millimeter
mmHg	Millimeters of Mercury
kg	Kilogram
p	p-value
SD	Standart Deviation

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