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Effect of Monopolar Radiofrequency on Cellulite in Obese Women

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ABSTRACT
Background: Cellulite is a complicated condition that involves alterations in the adipocytes, extracellular matrix, lymphatic system, and microcirculation.
Aim of study: This study aimed to assess impact of monopolar radiofrequency (MRF) on cellulite of thighs in obese women. **Patients and Methods:** Thirty women complaining from cellulite in thighs, their ages ranged from 25-35 yrs. and BMI ranged from 25-35 kg/m^2. They were randomly assigned into control group (A) (n=15) proceeded low caloric diet (1200 kcal/day) for 5 weeks and study group (B) (n=15) proceeded the same diet in addition to MRF 3 times per week for 5 weeks. Evaluating weight by a weight- height scale, calculating body mass index (BMI), and determining grade of cellulite by Nurenberger-Muller scale, thigh circumference by tape measurement and subcutaneous fat thickness by ultrasonography. All of which were done before and after 5 weeks of treatment. **Results:** Comparing both groups after treatment showed significant improvements in all evaluated measures in favor of study group (B) ($p< 0.05$). **Conclusion:** Monopolar radiofrequency improves significantly cellulite of the thighs in obese women.
Keywords*:* Cellulite, Monopolar radiofrequency, Thigh, Obesity, Women.

INTRODUCTION

Cellulite is defined by changes in the surface of the skin, providing appearance of cottage-like cheese, orange peel, or mattress, depressed parts occur because of fibrous septa existence drawing the skin down, whereas elevated parts occur due to underlying fat projection to the surface of skin. Cellulite happens primarily in post-pubertal women, in the upper posterior thighs and gluteal regions [(1)].

Cellulite can be caused by vascular, hormonal or genetic factors, and it may be linked to the structure and arrangement of the septa in the subdermal tissues, reduced lymphatic and vascular circulation, as well as fibrosis at the dermal-subcutaneous interface, may be contributing factors. Cellulite shapes influenced by subdermal anatomical structure [(2)].

Genetic predisposition, hormonal imbalances, medications that cause water retention, lack of physical activity, immobilization, skintight clothing, alcohol consumption, smoking, disordered eating with increased fats, carbohydrates and salt consumption, stress, anxiety, and emotional problems are all predisposing factors for cellulite [(3)].

Although the morphological aspects that highlight the cellulite clinical presentation, the cellulite etiology remains unknown. It appears to be a physiological condition, but it is a multi-causative condition with a variety of factors aggravating it [(4)].

Radiofrequency (RF) energy was used in various therapeutic applications for over a century. It is conducted electrically to the tissues, and heat is generated when the tissues' impedance transforms electrical currents to thermal waves. Cutaneous application of RF devices exhibits various physiological outcomes, including neocollagenesis, lifting impact, reduced local adiposity, decreased fibrosis and edema, and improved cellulite [(5)].

PATIENTS AND METHODS

Thirty women complaining from cellulite in thigh shared in our study. They were selected from outpatient clinic of Kasr-Alainy University Hospital.

Inclusion criteria: Their ages ranged from 25 to 35 years, BMI $\geq$ 25 and $\leq$ 35 kg/m^2, and cellulite at their thighs was at least grade II.
Exclusion criteria: Women with inflammatory or infective problem in the treated area, gestation or breast feeding, as well as history of scarring, cancer, implantations or pacemakers.
Participants were haphazardly distributed into 2 groups via 2 stages by an individual who didn't share other study parts. Firstly, initial recording of eligible subjects meeting the inclusion criteria. Next; random assignment of all recorded subjects to either control group (A) who proceeded low caloric diet (1200 kcal/day) for 5 weeks or study group (B) who proceeded the same diet for 5 weeks and received monopolar radiofrequency therapy (MRF) 3 times each week for 5 weeks, using an online random permutation generator from http://www.randomization.com.

Procedures

Before beginning evaluation and treatment processes, a full history was given from each woman in the two groups. All of participants received a complete description of the methodology and signed the consent form before initiating the study. All measurement were done for each woman in both groups (A and B) before starting the study and after 5 weeks of treatment course.

Assessment procedures

- Before beginning the trial, each woman's body weight and height were measured, as well as after 5 weeks of treatment. The weight (kilograms) was

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then divided by a squared height (meters square) for calculating BMI (kg/m^2).

- The grade of cellulite for each female was determined by using Nurenberger-Muller scale:
  - Grade 0 (zero): The surface of the skin was not altered.
  - Grade I: The affected skin area was smooth during lying or standing, however skin surface alterations could be noticed by contracting muscles or pinching skin.
  - Grade II: When standing, the appearance of orange skin or mattress was visible with no manipulations (contracting muscles or pinching skin).
  - Grade III: Elevated regions and nodules were evident, as well as the changes outlined in grade II.
- Tape measurement was used to measure thigh circumference at 3 points (at the widest part of the thigh, 10 cms and 20 cms above the upper border of the patella).
- Ultrasonography (Toshiba Aplio500 Ultrasound system, Model USFR-A500A) was employed to assess thickness of subcutaneous fold.

Treatment procedures

Monopolar radiofrequency device (EME srl – via DegliAbeti 88/1 661122 Pesaro (PU) – Italy) was used to apply the treatment to the study group. MRF device consists of two electrodes: one active electrode that has cylindrical shape (hand piece), negative charge and small size, and another ground electrode that has positive charge, large size and its application was far away from the active one. Parameters of monopolar radiofrequency device: Power: 150-200 Watt. Frequency: 455 KHz. Polarity of the probe: Monopolar. Electrode diameter: 70 mm.

- Each woman in the control group followed low caloric diet program, (1200 kcal/day) for 5 weeks. Breakfast (315 kcal) included cup of skimmed milk with one spoon sugar, two boiled eggs or free fat cheese, one slice toast and one apple or orange. Lunch (645 kcal) included one cup cooked vegetables, two grilled fish or chicken breast or roast beef, half cup of cooked rice, one banana or one apple and one plate of salad. Dinner (240 kcal) included one slice toast, a cup of yogurt and two apples**.**
- Each woman in the study group adopt the same low caloric diet program plus MRF sessions.
- Each woman in the study group was given instructions about MRF technique and its benefits for gaining their cooperation and motivation during the treatment course.
- Each woman in the study group received 3 sessions per week for 5 weeks; duration of the session is 40 minutes.
- During application of RF on anterior thighs woman were in supine lying position and during application of MRF on posterior thighs woman were in prone lying position and the therapist stood beside the woman.
- The positively charged electrode (grounding pad) was placed over the women's lower back.
- The monopolar RF hand piece (negative electrode) was delivered at 150-200 W for a 30-second pass and transparent oil would be applied on the skin surface.
- These passes were repeated through the session for 40 minutes, 3 times/week for 5 weeks.

Ethical consent: This study was ethically approved by the Institutional Review Board of the Faculty of Physical Therapy, Cairo University. Written informed consents were taken from all participants. The study was conducted according to the Declaration of Helsinki. The study had been allowed at September, 2019 (No: P.T.REC/012/003298).

Statistical Analysis

For conduction of statistical analysis, SPSS program (SPSS, version 23, Inc., Chicago, IL) was used. Data screening for homogeneity, normality of variance and existence of extreme values was performed before final analysis. Normality test of data using Shapiro-Wilk test showed normality of data distribution for measuring variables. Also, 2×2 mixed design MANOVA was used for comparing the tested variables with p value ≤ 0.05. Therefore, Wilcoxon Signed Rank tests were used to compare variables between before and after treatment within each group and "Mann-Whitney U test " was used for comparing between both groups at various measuring periods.

RESULTS

There was non-significant difference between both groups at baseline regarding all evaluated variables (Table 1).

Body weight, BMI, thigh circumferences as well as, subcutaneous fat thickness showed statistically significant reductions within the two groups (A and B) ($p<0.05$). The comparison between two groups after treatment showed a statistically significant reduction in favor of group (B) ($p<0.05$) (Table 2).

Regarding cellulite grades, in group (A), the percentages of grade 0, grade I, grade II and grade III of cellulite before treatment were 0%, 0%, 66.7% and 33.3%, respectively, and they also were 0%, 0%, 66.7% and 33.3%, respectively after treatment, indicating a statistically non-significant difference within group (A) ($p>0.05$). In group (B), the percentages of grade 0, grade I, grade II and grade III of cellulite before treatment were 0%, 0%, 60% and 40%, respectively, while they were 13.3%, 73.4%, 13.3% and 0%, respectively after treatment, indicating a statistically significant improvement within group (B) ($p<0.05$). The comparison between both groups after treatment proved a significant improvement in grade of cellulite in favor of group (B) ($p<0.05$) (Tables 3, 4 & 5).

Table (1): Physical characteristics of both groups

	Group (A) (n = 15)	Group (B) (n = 15)	p value
Age **(yrs.)**	30.33±3.71	30.46±3.15	0.916 NS
Height **(cm)**	162.2±5.03	163.2±4.17	0.558 NS

Table (2): Body weight and BMI for both groups

		Group (A) (n = 15)	Group (B) (n = 15)	p value*
Body weight **(Kg)**	Pre-treatment	83.82±6.7	82.99±4.84	0.709 NS
	Post-treatment	81.14±6.84	76.59±4.76	0.043 S
	% of improvement	3.19%	7.71%	
	p value**	0.0001 S	0.0001 S	
BMI **(Kg/m^2)**	Pre-treatment	31.71±2.07	31.25±2.53	0.603 NS
	Post-treatment	30.48±1.97	28.82±2.22	0.047 S
	% of improvement	3.87%	7.77%	
	p value**	**0.0001 S**	**0.0001 S**	

Table (3): Grade of cellulite for both groups

/		Group (A) (n = 15)	Group (B) (n = 15)	p value*
Grade of cellulite	Pre-treatment			
	Grade 0	0 (0%)	0 (0%)	0.775 NS
	Grade I	0 (0%)	0 (0%)	
	Grade II	10 (66.7%)	9 (60%)	
	Grade III	5 (33.3%)	6 (40%)	
	Post-treatment			
	Grade 0	0 (0%)	2 (13.3%)	0.0001 S
	Grade I	0 (0%)	11 (73.4%)	
	Grade II	10 (66.7%)	2 (13.3%)	
	Grade III	5 (33.3%)	0 (0%)	
	p value**	1.00 NS	0.0001 S	

Table (4): Thigh circumference (cm)

A- At widest part for both groups.

thigh circumference at widest part	Pretest Mean± SD	Post test Mean± SD	MD	% of change	p- value
Group A	74.5±5.59	72.72 ±5.72	1.77	2.37 %	0.0001*
Group B	73.95 ±3.85	68.62±3.38	5.33	7.2%	0.0001*
MD	0.54	4.1			
p- value	0.767	0.029*			

B- At 20 cms above upper border of the patella.

thigh circumference at 20 cms above upper border of the patella	Pretest Mean± SD	Post test Mean± SD	MD	% of change	p- value
Group A	68.3±5.06	67.2 ±4.98	1.1	1.61 %	0.016*
Group B	67.27 ±3.9	60.71±4.15	6.56	9.75%	0.0001*
MD	1.02	6.49			
p- value	0.556	0.001*			

C- At 10 cms above upper border of the patella.

thigh circumference at 10 cms above upper border of the patella	Pretest Mean± SD	Post test Mean± SD	MD	% of change	p- value
Group A	63.22±4.38	61.46 ±3.99	1.76	2.78 %	0.001*
Group B	62.34 ±3.83	53.22±3.84	9.11	14.61%	0.0001*
MD	0.88	8.24			
p- value	0.574	0.0001*			

Table (5): Subcutaneous fat thickness for both groups.

Sub thickness	Pretreatment	Posttreatment	MD	% of change	p- value*
	M± SD	M± SD			
Group A	75.75±12.54	71.1 ±12.17	4.65	6.13 %	**0.0001***
Group B	73.33 ±11.84	59.91±10.81	13.42	18.3%	**0.0001***
MD	2.42	11.2			
p- value**	**0.604**	**0.016****			

DISCUSSION

The grade of cellulite in this study showed non-significant difference in the control group, while it showed highly significant decrease within the study group after treatment. Also, post results showed significant difference between both groups in favor of study group (B). Also, the results of current study revealed highly significant decrease in thigh circumferences as well as, subcutaneous fat thickness within both groups after treatment. Additionally, post results comparison showed significant difference between both groups in favor of study group (B).

These findings are supported by the study of **Wanitphakdeedecha *et al.* [6]** who performed 6 sessions of RF and found a moderate cellulite reduction. **Adatto *et al.* [7]** found that percentages of women having laxity of the skin and deposits of subcutaneous fat in the belly, thighs, and buttocks. Showing good improvement, very good improvement and excellent improvement were 60%, 27% and 5%, respectively. However, there was no improvement in only 8% of the women. Also, these findings are supported by the study of **Bravo *et al.* [8]** who studied effect of MRF on cellulite in thighs and buttocks of grades II and III, and proved increase in dermal thickness and improvement in body contour. Moreover, our results are supported by those of **McDaniel & Samkova [9]** as well as **Goldberg *et al.* [13]** who found improvement in cellulite appearance and significant decrease in thigh circumference after treatment with MRF [9].

These improvements of cellulite appearance and fat thickness may be attributed to thermal effect of RF that improving circulation in subcutaneous tissues leading to better oxidation which in turn activates lipolysis and hypotrophy of fat cells. This explanation comes in agreement with explanation of **Alomairi *et al.* [10], Belenky *et al.* [11],** and **Mulholland *et al.* [12],** who suggested that raising of temperature excites sympathetic nervous system leading to secretion of adrenaline and noradrenaline which, in turn, enhances lipolysis. Also, heating of adipose tissues is precisely causing vasodilatation that enhance perfusion and cellular oxygenation. Thus, fat oxidation and breakdown will be enhanced, causing shrinking of adipocyte size (hypotrophy). In addition, **Goldberg *et al.* [13],** and **Emilia *et al.* [14]** suggested that RF may improve skin appearance through producing fibrosis and tissue contraction, thus, shrinking the spaces between cells and layers of deep fascia.

The positive effect of MRF on cellulite and deposit fats may be also related to enhancing collagen production. This explanation comes in agreement with **Van Der Lugt *et al.* [15]**, who found an increase in collagen by using RF. And attributed that to the effect of RF on activating inflammatory action in skin layers and denaturation of protein. After that, with remodeling process, there is a marked increase in collagen formation through enhancing activity of fibroblasts in the dermis. In contrast, **Boisnic *et al.* [16]** did not find a significant increase in collagen in their histological invistigations.

The results of this study revealed that post treatment of low caloric diet alone (control group) showed improvement in BMI, thigh circumference and subcutaneous fat thickness, but there was no improvement in cellulite. **Marques *et al.* [17]** concluded that controlled diet was effective in reducing weight and body composition, despite no effect in cellulite clinical appearance, and this is consistent with results of our study.

Although our study provided objective data, some limitations were noticed in it as small sample size, lack of follow-up to evaluate long-term effect of RF on cellulite and fat. Also, level of physical activity for each participant was ignored. So, further studies are needed to investigate impact of RF on cellulite and adipose tissues with larger sample size and multiple objective evaluation tools and follow up assessment.

CONCLUSION

It could be concluded that MRF is safe and effective and has a positive impact on BMI, thigh circumference, cellulite and subcutaneous fat thickness.

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