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Comparison between shock wave therapy and mechanical massage for the treatment of cellulite in women

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Rafaella Rêgo Maia[1], Rodrigo Marcel Valentim da Silva[1], Carolina Daniel de Lima Alvarez[1], Patrícia Froes Meyer[2], Liliane Santos de Vasconcelos[1], Júlio Davi Costa e Silva[3], Antônia Távora Pinho Rosado Ventura[4], Eneida de Morais Carreiro[2]

[1] Federal University of Rio Grande do Norte, Natal, Brazil
[2] University Centre of Rio Grande do Norte, Natal, Brazil
[3] Potiguar University, Natal, Brazil
[4] Federal University of Campina Grande, Campina Grande, Brazil

Abstract

Introduction. To evaluate the effects of shock wave therapy on the fibrous septa of cellulite in Brazilian women.
Methods. The sample consisted of 20 women with gluteal cellulite (grade III) evaluated through protocols and ultrasound examinations before and after treatment. The volunteers were randomly distributed into treatment group (TG) and control group (CG). TG received shock wave therapy, while CG volunteers received vibratory massage. The shock wave parameters were: intensity of 3.5 bar, frequency of 21 Hz, and 1500 pulses per application. Both groups underwent 6 treatment sessions, 1 per week, of 30 minutes each.
Results. Data were analysed by the SPSS software, with a significance level of 5% and a 95% confidence interval. TG presented a significant reduction of septa in the right gluteus ($p = 0.001$) and left gluteus ($p = 0.000$). Only the right gluteus revealed fat layer reduction ($p = 0.043$). There was no reduction in CG for these variables ($p > 0.05$). In the intergroup comparison, only the septum thickness measurement of the left gluteus showed some reduction, generating a significant value ($p = 0.008$). Although no change in the other variables was observed in any of the groups ($p > 0.05$), the participants reported improvement in quality of life.
Conclusions. The shock wave protocol applied in this study significantly reduced the fat layer and cellulite septa.
Key words: shock waves, aesthetic treatment, physiotherapy

Introduction

Cellulite is a dystrophic process of complex and multifactorial physiopathology. Overall, 85–98% of women of all races are affected, although their characteristics vary depending on the ethnic group [1, 2]. Cellulite is more frequent in Caucasian women as compared with Asian or Afro-Caribbean descendants owing to genetic differences in the distribution of adipose tissue and greater skin thickness of the latter, which favours masking the irregularities [3].

However, Latin American women with toned tissues have a greater number of fibrous septa in cellulite and the affected regions are rigid and have adhesions between the superficial and the deep layers [4]. Extracorporeal shock wave therapy originates from acoustic waves and the used device has 2 types of applicators: a focal one, which concentrates the shock wave in a focus, and a radial one, which distributes energy in the form of an inverted cone [5, 6].

The emitted waves reach the tissue surface and cross a homogeneous barrier without damaging other areas, producing various biological effects on different types of cells and tissues, such as cell membrane permeability increase with fat cells triglycerides release; stimulation of microcirculation with increased blood flow and lymphatic drainage; neovascularization and increased cell proliferation; antibacterial effects and growth factors and stem cells stimulation [7–9].

Several studies have pointed out that extracorporeal shock wave therapy is effective as a non-invasive therapeutic means in the treatment of cellulite. Adatto et al. [10] used a D-Actor 200™ device (Storz Medical, Switzerland) for 6 sessions among 25 patients. They found a significant elasticity improvement, irregularity reduction, and skin depression in the treated areas as compared with untreated ones. In another study, in which a DermaSelect™ device (Storz Medical, Switzerland) was applied, the treated area and the photographic analyses demonstrated an expressive surface improvement in more than 70% of the patients, but no changes were found in the cellulite degree [11].

There is increasing evidence that this therapy, used with both radial and focal applicators, is able to improve skin appearance and reduce subcutaneous fat in cellulite [12]. The life quality of patients with dermatological diseases reveals an important aspect that may be related not only to disease severity, but also to discomfort, stigmatization, and the interference in the social life of these individuals [13]. Hexsel et al. [14] evaluated the psychological, psychiatric, and behavioural features of patients with cellulite, observing that reports of emotional disorders and discomforts were common and expressed through negative feelings.

Other studies demonstrated a significant improvement in the life quality of women who underwent treatments for cellulite [15, 16]. Although the issue has already been ad-

Correspondence address: Rafaella Rêgo Maia, Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Av. Abel Cabral, 2400, Cond. Spazio Nimbus, Apt. 3-604, Bairro Nova Parnamirim, CEP: 59.151-250, Parnamirim-RN, Brazil, e-mail: maia.rafaella20@gmail.com

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dressed in scientific literature, none of the found studies used this therapy with a Brazilian women sample. Knowing that ethnic differences influence cellulite characteristics, greater clarification regarding the effects of shock waves in this population is required. Thus, the present study aimed at investigating the impact of shock wave therapy on the reduction of the fibrous septa of cellulite-affected gluteus among Brazilian women and the life quality of the participants.

Subjects and methods

Research description and sample qualification

This was an experimental, randomized, controlled, and blind study. The sample randomization consisted of drawing lots using envelopes that contained a response card, which indicated the group the participant would be allocated to. The group allocation sequence followed in accordance with a computer-generated list. The treatment group (TG) was compared with the control group (CG) with the analysis of independent groups for study control. The blinding criterion was adopted, in which only the researcher who was responsible for the treatment sessions was aware of the participants' group allocation.

The volunteers, from the city of Natal, Brazil, were recruited through an invitation published in social media, non-probabilistically chosen, and briefed on the procedures.

A total of 23 female patients aged 19–49 years (mean: 26.25 ± 9.36 years), weighting 55–94 kg (mean: 66.5 ± 11.8 kg), with grade III cellulite were evaluated. Sedentary, multiparous or nulliparous women were included, both contraceptives users and non-users. Those who reported abnormal blood coagulation (coagulopathy), the use of anticoagulant substances, polyneuropathies, pregnancy, or a malignant primary disease (tumours) in the area to be treated for the study were excluded. Women who did not agree with the procedures, presented sensitivity during sessions, or whose availability did not adapt to the schedule and/or to the procedures discontinued treatment. There was a sample loss of 3 participants from CG during the study owing to treatment schedule incompatibility.

The volunteers were divided into 2 subgroups by drawing: TG with 12 participants with mean age of 26.33 (± 9.63) years and mean weight of 68.25 (± 13.25) kg, and CG with 8 participants with mean age of 26.12 (± 9.60) years and mean weight of 64 (± 9.49) kg.

Procedures

When attending the evaluation session at the agreed place and date, the participants were initially assessed through a cellulite assessment protocol (PAFEG) [17], an evaluation instrument used to obtain personal, physical, morphological, and functional information.

The perimetry measurements of the gluteal circumference (metric tape positioned 7 cm below the iliac crest to ensure results standardization), plicometry of the gluteal region (mean of 3 gluteal fold measurements), and body weight (digital scales) were also registered before and after treatment.

The areas to be treated were photographed with the participants in orthostatism in a posterior view. The same camera was used to take all photos; it was placed on a tripod for better pre- and post-treatment image obtention, visualization, and standardization.

At the beginning and end of the study, an ultrasound examination was performed in the gluteal region, delimited by a mold in a 10 cm^2 area, which allowed to evaluate the transformation of the fibrous septa and fat layer in the area with cellulite before and after the proposed treatment. Ultrasonography is considered an efficient diagnostic method to assess fibrous septa integrity and to identify treatment effects on cellulite and on localized fat [18].

The volunteers filled in the Celluqol™ summary questionnaire [19] for life quality assessment and then they were classified in accordance with how much cellulite impacted their life quality (8–16 points: some impact, 16–24 points: little impact, 24–32 points: reasonable impact, and 32–40 points: great impact).

Shock wave therapy

In TG, the shock wave application was performed in ventral decubitus by using a D-Actor 200™ device (Storz Medical AG, Tägerwilen, Switzerland), which acts through a ballistic impulse that lasts around 5 milliseconds and is pneumatically generated with radial propagation (Figure 1).

The D-Actor™ handpiece has a projectile inside it, which is accelerated by an air compressor. When the transmitter is reached, the kinetic acceleration energy is converted into acoustic energy, and, with the coupling gel working as a conductor, that energy is transferred to the tissue. During the sessions, the applicator was positioned at the same treatment point, following the template used during the ultrasound session, and the body surface was covered with coupling gel. The following parameters were used: 3.5 bar intensity, 21 Hz frequency, and 1500 pulses per a gluteus dose.

In CG, the application was performed with a V-ACTOR™ handpiece (Storz Medical AG, Tägerwilen, Switzerland), which produces vibrating waves with the purpose of stimulating

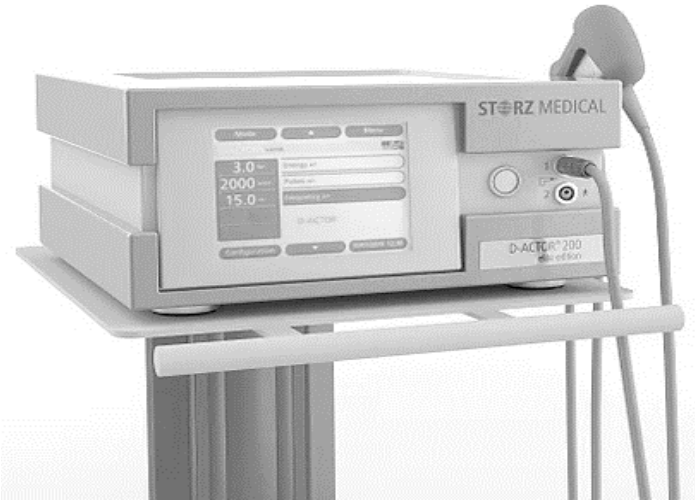

Figure 1. D-Actor 200™ (Storz Medical AG)

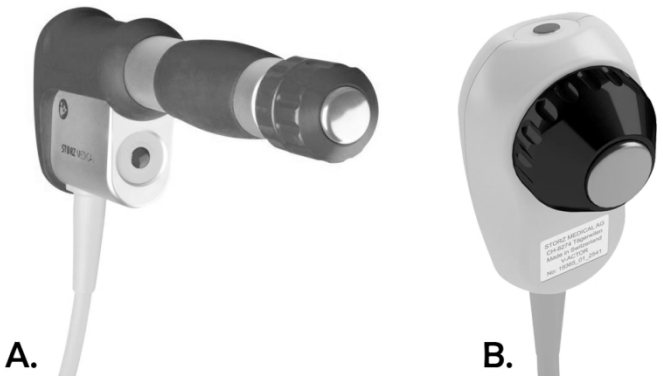

Figure 2. A. D-Actor™ handpiece. B. V-ACTOR™ handpiece

the tissue structures of large areas of the body and assist in muscle relaxation. The application was performed with the patient in ventral decubitus, under the same parameters as those used with TG (Figure 2).

The treatment lasted 6 weeks, with applications on both glutei, of approximately 30 minutes each. This time was distributed into the reception and preparation of the volunteer, application of the intervention (each gluteus received 7 minutes of therapy), and cleaning of the gel used. The patients were evaluated at the end of the treatment protocol, when all the assessment procedures carried out before treatment were repeated.

Statistical methods

Statistical data were analysed by using the SPSS Statistics software (IBM, Armonk, USA), version 17.0 for Windows. First, the Kolmogorov-Smirnov test was carried out for data normality verification. The paired *t*-test was applied for intragroup comparison (before and after treatment) and the independent *t*-test was run to compare intergroup data (before and after treatment). Throughout the statistical analysis, a 5% significance level and a 95% confidence interval were assigned.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the Brazilian National Commission of Ethics in Research (CONEP, opinion 2.137.331).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

Statistically, no differences were found regarding weight ($t = –0.162$, $p = 0.87$; $t = –2.183$, $p = 0.65$), perimetry ($t = 0.397$, $p = 0.69$; $t = –1.673$, $p = 0.13$), or plicometry ($t = 0.583$, $p = 0.57$; $t = 0.76$, $p = 0.46$) for TG and CG, respectively, between pre- and post-treatment measurements (Table 1).

Thus, it may be affirmed that weight did not interfere in the behaviour of any of the analysed variables, and their values resulted exclusively from the use of shock wave therapy.

The groups were similar since the comparison between groups showed no statistical difference ($p > 0.05$) for the following variables: initial weight ($t = 0.836$, $p = 0.44$) and final weight ($t = 0.585$, $p = 0.57$), initial perimetry ($t = 1.454$, $p = 0.16$) and final perimetry ($t = 1.009$, $p = 0.32$), initial plicometry ($t = 0.369$, $p = 0.71$) and final plicometry ($t = –0.094$, $p = 0.92$).

The fat layer and septa thickness were evaluated with pre- and post-treatment ultrasonography. There was a significant reduction in the fat layer for TG ($t = 2.290$, $p = 0.043$) in the post-treatment measurement for the right gluteus. The same was not observed with the left gluteus. After treatment, a reduction in the septa thickness was observed for both the right ($t = 4.570$, $p = 0.001$) and left side ($t = 5.066$, $p = 0.000$) (Table 2).

There were no differences in the fat layer or in the thickness of the right or left septa before or after treatment in CG ($p > 0.05$).

After treatment, a reduction of the TG left gluteal septum thickness was observed as compared with the results found

Table 1. Intragroup analysis of variables

Variable	Treatment group			Control group		
	Mean ± *SD*	*t*-test	*p*	Mean ± *SD*	*t*-test	*p*
Age (years)	26.33 ± 9.63			26.12 ± 9.60		
Height (m)	1.61 ± 0.07			1.62 ± 0.05		
Initial weight (kg)	68.25 ± 13.25	–0.162	0.87	64.00 ± 9.49	–2.183	0.65
Final weight (kg)	68.33 ± 13.37			57.9 ± 23.5		
Initial perimetry (cm)	95.42 ± 9.30	0.397	0.69	90.00 ± 5.95	–1.673	0.13
Final perimetry (cm)	95.17 ± 10.34			91.00 ± 6.52		
Initial plicometry (cm)	3.47 ± 0.64	0.583	0.57	3.38 ± 0.39	0.76	0.46
Final plicometry (cm)	3.42 ± 0.61			3.45 ± 0.50		

Table 2. Intragroup analysis of ultrasound data

Variable		Before treatment		After treatment					
		TG	CG	TG			CG		
		Mean ± *SD*	Mean ± *SD*	Mean ± *SD*	*t*-test	*p*	Mean ± *SD*	*t*-test	*p*
FL (cm)	RG	2.95 ± 0.50	2.90 ± 0.42	2.78 ± 0.38	2.29	0.04*	3.05 ± 0.63	–0.97	0.36
	LG	3.01 ± 0.46	2.86 ± 0.65	2.83 ± 0.38	1.70	0.117	2.83 ± 0.65	0.16	0.87
ST (mm)	RG	1.80 ± 0.15	1.80 ± 0.20	1.58 ± 0.14	4.57	0.00*	1.73 ± 0.19	1.35	0.21
	LG	1.88 ± 0.21	1.91 ± 0.18	1.60 ± 0.13	5.06	0.00*	1.83 ± 0.21	1.27	0.24

TG – treatment group, CG – control group, FL – fat layer, ST – septa thickness, RG – right gluteus, LG – left gluteus
* $p < 0.05$

Table 3. Intergroup analysis of ultrasound data

Variable		Before treatment		After treatment	
		t-test	*p*	*t*-test	*p*
FL (cm)	RG	0.226	0.82	–1.053	0.31
	LG	0.616	0.54	–0.018	0.98
ST (mm)	RG	0	1	–1.996	0.61
	LG	–0.297	0.76	–3.008	0.008*

FL – fat layer, ST – septa thickness, RG – right gluteus, LG – left gluteus
* $p < 0.05$

Table 4. Summarized Celluqol™ questionnaire results in pair percentage to control ($n = 8$) and treatment ($n = 12$) groups

Celluqol™ questionnaire	Before treatment		After treatment	
	TG	CG	TG	CG
Does not affect quality of life	0	0	0	0
Affects quality of life a little	33.3	37.5	33.3	25
Reasonably affects quality of life	33.3	37.5	41.6	62.5
Greatly affects quality of life	33.3	25	25	12.5

TG – treatment group, CG – control group

in CG ($t = –3.008$, $p = 0.008$). There were no significant differences in the other variables ($p > 0.05$) (Table 3).

In the present study, the participants' quality of life was evaluated by the summarized Celluqol™, a questionnaire elaborated by Hexsel et al. [14], and analysed through the response frequency of the participants of each group (Table 4).

Changes in the frequency (%) of the participants who had their quality of life a little affected by cellulite after the treatment were not observed within TG. However, there was an improvement in the quality of life of the TG participants who were classified as 'greatly affects,' as this dissatisfaction decreased by 8.3%. These participants' quality of life was reevaluated and went from greatly to reasonably affected by cellulite after the shock wave therapy.

CG presented a 12.5% reduction in the frequency of participants who were greatly affected by cellulite. That is, 50% of these women reported improvement in their quality of life. Similar to TG, there was an increase in the frequency of participants who were reasonably affected by cellulite, but in the 'affects a little' classification, there was a 12.5% reduction, indicating that in this group there was a decrease in the quality of life of participants after treatment.

In both groups, no participant scored below 16 points ('does not affect') before or after treatment, showing that, despite presenting itself in a variable shape, cellulite interfered in the women's quality of life, influencing aspects related to the way they dressed, felt, practised physical activity, and/or managed their nutritional routines. However, after treatment, an improvement in quality of life was observed in most participants from both groups.

The treatment was well tolerated, and no undesirable side effects were observed during the sessions. The participants only presented skin redness up to 24 hours after each application, but this is a usual consequence of shock wave therapy, so it was not considered as a side effect.

Discussion

The non-significant results of weight, plicometry, and perimetry found in this study corroborate the research by Schlaudraff et al. [20], who, upon analysing 14 participants after 8 sessions of treatment with radial extracorporeal shock waves, observed no correlation between the individual values of body mass index, weight, height, or age. Regarding the values obtained in the pre- and post-treatment ultrasound, an improvement in the fat layer and septa, these data are in agreement with a study by Nassar et al. [21], whose randomized clinical trial with 15 women receiving 8 shock wave therapy sessions over 4 weeks demonstrated a decrease in the fat layer thickness of the thigh region as analysed by ultrasound imaging.

Another paper that confirms the potential of shock waves for cellulite treatment is the one by Russe-Wilflingseder et al. [22]. They performed a double-blind randomized placebo-controlled study among 17 patients to evaluate the effects of shock waves in cellulite treatment. The interventions occurred once a week, totalling 8 sessions, and were applied with a D-Actor 200™ device. Different transmitters were used for each group. The results showed a significant improvement in the appearance of the skin with cellulite in most patients from the treated group, regarding skin surface undulations and the volume of depressions and elevations, whereas the placebo group did not present significant changes in any of the analysed criteria. The authors concluded that the investigated therapy might be considered efficient and safe for patients with cellulite.

A study by Kuhn et al. [23], who evaluated a 50-year-old woman before and after treatment, reinforces both the use of shock waves for cellulite treatment and the application of ultrasound as an instrument capable of measuring changes. As the histological analysis in this study did not reveal a reduction in the subcutaneous fat layer, the ultrasound examination demonstrated an improvement in the epidermis and in the extracellular matrix of the dermis, suggesting that

with optimized application parameters, shock wave therapy could be considered an effective, non-invasive treatment for cellulite.

The results achieved by Ferraro et al. [24], who analysed the use of shock wave therapy combined with cryolipolysis as a treatment option for localized fat and for cellulite, also reinforce the results obtained with shock waves in the present study. The treatment was performed in 50 women and employed a device that combined acoustic wave therapy and cryolipolysis (Proshock Ice™, Promoitalia Group, Milan, Italy). The intervention consisted of 4 sessions, scheduled every 2 weeks. There was a significant decrease in the circumference of the treated areas and of the fat layer thickness, demonstrating that the combination of these therapies was safe, effective, and well tolerated as a procedure to remove small-to-moderate amounts of adipose tissue and to treat cellulite.

Another randomized controlled trial investigated the effects of shock wave therapy on cellulite along with exercises for the gluteus. A total of 8 weekly sessions were scheduled for the treatment; the intervention group received shock waves in the gluteus and thigh regions, while the control group used a placebo shock wave transmitter. Both groups were prescribed daily strengthening exercise for the gluteus. The results of the intervention group were superior to those of the group that only performed gluteal strengthening training. There was a significant improvement in skin appearance and cellulite severity in 3 months, which suggests that in a mechanical analysis, shock waves may have favoured fat components breaking or septa weakening, or both, promoting the improvement of the treated skin [25].

The results found in the questionnaires show that, despite the lack of a significant reduction in other variables, there was a placebo effect on the quality of life among the CG participants. The expectation in treatment, as well as the care and attention given to the subjects may have positively influenced this variable [26]. This finding agrees with previous studies, where control group results showed significant improvements after the use of a shock wave therapy placebo [27–30].

Conclusions

The results suggest that the protocol applied in this study has good effects in the treatment of cellulite, since it promoted a reduction in the fibrous septa thickness and in the fat layer in TG, which resulted in an improvement in the skin appearance and the participants' quality of life.

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Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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