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# Effects of Tecar Therapy on Adipose Tissue: Clinical Trial

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## Abstract

**Introduction:** Localised adiposity is one of the leading aesthetic alteration complaints. Tecar therapy has been used in clinical practice for the treatment of fat located in the abdominal region. **Objective:** The objective is to analyse the effect of Tecar therapy on abdominal adiposity. **Methodology:** This is a clinical trial in which the participants were 32 female volunteers who have flaccidity and fat located in the abdominal region. The volunteers were divided into three groups, which respectively received applications of the capacitive mode, the resistive mode, and combined therapy of the two modalities. We have performed ten applications and analysed the anthropometric measures, the ultrasonography of the adipose layer, and the level of satisfaction. **Results:** All groups presented a reduction in perimetry compared to the baseline (p = 0.001). The ultrasonography showed a significant reduction in the combined therapy group compared to the baseline (p = 0.04 and p = 0.03). The level of satisfaction was good in all groups, with few adverse responses. In the bodyweight and percentage of fat analyses, we observed an increase in measurements, probably due to the restriction measures related to the new coronavirus pandemic in 2020. **Conclusion:** In this present study, we have concluded that Tecar therapy resulted in a reduction of the fat located in the abdominal region.

## Keywords

Radiofrequency, Abdominal Fat, Ultrasonography

## 1. Introduction

Localized adiposity is one of the leading aesthetic alteration complaints, and the concentration of fat in the abdominal region is an important risk factor for cardiovascular health. In addition to providing an unaesthetic aspect to body image, it poses a risk for the development of several other pathologies. The accumulation of fat in each region can occur due to a positive energy balance, with an increase in the concentration of fat. An unbalanced hormonal mechanism may also be responsible for the activation of regions of higher fat concentration [1] [2] [3].

Radiofrequency is one of the various resources used for the treatment of localised fat and flaccidity in the abdominal region. One of the forms of radiofrequency is therapy using the transfer of capacitive and resistive energy (TECAR). Radiofrequency is a fast and non-invasive electrothermal technique in which the emission of electromagnetic waves induced in a capacitive or resistive monopolar manner generates diathermy. Diathermy is defined as a procedure for heating the body based on the transformation of high-frequency relative energy in an increase in the internal temperature of our organism, reaching superficial and deep tissues [4] [5] [6].

Tecar therapy provides two different treatment modes: capacitive (CAP) and resistive (RES), inducing different tissue responses depending on the resistance of the tissue treated. The electrode has an insulating layer made of ceramic, rubber, porcelain, etc. that works as a dielectric medium in the capacitive mode. As a result, the energy transmitted only produces heat in the superficial layers of the tissue, with a selective action on the low impedance soft tissues (rich in water), e.g., muscle and lymphatic system. On the other hand, in the resistive mode, the electrode has no insulating layer, so the radiofrequency energy passes directly through the body towards the inactive electrode, generating heat in deeper tissues (low water content), for example, bone tissue, muscle fascia, capsules, and tendons. Tecar therapy can promote adverse effects when used incorrectly, without proper temperature control, promoting the risk of burns, superficial injuries and the aggravation of hemorrhages or diseases with tumor characteristics [6].

The Tecar therapy device promotes an increase in temperature in the deep dermis that damages the adipocyte membrane, resulting in the release of free fatty acids. The damage to the adipocyte membrane induces the activation of macrophages and other inflammatory mediators, which cause tissue reorganisation. We have also observed an improvement in terms of looseness and the smoothing and softening of the skin [7] [8] [9] [10]. Although these effects are mentioned in the literature, they are rarely mentioned regarding Tecar therapy, with more studies focused on the effects in deep tissues. Therefore, this study sought to investigate the effects of different forms of Tecar therapy stimulation on adipose tissue.

## 2. Materials and Methods

This is an experimental study of the clinical trial type, which followed the recommendations of the Consolidated Standards of Reporting Trials—CONSORT.

The study was submitted to the Brazil platform and approved by the Ethics and Research Committee of Potiguar University, UnP, Natal/RN, under opinion number 3,548,979. The participants were instructed about the procedures that would be performed and signed the Free and Informed Consent Form, under Resolution 466/12 of the National Health Council and in line with the Declaration of Helsinki.

The population of this study consisted of 35 women, aged 25 to 45 years old, who presented localised adiposity in the abdominal, infraumbilical, and flank regions.

Tecartherapy can be used in men; however, it prefers to use it exclusively in women, as it is a more suitable audience for aesthetic treatments and as a way of standardizing data collection. The volunteers met the following inclusion criteria: having a body mass index (BMI) between 18.5 and 29.99 kg/m$^2$ (Normal to overweight), with adiposity located in the infraumbilical region, who were not taking anti-inflammatory medication up to 1 week before the start of the study. Volunteers who did not undergo the proposed evaluations, missed successive treatment sessions, gained excessive weight during the research or presented severe skin reaction and reduced sensitivity were excluded.

### 2.1. Instruments

The instruments used for data collection were a Canon PowerShot semi-professional digital camera, model SX530 HS, 12.1 MP resolution, together with a Vx photo tripod case—Tomate brand, and a LED Ring Light for a studio, with RoHS brand tripod. A full-body bioimpedance digital scale was also used to obtain data on the percentage of body fat and skeletal muscle, visceral fat, and body age (OMRON, HBF-514). An adipometer was used for fat thickness analysis (Sanny). To measure the thickness of the subcutaneous abdominal fat, we used a SONUS brand flat Wi-Fi, 96 E, SIFULTRAS-5.12 ultrasonography equipment, with a 7.5 MHz frequency. Finally, the protocol for Physiotherapeutic Assessment in Localized Adiposity—PAFAL10 was applied. The Mira Laser Digital Infrared thermometer, temperature range of −50˚C to 380˚C, and thermographic camera (Flir C2, 4800 pixels) were adopted to evaluate and monitor the abdominal temperature during the procedure. The Tecar therapy device used to carry out the treatment protocol was the Medical San model TEKAH MEDICAL SAN™.

### 2.2. Experimental Protocol

During data collection, three volunteers withdrew from participating in the research, so the remaining 32 volunteers were divided into three groups: resistive therapy (9 volunteers), capacitive therapy (9 volunteers), and combined resistive and capacitive therapy (10 volunteers). Before starting the treatment, the volunteers signed the Free and Informed Consent Form (FICF) and the image use authorisation term. Soon after that, appointments were made for the assessments to select the women who would undergo the procedure.

After selecting the volunteers who would participate in the data collection, an individual assessment was carried out using the PAFAL to obtain personal identification data such as name, age, and anamnesis, complementing this data with questions related to the health of the volunteers. In the next step, we analysed anthropometric data such as supraumbilical and infraumbilical perimetry measured 5 cm above and below the umbilical scar; weight and BMI data; bioimpedance; and plicometry of the left and right, and upper and lower abdominal skinfold, divided by the umbilical scar, where the adipose tissue was highlighted with the thumb and forefinger. This measurement was recorded by repeating the procedure three times for each application (the measurements were taken with the participant in an orthostatic position, 4 cm below the umbilical scar). Later, photographic images of the anterior, posterior, and lateral faces were taken only of the truncus region, with the volunteer in an orthostatic position and the tripod at a distance of 66 cm from the target to be photographed.

Ultrasonography was performed in the infraumbilical region, with a 10 × 10 cm mould positioned in the centre of the infraumbilical region on both sides, following three marking points with a distance of 5 cm between them towards the Linea Alba. The measuring region was marked with the volunteer standing up, and the ultrasound examination was performed in the supine position, with no pressure from the applicator against the skin.

We measured the temperature of the treated areas before, during, and at the end of the application using an infrared thermometer and a thermographic camera. The device was used in Tecar therapy mode with a frequency of 650 kHz, with the power starting at 140 W until it reached 40˚C. After it reached 40˚C, and to maintain this temperature, the power was reduced to 120 W or down to 80 W.

Table 1 describes the application times in the different application areas in the various groups. For the treatment, we delimited two 10 × 10 cm areas in the supraumbilical region and two areas in the infraumbilical region. Each sub-area was treated for 10 minutes in the applications with capacitive or resistive tips and 20 minutes for the applications using a combination of the capacitive and resistive tips.

**Table 1.** Application times in the different radiofrequency modes and areas.

| Group | *Application Time Supraumbilical* | *Application Time Infraumbilical* | *Total Application Time* |
|---|---|---|---|
| Capacitive | 10 minutes | 10 minutes | 20 minutes |
| Resistive | 10 minutes | 10 minutes | 20 minutes |
| Capacitive and Resistive | 10 minutes with the capacitive tip | 10 minutes with the capacitive tip | 40 minutes |
| | 10 minutes with the resistive tip | 10 minutes with the resistive tip | |

In all groups, 10 treatment sessions were carried out, with one session per week. During the treatment, the volunteers were evaluated three times: before the interventions, 30 days after the first session, and at the end of the treatment, 60 days after the first session.

In addition to the local physical reassessment, they answered a questionnaire informing the occurrence of possible adverse and/or deleterious effects during and after treatment and a satisfaction questionnaire regarding the results. The questionnaires were based on the Global Aesthetic Improvement Scale (GAIS) by Narins [11], and the satisfaction questionnaire was adapted from Segot-Chicq *et al.* (2007) [12].

Descriptive and inferential statistics of the data were performed using the SPSS 22.0 program (Statistical Package for the Social Sciences, version 22.0). Data normality was observed using the Kolmogorov-Smirnov (KS) test. The two-way ANOVA test, with Tukey post roc, was performed to compare the measurements obtained in all evaluations (initial, 30 days, and 60 days). A significance level of 95% was adopted (with $p < 0.05$).

## 3. Results

The sample consisted of volunteers with a mean height of 1.54 ± 0.07 m, a weight of 69.12 ± 8.21 kg, and 50% of the volunteers were sedentary.

**Figures 1-3** show the results of the photographic and ultrasound analyses 60 days after the initial assessment, with 10 applications done once a week, with volunteers respectively from the capacitive, resistive, and combined capacitive and resistive therapy groups.

Among the groups analysed in the photographic image, we can observe a more evident reduction in abdominal adiposity in the CAP + RES group. In the comparisons of the initial and final moments of the ultrasound, we also verify a reduction in all groups, with a more significant reduction in the group submitted to the combination of capacitive + resistive therapy in the same session.

**Figure 4** shows the average results of the anthropometric analysis of perimetry, plicometry, and ultrasound from the initial assessment and after 30 and 60 days.

In the analysis of the variables, we can see a significant reduction in the perimetry measure when comparing the 30 and 60 days and the initial moment ($p = 0.001$). In the analysis of the ultrasound measurement compared to the initial moment in the resistive therapy and the combined capacitive and resistive therapy groups ($p = 0.04$ and $p = 0.03$).

In the analysis of the results of the satisfaction questionnaires regarding the aspects analysed in the volunteers' responses, the presence of marks on the skin was not reported. There were no complaints about shock, pain or change in sensitivity. Furthermore, the volunteers said that 100% of the marks and redness disappeared soon after the application. There were no reports of bruises/hematomas or burns, and 100% of the volunteers reported that the skin was firmer, and they

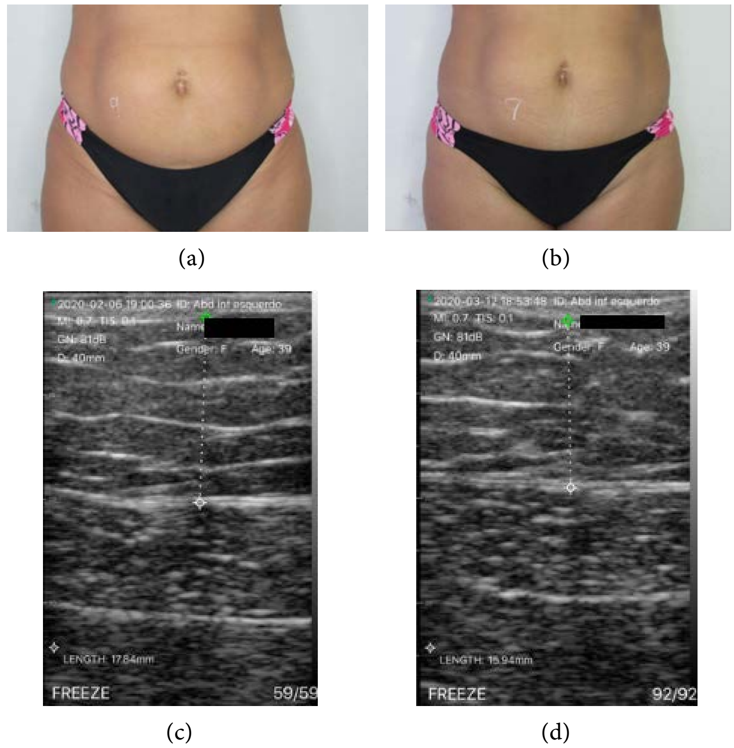


Figure 1. Photographic and ultrasonographic (USG) analyses of the results of the capacitive group after 60 days. (a): Initial anterior view. (b): Anterior view after 60 days. (c): Initial USG analysis (1.78 cm of adipose tissue). (d): Final USG (1.59 cm of adipose tissue).

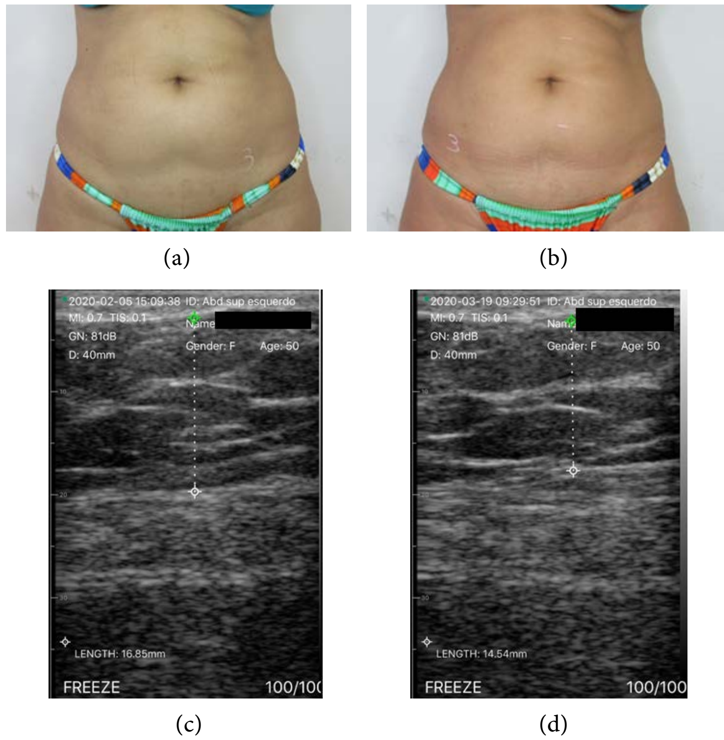


Figure 2. Photographic and ultrasonographic (USG) analyses of the results of the resistive group after 60 days. (a): Initial anterior view. (b): Anterior view after 60 days. (c): Initial USG analysis (1.65 cm of adipose tissue). (d): Final USG (1.45 cm of adipose tissue).

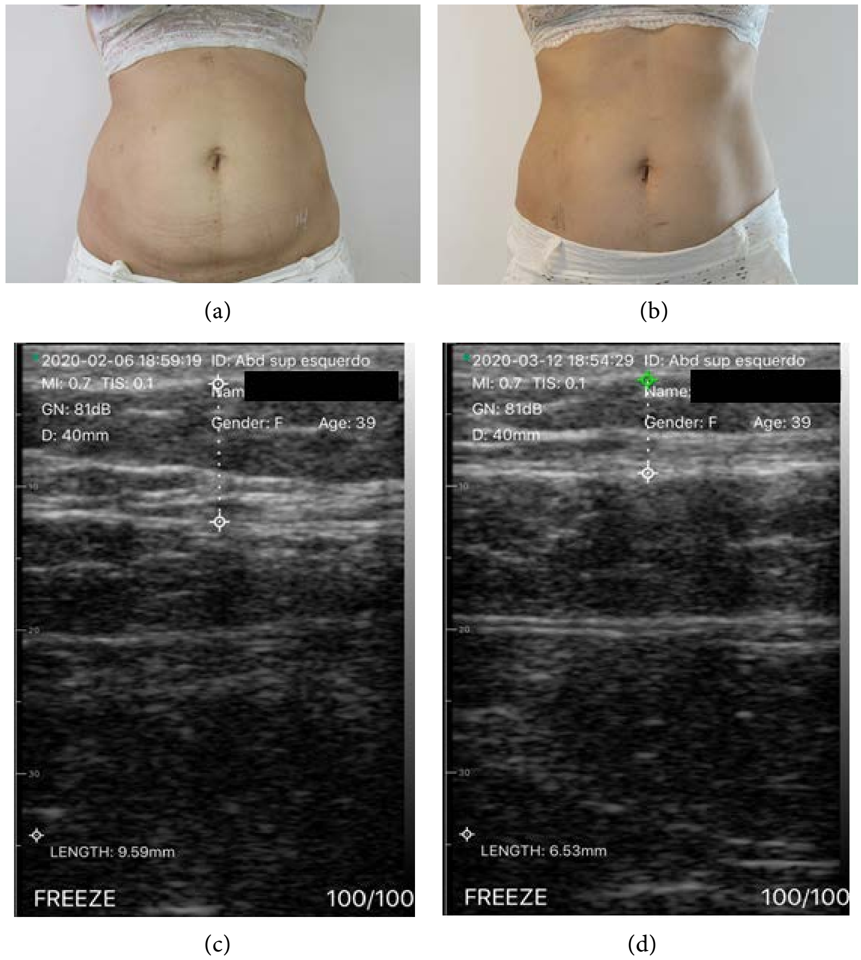
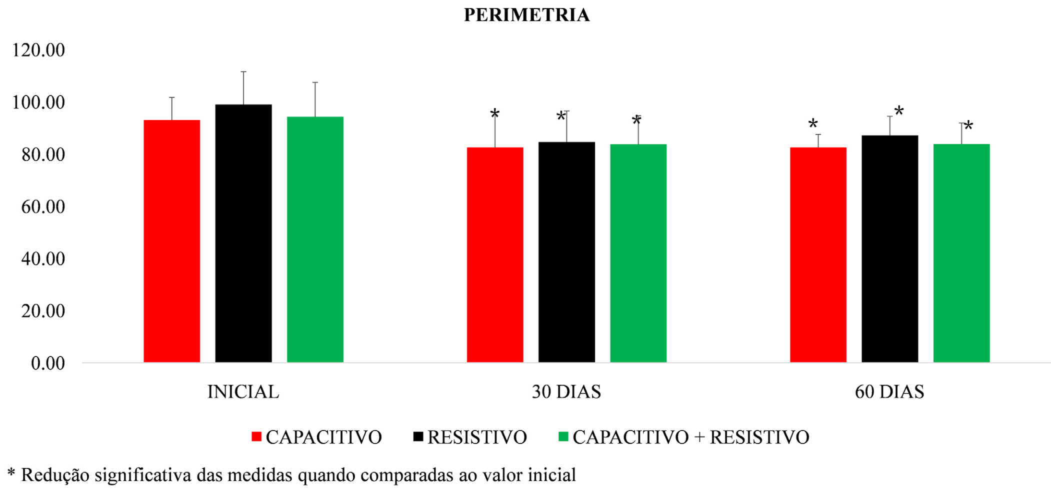


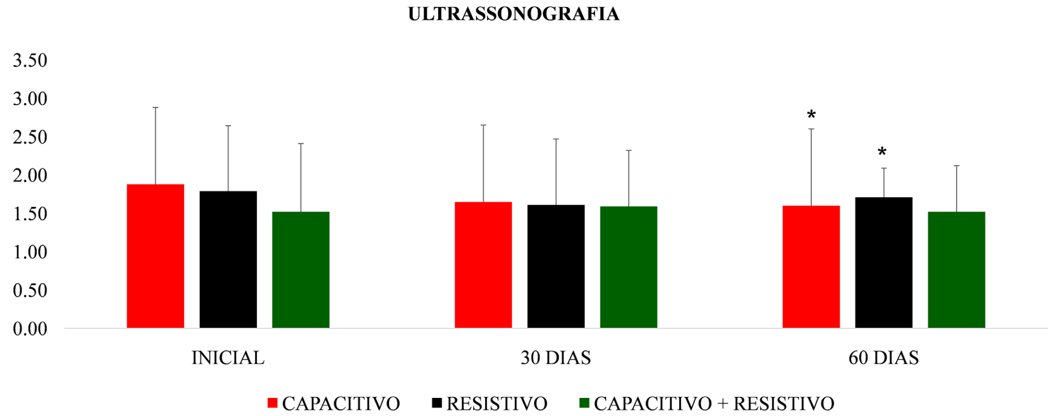

**Figure 3.** Photographic and ultrasonographic analyses of the results of the resistive group after 60 days. (a): Initial anterior view (b): Anterior view after 60 days. (c): Initial USG analysis (0.95 cm of adipose tissue). (d): Final USG (0.65 cm of adipose tissue).

were satisfied with the results. In the analysis of loose clothing, we observed that 33% of the volunteers in the resistive group said they felt their clothing loose in the first week. From the second week onwards, loose clothing was observed by 33% of the volunteers in the resistive group, 67% in the capacitive group, and 50% in the combined capacitive and resistive therapy group. After the fourth week, 33% of the volunteers in the capacitive group reported feeling their clothing loose, and after the sixth week, 50% of the combined capacitive and resistive therapy group reported seeing their clothes looser. Erythema was observed in 33% of the volunteers in the resistive and capacitive groups and 100% in the combined capacitive and resistive therapy group, though the erythema resolved in a few minutes/hours.

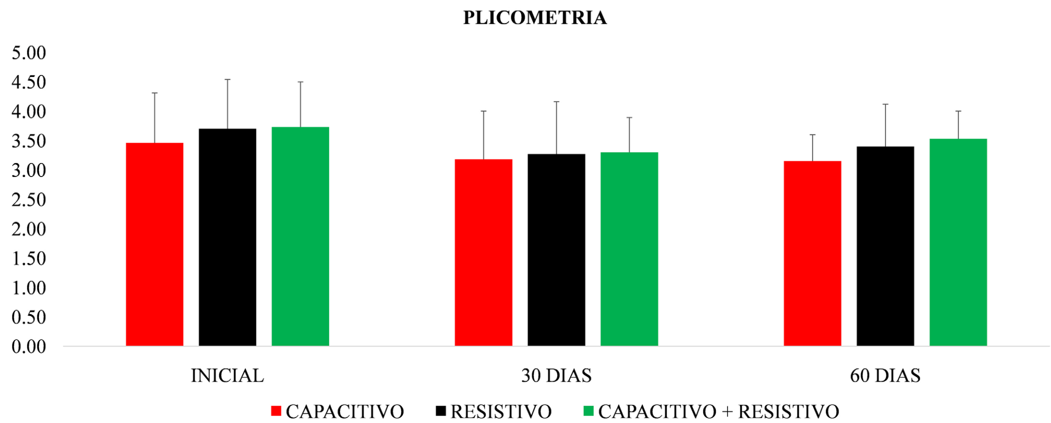
There was no significant change in the percentage of fat and body weight in any of the groups after approximately 60 days. We observed few changes regarding weight and body fat at this stage but noticed a slight increase in this anthropometric data. This pattern may have occurred due to changes in habits caused by the COVID-19 pandemic and the need for isolation.




(a)




(b)




(c)

**Figure 4.** Comparative results of anthropometric measurements. (a): Perimetry (*significant reduction compared to baseline with $p = 0.001$). (b): Ultrasonography (*significant reduction compared to baseline $p = 0.04$ and $p = 0.03$). (c): Plicometry (nonsignificant reduction).

## 4. Discussion

The present study evaluated the effect of Tecar therapy on abdominal adiposity.

In the anthropometric analysis, we observed no significant change in the percentage of fat and body weight after 60 days. This pattern may have occurred due to changes in habits caused by the COVID-19 pandemic and the need for isolation. However, we have observed that the combined capacitive and resistive therapy group showed the most significant reduction in the average anthropometric measures, with reduced perimetry and ultrasonography measures.

It is suggested that thermal energy promotes an increase in local vasodilation and lymphatic flow, causing a reduction of fluid concentration in the region, a decrease in adipose tissue, and the production of collagen fibres [13] [14]. The combination of these effects promotes a significant response in terms of reducing waist circumference.

When analysing the ultrasound data, the group that showed the most significant reduction in the fat layer was the group in which the capacitive and resistive modes were combined. This result is in line with another study [15] that carried out exposure to Tecar therapy, promoting a significant and systematic reduction in lipid content. These results suggest that when administered simultaneously with the thermal and mechanical stimulation of Tecar therapy, electrical stimulation could significantly reduce lipids present in the advanced stages of adipogenesis [15].

According to the analysis of the photographs, we verified a visually satisfactory reduction in body contour in the group that combined the capacitive and resistive modes. However, concerning the patients' opinion, the findings reported in the questionnaires demonstrate satisfaction in the three groups involved, expressed through the reduction in measures perceived in loose clothing [13] [14] [15].

It is worth noting that the response to treatment was better when the two therapy modes (capacitive/resistive) were combined. This occurs because the capacitive mode acts on the most superficial layer, and the resistive reaches deeper tissues, so the combination of both areas generates better results. Ganzit *et al.* (2000) [16] confirmed this theory when they verified that the capacitive method is more directed to tissues close to the active electrode, mainly skin, muscles, connective tissue, lymphatic and circulatory systems. The authors also reported that the resistive method acts on tissues with higher resistance – joints, cartilage, tendons, ligaments, and deeper muscle tissues, thus enabling a deeper therapeutic action.

We can notice that the combination of capacitive and resistive technology can achieve deeper thermal energy penetration and more effective action, proportionally reaching superficial and deeper regions in the application area more thoroughly. These results are similar to some findings from other studies that demonstrated that the association of radiofrequency modalities would promote improvement in body contour, cellulite reduction and circulation improvement [17] [18] [19]. Another study also shows the reduction of the adipose layer in photographic, thermographic, and ultrasonography analyses [20].

It is worth considering that the application of capacitive and resistive tips in the same appointment results in a lengthier intervention, which is an important factor when considering the increase in the thermal effect on the tissue, thus favouring a more intense response in the connective tissue. In addition, various studies have shown the effects of radiofrequency modulating the connective tissue, thus being responsible for reducing sagging and adipose tissue [21] [22] [23].

Most volunteers in this study reported that hyperaemia disappeared one hour after application. And as for the duration of hyperaemia, there is the formation of a moderate to intense erythema with a maximum duration of one to two hours. Some authors [21] [22] [23] have reported that, during treatment, several volunteers presented mild erythema after the application, which stopped within a few hours without treatment. To analyse the effectiveness of radiofrequency in facial rejuvenation, Da Silva [24] observed that all participants presented controlled hyperaemia during the application of radiofrequency, though the face colour returned to its regular state hours after treatment.

In the analysis of body weight and percentage of fat, we have observed an increase in measurements, which may be a result of the social distancing measures implemented during the lockdown period caused by the coronavirus pandemic in 2020. The practice of regular physical activity or of some sports modality can be efficient as factors that can collaborate with the reduction of the concentration of adipose tissue. The use of a balanced diet, with reduced consumption of sugars and saturated fats, can help with the effects observed in the intervention of tecartherapy [25] [26] [27] [28].

This study was limited by the absence of immunological tissue analysis and the difficulties arising from the new coronavirus pandemic, which required implementing social distancing measures that resulted in weight gain in some volunteers.

## 5. Conclusion

In this study, we have concluded that Tecar therapy promoted a reduction in adiposity located in the abdominal region. Furthermore, ultrasonography and perimetry showed measurement reduction results mainly in the combined resistive and capacitive therapy group, which presented a more significant reduction when compared to the other groups.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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