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Evaluation Study

Evaluation of the effectiveness of non-invasive methods of compressive microvibration and ablative sensory microvibration on local areas with excess fat deposits in volunteers of different age groups

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ABSTRACT

The aim of the study was the apparatus of compressive microvibration "Endospheres Therapy® Body" (Registration certificate RZN 2016/3863 of 29 December 2017) used in women with mild to moderate edematous fibrosclerosis (panniculopathy) of peri- and post-menopausal age. The purpose of the project is to evaluate the effectiveness of the non-invasive technique of compressive microvibration in volunteers of different age groups. The basis for the work is the agreement No. 002/2022-n between the GBUZ MO MONIKI named after M.F. Vladimirsky and ItalConsult, LLC of 01.03.2022. The main tasks were: form 3 cohort groups of volunteers in accordance with the criteria agreed with the Customer (mild or moderate edematous fibrosclerosis, as panniculopathy), aged 30 to 44 years old, 45 to 54 years old and 55-65 years old; ensure that all participants receive a course on procedures (12 procedures every other day) regularly and correctly; evaluate the effectiveness of the non-invasive method of compressive microvibration on local areas of excess fat deposits in volunteers of different age groups through subjective testing (with a questionnaire), objective results of laboratory tests (blood test with hormone levels) and instrumental studies (ultrasound examination of the skin of fat trap zones, in abdomen and thighs) and assessment of the microcirculation system. Hypothesis: compressive microvibration generated by the manipulator-cylinder, consisting of 50 spheres of hypoallergenic silicone that generates low-frequency vibrations, makes it possible to activate microcirculation, stimulate lymphatic drainage, increase muscle tone and improve skin trophism. For all study results, mean values (Mean), standard deviations (Std.Dev.), minimum (Minimum), maximum (Maximum) values, and SD confidence of all results were obtained. The difference between the mean values and the variation coefficients was tested using a two-sample Student's t-test (considering the distribution's normality). Our results have convincingly demonstrated the effectiveness of the Endospheres Therapy® procedures for treating cellulite, with the effect maintained for at least 60 days after the course of therapy. Instrumental studies confirmed a pronounced improvement in the skin's condition, microcirculation, cellular metabolism activation, hypoxia reduction and tissue perfusion improvement. Endospheres Therapy® procedures are safe and effective in treating cellulite in the long term without side effects. Patients noted a high degree of satisfaction with the Endospheres Therapy® course, which indicates the quality of the procedures and the level of specialists.

INTRODUCTION

The current demographic situation is characterised by an increase in life expectancy and, consequently, an increase in the population of older people. Accordingly, the number of women entering menopause continues to increase. At the same time, in the opinion of a society focused on youth, there is a certain negative perception of menopause: pessimism, emotional vulnerability, and confidence in the loss of femininity and sexual attractiveness. Menopause is perceived as a biological and emotional crisis (1-5).

According to Rosstat, the Russian population includes more than 25 million peri- and post-menopausal women. The average age of natural menopause has remained virtually unchanged over the past 100 years and is about 51 years (range 40 to 60 years), meaning that a woman spends about one-third of her life in this natural phase of the ageing process.

Menopause is an important stage in the physiological ageing of a woman, which is characterised by a whole range of various negative manifestations associated with vegetative-vascular and metabolic-endocrine disorders, changes in the psycho-emotional sphere and cognitive function, a progressive decrease in ovarian function and a gradual process of involutive changes in the functioning of the whole organism. While

mechanisms of menopause are the same for everybody, the clinical manifestations of menopause are quite individual, and the degree of their severity depends on hormonal changes and external factors (living conditions, health status, social functioning and subjective perception of ageing).

Experts note that, regardless of ethnic origin and socio-demographic factors, about 30-60% of women suffer from severe menopausal disorders: vasomotor, urogenital, somatic, psycho-emotional and cognitive (6-8).

During menopause, the female body undergoes tremendous changes, which negatively affect a woman's body structure and appearance without proper measures. They are prompted by a slowed metabolism caused by hormonal disorders, a sedentary lifestyle and nutritional flaws. In addition, bone and muscle tissue regeneration decrease, and skin elasticity decreases; therefore, noticeable wrinkles appear, and complaints of weakness, insomnia, increased blood pressure, heart rhythm disturbances, headaches, tachycardia, and other symptoms are not uncommon. Furthermore, more than 90% of perimenopausal and post-menopausal women suffer from manifestations of cellulite. Moreover, this cosmetic defect is unattractive and emotionally unpleasant for most women, significantly impacting their quality of life.

Admittedly, the pathophysiology of cellulite has not been fully established; however, the available clinical and experimental data point to a multifactorial process, including the number and types of fibrous septa, microvascular dysfunction, subcutaneous inflammation, dermal thinning with age, and fat deposition (9, 10).

The etiopathogenesis of cellulite is associated with environmental, hormonal and genetic factors. It is known that the severity of cellulite is the same in women who are related. Apart from that, among common factors that affect the incidence and severity are gender (more common in women than men), race (more common in Caucasians), and biological type (11).

Some authors suggest that the main cause of cellulite is microcirculatory changes since blood flow in the area affected by cellulite is 35% lower than that of the unaffected areas (12). According to the assumed mechanism, the formation of cellulite lesions is associated with microcirculation disorders that cause local accumulation of cytokines and other biologically active molecules that induce changes in the function and metabolism of local tissues.

Fat cells increase their volume, causing pressure on the blood vessels and further disturbances in adipose tissue metabolism. As a result, the flow of blood and lymph is disturbed, leading to fluid stagnation in the vessels and exudation; this manifests itself on the surface of the skin in the form of numerous cavities and tubercles, limited nodes or diffuse thickenings, characteristic of cellulite changes and most pronounced in persons with metabolic or endocrine disorders (obesity, menopause, menstrual disorders and hypothyroidism, among others.

However, unlike obesity, which is characterised by hypertrophy and hyperplasia of adipocytes not related to a specific anatomical location, cellulite is the result of a complex of various ultrastructural, inflammatory, histochemical, and biochemical changes in the dermis, microcirculation, and adipocytes.

The primary function of adipocytes in the human body is to store and metabolise fatty acids. Their complex endocrine activity also draws attention. Therefore, dysfunction of adipocytes not only leads to changes in the skin's topography and an undesirable visual effect and affects the metabolism (13, 14).

The degree of manifestation of cellulite might be related to differences in the quantity, thickness, and orientation of septal junctions in the superficial fascia and dermis.

Also, the physiology and appearance of the skin in women are significantly affected by female sex hormones such as estrogens and progesterone: estrogen deficiency reduces the production of connective tissue in the skin. In addition, estrogen, oxidative stress, and inflammation can contribute to fluid retention, which leads to changes in local vascular and lymphatic drainage and causes local tissue oedema (10).

The effect of estrogen on the wall of the blood vessel is manifested by an increase in the permeability of its

wall, which can lead to oedema of the surrounding tissues. This oedema puts pressure on small veins and arterioles, resulting in abnormal blood flow in the skin and fatty tissue. The process is aggravated by a combination of progesterone deficiency and hyperestrogenism, which leads to metabolic disorders and adipocyte dysfunction. These phenomena exacerbate fibrosis and the formation of nodules in the subcutaneous tissue, which inevitably leads to the progression of cellulite (13-15).

In addition, age-related reduced content of type I and III collagen and elastin fibres also contributes to cellulite formation (16).

In order to explain the pathogenesis of cellulite, the so-called "two-hit" hypothesis has been proposed, according to which impaired microcirculation in the gluteal-femoral tissue (first hit) leads to hypoxia (second hit), which, in turn, contributes to the development of fibrosis of the subcutaneous connective tissue. In addition, due to increased fibrogenesis and collagen deposition, the number of subcutaneous collagen strands (partitions) decreases in cellulite areas, and they become oriented perpendicular to the skin surface. Due to this spatial distribution, thinning of the septa and reduction in the number of septa connections, increased pressure pushes subcutaneous fat to the interface between the dermis and hypodermis, leading to dimples on the skin (17, 18).

This problem often affects the subcutaneous tissue around the thighs, buttocks and thigh areas most affected by the adipose tissue deposits in women. In this case, cellulite formation is accelerated in adolescence, in pregnant women or women at menopausal age (19-21).

Today, it is the treatment of obesity and cellulite that is the most frequent request of patients to an aesthetic doctor and a plastic surgeon, and while aspiration techniques (liposuction) remain the gold standard for localised fat deposits, skin laxity and cellulite require different approaches. As a result, the demand for non-invasive and long-term treatments for cellulite has increased, fueling the emergence of new medical devices and technologies. Non-surgical (topically applied creams and massage) or instrumental treatment methods (extracorporeal shock wave therapy and radiofrequency, laser and light therapy) become particularly relevant. The previous convincingly shows the demand and the need to study the possibilities of various cosmetic techniques for treating cellulite. In this regard, this research work was aimed at evaluating the effectiveness of the non-invasive technique of compressive microvibration in volunteers of different age groups.

MATERIAL AND METHODS

The objects of the study were the apparatus of compressive microvibration "Endospheres Therapy® Body" (Registration certificate RZN 2016/3863 of 29 December 2017), used in women with mild to moderate edematous fibrosclerosis (panniculopathy) of peri- and post-menopausal age.

The study included 9 female volunteers with mild or moderate edematous fibrosclerosis (panniculopathy), who were divided into 3 clinical groups of 3 women each by age criteria agreed with the Customer: group 1 (before menopause, aged 40 - 49), group 2 (during menopause, aged 50 - 59) and group 3 (postmenopause, aged 60 - 69).

Criteria for inclusion in the study:

1. Signed informed consent;
2. The presence of mild or moderate edematous fibrosclerosis (persistent fat deposits, cellulitis, oedema);
3. Age - 40 to 69 years old.

Non-inclusion Criteria:

1. lack of signed informed consent;
2. pregnancy;
3. thrombophlebitis;

4. oncological diseases;
5. any acute conditions or flares up of chronic diseases;
6. skin diseases.

Exclusion Criteria:

1. withdrawal of informed consent.
2. detection of autoimmune, haematological, and oncological diseases.
3. manifestation of an acute infectious-inflammatory disease or exacerbation of chronic disease.

The primary phenomenon under study, secondary and end points of the study:

- anamnesis data (once, before the procedures);
- laboratory exam results: biochemical blood test (glycated haemoglobin, cholesterol level; lipid metabolism (triglycerides, total cholesterol, HDL, LDL, atherogenic index) - once before the course of therapy;
- hormone levels (TSH, T3, T4) - once before the therapy.

Instrumental examination results:

a) bioimpedancemetry, exam before and after the course of treatment;
b) non-invasive clinical diagnostics of peripheral blood flow and oxidative metabolism (assessment of microcirculation) before and after each procedure throughout treatment;
c) ultrastructural skin exams (ultrasound) three times: before, after the course of treatment and 2 months after the course of therapy.

Computer analysis of body electrical conductivity data (bioimpedancemetry) was performed using the Medass apparatus at the Clinic of Professor Kalinchenko. The body mass index, fat, lean, active cellular and skeletal muscle mass, specific basal metabolism, total and extracellular fluid, and bioimpedance phase angle at a frequency of 50 kHz were evaluated.

Microcirculation was assessed using a portable laser analyser of blood microcirculation “LASMA PF” (GOSTR5044492, TU 9442-012-13232373-2018, a set of design documentation for IABZH. 941349.015.). The blood microcirculation level was determined indirectly based on the optical characteristics of the probing area (upper third of the thigh) by laser Doppler flowmetry (LDF) in relative units for 10 minutes before and after each procedure.

Ultrasound scanning was performed with HFUS using DUB SkinScanner (TPM GmbH, Germany), a specialised high-resolution digital ultrasound system equipped with 75 and 30 MHz transducers with a resolution of 21 and 48 microns and a scanning depth of 4 to 8 mm, respectively. Each CCP was scanned in turn by both ultrasonic sensors. In addition, the depth of BCC propagation was measured using a specialised program, AxioVision Rev 4.8.

The obtained data were analysed using Microsoft Excel and Statistica 13 StatSoft Inc. Descriptive statistics methods were used, and mean values (Mean) and standard deviations (Std.Dev.) were calculated. We checked the difference between the mean values and variation coefficients using a two-sample Student’s t-test (considering the distribution’s normality).

RESULTS

Results of laboratory examination of patients

Prior to the start of the Endospheres Therapy® course, all participants of the project were assessed once for the main biochemical parameters of blood (glycated haemoglobin, cholesterol levels; lipid metabolism (triglycerides, total cholesterol, HDL, LDL, atherogenic index) and hormone levels (TSH, T3, T4).

In Table I, we can summarise the results of the biochemical analysis of the blood of the examined women.

Table I. *Biochemical parameters of the blood of the examined women.*

Group Age, (years)	Glycosylated hemoglobin HbAlc, % (ref: 4.00 - 6.00%)	BIOCHEMISTRY				
		Cholesterol general, ref: 3.1 - 5.2 - 6.2 mmol/l	HDL-C ref: 1.2 - 2.2 mmol/l	LDL-C ref: 2.1 - 3.4 - 4.1 mmol/l	triglycerides, ref: 0.5 - 1.7 - 2.25 mmol/l	atherogenic coefficient, ref: 2-3-4 units
General group 40 - 69	5.23±0.19	5.40±0.85	1.66±0.36	2.88±0.64	1.17±0.80	2.46±1.24
Group 1 40 - 49	5.23±0.05	4.83±0.70	1.41±0.43	2.60±0.67	1.40±1.00	2.90±1.77
Group 2 50 - 59	5.13±0.29	5.4±0.96	1.74±0.11	3.00±0.76	0.70±0.17	2.13±0.70
Group 3 60 - 69	5.33±0.15	5.97±0.49	1.83±0.29	3.03±0.47	1.40±0.72	2.33±0.72

The general cohort of project participants and each age group had no deviations in the main biochemical blood parameters: all results were within the range of reference values. It can only be noted that the level of total cholesterol in patients of groups 2 and 3 approached the upper limit of the norm, which indicated the initial signs of age-related atherosclerotic lesions of the walls of blood vessels. The rest of the metrics remained within normal limits: HDL, LDL, Triglycerides and atherogenic index (HDL to LDL ratio).

The test results for haemoglobin A1c (glycated haemoglobin level) did not exceed 5.33%, indicating an average overall level of glycemia for the previous 3 months and standard glucose tolerance. Given that the thyroid gland is responsible for the acceleration and deceleration of human metabolism, and ageing is associated with an increase in thyroid dysfunction, the patients were examined for the level of hormones TSH, T4 and T3 (Table II). No deviations from average values were found.

Table II. *Assessment of thyroid hormone levels in project participants.*

Group Age, (years)	HORMONES		
	TSH, ref: 0.34 - 5.6 mIU/l	T4, ref: 7.86 - 14.41 pmol/l	T3, ref: 3.8 - 6 pmol/l
General group 40 - 69	1.58±0.68	12.78±1.16	4.50±0.37
Group 1 40 - 49	1.61±0.31	13.02±0.66	4.69±0.17
Group 2 50 - 59	1.42±0.48	12.80±0.83	4.57±0.56
Group 3 60 - 69	1.70±1.19	12.27±1.79	4.25±0.18

Thus, the entire cohort of project participants had no deviations in blood biochemistry and thyroid hormone levels, which could negatively affect the project results, underestimating the body's metabolic activity.

Results of bioimpedance examination of patients

Currently, bioimpedancemetry is increasingly used in the diagnosis of various pathological conditions. Although the results of non-invasive bioimpedancemetry are not always accurate and reliable, the method's significant advantage is the absence of damage to organs and tissues while it provides a reasonably wide range of diagnostic data. Therefore, special attention was paid to the bioimpedance comparative analysis of body composition, which allows, based on the measured values of the electrical resistance of the human body and anthropometric data, to dynamically evaluate (before and after the course of therapy) the absolute and relative values of body composition parameters and metabolic correlates, to compare them with intervals of average values, assess the reserve capacity of the body and the effectiveness of the "Endospheres Therapy®" course.

According to the results of bioimpedancemetry (Tables III and IV), the method showed the greatest efficiency in patients of group 1 (aged 40-49).

Table III. *The results of bioimpedancemetry of the project participants before the course "Endospheres Therapy.*

Group Age, (years)	BMI	Fat mass normalized by height (kg)	Lean mass (kg)	Active cell mass (kg)	Active cell mass (%)	Skeletal muscle mass (kg)	Skeletal muscle mass (%)	Specific basal metabolism (kcal/sq.m./day)	General liquid (kg)	extracellular fluid (kg)	Waist/Hip Ratio	Classification by percentage of fat mass (obesity)
General group 40 - 69	27.80±4.81	27.48±11.32	50.29±6.82	27.74±3.95	55.13±2.25	22.53±3.59	44.67±1.84	814.34±57.45	37.11±4.93	15.54±2.52	0.84±0.07	33.97±7.77
Group 1 40 - 49	26.73+3.82	26.57+7.50	48.23+7.39	27.53+5.16	56.80+2.14	21.93+4.31	45.23+2.54	816.67+42.73	35.33+5.42	14.90+2.52	0.85+0.07	35.20+4.05
Group 2 50 - 59	28.90±8.40	30.80±18.72	53.77±9.53	29.43±5.18	54.83±2.35	24.63±4.49	45.80±0.53	802.17±73.95	39.33±6.98	16.87±3.61	0.80±0.11	33.47±13.59
Group 3 60 - 69	27.77±1.96	25.07±8.90	48.87±3.63	26.27±1.16	53.77±1.75	21.03±1.55	42.97±0.12	824.20±74.36	36.67±2.58	14.87±1.46	0.87±0.05	33.23±6.08

Table IV. *The results of bioimpedancemetry of the project participants after the "Endospheres Therapy®" (M±b) course.*

Group Age, (years)	BMI	Fat mass normalized by height (kg)	Lean mass (kg)	Active cell mass (kg)	Active cell mass (%)	Skeletal muscle mass (kg)	Skeletal muscle mass (%)	Specific basal metabolism (kcal/sq.m./day)	General liquid (kg)	extracellular fluid (kg)	Waist/Hip Ratio	Classification by percentage of fat mass (obesity)
General group 40 - 69	27.48±4.28	25.59±11.85	51.17±6.50	28.99±6.02	56.34±6.11	23.21±4.02	45.01±2.94	842.03±119.9	37.34±4.62	15.56±2.13	0.83±0.05	31.71±9.66
Group 1 40 - 49	26.67±3.31	22.83±11.62	51.80±8.97	31.70±10.36	60.13±10.07	24.70±6.40	47.17±4.56	893.60±192.7	37.93±6.56	15.33±2.15	0.86±0.07	30.00±12.10
Group 2 50 - 59	28.00±7.54	29.20±17.70	52.53±8.11	27.93±4.20	53.27±2.66	23.70±3.44	44.70±1.25	788.83±83.1	38.10±5.56	16.43±3.07	0.79±0.03	32.40±13.47
Group 3 60 - 69	27.77±1.99	24.73±9.04	49.17±3.68	27.33±1.76	55.63±2.06	21.23±1.53	43.17±0.21	843.67±72.5	36.00±2.70	14.90±1.49	0.85±0.03	32.73±6.25

Thus, the index of fat mass normalised by height (kg) in patients of group 1 decreased by 16.4%, active cell mass increased by almost 15%, skeletal muscle mass - by 13%, the rate of specific basal metabolism - by almost 10%, and the classification score by the percentage of fat mass decreased by 17.3%. In the second group, only the index of fat mass normalised by height (kg) (decreased by 5.5%) and the classification index by the percentage of fat mass (decreased by 3.3%) were the most significant. The results of the representatives of group 3 (60-69 years old) turned out to be somewhat unexpected. The dynamic trend of the indicators corresponded to the data of Group 1. However, the changes were less pronounced: the active cell mass increased by almost 5%, the specific basal metabolism indicator - by almost 4%, and the classification indicator by the percentage of fat mass decreased by 1.5%.

As an illustration, we present a comparative analysis of the dynamics of bioimpedancemetry indicators in

individual representatives of age groups (Fig. 1).

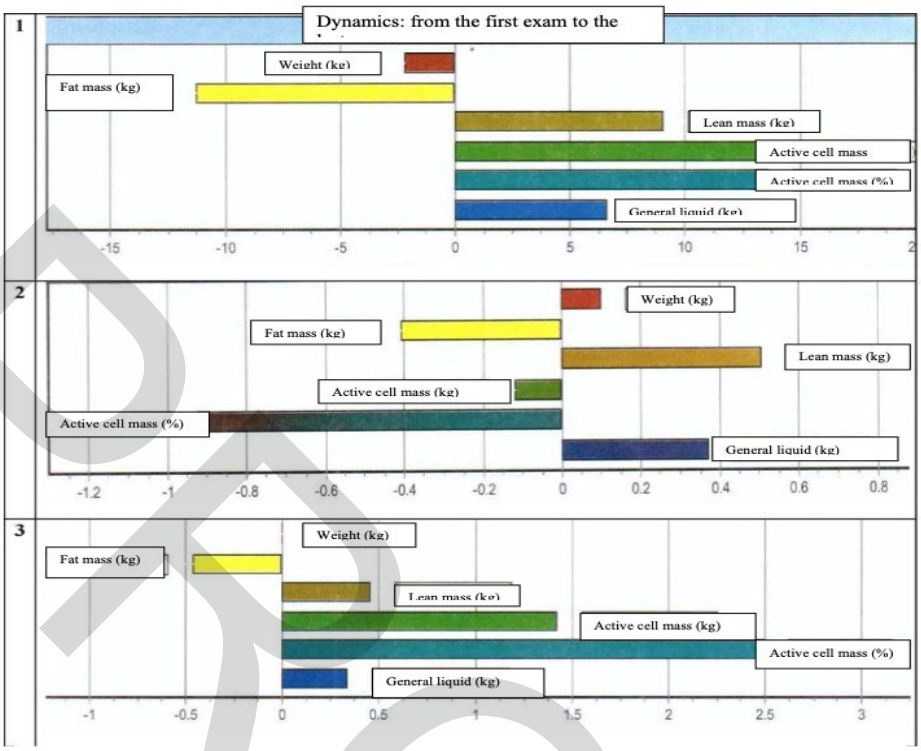

Fig. 1. *Comparative assessment of body composition (bioimpedance analysis) before and after Endospheres Therapy® course: 1) Patient E. (44 years old) group 1 – 2) Patient L. (56 years old) group 2 – 3) Patient K, (67 years old) group 3.*

The ultrasound scanning results of patients

High-frequency ultrasound scanning measures the acoustic signal recorded for a digital sound wave reflected from biological tissues and provides direct visualisation of the thickness of the epidermis and dermis (Fig. 2)

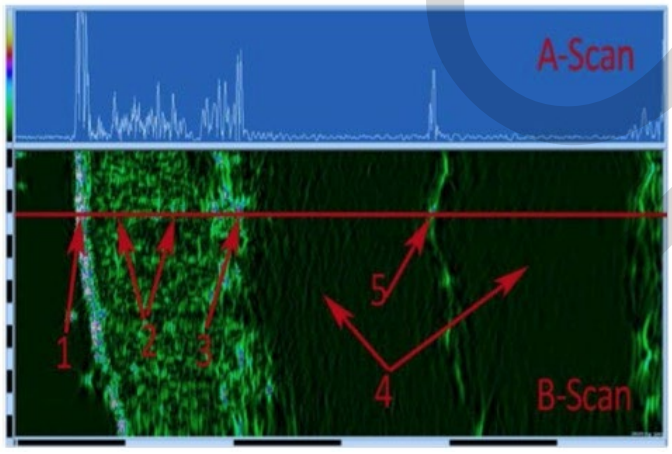

Fig. 2. *The structure of the skin during ultrasound scanning: 1: Epidermis; 2: Derma; 3: Border of the dermis and hypodermis; 4: Hypodermis; 5: Fascial, connective tissue in the hypodermis.*

Skin ultrasound was performed using a specialised high-resolution digital ultrasound system DUB SkinScanner (TPM GmbH, Germany), equipped with a 75 MHz transducer with a 21 and 48 µm resolution and scan depths of 4 to 8 mm, respectively. A 75 MHz probe was used for high-frequency ultrasounds, with

which it is impossible to visualise the thickness of the subcutaneous fat, but it is very useful for evaluating the efficacy of the treatment on the structure of the dermis and superficial subcutaneous tissue. Four points were selected for each patient for high-frequency ultrasound: the anterior surface of the thigh, the posterior surface of the thigh, the inner surface of the thigh, and the anterior surface of the abdomen. Skin areas were marked with the natural pigment using a special handpiece with sterile disposable tips. Then, the black pigment was injected into the upper layers of the skin to a depth of 1mm. The size of the sign was approximately 1x1 mm. Ultrasound was performed before the Endospheres Therapy® treatments and after 12 procedures, therefore 60 days after the end of Endospheres Therapy®.

The dynamics of the skin condition were assessed according to the following criteria: dermis thickness, the acoustic density of subcutaneous fat, the length of the boundary line between the dermis and subcutaneous adipose tissue. The results of the evaluation are shown in Fig. 3.

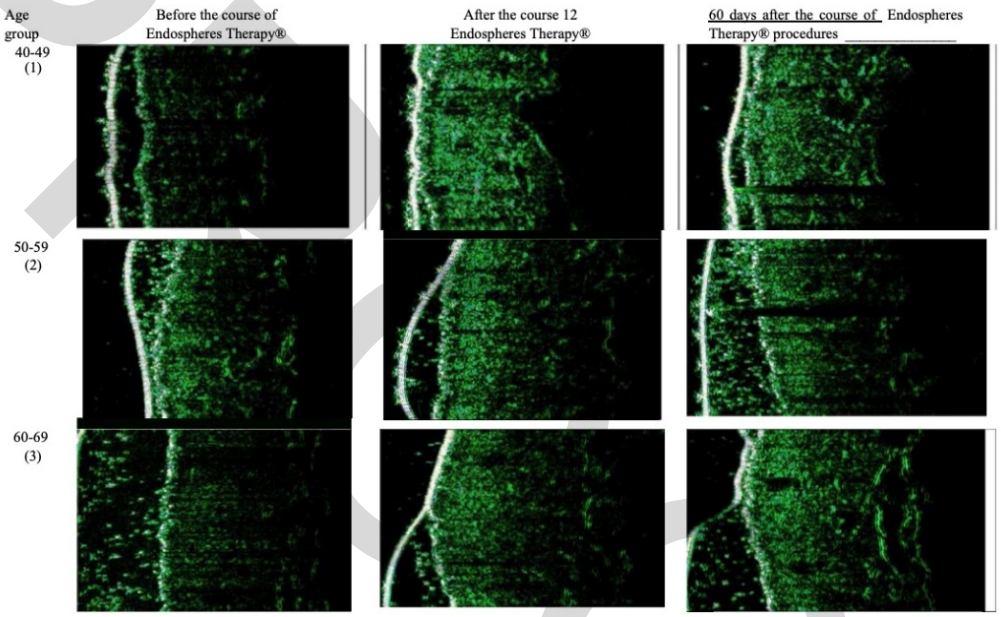

Fig. 3. *Ultrasound examination of the dermis of women with cellulite: before, after and 60 days after the course of Endospheres Therapy® procedures. Scans of patient E. (group 1, 44 years old); Patient L. (Group 2, 56 years old) and Patient Sh. (Group 3, 66 years old).*

The epidermis was visualised on all scans as a homogeneous hyperechoic white band interspersed with blue and green hues. The dermis was visualised as hyperechoic, intersecting green lines with white patches, an image of collagen and elastin fibres bundles. Subcutaneous adipose tissue was found to be a hypoechoic area, and its structure was getting echo signals reflected from fibrous structures and vessels. In addition, the underlying fibrous septa were visualised. Large fibrous septa lead to lobulation of adipose tissue, defining the typical “orange peel” structure associated with cellulite.

The details of the results highlighted are in the following tables V, VI, and VII.

Table V. *Before treatments.*

Before treatment	anterior surface of the thigh			Internal thigh			posterior thigh			Anterior surface of the abdomen		
Age, years	Dermal thickness	Dermal echogenicity	Echogenicity of the hypodermis	Dermis thickness, μm	Echogenicity of the dermis	Anterior surface of the abdomen	Dermis thickness, μm	Echogenicity of the dermis	Echogenicity of the hypodermis	Dermis thickness, μm	Echogenicity of the dermis	Echogenicity of the hypodermis
40 – 69	1399,56±388,97	22,11±8,91	5,44±1,88	1067,78±194,89	30,16±12,37	7,44±3,36	1502,78±403,51	16,89±4,08	5,22±2,39	1606,78±289,19	14,33±5,17	4,56±2,24
40 – 49	1366,33±458,73	18,67±5,77	6,00±1,96	1046,33±143,24	27,33±13,32	6,67±1,53	1273,73±521,67	18,33±1,53	5,67±2,52	1839,33±130,4	15,67±6,66	5,67±3,06
50 – 59	1206,00±352,34	25,67±8,74	5,07±2,65	1009,07±182,68	26,24±13,89	6,67±3,21	1419,33±195,22	15,33±4,36	6,33±2,52	1475,33±431,98	15,33±6,11	4,33±2,31
60 – 69	1626,33±368,26	22,00±13,08	5,33±2,52	1248,00±104,01	26,67±12,66	9,51±5,21	1816,32±322,85	17,33±6,03	3,67±2,08	1505,67±92,41	12,27±3,61	3,67±1,53

Table VI. *After treatments.*

AFTER TREAMENT	anterior surface of the thigh			Internal thigh			posterior thigh			Anterior surface of the abdomen		
Age, years	Dermal thickness	Dermal echogenicity	Hypodermis Echo	Dermal thickness	Dermal echogenicity	Hypodermis Echo	Dermal thickness	Dermal echogenicity	Hypodermis Echo	Dermal thickness	Dermal echogenicity	Hypodermis Echo
40 – 69	1192,11±415,12	34,67±12,44	4,44±3,13	947,78±161,21	33,67±13,3	4,78±2,22	1319,89±454,62	24,56±5,96	3,67±1,32	1318,27±265,61	21,67±7,21	3,78±2,05
40 – 49	1153,33±627,98	37,67±16,5	4,15±5,23	932,24±265,05	32,33±16,52	5,33±1,53	1196,67±516,89	26,44±1,73	3,22±1,94	1408,33±268,01	20,33±8,52	4,33±2,52
50 – 59	1091,23±219,91	37,33±9,02	3,67±1,53	903,67±140,59	37,67±13,82	4,18±2,41	1196,33±403,32	22,33±5,13	2,67±1,15	1259,22±237,42	23,67±8,33	3,67±2,89
60 – 69	1332,31±446,8	29,27±13,89	3,67±2,08	1007,67±72,57	31,33±14,43	5,67±3,46	1566,67±509,77	25,33±10,07	3,33±0,58	1287,19±367,69	21,33±7,55	3,33±1,15

Table VII. *After 60 days from the end of treatments.*

After 60 days	anterior surface of the thigh			Internal thigh			posterior thigh			Anterior surface of the abdomen		
Age, years	Dermal thickness	Dermal echogenicity	Hypodermis Echo	Dermal thickness	Dermal echogenicity	Hypodermis Echo	Dermal thickness	Dermal echogenicity	Hypodermis Echo	Dermal thickness	Dermal echogenicity	Hypodermis Echo
40 – 69	1197,78±534,58	29,44±9,15	4,67±1,8	1005,33±124,19	31,22±12,33	5,67±2,24	1432,56±406,71	18,56±3,32	4,28±1,22	1452,78±243,98	17,67±5,57	3,78±1,99
40 – 49	960, 34±833,15	31,67±10,26	5,21±1,13	953,78±174,52	29,22±14,18	5,33±1,53	1229,67±492,1	21,67±1,15	4,33±1,53	1619,33±63,66	15,67±5,29	4,67±3,06
50 – 59	1119,33±151,86	32,54±6,73	4,33±2,65	1035,33±144,61	36,67±13,05	5,67±2,08	1298,33±306,17	15,67±1,15	4,33±0,58	1298,67±340,64	20,33±7,22	3,33±1,53
60 – 69	1514, 22±426,49	24,67±11,93	5,67±2,31	1026,67±64,66	28,67±13,12	6,33±3,61	1769,67±257,94	18,33±3,79	3,33±1,53	1440,67±201,8	18,24±5,29	3,33±1,53

In summary, it was found that after the "Endospheres Therapy®" treatment in patients of the first, second and third age groups in the areas of the anterior, inner, posterior thigh and anterior surface of the abdomen, the thickness of the dermis decreased by 15.6, 9.5 and 18.1%; 10.9, 10.5 and 19.3%; 6.1, 15.7 and 13.8%, 23.4, 14.7 and 14.5%, respectively.

There was a 2, 1.4 and 1.3-fold increase in dermal echogenicity in the anterior, inner, posterior thigh and anterior abdominal areas; 1.2, 1.4 and 1.2 times; 1.4, 1.4 and 1.5 times; 1.3, 1.5 and 1.7 times, respectively. Hypodermis echogenicity decreased in the studied areas by 30.8, 27.6 and 31.2%; 20.1, 37.3 and 40.4%; 43.2, 57.8 and 9.3%; 23.6, 15.2 and 9.3%, respectively.

It was established that in groups 1 and 2 patients, uneven thickening of the epidermis was observed before treatment, which corresponded to an increase in the skin pattern. Thickening of the dermis and a decrease in echogenicity was noted, especially in its lower divisions. After treatment, the thickness and structure of the

epidermis became more uniform. The dermis became compacted, and its echogenicity increased. However, simultaneously, the echogenicity of its lower parts remained reduced compared to the upper ones. The resulting positive effect persisted 60 days after the course of therapy.

In patients of group 3 (postmenopause), before treatment, a uniform thickening of the epidermis was observed throughout its entire length. Clinically, this was manifested through mild hyperkeratosis. The echogenicity of the dermis was reduced uniformly throughout its thickness. After 12 procedures, the thickness of the epidermis decreased, and manifestations of hyperkeratosis were resolved. The dermis has become more hyperechoic, and its structure - is more homogeneous. Moreover, in contrast to groups 1 and 2, the echogenicity of the dermis increased equally in both its upper and lower sections. The resulting positive effect persisted 60 days after the course of therapy.

The destruction of the fibrous septae was judged indirectly by changes in the echogenicity of the hypodermis based on the technical capabilities of the sonographer. However, it is important to note that the destruction of fibrous septa was noted in patients in all groups after the course of therapy, which confirms the high efficiency of the course of procedures and indicates that this method meets the requirements of the modern strategy, providing a stable improvement in skin topography. Finally, aesthetic improvements have indeed been obtained in the appearance of cellulite manifestations in most of the treated areas, and we consider it very important that the changes recorded persist largely for 60 days after the end of the Endospheres Therapy®.

The results of laser Doppler flowmetry (LDF) of the microvascular bed of patients

In modern literature, vascular endothelial dysfunction plays a key role in the pathogenesis of many diseases. This single layer of cells lining the inner walls of blood vessels is considered a distinct organ due to its endocrine, vasodilating, and vasoconstrictive properties. Therefore, during the Endospheres Therapy® course, close attention was paid to the assessment of the microvasculature and the dynamics of its indicators.

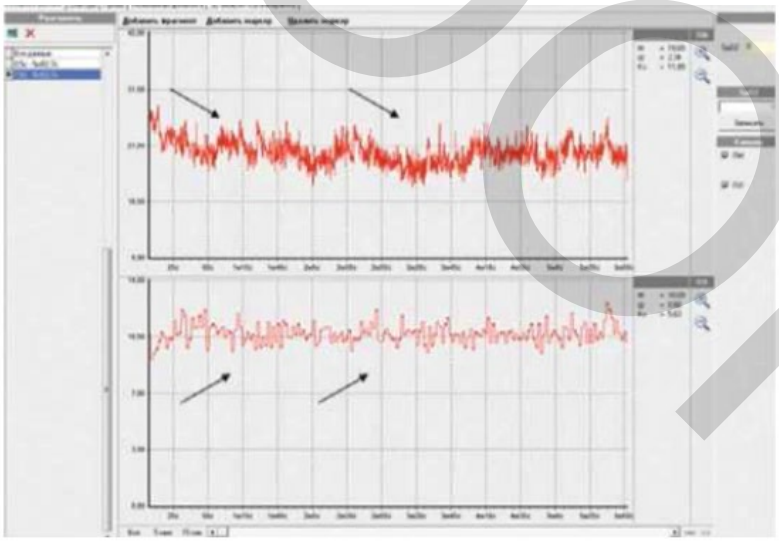

Fig. 4. *LDF of microcirculation assessment.*

It is believed that the signal recorded during LDF characterises the blood flow in microvessels in a volume of about 1 mm3 of tissue; this means that for human skin, LDF provides integral information on a vast number of erythrocytes, about 3.4x104, simultaneously located in the probed tissue volume.

Using laser Doppler flowmetry, we studied all the parameters obtained using the software for the LASMA apparatus, characterising the microcirculation of blood flow and tissue coenzymes, which are biomarkers of

tissue oxidative metabolism in the subjects. In addition, further analysis of their intergroup differences was carried out.

When analysing the effectiveness of Endospheres Therapy®, microcirculation indicators such as the average level of microcirculation, the average value of the nutritional blood flow and the average value of the shunt blood flow were taken into account.

These parameters characterise the general state of peripheral blood flow and the intensity of blood movement along the main and additional pathways of tissue blood supply. The exam results are presented in Tables VIII, IX, and X.

Table VIII. *Average indicators of microcirculation (M±σ).*

Procedure No.	Group 1 (before menopause		group 2 menopause		group 3 postmenopause		All subjects	
	before the procedure	after the procedure	before the procedure	after the procedure	before the procedure	after the procedure	before the procedure	after the procedure
procedure 1	6.67±2.51	5.15±0.83	4.59±2.3	4.77±0.35	5.64±0.74	5.37±1.65	5.98±1.83	5.16±0.93
procedure 2	6.01±0.99	7.69±1.32	4.25±1.12	5.32±0.41	6.67±1.5	5.5±0.51	5.94±1.56	6.78±1.56
procedure 3	5.24±0.65	5.04±1.29	4.62±1.34	6.40±0.30	3.59±0.88	4.42±0.49	4.59±1.1	5.39±1.14
procedure 4	8±2.66	8.89±0.85	5.26±0.81	6.74±0.93	5.92±0.28	5.73±0.18	6.45±1.98	7.29±1.54
procedure 5	6.34±0.77	8.46±2.13	5.06±0.79	7.42±2.69	4.27±0.23	9.96±1.46	5.5±1.34	8.44±2.31
procedure 6	5.16± 1.19	10.53±2.71	4.72±1.33	7.04±0.85	4.52±0.26	4.38±0.32	4.83±1	7.68±3.58
procedure 7	6.23±0.81	9.04±2.22	6.25±0.73	8.99±2.84	5.25±0.34	4.8±0.22	5.96±1.77	7.81±2.66
procedure 8	5.01±0.22	8.61±1.51	4.68±0.29	7.94±0.95	5.22±0.84	5.66±2.59	4.92±1.46	7.48±1.85
procedure 9	6.29±0.08	8.09±1.51	4.02±0.5	6.88±1.83	4.91±1.6	6.06±0.81	5.07±1.27	6.99±1.87
procedure 10	7.06±2.13	7.06±1.37	4.97±1.13	9.37±2.34	5.92±1.21	7.35±1.38	5.84±1.69	8.13±2.32
procedure 11	6.31±1.4	6.9±1	6.15±1.12	6.93±0.55	3.86±0.53	5.95±1.00	5.82±1.35	5.92±1.3
procedure 12	6.01±1.62	7.65±1.21	5.77±2.66	6.99±0.13	4.52±0.91	5.67±0.77	5.14±1.78	6.19±1.62

Table IX. *Mean indicators of nutritional blood flow (M±σ).*

Procedure No.	Group 1 (before menopause)		group 2 menopause		group 3 postmenopause		All subjects	
	before the procedure	after the procedure	before the procedure	after the procedure	before the procedure	after the procedure	before the procedure	after the procedure
procedure 1	3.63±0.46	3.59±2.21	1.86±0.68	1.95±0.91	3.67±0.48	3.23±1.38	3.18±0.94	3.13±0.93
procedure 2	3.75±0.92	6.60±3.00	1.33±0.71	2.38±0.81	3.07±0.45	5.5±0.86	3.12±0.55	5.31±1.13
procedure 3	2.62±0.81	4.8±1.04	1.82±1.62	3.78±0.66	1.4±0.15	4.03±0.66	2.01±0.4	2.98±1.61
procedure 4	6.43±1.13	7.09±1.84	2.38±1.28	3.85±0.55	2.59±0.59	5.18±0.60	3.95±0.46	5.4±1.54
procedure 5	4.16±0.91	7.55±1.67	2.36±0.73	5.01±1.8	1.77±0.64	3.82±0.57	3.05±0.22	5.67±1.18
procedure 6	3.90±0.83	7.98±1.87	1.29±0.61	4.57±1.8	1.81±1.21	3.91±0.49	2.40±0.85	5.19± 1.14
procedure 7	4.66±1.03	8.18±2.45	2.01±0.72	6.89±1.19	2.35±0.94	3.05±0.79	2.86±0.8	5.87±1.72
procedure 8	4.04±0.88	7.94±2.47	1.44±0.62	4.48±0.93	2.35±0.81	2.73±0.46	2.44±0.34	4.97±1.99
procedure 9	5.53± 1.15	5.53±2.11	1.19±0.39	5.28±1.77	1.98±0.57	4.93±1.9	2.9±1.15	5.25±1.84
procedure 10	6.07±0.73	6.44±2.25	1.74±0.9	7.49±2.79	4.41±1.8	5.07±2.6	3.74±1.37	6.50±1.57
procedure 11	3.93±0.97	3.78±2.59	2.58±1.14	3.22±0.83	2.02±0.83	3.77±1.02	2.94±0.54	3.33±1.68
procedure 12	4.20±1.10	7.65±2.10	1.45±0.49	2.18±0.79	3.32±0.77	4.17±2.17	2.38±0.74	4.07±1.77

Table X. *Mean values of shunt blood flow (M±σ).*

Procedure No.	Group 1 (before menopause)		group 2 menopause		group 3 postmenopause		All subjects	
	before the procedure	after the procedure	before the procedure	after the procedure	before the procedure	after the procedure	before the procedure	after the procedure
procedure 1	3.05±0.89	1.56±0.38	3.73±0.82	3.22±0.76	1.97±1.22	2.15±0.73	2.8±2.03	2.03±1.14
procedure 2	2.26±0.65	1.10±0.90	2.92±0.85	4.04±0.98	3.6±2.05	2.45±1.25	2.82±1.81	1.47±2.02
procedure 3	2.62±0.27	2.23±1.16	2.8±0.9	2.62±0.71	2.19±1.03	2.39±0.85	2.58±1.39	2.42±1.62
procedure 4	1.57±0.36	1.8±0.62	2.88±0.49	2.89±1.12	3.33±0.32	1.55±0.78	2.5±1.12	1.90±2.14
procedure 5	2.18±0.91	0.91±0.57	2.7±0.97	2.41±1.37	2.5±1.13	4.64±1.2	2.45±1.26	2.78±2.71
procedure 6	1.26±0.47	2.55±1.17	3.43±1.01	2.47±1.21	2.71±0.95	2.47±0.52	2.44±1.46	2.50±2.33
procedure 7	1.57±0.22	0.87±1.22	4.23±1.2	2.11±1.11	2.90±1.37	2.75±0.93	3.09±1.99	1.94±1.53
procedure 8	0.97±0.36	0.68±0.35	3.24±0.42	3.46±0.95	2.87±0.88	2.93±1.13	2.48±1.27	2.51±1.85
procedure 9	0.76±0.47	2.57±0.63	2.83±0.51	1.6±0.99	2.94±1.22	1.13±1.09	2.17±1.32	1.74±2.02
procedure 10	1.99±0.4	0.62±0.28	3.23±0.71	1.88±0.75	1.51±0.59	2.29±0.22	2.10±1.26	1.63±2.04
procedure 11	2.39±0.37	1.12±0.58	3.57±1.09	2.71±1.32	1.84±0.41	2.18±0.34	2.89±1.83	2.09±1.35
procedure 12	2.13±0.41	1.65±0.64	4.33±1.17	3.81±0.93	1.20±0.54	1.50±0.40	2.76±2.22	2.12±1.73

In Figs. 5-16, we can see the dynamics of changes in microcirculation during twelve procedures before and after exposure. It should be noted that the study participants were healthy women without trophic changes in the microvascular system, which affected the overall picture of the measurement results.

At the same time, dynamic observation and analysis of trend lines on the graphs revealed a significant effect of Endospheres Therapy® on the blood supply to the upper layers of the skin, especially when comparing the indicators of different groups of subjects.

In Group 1, with insufficient initial average microcirculation, there was a clear trend towards an increase in microcirculatory response to impact; Group 2 showed a significant improvement in the microcirculation level and a significant increase in microcirculatory activity during therapy; Group 3, improvement in microcirculation was observed only by the end of the 12th procedure.

A comparison of the values of nutritive and shunt blood flow revealed a redistribution of the level of blood supply towards the main flow, which was especially significant in the subjects in groups 1 and 3.

Since the restoration of microcirculation naturally leads to the activation of cellular metabolism and the synthesis of macroergs necessary for tissue repair and restoration of its function, an improvement in tissue perfusion can lead to a significant reduction in cellulite.

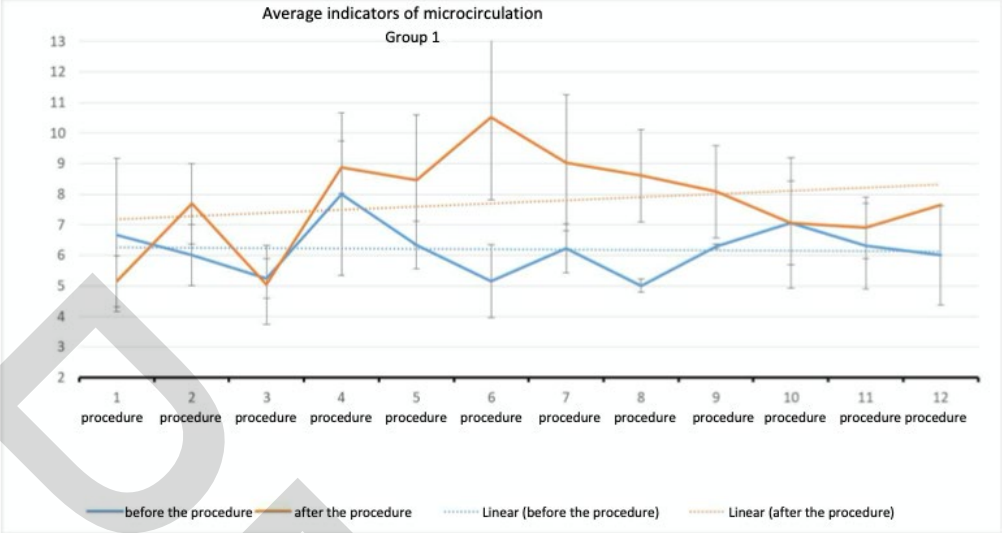

Fig. 5. *Average indicators of microcirculation in patients of Group 1.*

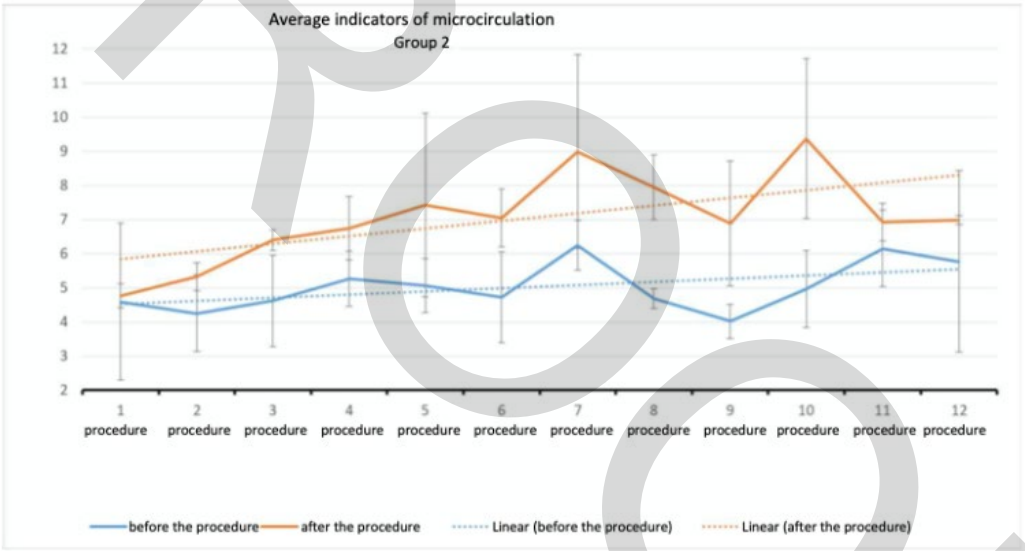

Fig. 6. *Average indicators of microcirculation in patients of Group 2.*

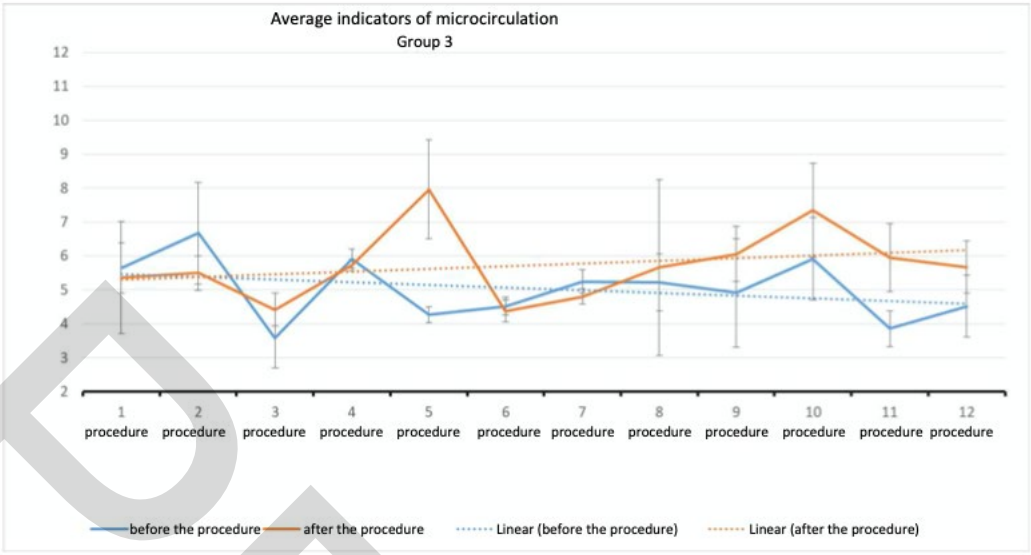

Fig. 7. *Average indicators of microcirculation in patients of Group 3.*

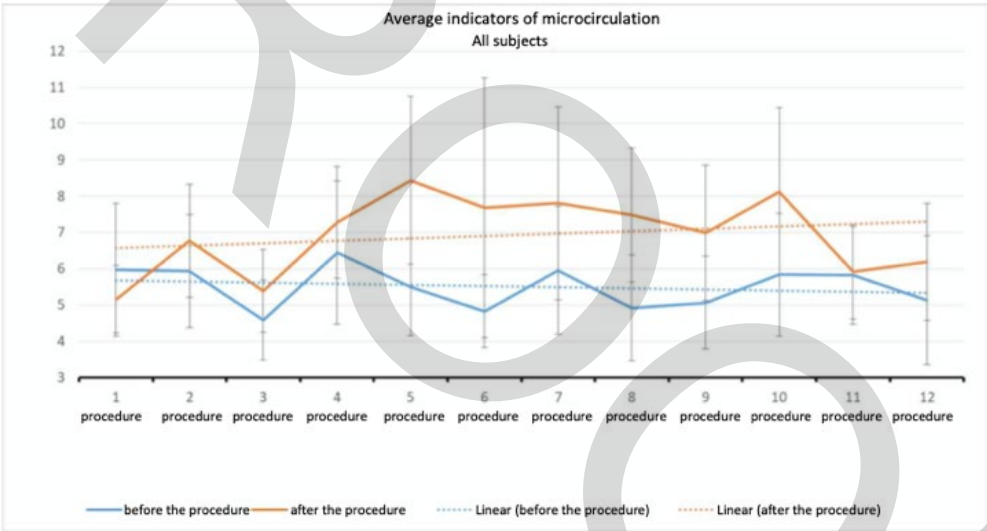

Fig.8. *Average parameters of microcirculation in all patients.*

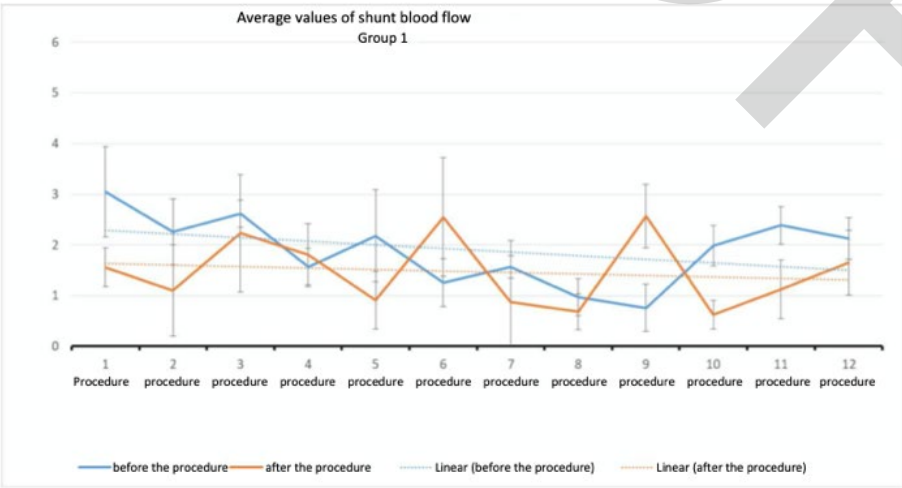

Fig. 9. *Average values of shunt blood flow in patients of Group 1.*

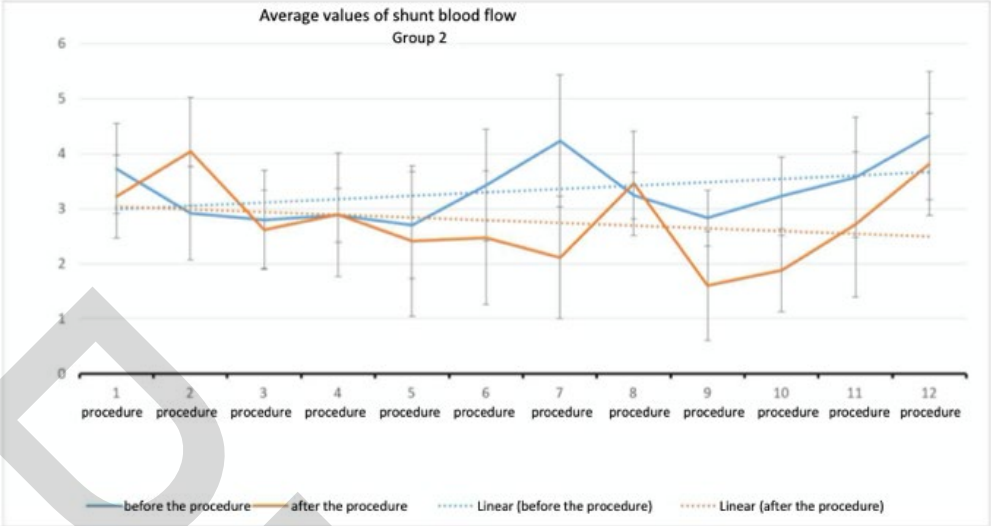

Fig. 10. *Average values of shunt blood flow in patients of Group 2.*

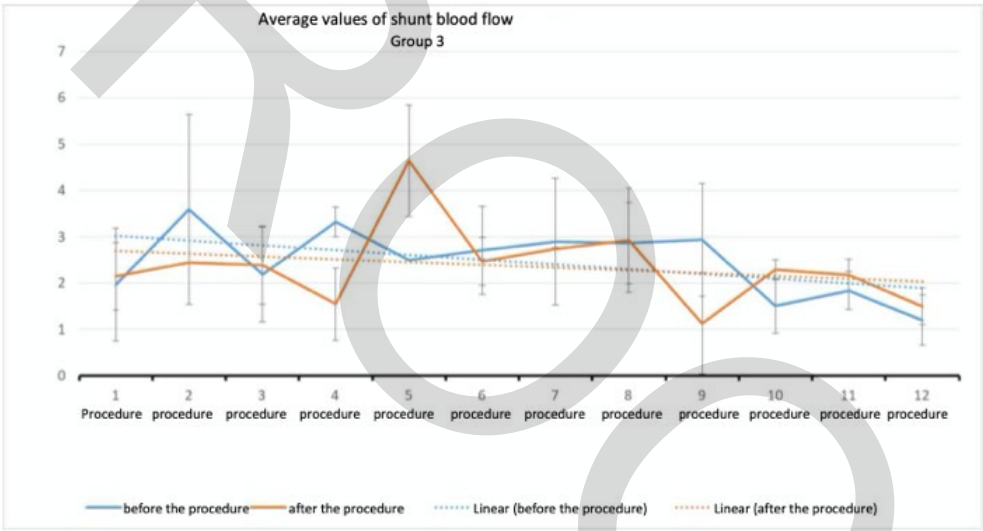

Fig. 11. *Mean values of shunt blood flow in patients of Group 3.*

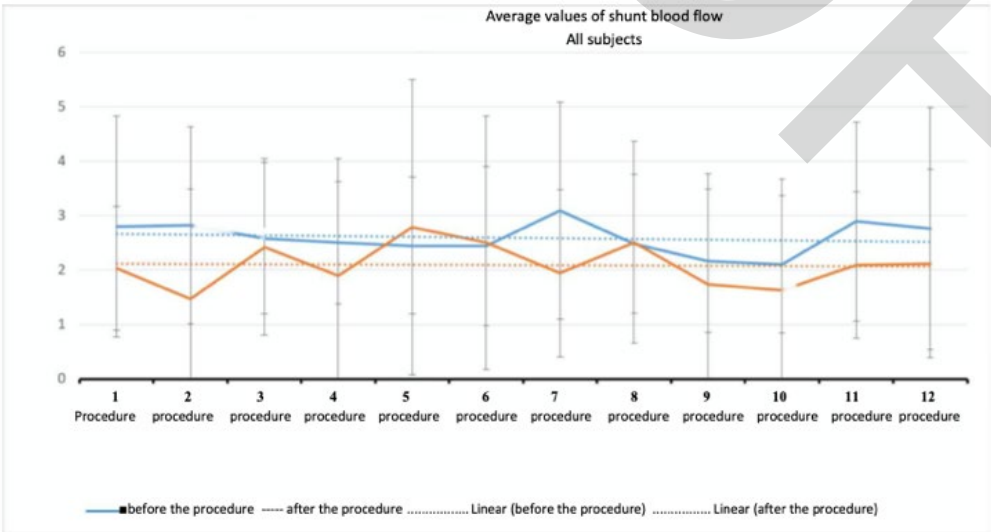

Fig. 12. *Average values of shunt blood flow in all patients.*

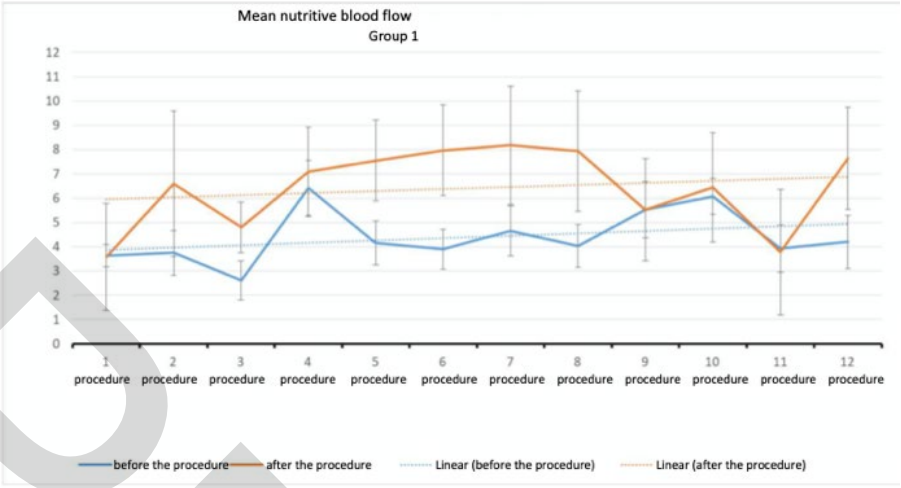

Fig. 13. *Mean values of nutritional blood flow in patients in Group 1.*

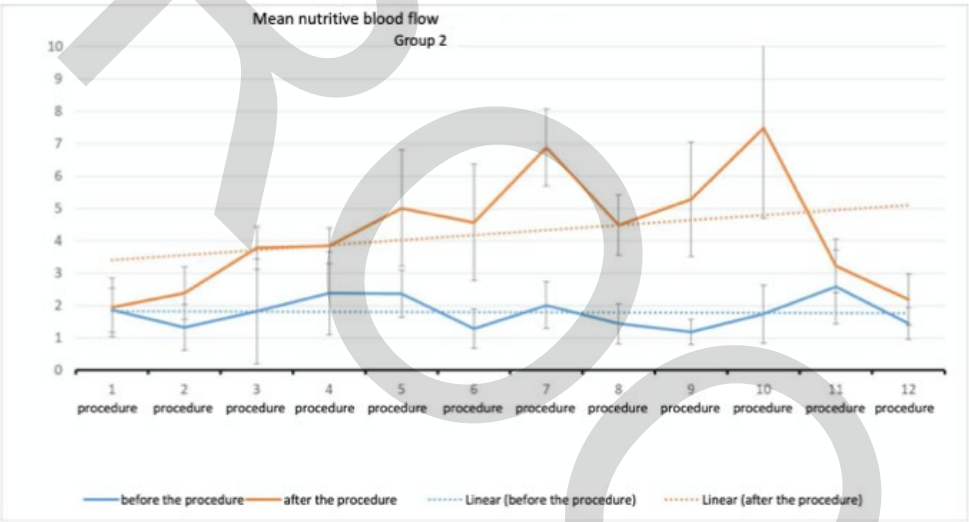

Fig. 14. *Mean indicators of nutritional blood flow in patients in Group 2.*

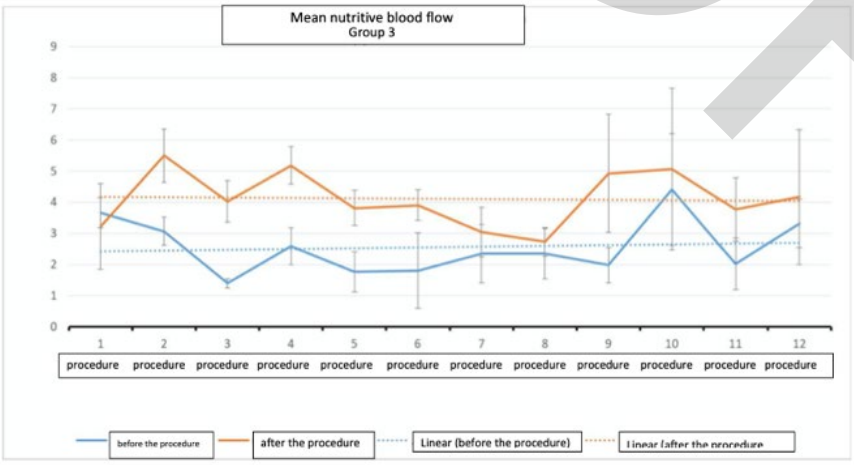

Fig. 15. *Mean indicators of nutritional blood flow in patients of Group 3.*

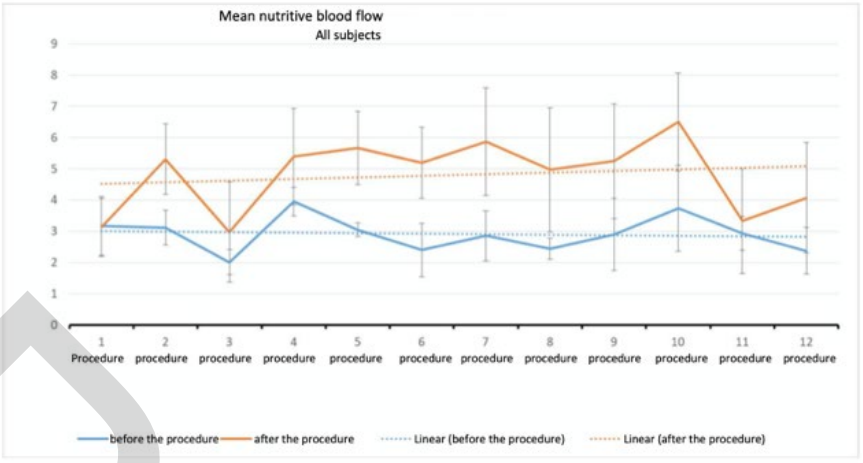

Fig. 16. *Mean values of nutritional blood flow in all patients.*

Results of subjective assessment of satisfaction with Endospheres Therapy® procedures

The results of clinical, instrumental and laboratory studies are traditionally considered criteria for the effectiveness of the treatment methods. At the same time, they do not always reflect the change in the well-being of patients and the dynamics of their behavioural reactions in the surrounding reality and quality of life, including social, psychological and emotional aspects. In women during menopause, an age-related physiological restructuring of the body occurs, and it is significant in this situation that the principle of "participation" is observed, i.e. the direct participation of the patient in the assessment of her health, since the subjective perception of her condition does not always correspond to the received objective data.

In this regard, a new definition of the questioning and/or scaling process is proposed - "patient-reported outcomes", which involves obtaining any information containing a description of the subjective assessment of the patient's symptoms and her opinion about their dynamics resulting from certain impact factors.

After completing the "Endospheres Therapy®" course, all project participants answered the questionnaire questions designed to evaluate satisfaction with the achieved results (Appendix 1). The results of the analysis of the questionnaires showed the following:

- the comfort of the procedures was noted by 100% of the respondents;
- unpleasant sensations during the procedure were noted by 22.2%, not noted by 77.8%;
- muscle soreness after the procedure (like after going to a gym) was experienced by 33.3%;
- lightness in the body after the Endospheres procedure was experienced by 100% of the respondents;
- the effect after the 1st Endospheres Therapy® procedure was noticed by 44.4%; after 6 procedures - 100%; after 12 - 100%;
- after the course of procedures, "Endospheres Therapy®" weight decreased in 88.9% of the participants;
- external body appearance improvement was noted by 100% of women;
- skin rejuvenation effect - 100%;
- smoothness, elasticity and firmness of the skin - 100%;
- when evaluating the condition of cellulite after the course, pronounced changes were noted by 55.6%, the answer "rather yes than no" - 44.4%, "I do not know" - 11.1%;
- the normalisation of muscle tone after the course of the Endospheres Therapy® procedure was noted by 77.8%;
- 100% of the participants responded positively to the question, "Did you like the Endospheres Therapy® procedure?";
- 77.8% of women expressed their desire to repeat the Endospheres Therapy® course.

To the question “Rate how this procedure met your expectations from 1 to 10, 1 - very bad, 10 - excellent: 88.9% chose “10” - “excellent”, 11.1% - “9”.

The results obtained demonstrated satisfaction with the Endospheres Therapy® course, and they confirm the procedure’s high quality and the specialists’ level of work.

Fig. 17 illustrates the effects of Endospheres Therapy® treatments on cellulite in project participants in different age groups.

Fig. 17. *Photos of patients with cellulite: before and after Endospheres Therapy® treatments. 1 - group 1, 2 - group 2; 3 - group 3.*

DISCUSSION

The study aims to evaluate the effectiveness of the “Endospheres Therapy® Body” compressive microvibration in cases of fibrosclerotic panniculopathy in females around the menopausal period.

Our society is experiencing a dramatic period of adipose pandemic characterised by a correlation between increased visceral fat, adipose disorders, venolymphatic insufficiency, endothelial dysfunction and fibrous transformation of the adipose-connective structures of the female subcutaneous tissue, especially in the abdomen and lower limbs, knowing that these transformations, even if often advertised as banal blemishes and suffered by patients as aesthetic dramas or psychodramas, are in truth expressions of actual endocrine, metabolic or vascular pathologies, even disabling ones, which sometimes present themselves as a symptom of pathological alterations in other locations (for example orange peel skin typical in celiac disease, intestinal inflammation, lipolymphedema or premenopausal fibroedema), more often they are pathologies in themselves, as in lipoedema, lipodystrophy or menopausal adipose cellulite (22-25).

The patients studied in the present work were very similar from the point of view of the metabolic structure; all presented increased visceral adipose tissue (ICD Code 278.1), adipose hypertrophy (ICD Code 729.30), diffuse adiposity (ICD Code 278.0), connective tissue /Fibroedema (ICD Code 728.3), are all endocrinometabolic pathologies characterised both by a reduction in microcirculation, both in the skin and in the subcutaneous tissue and in the muscle, and by the fibrosclerotic tendency of the adipose and connective structures of the subcutaneous tissue (26).

During menopause, the female body undergoes enormous changes that negatively affect the body structure and appearance of a woman; the doctor’s greatest goal is, therefore, to try to slow down the evolution of the phenomena and the appearance of the alterations that transform a period of physiological in a moment of

suffering for chronic and degenerative pathologies connected to the time of menopause, such as obesity, arthrosis, venolymphatic insufficiency, diabetes, various forms of dyslipidemia, intestinal inflammation and tissue prolapse. For these reasons, the first therapy is prevention, which can only be performed with the collaboration of the patient in terms of lifestyle, physical activity, a suitable diet and non-invasive physiotherapy or dermo-cosmetic treatments.

The compressive microvibration "Endospheres Therapy® B has shown its action above all in tissue vascularisation by restarting the mitochondrial energetic activities, which are essential for the purification of the tissues and for the reactivation of the stem regenerative activities, therefore a brake on the degenerative processes and stimulation of physiological reactions, with visible results confirmed by the patient's satisfaction with the aesthetic and symptomatic improvement, in addition to the data from the microcirculatory evaluation tests and the metabolic impedancemetry which highlighted the tendency towards fat tissue reduction above all with reduction of inflammation and insulin-dependent processes.

The eco-scanner tests are of minor importance since the morphological variations are slight and much slower than the physiological and metabolic variations; by their nature, non-invasive treatments have the characteristic of having longer action times precisely because they act on the purification/regeneration processes of the interstitial matrix. The data collected in the test demonstrate slight but significant variations, which must be interpreted in a metabolic and not a morphological sense.

Instead, based on the bio-impedancemetry results, we observed that after 12 treatment sessions, the fat mass index normalised for height (kg) decreased to different extents, depending on the age of the patients. In contrast, cell mass is active, muscle mass weight and the specific basal metabolic rate increased, and the classification index for body fat percentage decreased. Furthermore, it has been established that under the impact of "Endospheres Therapy®" an improvement in the microcirculation of integumentary tissues is observed: a comparison of the values of nutritional and shunt blood flow revealed a redistribution of the level of blood supply towards the main flow, which contributes to the activation of cell metabolism and the synthesis of macroergs required for tissue repair, restoring its functions and improve tissue perfusion.

Thus, "Endospheres Therapy®" solves at least 3 main problems of the pathogenesis of cellulite - impaired microcirculation in the gluteal-femoral tissue, which leads to hypoxia, a morphological and functional improvement in the skin condition and the destruction of fibrosis of the subcutaneous connective tissue. In addition, Endospheres Therapy® procedures have been proven to be safe and effective in the long-term treatment of cellulite and free of eventual side effects. Patients noted a high degree of satisfaction with the Endospheres Therapy® course, which indicates the quality of the procedures and the level of specialists.

These results confirm the pathophysiological observations referred to the treated patients.

CONCLUSION

The involvement of many complex physiopathological mechanisms in the various vital processes of the body suggests that cellulite is not only a cosmetic problem but also develops as a result of several homeostatic disorders, which requires an integrated approach to its treatment (27).

Our results have convincingly demonstrated the effectiveness of the Endospheres Therapy® procedures for treating cellulite, with an effect that persists for at least 60 days after the course of therapy.

The study indeed confirmed the initial hypotheses and the purpose of the work, confirming both the correspondence between clinical symptoms and the therapy used and the correspondence between the study methodology and the non-invasive diagnostics used, with a work scheme that confirms the clinical and scientific significance of the work, and which offers the possibility of being reproduced, perhaps with a more significant number of patients.

In conclusion, the purpose of the study is confirmed by the results obtained. However, it is above all, the well-being reported by the patients and the improvement of the microcirculation highlighted by the studies that place compressive microvibration “Endosphères Therapy” as an important non-invasive treatment for the treatment of fibroedema in menopause but above all as an important weapon of prevention of overweight and obesity, as well as slowing down the development of related chronic diseases.

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Appendix 1

Endospheres Therapy® Satisfaction Questionnaire

FULL NAME _____

Age _____

Date of Birth _____

Were you comfortable with the Endospheres Therapy® procedure?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did you experience any discomfort during the Endospheres Therapy® procedure?

1. Yes
2. Not
3. Do not know
4. Rather yes than no

5. Rather no than yes

Have you experienced any muscle soreness after the Endospheres Therapy® procedure (like after going to a gym)?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Have you experienced lightness in your body after the Endospheres Therapy® procedure?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did you notice any effect after the 1st Endospheres Therapy® procedure?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did you notice any effect after the 6th Endospheres Therapy® procedure?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did you notice any effect after the 12th Endospheres Therapy® procedure?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Has your weight changed since the Endospheres Therapy® course?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Has the appearance of your body improved?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did you feel the effect of skin rejuvenation?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did the skin become smooth after the Endospheres Therapy® course of procedures?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did the skin become elastic and tightened after the course of the Endospheres Therapy® procedures?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Have stretch marks become less noticeable, if any?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Please rate whether the situation with cellulite has changed after the course, if it was present before?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did muscle tone return to normal after a course of Endospheres Therapy® procedures, if it was not normal?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

How does your skin look after a month of Endospheres Therapy® procedure? Describe in a few words:

Did you follow the recommendations after the Endospheres Therapy® procedure (drink more water, douche, try not to eat unhealthy food, etc.)?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Did you enjoy the Endospheres Therapy® procedure?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Describe in a few words your feelings and impressions after the course “Endospheres Therapy®” (12 procedures):

_____

How does your skin look after 2 months of Endospheres Therapy® procedures? Describe in a few words: Would you take the Endospheres Therapy® course again?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Will you be attending Endospheres Therapy® follow up procedures (once every 2 weeks) after completing the course?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Do you play sports?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Do you receive other massages or other body treatments?

1. Yes
2. Not
3. Do not know
4. Rather yes than no
5. Rather no than yes

Rate the extend to which the procedure met your expectations, 1 to 10, 1 - very bad, 10 - excellent: Rate how satisfied you are with the quality of the Endospheres Therapy® procedure, 1 to 10, 1 - very bad, 10 - excellent:
_____

Rate how satisfied you were with the work of a specialist in general, 1 to 10, where 1 is very bad, 10 is excellent:
_____

Also, if you want, you can add something (for example, your feedback, comments or suggestions, what you liked, what you didn't like, what is missing, etc.):_____

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