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The Effect of Complex Decongestive Therapy on Physical Performance, Balance, Muscle Strength and Mood in Patients with Lower Extremity Lymphedema

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Abstract

Purpose: We aimed to investigate the effects of complex decongestive therapy (CDT) on physical performance, balance, muscle strength and mood in patients with lower extremity lymphedema.

Methods: Twenty female patients diagnosed with lower extremity lymphedema were included. Therapy was applied once a day, 5 days a week, for 4 weeks. Sessions lasted approximately 60 minutes. All measurements and evaluations were recorded before and after therapy.

Results: A significant difference was found between healthy and affected circumferential measurements. Mean of timed up and go test 6.70±1.71 before the treatment and 6.15±1.56 after the treatment, the difference was significant. The mean of standing on one leg was 8.31±5.16 before treatment and 9.2±6.20 after treatment, difference was not significant. Before treatment, there was no significance between hip flexion, hip extension, knee flexion and plantar flexion muscle strength values in healthy extremities and in affected extremities. The number of participants classified as non-depressed was 4 before therapy but 8 after therapy. 9 people were mildly depressed before therapy, this number decreased to 7 after therapy. Before and after the therapy, 4 people were evaluated as moderately depressed. Number of patients with severe depression was 3 before therapy, but decreased to 1 after therapy.

Conclusion: Complex decongestive therapy is a standard treatment method for lymphedema. We suggest that CDT had beneficial and curative effects on physical performance, balance, muscle strength and depression parameters in our patients.

Keywords: lymphedema, CDT, physical activity, muscle strength, balance, mood

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Alt Ekstremite Lenfödemli Hastalarda Kompleks Dekonjestif Tedavinin Fiziksel Performans, Denge, Kas Gücü ve Duygudurum Üzerine Etkisi

Öz

Amaç: Alt ekstremite lenfödemli hastalarda kompleks dekonjestif tedavinin (KDT) fiziksel performans, denge, kas gücü ve ruh hali üzerine etkilerini araştırmayı amaçladık.

Yöntemler: Alt ekstremite lenfödem tanısı alan 20 kadın hasta çalışmaya dahil edildi. Terapi 4 hafta boyunca haftada 5 gün, günde bir kez uygulandı. Oturumlar yaklaşık 60 dakika sürdü. Tedavi öncesinde ve sonrasında tüm ölçüm ve değerlendirmeler kaydedildi.

Bulgular: Sağlıklı ve etkilenen çevresel ölçümler arasında anlamlı fark bulundu. Tedavi öncesinde 3 metre kalk ve yürü testi ortalaması 6,70±1,71 iken tedavi sonrasında 6,15±1,56 olup aradaki fark anlamlıydı. Tek ayak üzerinde durma ortalaması tedavi öncesinde 8,31±5,16 iken tedavi sonrasında 9,2±6,20 olup fark anlamlı değildi. Tedavi öncesi sağlıklı ekstremitelerde ve etkilenen ekstremitelerde kalça fleksiyon, kalça ekstansiyon, diz fleksiyon ve plantar fleksiyon kas kuvveti değerleri arasında anlamlılık yoktu. Terapiden önce depresyonda olmayan katılımcı sayısı 4 iken tedavi sonrasında 8'di. Tedavi öncesi 9 kişi hafif depresifti, tedavi sonrasında bu sayı 7'ye düştü. Terapi öncesi ve sonrasında 4 kişi orta derecede depresyonlu olarak değerlendirildi. Şiddetli depresyonu olan hasta sayısı tedavi öncesinde 3 iken tedavi sonrasında 1'e düştü.

Sonuç: Kompleks dekonjestif tedavi lenfödem için standart bir tedavi yöntemidir. Hastalarımızda KDT'nin fiziksel performans, denge, kas gücü ve depresyon parametreleri üzerinde yararlı ve iyileştirici etkilerinin olduğunu düşünüyoruz

Anahtar kelimeler: Lenfödem, KDT, Fiziksel Aktivite, Kas Gücü, Denge, Duygu Durum.

INTRODUCTION

Lymphedema is a progressive disease characterized by edema resulting from inadequate drainage of the lymph fluid and accumulation of protein-rich fluid in the interstitial space, and over time, chronic inflammation at the tissue level and reactive fibrosis[1]. More than 250 million people worldwide are affected by lymphedema, which occurs in the upper and lower extremities and sometimes in other parts of the body, caused by the accumulation of lymphatic fluid in the interstitial tissue. Lymphedema is examined in two classes, primary and secondary, according to its underlying etiology. Lymphedema causes fatty tissue, fibrosis and skin changes. Patients often complain of tension, heaviness, restlessness and stiffness. Lymphedema is generally painless, but chronic inflammation, tumor or neurological disorders, or skin tension occurring in the early stages of lymphedema may cause pain[2]

The quality of life in people with lymphedema is greatly affected by swelling, pain, numbness, fatigue, depression, limited daily and social activities, and swollen limbs, causing the person to have an inability to perform daily living activities[3]. Lymphedema causes functional impairment, increases body weight, promotes the development of skin and subcutaneous tissue infections, and negatively affects the patient's psychology and self-perception, thus reducing the patient's quality of life[4].

In the treatment of lymphedema, physical therapy should be tried first. The first step of the treatment is to bring the extremity to near-normal dimensions and prevent possible complications because there is no cure for lymphedema[5]. According to the declaration published by the International Lymphology Association in 2016, Complex Decongestive Therapy is the most effective and evidence-

based practice in the treatment of lymphedema[6].

Complex decongestive therapy is a set of practices and includes[7]: Manual lymph drainage (MLD), Multi-layer bandaging, Skin care, Physical exercise, Long-term education on self-management of lymphedema and compression stockings.

Lower extremity lymphedema is a chronic condition that negatively impacts individuals' quality of life, leads to functional limitations, and reduces physical activity levels. CDT is considered one of the most common and effective treatment approaches in lymphedema management. However, CDT's effectiveness not only in reducing edema but also in patients' physical performance, balance skills, muscle strength, and psychological state deserves further investigation. Therefore, the aim of our study was to evaluate the effects of CDT on physical performance, balance, muscle strength, and mood in individuals with lower extremity lymphedema.

METHODS

This study included 20 patients diagnosed with lymphedema who applied for lymphedema treatment at Dicle University Faculty of Medicine Physical Therapy and Rehabilitation Clinic between 01 April 2022 and 31 December 2022, met the study criteria and volunteered to participate in the study. This study was approved and certified by Dicle University Faculty of Medicine Ethics Committee (14.04.2022/110). All patients included in the study were included in the study after signing the voluntary consent form. Inclusion criteria are as follows: being female, being between the ages of 20-60, being diagnosed with lower extremity unilateral lymphedema, and patients agreeing to participate in the study.

Presence of recent metastatic disease, participants refusing to participate in the study, patients diagnosed with severe heart failure, renal dysfunction, presence of acute infection, malignant prognosis, presence of uncontrolled diabetes, deep vein thrombosis, acute bronchitis and bronchial asthma, presence of liver cirrhosis or liver disease, neurological Conditions such as the presence of diseases were excluded from the study.

Information about the participants who accepted the study and met the inclusion criteria was recorded in the evaluation form at the first session of the treatment. Circumference measurement of healthy extremities and extremities with lymphedema, timed up and go test among physical performance tests, standing on one leg test for balance and 30 sec stand-sit test on a chair, isometric muscle strength test with dynamometer for muscle strength measurement, Beck Depression Questionnaire evaluations for emotional states was made and recorded.

Personal information and clinical characteristics of the patients were recorded in the evaluation form. First, circumference measurements were taken while the subjects were in a semi-sitting position. Measurements were made with the foot and ankle in a neutral position and the knee in a straight position. The measurement locations for circumference measurements MTFE: Above the metatarsophalangeal joint, AJ: Ankle Joint, GM: Gastrocnemius muscle at its swollen point, FH: Fibula Head circumference, KJ: Knee joint, MT: Mıddle Thıgh, T: Thıgh. Values were recorded in cm. Healthy and diseased extremity measurements were evaluated before and after treatment.

To determine the physical performance of the subjects, the timed up and go test was applied. This test applied to the patients aims to evaluate dynamic balance, walking speed and mobility[8]. A chair was determined and a 3-meter area was marked, and the participant was asked to get up from the chair he was sitting in, walk the 3-

meter area and sit on the chair again. The obtained time value was recorded.

Balance assessment was performed by standing on one leg and doing a sit-to-stand test on a chair for 30 seconds. One-leg standing test (TAST) was applied to evaluate static balance. The subjects were asked to stand on one leg without touching their legs on the ground, look straight ahead and maintain this position for 30 seconds. The test performed on the affected leg was repeated before and after treatment[9]. Dynamic balance was evaluated with a 30-second Sit-Stand Test (OCT). The subjects were asked to stand up and sit from a 45 cm high flat chair with their arms aligned on the chest for 30 seconds. The number of times you stood up and sat down constituted the total score[10].

Isometric muscle strength was measured with a Jamar brand hand dynamometer. The handheld dynamometer has good to excellent reliability and validity for most measurements of isometric lower extremity strength and power, particularly for proximal muscle groups[11].

The emotional states of the participants were evaluated with the Beck depression scale (BDI). BDI is a survey whose validity and reliability studies have been conducted. The survey aimed to express the patients' emotional states numerically and evaluate the effect of the applied treatment on the patients' mental states. BDI consists of 21 questions. Each question is scored from 0 to 3. A total score of 0-9 is defined as normal, 10-16 as light depression, 17-29 as middle depression, and 30-63 as severe depression[12].

After the initial evaluations were made, the treatment program was started. The first phase of the complex decongestive therapy applied to the patients was planned for a total of four weeks, five days a week. Each session lasted approximately 60 minutes. The treatment included manual lymphatic drainage, short-stretch bandaging, resistive lower extremity exercises with bandages, and skin care treatments. All treatments were performed by an experienced physiotherapist. All measurements and evaluations were performed twice by the same physiotherapist, before the treatment and at the end of the treatment at the end of 4 weeks.

Statistical Analysis

Analyzes were evaluated in 22 package programs of SPSS (Statistical Package for Social Sciences; SPSS Inc. Chicago, IL). In the study, descriptive data consists of n, % values from categorical data; In continuous data, it was expressed as mean±standard deviation (mean±SD) values and median values (min-max). The normality of the variables was assessed using the Kolmogorov-Smirnov test. In comparing dependent groups, Paired Sample-T test was applied to variables with normal distribution, and Wilcoxon test was applied to variables that did not show normal distribution. In statistical evaluations, $p \leq 0.05$ level was considered significant.

RESULTS

The mean age of all participants was 40.50±12.13 years, mean height was 160.20±7.82 cm, mean body weight was 76.65±18.20 kg and body mass index (BMI) was 30.37±9.30 kg/m^2 (Table 1).

Table I: Demographic Characteristics of the Participants

N=20	MEAN±SD
Age(year)	40.50±12.13
Height (cm)	160.20±7.82
Body Weight (kg)	76.65±18.20
BMI(kg/m²)	30.37±9.30

The lymphedema type, affected extremity, dominant extremity and smoking status of the participants are shown in Table 2.

Table II: Demographic Information of Participants

		N	(%)
LymphedemaType	Primer	11	(%55)
	Sekonder	9	(%45)
Extremity with lymphedema	Right	11	(%55)
	Left	9	(%45)
Dominant Extremity	Right	18	(%90)
	Left	2	(%10)
Smoking Condition	Yes	5	(%25)
	No	15	(%75)

Circumference measurements taken from the healthy and affected extremities before treatment are given in Table 3. When extremity circumference values were compared at MTFE, AJ, GM, FH, KJ, MT, T points, a significant difference was detected (p <0.001).

Table III: Comparison of Circumference Measurement Values of Healthy Extremity and Affected Extremity Before Treatment

	Healthy Extremity B.T		**Lymphedema Extremity B.T**		
Measurement Points	(MEAN±SD)	**Median Min-Max**	(MEAN±SD)	**MedianMin-Max**	P
MTFE	22.07±1.85	21.50(19-25)	23.87±1.57	23.25(21-27)	<0.001*[a]
AJ	23.77±3.74	2250(19-33)	27.97±3.59	26.50(25-39)	<0.001*[a]
GM	33.62±6.87	33.50(26-51)	37.67±7.09	36.50(29-58)	<0.001*[a]
FH	38.82±8.51	37.25(29-54)	42.20±7.87	38.50(32-55)	<0.001*[a]
KJ	41.10±8.08	36.75(33-55)	43.72±7.84	41(34-57)	<0.001*[b]
MT	47.90±7.53	46.50(39-61)	51.47±8.62	49.25(41-69)	<0.001*[b]
T	56.02±8.10	53(48-73)	59.77±8.79	57(51-78)	<0.001*[b]

P<0,001, MTFE: Above the metatarsophalangeal joint, AJ: Ankle Joint, GM: Gastrocnemius muscle at its swollen point, FH: Fibula Head circumference, KJ: Knee joint, MT: Mıddle Thıgh, T: Thıgh B.T: Before Treatment (a Paired Sample-T test) (b Wilcoxon Test)*

Circumference measurement values of the affected extremity before and after treatment are shown in Table 4. According to these values, it was determined that there was a significant decrease in MTFE, AJ, GM, FH, KJ, MT, T from the measurement points taken after treatment compared to before treatment (P <0.001).

Table IV: Comparison of Circumference Measurement Values of the Affected Extremity Before and After Treatment

	Before Treatment		**After Treatment**		
Measurement Points	(MEAN±SD)	**Median Min-Max**	(MEAN±SD)	**Median Min-Max**	P
MTFE	23.87±1.57	23.25(21-27)	22.82±1.63	22.25(20-25)	<0.001*[a]
AJ	27.97±3.59	26.50(25-39)	25.15±3.19	24.25(22-34)	<0.001*[a]
GM	37.67±7.09	36.50(29-58)	35.20±6.80	35(26-53)	<0.001*[a]
FH	42.20±7.87	38.50(32-55)	39.72±7.92	37.50(31-54)	<0.001*[a]
KJ	43.72±7.84	41(34-57)	41.90±8.01	38.50(32-56)	<0.001*[b]
MT	51.47±8.62	49.25(41-69)	49.60±8.37	48(39-63)	<0.001*[b]
T	59.77±8.79	57(51-78)	57.60±8.46	54.50(49-75)	<0.001*[b]

P<0.001, (a Paired Sample-T test) (b Wilcoxon Test)*

A statistically significant difference was found in the timed up and go test after treatment compared to before treatment (p<0.05). The mean score of 30 sec stand-sit test increased statistically significantly after treatment (p<0.05). Although the one-leg standing test increased after treatment compared to before treatment, it was not statistically significant (p>0.05) (Table 5).

Table V: Comparison of Timed up and go test, dynamic and static balance test values before and after treatment

	Before Treatment		After Treatment		
	(MEAN±SD)	Median Min-Max	(MEAN±SD)	Median Min-Max	P
Timed up and go test	6.70±1.71	6.50(4-10)	6.15±1.56	6.50(3-8)	0.030*
30 sec stand-sit test (n)	14.95±5.78	14.50(6-30)	16.70±5.54	15.50(8-33)	0.002*
One leg standing test (sec)	8.31±5.16	6.5(2-19)	9.2±6.20	7(3-23)	0.286

*Paired Sample-T test (*P<0.05)*

Before treatment, no significant relationship was found between the hip flexion, hip extension, knee flexion and plantar flexion muscle strength values of the healthy extremity and the affected extremity (p≥0.05). However, a significant relationship was found between knee extension and ankle dorsiflexion (p≤0.05) (Table 6).

Table VI: Muscle Strength Measurement Values of Healthy and Affected Extremities Before Treatment

(n=20)	Healthy Extremities B.T (MEAN±SD)	Affected Extremities B.T (MEAN±SD)	P
Hip Flexion	15.55±4.05	15.50±4.71	0.883
Hip Extension	15,80±4.20	15.40±4.53	0.372
Knee Flexion	17.25±5.13	17.00±4.42	0.719
Knee Extension	18.80±4.22	17.20±3.38	0.046*
Ankle Dorsiflexion	18.50±4.38	17.45±3.77	0.029*
Ankle Plantar Flexion	19.30±4.04	19.80±4.17	0.525

*Paired Sample-T test (*P<0.05)*

After treatment, hip flexion, knee extension and dorsiflexion muscle strength increased significantly compared to before treatment (p≤0.05) (Table7).

Table VII: Muscle Strength Values of the Affected Extremity Before and After Treatment

	Before Treatment (MEAN±SD)	After Treatment (MEAN±SD)	P
Hip Flexion	15.50±4.71	16.25±4.36	0.018*
Hip Extension	15.40±4.53	15.50±4.61	0.876
Knee Flexion	17.00±4.42	17.50±4.24	0.126
Knee Extension	17.20±3.38	18.50±3.72	0.001*
Ankle Dorsiflexion	17.45±3.77	18.25±4.41	0.049*
Ankle Plantar Flexion	19.80±4.17	19.50±3.91	0.734

*Paired Sample-T test (*P<0.05)*

It was observed that there was a significant decrease in the severity of depression after treatment (p≤0.01) (Table 8).

Table VIII: Beck Depression Test Values Before And After Treatment

Beck Depression	Before Treatment N (%)	After Treatment N (%)	P
Normal	4 (%20)	8 (%40)	0.002
Light	9 (%45)	7 (%35)	
Middle	4 (%20)	4 (%20)	
Severe	3 (%15)	1 (%5)	

DISCUSSION

Lymphedema results from disruption of the lymphatic system and results in progressive swelling due to the accumulation of protein-rich fluid in the interstitial spaces. Lymphedema causes problems such as swelling, pain, numbness, fatigue, depression, and limitation in daily and social activities. These problems greatly negatively affect the quality of life[13].

Obesity is another risk factor for lymphedema. It has been reported that obesity is not only a risk factor but also negatively affects lymphedema[14]. It is known that increased

adipose tissue causes lymphatic vessel dysfunction and decreased lymphatic flow, especially in the proximal areas, increasing the risk of lymphedema development. In our study, the average body mass index (BMI) was found to be 30.37 kg/m2, and this is consistent with the literature showing that being overweight is a risk factor.

Volume and circumference measurement methods are generally used in the diagnosis and follow-up of lymphedema patients. The circumference measurement method is used in most studies to evaluate the severity of lymphedema and the results of treatment[15]. In our study, CDT was applied to 20 patients with lower extremity lymphedema, for a total of 20 sessions over 4 weeks. Extremity cicumference values were made from MTFE, AJ, GM, FH, KJ, MT, T points. A statistically significant decrease was detected at all measurement points before and after treatment ($p<0.001$).

Our results are consistent with findings from previous studies. Michopoulos et al. reported that 4 weeks of decongestive therapy resulted in a reduction in extremity volume between 296 and 1038 mL, depending on the stage of lymphedema[16].

In a study evaluating 105 patients, a total of 20 sessions of treatment were applied to the patients over a period of 4 weeks, and at the end of the study, it was stated that there was a statistically significant decrease in the volume of the lymphedematous upper (31.4%) and lower (68.6%) extremities before and after treatment[17].

Lymphedema is a chronic disorder and as it progresses, the volume of the extremities increases and becomes more severe. The weight of the extremity restricts joint movement and seriously affects daily life functions. Along with lymphedema accompanied by muscle weakness, structural and functional abnormalities have been observed in the hip, knee and ankle joints. There is a change in the center of gravity of patients with lymphedema, and patients cannot generate the necessary muscle strength to control this change. It has been reported that as lymphedema decreases, the risk of falling and postural sway during walking will decrease[18].

Functional capacity is often diminished in patients with lower limb lymphedema. In our study, we assessed this using the Timed Up and Go (TUG) test, a standard clinical tool for evaluating mobility, balance, and walking speed[19]. After treatment, patients showed significant improvement in TUG performance. Previous research also supports that physical performance tends to be impaired in lymphedema patients, particularly among women with cancer-related conditions[20].

Another tool used to evaluate leg strength, endurance, and dynamic balance is the 30-second chair sit-to-stand test[21]. In our study, this test also showed significant improvement after CDT. This aligns with existing literature which highlights the value of combining CDT with exercise programs. One study that compared CDT alone to CDT plus aerobic exercise found improvements in both groups, but greater progress was observed in the group that received aerobic training[22].

Recent meta-analyses suggest that both static and dynamic balance are adversely affected in patients with lymphedema, especially those recovering from breast cancer[23]. These patients often have reduced ability to stand on one leg, and shifts in body weight due to asymmetrical fluid accumulation contribute to postural instability[24]. Some research even found that patients tend to lean more toward the lymphedematous side, further destabilizing balance. However, results on balance improvement post-treatment are mixed[25].

In our study, although the one-leg standing test increased before treatment compared to post-

treatment, it was not statistically significant. Conflicting results in the literature vary depending on the number of patients included, the EBM application performed, and whether the exercises given are effective or not.

Lower limb lymphedema is often more complex than upper limb forms due to greater volume of swelling and restricted movement. This inactivity leads to muscle deconditioning and altered walking patterns[26]. Multiple studies have shown that CDT and exercise can improve muscle strength, particularly in the quadriceps, hamstrings, dorsiflexors, and evertors of the affected leg[25,27,28]. In our study, muscle strength was assessed with an isometric handheld dynamometer. Before treatment, the quadriceps femoris and tibialis anterior muscles on the affected side were significantly weaker than those on the healthy side. After completing CDT, strength in hip flexors, knee extensors, and ankle dorsiflexors improved significantly. Other muscle groups showed no statistically significant changes. These improvements may be attributed to reduced swelling, which allows better muscle activation and joint mobility. Decongestive exercises likely enhanced lymphatic return and increased the efficiency of the muscle pump, thus supporting overall functional gains.

Beyond physical symptoms, lymphedema also impacts emotional well-being. Heaviness and limited mobility often cause frustration and mood disturbances[29]. In our study, depression levels were measured using the Beck Depression Inventory. Results showed a statistically significant improvement in mood after treatment. This may be due to increased independence and activity levels following CDT.

Overall, Complex Decongestive Therapy has been shown to be an effective treatment for improving not only edema but also balance, strength, functional mobility, and emotional well-being.

This study has several limitations. First, the relatively small sample size limits the generalizability of the results. Furthermore, due to the short follow-up period, long-term effects of treatment could not be assessed. Future multicenter studies with larger samples and longer follow-up periods may provide more comprehensive results.

Ethical approval: This study was approved and certified by Dicle University Faculty of Medicine Ethics Committee (14.04.2022/110).

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