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Original Article

The effect of the instrument-assisted soft tissue mobilization technique on cellulite located in the lower quarter of the body

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Abstract:
The study focuses of cellulite, conducted among 30 healthy non-athletic women without increased level of body fat, aged between 25-40. They were randomly divided in two groups (control- CG and experimental- EG). For a month both groups were subjected to anti-cellulite treatment procedures three times per week. A thorough evaluation on each patient`s stage of cellulite (according to Cellulite Severity Scale CSS) was made, together with assessment of body composition and parameters of buttocks and thighs (according to Global Aesthetic Improvement Scale -GAIS). The CG women were subjected to 40-minute procedures of anti-cellulite thigh and buttocks massage. The Experimental group participants were subjected to the same procedures together with instrument-assisted soft tissue mobilization (IASTM) of the cellulite-affected areas. The results have shown statistically significant reduction of the observed parameters in the EG (about 5 cm), as a result of the applied IASTM technique on the affected areas. The CCS scale showed improvement in both groups but the effect was proven superior in EG compared to CG. The GAIS scale showed satisfactory results for EG (28% improved, 42% much improved and 30% very much improved) compared to CG at the end of the study. In conclusion, the results of the group of IASTM techniques (EG) exceed those of the other group (CG) and occur faster. In this way IASTM techniques prove be a great addition to manual massage being as effective, affordable and a completely safe way of reducing and removing cellulite in problematic body areas.
Key Words*:* **- Cellulite, ERGON® IASTM Technique, Cellulite Severity Scale, Global Aesthetic Improvement Scale**

Introduction

Cellulite is a multifactorial condition affecting nearly 80-90% of women past puberty. A rough, localized skin condition is most commonly seen on the thighs, lower buttocks and abdomen, with visible deformations of the skin surface (grainy and porous texture of the skin), resembling dimples or "orange peel" recognizes it. The first definition of the problem dates back to 1978, when German scientists Nuremberg and Müller described cellulite as the result of gender differences in skin structure and the presence of excess subcutaneous fat (Rudolph et al., 2019).

Various studies show that in women, vertically arranged fibrous tissue cords allow the subcutaneous fat to protrude, forming a wrinkled skin texture. The cross structure of the fabric in men prevents this phenomenon from occurring. Recent studies confirm these structural sex-related differences and further develop the cause of cellulite as the result of several overlapping physiologic changes, such as focally enlarged fibrosclerotic cord tissue that connects the skin in areas of cellulite and/or uneven dermo -hypodermal connection. Due to its widespread prevalence in women, cellulite is perceived as a secondary characteristic of gender rather than a type of disease, and remains one of the main aesthetic concerns of the female half of humanity (Zerini et al., 2015, Bayrakci Tunay et al., 2010, Avramova, 2021).

Gender differences in fascial architecture have been observed from birth it tends to be more common in white women (Rudolph et al., 2019). Cellulite tends to worsen with age, and laxity is one of the major skin aggravating factors that may be considered in the efficient diagnosis, treatment, and prevention of this condition (Lorencini et al., 2015) especially in women over 30 and especially after childbirth. The pathophysiology of cellulite formation remains to be fully elucidated; however, it appears to be a multifactorial process in which the number and types of fibrous septae, microvascular dysfunction, subcutaneous inflammation and fibrosis, decreased dermal thickness with age, and adipose tissue deposition may all play a role. For example, estrogen, oxidative stress, and inflammation may promote fluid retention by altering local vascular and lymphatic drainage, resulting in edema (Young, et al., 2020, Lorencini et al., 2015).

Nowadays, there is still no effective and long-term solution to the problem of cellulite (Zerini et al., 2015). A number of scientific studies verify the effect of applying various mechanical, chemical, physical and

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other methods to reduce or eliminate it. Most of them report good results but do not track long-term performance. However, some existing scientific research helps us understand the physiology of cellulite and explains its occurrence. Morphologically, cellulite is regarded as lipodystrophy, or rather as the degeneration of adipose tissue (Sadowski et al., 2020; Bass, Kaminer, 2020; Tokarska et al., 2018). This serves as a good guide as to the methods of dealing with this problem and points to adequate treatment approaches. Cellulite treatment is tedious and expensive, and its effectiveness is doubtful.

Potential strategies for reducing and eliminating cellulite include a variety of non-invasive interventions such as mechanical stimulation to improve lymphatic drainage; local therapy to improve circulation or to reduce fat deposition or inflammation; acoustic wave therapy (AWT); or the application of laser, light or radio frequency energy and minimal invasive techniques such as subcision or collagenase clostridium histolyticum injection (Young, DiBernardo, 2020). The effectiveness of some of these strategies has been proven by scientific studies, but many of them are not supported by strong scientific evidence. In addition to the ones listed, other approaches are being sought to deal with this serious aesthetic and systematic problem.

Massage techniques have been proven effective during the process of cellulite reduction. In recent years, manual massage is increasingly assisted with various techniques for instrumental soft tissue mobilization. The methods of instrument-assisted soft tissue mobilization (IASTM) are relatively innovative and there is not yet a sufficient number of scientific studies regarding their effectiveness and their role in combating this type of problem. Similar to massage, the movements used during IASTM treatments vary in direction, force, and pattern and allowing the pressure to be to be dispersed to the underlying tissues. IASTM facilitates the healing process through increased fibroblast proliferation and increased collagen synthesis, maturation, and alignment (Seffrin et al., 2019). IASTM techniques mobilize the cross-links between connective tissue, stimulate anabolic processes of soft tissue and reduce the stiffness of already formed accumulations of connective tissue. In other hand the techniques induce controlled micro injuries to induce linear tissue reattachment, change the microvascular morphology, induce hyperemia and increase fibroblast recruitment and activation leading to regeneration and restoration of the injured collagen. All this leads to a faster, easier and more effective reduction of the levels of fat cells in the tissues, their easier release and elimination. Furthermore, IASTM techniques accelerate tissue recovery through increased blood flow and fibroblasts activation and restore elasticity of soft tissue (Mylonas et al., 2019).

Initially IASTM was used in sports rehabilitation due to the need to reduce recovery time, but in recent years it has become an accessible method for the general population (Loghmani, 2016; Zlatkov et al., 2021; Mylonas et al., 2021; Ikeda et al., 2019). Modern types of interventions applying a combined approach of exercises with the use of soft tissue mobilizations with instruments are: GuaSha, Graston, Ergon, Hawk Grips and Rock Tapes. These instruments have different sizes, shapes and specific handling and grip, they are used on the skin after applying a gel that reduces friction in the region of the area to be treated, thus facilitating passage through the tissue (McMurray et al., 2015; Wagner, 2015). The tools break down cicatrixes and fascial restrictions. The therapist locates the area and then mobilizes it by applying the required amount of force to the specific location. The applied force is aimed at the specific constraints and adhesions (Schaefer et al., 2012).

The purpose of the present study is to measure and evaluate the effect of instrument-assisted soft tissue mobilization (IASTM) technique as a supplement to anti-cellulite manual massages and as another treatment in cellulite reduction in women in the area of the lower body quarter.

Material & methods

The study was conducted in the University Research Sports and Rehabilitation Center “Bachinovo” in the period May-July 2022. Informed consent for participation and use of personal data for scientific purposes was obtained from all participants

Participants

30 healthy untrained women aged 25-40 participated in the study with a cellulite located on the thighs and/or buttocks. They were randomly divided into 2 groups - control (n=15) and experimental (n=15). In a period of 4 weeks, the two groups visited the center 3 times a week for procedures. The control group was applied only manual anti-cellulite massage for 40 min, and the experimental group was also applied manual anti-cellulite massage in addition with IASTM technique with ERGON® tools for the same timing and period. For the cellulite treatment was applied basic ERGON® IASTM techniques: Rub, Wave, Snake, Razor, Globe, Cyriax, Switch, Sep and Excave following the protocol for each treated area. Both groups reduced their carbohydrate intake and increased their daily water intake. The motor mode of the subjects was not changed and they continued to take walks in their free time.

Procedure and Test protocol

The participants were measured body composition, centimeters of buttocks and thighs, assessment of cellulite according to the Cellulite Severity Scale (CSS) and Classification, as well as assessment before and after the procedures according to the Global Aesthetic Improvement Scale (GAIS).

The following anthropometric parameters were registered and measured by bioimpedance analyzer (Tanita): age (years), height (cm), body mass (BM, kg), body mass index (BMI, kg/m2), lean body mass (LBM, kg), and mass of body fat (MBF, kg).

Hip circumference was measured undressed by standing straight to the nearest 0.1 cm using a flexible narrow non-stretch tape. Measurements were done at the largest circumference around the buttocks, embracing both trochanters. Thigh circumference was measured at 8, 16, and 24 centimeters to account for fat deposits at different levels of the lower limb.

Five key clinical morphologic features of cellulite were identified by the CSS of Hexsel Dal'Forno & Hexsel (2008): (A) the number of evident depressions; (B) depth of depressions; (C) morphological appearance of skin surface alterations; (D) grade of laxity, flaccidity or sagging skin; and (E) the classification scale originally described by Nürnberger and Müller. The CSS objectively adds additional morphologic characteristics of cellulite to the other classifications. By summing the scores of the five items, the CSS facilitates the objective classification of cellulite as mild, moderate, or severe. This scale allows a more complete and comprehensive assessment of the state of cellulite in different individuals.

To evaluate subject satisfaction, subjects were asked to complete a questionnaire. On days 10 and 30 subjects were asked how they were asked to evaluate their change of appearance after treatment by using GAIS. It is a five-point scale for accessing global aesthetic improvement in physical appearance compared to pretreatment. Ratings range from very much improved, much improved, improved, unchanged, and worsened. The evaluation is assessed by the researcher and/or the subject.

Data collection and analysis / Statistical analysis

All anthropometric indices and indexes are presented as means with standard deviations (SD) and coefficients of variation, obtained by descriptive statistics. To measure the differences between mean values, the nonparametric test of Mann-Whitney, the Kruskal-Wallis ANOVA test, and Dunn's post hoc test were applied.

Results

The results obtained from the conducted research show that the two groups of examined women do not differ statistically of the anthropometric parameters. The CG and EG data are presented in Table 1. No statistically significant difference (Mann Whitney test, ns) was found in the two studied groups with respect to height, body mass, mass of body fat (kg), percent of body mass (%), soft lean mass (kg) and body mass index (kg/m^2). In both groups the average percentage of fat was normal (21.0-32.9% for CG and 23.0-33.9% for EG), which is believed to be closely related to cellulite and its accumulation as fat deposits. Although in both groups there is one person with a high percentage of body fat − 35.9 in the CG and 36.3 in the EG, respectively (Gallagher, et al., 2000). The study included women with normal weight, which can be seen from the BMI, which averages 22.3 and 22.8 kg / m2 in both groups. The normal body mass index is in the range of 18.5–25 kg / m2 (Roberts & Dallal, 2001). The data presented show that the groups with similar results are assumed to be homogeneous and further differences in the obtained results are due to the difference in the techniques used to treat cellulite

Table 1. Anthropometric indicators and body composition of the two studied groups

Parameters	*CONTROL GROUP (n=15)*	*EXPERIMENTAL GROUP (n=15)*	*P*
Age (years)	33.2 ± 3.9	34.2 ± 3.4	0,2532
Height (cm)	163.4 ± 4.3	166.2 ± 7.8	0,1028
Body mass (kg)	59.9 ± 5.8	60.6 ± 9.8	0,4669
Mass of body fat (kg)	17.5 ± 3.9	18.4 ± 6.3	0,3700
Percent Body Fat (%)	28.2 ± 3.8	28.6 ± 6.3	0,3858
Soft lean mass (kg)	38.5 ± 2.8	40.1± 4.1	0,1451
Body mass index (kg/m^2)	22.3 ± 1.8	22.8 ± 3.7	0,4423

It was shown that at the beginning of the study, both groups had similar values of hip and thigh circumferences, and after the 4-week application of anti-cellulite treatments, statistically significant differences ($p<0.05$) were observed only in some EG values (Table 2). The obtained results of the centimeters of the hip and thighs show a statistically reliable reduction of the centimeters in the EG as a result of the applied IASTM technique (Table 2). The most significant difference was at 24 cm thigh circumference, where EG reduced its circumference by nearly 5 cm compared to the beginning of the procedure and from 57.1 ± 6.1 it became 52.5 ± 6.2, while in CG the circumference decreased by only 1.5 cm. Such statistically significant differences were also found in the hip circumferences, as after the application of the IASMT technique, in the EG the hip circumference was reduced by 5.2 cm, and in the CG it decreased by only 2.5 cm. The lack of statistically significant differences ($p<0.05$) mainly in these 2 areas corresponds to the places where cellulite is accumulated - the upper thighs and buttocks.

The cellulite severity scale allows the qualitative and quantitative assessment of key clinical and morphological aspects that in our subjects showed a better response in EG after the adjunctive IASTM technique compared to CG in which only manual massage was used. The values of CCS show that the EG of 11.2 ± 1.4,

which according to the scale was defined as a classification of 11-15 - Severe, at the end of the study became 5.1 ± 1.3, which was defined as mild. At CG, the values of CCS at the beginning of the procedures scores were 10.6 ± 1.8 and improved to 8.9 ± 1.7, which is defined as moderate on the scale. The improvement in the values of cellulite in EG was 3.8 points on the CCS scale compared to CG. The differences between the two groups showed better results in EG after the application of IASMT and reduction of cellulite compared to CG, where only manual anti-cellulite massage was applied. All elements of the CSS (number of depressions, depth of depressions, morphology of skin surface alterations, presence of flaccidity and grade of cellulite) and showed better results in EG after the applied IASTM technique compared to CG, where had less improvement in the scores.

Table 2. The values of measurements taken in women before and after anti-cellulite procedures

Region/Scale		*Control Group*		*Experimental Group*	
		Before	***After***	***Before***	***After***
Left Thigh (cm)	*8 cm*	43.8 ± 3.7	42.9 ± 3.5	43.0 ± 2.8	40.8 ± 3.9
	16 cm	51.0 ± 4.3	49.4 ± 4.5	50.7 ± 4.8	47.6 ± 5.5
	24 cm	56.9 ± 4.4	55.4 ± 4.8	57.1 ± 6.1	52.5 ± 6.2*#
Right Thigh (cm)	*8 cm*	43.6 ± 3.1	42.7 ± 3.2	43.0 ± 3.0	40.9 ± 4.1
	16 cm	57.7 ± 4.3	49.2 ± 4.4	57.0 ± 5.8	47.7 ± 5.6
	24cm	56.0 ± 4.1	55.0 ± 4.6	56.9 ± 6.2	52.6 ± 6.4*#
Hip (cm)		103.9 ± 8.7	101.1 ± 8.7	102.2 ± 9.3	97.0 ± 9.3*#
CSS		10.6 ± 1.8	8.9 ± 1.7	11.2 ± 1.4	5.1 ± 1.3* #

Designation: Cellulite Severity Scale (CSS);
*Statistically significant difference ($p < 0.05$) as compared to control group (Mann Whitney test).
#Statistically significant difference ($p < 0.05$) as compared to before period (Wilcoxon matched pairs test).

The results of the GAIS show good satisfaction with the procedures in both groups of women. As about 50% of the participants had seen an improvement 1 week after starting the anti-cellulite treatment, with EG the percentage of much improved being 20% greater than CG (Fig 1). On the basis of researcher-evaluated GAIS scores, the cellulite located on the thighs and/or buttocks and appearance had improved in all participated women in EG after the end of the procedures (28% improved, 42% much improved, and about 30% very much improved). While in the CG at the end of the procedure, about 5-6% of individuals were still reported no change. According to the GAIS scale, more satisfactory results were reported for EG compared to CG within 4 weeks of application of the IASTM technique.

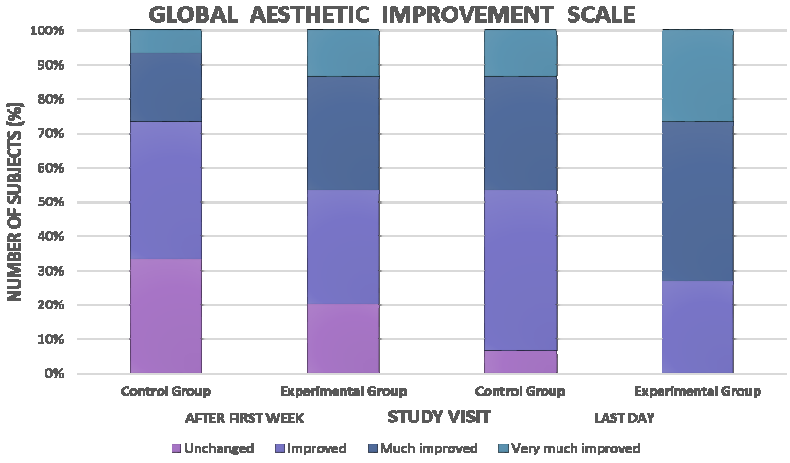

Fig 1. Percentage of subjects with an improvement in GAIS after first week and last day of the study visit

Dicussion

The formation of cellulite is still a matter of deep debate. It is considered an endocrine-metabolic microcirculatory disorder that causes changes in the interstitial matrix and structural changes in subcutaneous fat and connective tissue. However, its pathogenesis is not fully understood. Key factors include, among others, connective tissue structure, and some hormonal changes (Zerini et al., 2015). Recent studies show that body composition is a major determinant of health and the physical condition of the research contingent (Dzimbova et al., 2022). Data of the studied contingent corresponded with those of healthy subjects and showed that the groups

were homogeneous. All measured indices show that there are no values outside the norms for healthy individuals and are characteristic of the females in the studied age range SLM includes not only muscle mass, but the mass of bones and body fluids (Tsvetkova-Gaberska et al., 2022). It is known (Burke & Deakin, 2015) that maximum bone density with proper nutrition and physical activity can be reached around the 35th anniversary of a person. Both groups are quite heterogeneous in terms of anthropometric parameters which can help us more accurately determine the effect of the procedures performed. In addition, lifestyle factors such as a high-carbohydrate diet or sedentary habits may promote cellulite formation via effects on body fat content or vascular stasis, respectively (Rudolph et al., 2019). Also treatment options for cellulite are varied and numerous (Sadowski et al., 2020; Bass, Kaminer, 2020; Tokarska et al., 2018). The final objective of these treatments is to improve the appearance of cellulite and maintaining its response over a period of time. While many treatments claim to be able to improve the appearance of cellulite, this condition remains elusive to treatment.

From the analysis of the results, it is clear that statistically significant changes occur in the women in EG. The most significant difference was at 24 cm thigh circumference, where EG reduced its circumference by nearly 5 cm compared to the beginning of the procedure and from 57.1 ± 6.1 it became 52.5 ± 6.2, while in CG the circumference decreased by only 1.5 cm. Such statistically significant differences were also found in the hip circumferences, as after the application of the IASMT technique, in the EG the hip circumference was reduced by 5.2 cm, and in the CG it decreased by only 2.5 cm. The lack of statistically significant differences in only these two areas corresponds to the places where cellulite is accumulated - the upper thighs and buttocks. The results obtained in the study coincide with studies conducted by other authors. Some pilot studies are emerging that report fairly good results in terms of reducing the cellulite (gynoid lipodystrophy). Studies prove that cellulite affects the connective tissue and leads to changes in their structure. Romero et al. (2008) found that mechanical massage provides a non-invasive method, which has been demonstrated to treat cellulite in a similar manner to procedures used in a clinical plastic surgery setting. Similarly, Bayrakci Tunay et al. (2010) found that both mechanical massage and fascia manipulation resulted in an improvement in thinning of the subcutaneous fat after the treatment and decreased thigh circumference.

The mechanism of action of myofascial techniques is still not fully understood, but it has been clearly demonstrated in various studies that the manipulation of the fascia frees the fat cells from the fibrous tissue and, in a positive way, reduces their projection into the dermis. Histological analyzes have been made which prove that manual massage improves the turgor of the skin, thickens the fibers and tightens its layers. (Romero et al., 2008).

All this is achieved even faster and more efficiently when using IASTM, as is evident from the analysis of the results we obtained. IASTM affect the level of connective tissue changes and, in addition, extremely improve the microcirculation in the treated area. Different techniques aimed to mobilize subcutaneous connective and lipoid tissue, and one of its great advantages is that it is a painless approach, without any side effects (Loghmani, 2016; Zlatkov et al., 2021; Mylonas et al., 2021).

A similar hypothesis was also confirmed by Lucassen et. al., as early as 1997, who found that mechanical irritation and manipulation of the fascia leads to a noticeable smoothing of the dermis and hypodermis layers and the connection between them. This was visualized by the authors with ultrasonography. Other authors in more recent studies reached similar conclusions and visualized the same results. Jameson et al., present convincing evidence that fascia manipulation techniques, using specialized instruments (FasciaBlaster®), reduce subcutaneous fat levels and the appearance of cellulite in adult women after 12 weeks of application. The results they obtain also show improved collagen remodeling and safety of instrument application (Jameson et al., 2019).

A detailed analysis and classification of the participants` condition were performed for the purpose of our study with the help of Cellulite Severity Scale (CSS). The CSS allows the qualitative and quantitative assessment of key clinical and morphological aspects that in our subjects showed a better response in EG after the adjunctive IASTM technique compared to CG in which only manual massage was used. The scale classifies females into several groups, dividing them into severe, moderate and mild. The initial results show that the women in both groups are homogeneous. An improvement in condition was reported in all participants in the study. Better results in the CG as well proved the effectiveness of manual massage, with women having severe to moderate improvement. The women on EG showed significantly better results. In the majority of them, at the end of the procedures, an average to mild degree on the scale is observed with a statistically significant difference between the initial and final measured values.

In order to assess the patients' condition and satisfaction with the performed procedures, we used the GAIS scale. It is a five-point scale to assess global aesthetic improvement in appearance compared to pretreatment. Ratings range from much improved, much improved, improved, unchanged, and worsened. The results of the GAIS show good satisfaction with the procedures in both groups of women. About half of the studied contingent showed an improvement on the scale after the first week of application of the procedures, and for women in the experimental group this percentage was 20% higher compared to those in the control group. The scale was administered again after 12 weeks, when the results were significantly in favor of the experimental group. The majority of women in the experimental group moved into the category of very

satisfactory, satisfactory and with improvement, while those in the control group was 5-6% without any improvement.

In general, all women who took part in the study showed satisfaction with their participation in the procedures. All of them felt improvement in some aspect, and showed determination to continue with the procedures in the longer term. The multifactorial etiology of cellulite makes it difficult to influence, as sometimes the problem is systemic and requires a much more complex treatment approach. Manual massage is a good non-invasive, relatively cheap and safe method, with almost no contraindications. It is affordable and pleasant for most people and has been proven to work well in most cases. It can be combined with almost all other methods, supporting their effect. Instrumental methods for soft tissue mobilization, which are increasingly entering therapeutic practice, are a great tool for enhancing the effect of manual massage and achieving even more satisfactory results, painlessly and without any risk for patients. Apart from the fact that the results are better, they also tend to happen faster. It would be interesting to follow in a future study whether these results obtained from the IASTM procedures affecting the fascial level are maintained in the longer term.

Conclusions

This article introduces efficiency of non-invasive cellulite treatment methods such as manual massage and IASTM techniques in the hip and thigh area. Both techniques have been shown to positively impact cellulite reduction. However, the results obtained in the group to which was applied IASTM are significantly better and they tend to occur faster. In conclusion IASTM techniques are an effective, affordable and completely safe way for removing and reducing cellulite in problem areas and could be applied as a supplement to manual massage. There is better success of the combined these two treatments

Conflicts of interest - There have been no conflict of interest situations during the course of the research and the publication of the manuscript. The experimental work meets the ethical requirements concerning research and involving the participation of people asset for the Helsinki Declaration.

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