

ORIGINAL ARTICLE

Effects of mechanical massage, manual lymphatic drainage and connective tissue manipulation techniques on fat mass in women with cellulite

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Supported by Hacettepe University, Department of Scientific Researches, Research Project.

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Abstract

Objective To evaluate and compare the effectiveness of three different noninvasive treatment techniques on fat mass and regional fat thickness of the patients with cellulites.

Methods Sixty subjects were randomized into three groups. Group 1 ($n = 20$) treated with mechanical massage (MM), group 2 ($n = 20$) treated with manual lymphatic drainage (MLD) and group 3 ($n = 20$) treated with connective tissue manipulation (CTM) techniques. Subjects were evaluated by using standardized photographs, body composition analyzer (TBF 300) (body weight (BW), body mass index (BMI), fat %, fat mass (FM), fat free mass (FFM), total body water (TBW)), circumference measurement from thigh, waist-hip ratio (WHR), fat thickness measurements from abdomen, suprailium and thigh regions with skin fold caliper.

Results All groups had an improvement in thinning of the subcutaneous fat after the treatment ($P < 0.05$). Thigh circumference decreased by an average of 0.5 cm in all groups and thigh fat thickness decreased 1.66 mm in Group 1, 2.21 mm in Group 2 and 3.03 mm in Group 3. Abdomen and suprailium fat thicknesses decreased 2.4 and 2.58 mm in Group 1, 1.78 and 2 mm in Group 2 and 1.23 and 0.64 mm in Group 3, respectively. The mean difference in waist-hip ratio was 0.1 cm in all groups.

Conclusion All the treatment techniques are effective in decreasing the regional fat values of the patients with cellulites.

Received: 23 March 2009; Accepted: 25 May 2009

Keywords

cellulite, treatment, women's health

Conflicts of interest

None declared.

Introduction

Cellulite (gynoid lipodystrophy) is the non-inflammatory pathology of subcutaneous cells affecting over 80% of post-pubertal females. It is localized frequently on the thigh and buttock regions characterized by the 'orange peel' appearance.^{1,2} Deposition of excessive fat is the result of ingestion of foods which are not utilized by the body. The excessive calories taken with carbohydrates, lipids and proteins are stored and metabolized in fat cells or adipocytes.³ Deposition of excessive fat may result in abnormalities in the function of hormones which decrease the levels of lipolytic enzymes or enzymatic functions. Adipocytes are localized in the fibrillary network of the connective tissue between the superficial dermal layer and muscle fibers.⁴ In this condition, the venous and lymphatic stimulation will be decreased along the macromolecules

which embrace the lymphatic transport. As a result, fluid is accumulated within the dermal and subcutaneous tissues.

The presence of large amounts of alpha 2 and beta adrenergic receptors in the hips and thighs of women make the elimination of fat particles deposited in these regions difficult. Also, reduced local blood flow in those specific fat areas (thighs and hips) is another etiological factor of cellulite.⁵ The volume of fat increases with the accumulation of tissue fluids and fat makes protrusions. The reasons for the formation of cellulite include genetic factors, hormonal disturbances, and disturbances of lymph and blood circulation, dietary habits, psychological factors, pregnancy, sedentary lifestyle and alcohol.^{6,7} Cellulite is a condition which occurs due to different causes, constitutes an important problem for women and little has been searched for noninvasive treatment.^{3,4,8}

Table 1 Physical characteristics of the patients (ANOVA)

Parameters	Group 1 X ± SD	Group 2 X ± SD	Group 3 X ± SD
Age (year)	43 ± 7.38	42.08 ± 11.08	40.53 ± 7.37
Height (cm)	161.46 ± 6.77	165.06 ± 6.07	161.06 ± 4.09
Body weight (kg)	62.98 ± 6.56	68.01 ± 9.7	62.28 ± 8.54
Body mass index (kg/m ²)	24.16 ± 2.29	25.02 ± 3.75	24.00 ± 3.10
N	20	20	20

**P* < 0.05, significance level.

Different treatment techniques including application of liposuction as an invasive surgery and endermologie, mesotherapy, carboxytherapy and laser or radiofrequency and infrared light techniques as noninvasive or minimally invasive methods have been employed with a little evidence that any of these therapies are effective in cellulite.^{2–4,9–13}

This study was designed to determine the effectiveness of mechanical massage, manual lymphatic drainage and connective tissue manipulation techniques, and compare their effects on fat mass and regional fat thickness in patients with cellulites.

Materials and methods

This study was carried out on 60 women over the age of 30 with the cellulite diagnosis of grade ≥ 2 according to Nurnberger and Muller classification.¹⁴ The subjects participated in a 5-week trial. Table 1 shows the physical characteristics of the patients. Exclusion criteria were cardiac disease, hepatic disease, pregnancy, hyperthyroidism, haematologic disorders, aminophylline/theophylline therapy, varicose veins, dieting/recent weight loss, liposuction or other surgery to thighs/buttocks. Sixty cases were randomly stratified into three groups and the first group (*n* = 20) was treated with mechanical massage (MM) technique, the second group (*n* = 20) with manual lymphatic drainage (MLD) technique and the third group (*n* = 20) with connective tissue manipulation (CTM) technique. They were asked to maintain their normal lives and not to attend any exercise or diet programmes that will change their weight. All subjects provided written informed consent for participation.

Assessments were done at the same menstrual cycles (luteal phase) and at the same time of the day before and after treatment. Treatments were done at the same time of the day and we disregarded menstrual cycles.

The following assessments were carried out in the clinic before and after treatment:

Body weight (BW), body mass index (BMI), the percentage of fat (% Fat), fat mass (FM) and total body water (TBW) were obtained from TBF-300 (Tanita Corp., Japan) body composition analyzer. Patients were positioned on the weighing platform with bare feet so they touched the electrodes in standing position.

Bilateral thigh circumferences were measured at 30 cm (arbitrarily chosen) from the medial tibial plate by the same physiotherapist using a single tape measure for the assessment of the changes in the thickness of thigh.

Standardized photographic documentation (anterior, posterior, right–left lateral views) without using camera flash was used to document contour and superficial changes from a 2-m distance in a special room designed for this purpose.¹⁵ Visual inspection and photographic evaluation was quantified but could not be statistically examined because of difficulty in gradation. Photographic evaluation was a subjective evaluation criterion for our research but it was helpful for the patients to identify the changes of their contour and cellulite. Assessments were done from the photographic view of the patients, either recovery in body contour ‘existing’ or ‘not’ before and after treatment.

In order to determine whether the treatment modalities had any effects on thinning of the waist and hip, the circumference of the waist and the circumference of the hip through trochanter major were used to calculate the waist/hip ratio.

Fat thickness measurements were taken from the abdomen, suprailium and thigh regions by Skyndex digital caliper (SKYND-DEX System I, Caldwell, Justiss & Company, Inc. Fayetteville, AR, USA) for the determination of the regional changes in the fat tissue. The patients were asked to stand during the measurements. The measurements from the abdomen were taken vertically 2 cm away from the umbilicus on the right side, the measurements from the suprailium were taken over the anterior superior iliac spine in oblique position and the measurements from the thigh were taken from middle point of the right thigh vertically.

Group 1 patients were treated with the MM technique from both thighs and buttocks by a trained physiotherapist. The MM technique (Dermatonie) is based on a two-stage strategy in the treatment of the cellulite: (i) manual diagnosis using the analytical palpating/rolling technique; (ii) reflex therapy and lymphatic draining. The principle is based on a technique called depresso-massage, using a machine known as CFK concepts–Skintonic (Valence, France). It was initially used in France in 1991 for muscle pain and for smoothing burn scars. This method was then used for decreasing the adipose tissue by dissipating it. It is a treatment method in which rolling is performed both on the subcutaneous tissues and the skin using suction (negative pressures) and powered rollers (positive pressure). In this method, connective tissues are pulling in vertically and the lymphatic flow is also stimulating. Its effects include the vascularization of the skin, hyperoxygenization, restoration of the metabolic changes, drainage of the fluids and decongestion by stimulating the circulation.^{16,17}

Treatment with MM technique:

The stretched lipodystrophic areas were stimulated by vacuum electrodes with a frequency of 1/6. Afterwards, negative pressure was applied which was determined by patient tolerance on the abdomen, anterior and posterior aspects of the thigh and buttocks. The lymph nodes in the inguinal and popliteal area were stimulated

Table 2 Statistical analyses of before and after treatment (paired sample *t*-test)

Parameters	Before			After		
	Group 1 X ± SD	Group 2 X ± SD	Group 3 X ± SD	Group 1 X ± SD	Group 2 X ± SD	Group 3 X ± SD
Body weight (kg)	62.98 ± 6.56	68.01 ± 9.7	62.28 ± 8.54	62.6 ± 6.43	67.75 ± 10.41	62.29 ± 8.29
Body mass index (kg/m ²)	24.16 ± 2.29	25.02 ± 3.75	24.00 ± 3.10	23.77 ± 2.89	24.96 ± 3.96	23.99 ± 3.04
Fat %	32.24 ± 4.58	34.64 ± 7.05	31.41 ± 5.87	32.9 ± 4.31	34.86 ± 7.56	31.92 ± 6.16
Fat mass (kg)	20.4 ± 4.08	24.06 ± 7.98	19.96 ± 5.93	20.67 ± 3.61	24.21 ± 8.55	20.28 ± 6.03
Total body water (kg)	31.17 ± 3.17*	32.35 ± 2.94	30.98 ± 2.41	30.74 ± 3.49*	31.88 ± 3.08	30.74 ± 2.20
Fat thickness: suprailium (mm)	14.06 ± 3.74*	17.02 ± 7.94*	13.84 ± 5.26*	11.48 ± 3.39*	15.02 ± 7.37*	13.2 ± 4.85*
Fat thickness: abdomen (mm)	16.42 ± 3.51*	21.90 ± 8.68*	19.99 ± 5.87*	14.02 ± 2.46*	20.12 ± 8.17*	18.76 ± 5.38*
Fat thickness: thigh (mm)	23.12 ± 5.14*	30.59 ± 5.26*	28.29 ± 6.13*	21.46 ± 4.47*	28.38 ± 4.88*	25.26 ± 4.81*
Thigh circumference (cm)	60.21 ± 4.35*	61.4 ± 4.06*	60.65 ± 4.31*	59.3 ± 3.47*	59.79 ± 4.09*	60.05 ± 3.36*
Waist-hip ratio	0.80 ± 0.56	0.78 ± 0.07	0.76 ± 0.05	0.79 ± 0.56	0.77 ± 0.057	0.75 ± 0.046

**P* < 0.05, significance level.

by the intermittent mode and then lymphatic drainage was performed in the constant low mode. Finally, the proximal lymph nodes were stimulated once more and the treatment was ended. Subjects received a total of 15 sessions (three sessions per week for 5 weeks) with the MM technique according to a specific protocol.

The patients in Group 2 were treated with the MLD technique. This is a technique in which the blocked lymphatic fluid is forced to flow freely by manipulating the lymphatic system manually. It shapes the adipose tissue, decreases the intercellular edema of the fat tissue, increases the lymphatic flow and accelerates the flow of the lymphatic fluid into lymphatic channels.¹⁸ It affects on the sympathetic nervous system, relieves pain and provides a deep sense of comfort. It strengthens immunity. MLD supports the formation of collagen in the skin and therefore skin is tightened.

Treatment with MLD technique:

First, the abdominal region was treated with MLD, and subsequently, the inguinal lymph nodes were stimulated. Then, the popliteal lymph nodes were stimulated once more after the thigh was drained. The lymphatic drainage of the thigh and the lymph nodes were next stimulated again. The patients were asked to wear pressured varicose vein stockings [Class I (CCL-I) 18–20 mmHg, Mediven, Germany] until the next therapy session. The patients were asked to wear the stockings even while sleeping at night. They were treated four times a week for 5 weeks, for a total of 20 sessions.

Group 3 patients were treated with connective tissue manipulation (CTM). CTM forms mechanical effects on cells and fibroblasts which constitute the connective tissue. It decreases the sympathetic activity by forming vasodilatation. As a result, the circulation in the body is improved. CTM increases the arterial-venous and lymphatic flow by stimulating the connective tissue and increases the elasticity of the connective tissue.¹⁶

Treatment with CTM technique:

The connective tissue areas in the lumbosacral region were stimulated first in a sitting position, the connective tissue tractions

were applied on the abdominal region while the patients were lying on their backs, and lastly, the anterior and posterior aspects of the thigh were treated. The patients were treated four times a week for 5 weeks, for a total of 20 sessions.

Statistical analyses

The statistical data analyses were made using SPSS 11.5 program (SPSS for Windows release, Chicago, IL, USA). The differences between the beginning and the end of the treatment were analysed by Student's *t*-test. In order to determine the differences between all of the three groups, the variance analyses of the differences between the beginning and the end of the treatment was assessed. The mean values and standard deviations were calculated. The level of significance was accepted as *P* < 0.05.

Results

All the patients completed the treatment programmes. The demographic characteristics of the groups were similar before the treatment (*P* > 0.05) (Table 1).

When the measurements of pre- and post-treatments were compared, the values of the total body water in Group 1, the thigh circumferences of Group 1 and Group 2 from the 30 cm and the values of the fat thicknesses from the abdominal, suprailiac and thigh regions of all the three groups, displayed significant differences in favour of the post-treatment values (*P* < 0.05) (Table 2).

When the variance analyses of the differences were examined, the values of fat thickness in the suprailiac region between Group 2 and Group 3 and the values of circumferences from the 30 cm between Group 1 and Group 3 were statistically different (*P* < 0.05) (Table 2). The other measurements revealed no significant differences (*P* > 0.05) (Table 3). Patients in Group 1 showed better results in suprailium fat thickness while Group 3 showed better results in thigh circumference between three groups.

All groups had thinning of the subcutaneous fat after the treatment (*P* < 0.05). Body weight remained nearly at the same

Table 3 Analysis of variance of the differences between groups

Parameters	Group 1 D	Group 2 D	Group 3 D	F
Body weight (kg)	-0.32	-0.26	0.01	0.39
Body mass index (kg/m ²)	0.06	0.06	0.013	0.06
Fat %	0.66	0.22	0.50	0.35
Fat mass (kg)	0.26	0.14	0.32	0.1
Total body water (kg)	0.43	0.46	0.24	0.2
Fat thickness: suprailium (mm)	2.57	1.99	0.64	3.6*
Fat thickness: abdomen (mm)	1.23	1.78	1.23	0.89
Fat thickness: thigh (mm)	1.65	2.21	3.02	0.8
Thigh circumference (cm)	0.91	1.61	-0.09	4.1*
Waist-hip ratio	0.008	-0.0027	0.009	0.6

* $P < 0.05$, significance level; D: mean of pre-post treatment difference.

weight, thigh circumference decreased by an average of 0.5 cm in all groups and thigh fat thickness decreased 1.66 mm in Group 1, 2.21 mm in Group 2 and 3.03 mm in Group 3. Abdomen and suprailium fat thicknesses decreased 2.4 and 2.58 mm in Group 1, 1.78 and 2 mm in Group 2 and 1.23 and 0.64 mm in Group 3, respectively. The mean difference in waist-hip ratio was 0.1 cm in all groups.

Based on before and after photographs, we found that 30% (6 out of 20) in Group 1, 25% (5 out of 20) in Group 2, and 25% (5 out of 20) in Group 3, showed better body contouring results.

Discussion

The present investigation is the first attempt to characterize the supposed effects of the treatment techniques on the total fat mass and fat thickness located in cellulite areas. The main finding of this study is that using different treatment techniques promoted a decrease in regional fat thickness (abdomen, suprailium, and thigh via skin-fold caliper) located in cellulite areas and body contour changes (via photographs) but no changes were detected in total fat per cent and fat mass (via body composition analyzer).

Cellulite is a common and difficult problem which affects the buttocks and thigh regions of post-pubertal females and has a difficult treatment.^{18–20} It may be an effect of obesity although this relation is not clear. The range of body mass indices and subcutaneous fat thickness across the ranges of cellulite appearance in our study confirms this result.

Smalls *et al.* investigated the role of weight loss in women diagnosed with lipodystrophy. In their study, the amount of cellulites decreased in patients with high body mass index and severe cellulites, whereas no significant differences were observed in patients with low body mass index and mild cellulites. The subjects included in our study did not have body mass indices over 25. No significant developments were detected in terms of fat percentages with the data gathered from body composition analyses as in the study of Smalls *et al.* However, regional fat thickness and thigh circumferences found were significantly different.¹⁸

A sole study example in the literature about the efficacy of depressomassage (mechanical massage) in chronic venous insufficiency (CVI) belongs to Laffont.¹³ He applied depressomassage to 12 women with CVI for a total of 12 sessions during 6 weeks and found out that for all the patients treated, volumetric examination with water demonstrated a significant decrease in the leg volume and clinical improvement was approximately greater than 45% in parameters such as pain, heaviness, sensation of swelling and parasthesia which were evaluated with VAS.¹³ Laffont's study is important for understanding the effects and description of the mechanical massage (dermatonic-depressomassage) technique we used in our research.

Ersek *et al.* used endermologie (a mechanical massage technique) for noninvasive body contouring. Six of 22 patients completed 14 sessions' treatments and they were encouraged to maintain a low-fat diet and drink water. No control group was used in their study. They found reduction in body circumference measurements.²¹ Similar findings (reduction in thigh circumference measurements) were observed in the MM technique in our study.

Adcock *et al.* studied the effects of endermologie treatment in a porcine model and found no decrease in subcutaneous tissue thickness after treatment.²² Endermologie is a mechanical massage technique like dermatonic (depressomassage) that we used in our study. In the results of the MM technique, we found a decrease in subcutaneous fat thickness after treatment.

In the study of Chang *et al.*, 75 % of their patients who gained weight after 14 treatment sessions with endermologie showed a loss in mean body circumference.⁴ Our patients did not lose weight but they demonstrated a significant reduction in thigh circumference and fat thicknesses from suprailium, abdomen and thigh.

In contrast to our study, Collis *et al.* found no significant reduction of thigh circumferential measurements after either endermologie or topical aminophylline treatment vs. a combination of both techniques.³

Nootheti *et al.* compared the efficacy of treatment of cellulite using two novel modalities, TriActive vs. VelaSmooth. In their study, both machines reduced the appearance of cellulite but they did not find any difference between the machines. They also used visual inspection and photographic (before and after treatment) grading in their study. They did not find any difference in cellulite appearance between the two treatments.¹⁵ We used photographic evaluation similar to the study of Nootheti *et al.* However, we could not analyse the results statistically. But according to the inspection results, nearly 25% of the subjects in each group showed better body contouring results.

In the study of Monteux and Lafontan, they demonstrated that a treatment with mechanical massage technique improved the lipid-mobilizing effects of *in situ* administered isoproterenol in femoral adipose tissue of women with cellulite. In addition to these results, their treatment reduced body circumferences and skin-fold measurement.²³

Although the non-invasive treatment techniques are widely accepted and continue to be increasingly used today, researches about non-invasive treatment of cellulites have little scientific validation.

In conclusion, mechanical massage (dermatonie–depresso-massage), manual lymphatic drainage and connective tissue manipulation techniques offer safe and effective methods for cosmetic local fat reduction or distribution from the waist–buttocks and thighs. When treatment groups were compared, patients in the mechanical massage group showed better results in suprailium fat thickness while the manual lymphatic drainage group showed better results in thigh circumference. For this reason, we suggest the mechanical massage treatment method in lipodystrophy. We think that reduction in thigh volume is dependent on wearing compression stocking all day long. Water retention is also very important for these patients, and all of them were assessed in the same menstrual cycles (luteal phase). Although there was no difference found between treatment groups, the most water reduction was seen in the mechanical massage group before and after treatment.

There is no study in the literature about these techniques and comparison of their effects on cellulite formation and fat mass. The mechanisms of actions of such treatments are still unclear. It was established in the study of Monteux and Lafontan that blood flow changes occur after treatment with the mechanical massage.²³ This can be true for the other techniques we used in our study. From this viewpoint, complementary studies are needed and necessary to confirm the effects of such techniques on lipid mobilization in fat deposits and on lymphatic and blood circulation.

In our opinion, none of these techniques could be a true substitute for conventional surgical liposuction but these methods seem to be suitable alternative therapies for patients who do not want to undergo surgery.

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