

SUMMARY

Ultrasound imaging of cellulite using classic and high-frequency ultrasound and monitoring the effectiveness of anti-cellulite therapies

Cellulite is a cosmetic defect of multifactorial aetiology affecting 80-90% of the female population. Cellulite manifests itself on the skin as bumps and nodules, which are more or less visible, depending on the severity of the cellulite. It most often appears on the thighs, buttocks and abdomen. Cellulite has negative effect on the perception of one's body, attractiveness, and is thus unacceptable to those affected. In response to the lack of cellulite acceptance and the prevalence of the phenomenon, the number of methods and means to eliminate it is steadily increasing, and the global market value for this category is growing rapidly. Methods and measures for cellulite elimination include systemic oral agents, topical therapies based on the administration of appropriately selected active ingredients, numerous treatments using modern equipment, as well as surgical procedures. Cellulite reduction has thus become the domain of cosmetologists and doctors alike. Unfortunately, despite the plethora of treatment offers, there is no solid evidence to support the effectiveness of these treatments, as well as no defined standard for cellulite diagnostics and monitoring the effects of conducted therapies. In this situation, it seems important to undertake research aimed at developing a standard method for cellulite diagnostics and monitoring the ongoing therapies, based on accurate and reliable methods. Over the last years, ultrasound has been increasingly used in skin tests, including cellulite, pointing to its advantages as an objective, reproducible, reliable, safe, non-invasive and relatively low-cost method. It is therefore highly likely that ultrasound will be the one to reliably assess and monitor the effectiveness of the anti-cellulite measures taken.

Aim of the Study

The main purpose of this study was to evaluate the applicability of both classic and high-frequency ultrasound in the evaluation of cellulite and monitoring the course and effectiveness of anti-cellulite therapies.

Material and method

The study included 84 women aged 21-66, with cellulite localized on the thighs. The women were randomly divided into three smaller groups, which were subjected to different anti-cellulite therapies: group 1– mesotherapy using Alidya™, group 2– professional

cosmetology therapy; group 3– a series of endermologie treatments. Before starting anti-cellulite treatments, a detailed interview was conducted with each woman, biometric measurements were taken, i.e. weight, height, thigh circumferences, BMI (body mass index), cellulite severity was assessed using the Hexsel Dal'Forno & Hexsal and Nürnberger-Müller scales, and photographic documentation was taken. Subsequently, cellulite ultrasound was performed. The examination involved using both a high-frequency ultrasound machine (dedicated to skin examinations) equipped with a mechanical probe with a frequency of 48 MHz and a classic ultrasound device equipped with a linear probe, working in the frequency range up to 18MHz. Using a high-frequency device, the thickness of the epidermis, the thickness of the dermis, the echogenicity of the dermis and the surface area of the subcutaneous tissue bands growing into the dermis of the so-called cellulite teeth were evaluated. Subcutaneous tissue thickness and ultrasound elastography were measured using a classic ultrasound device. All measurements and ultrasound examinations were performed again approximately 14-18 days after anti-cellulite therapy completion. In addition, patients were asked to rate their subjective satisfaction with the results of the procedure.

Statistical analysis was performed using Statistica 13.3 software. The statistical significance level was set at $\alpha=0.05$.

Results

The results obtained were analysed both for the entire study, as well as separately for groups that used a particular therapy type. The data obtained clearly indicate that anti-cellulite therapies are the cause of statistically significant changes in the studied parameters. The anti-cellulite therapy resulted in a statistically significant change in the epidermal and dermal thickness in the cosmetic therapy groups, as well as the endermologie group; there were no statistically significant differences noted for these parameters in the mesotherapy group. The anti-cellulite therapy also led to a reduction in the dermis echogenicity, measured in the range of 0 to 30 grey-scale pixels. All results obtained in this regard were statistically significant. Furthermore, statistically significant results were also obtained when measuring the surface area of subcutaneous tissue bands growing into the dermis, the so-called cellulite teeth. All groups demonstrated a significant decrease in the area of cellulite teeth after the end of therapy. The biggest change, at nearly 37.5%, was observed in the group treated with cosmetic preparations. The parameter also showed correlation with the clinical cellulite assessment scales included in the study. Measurements made by classic ultrasound showed that there was a statistically significant decrease in subcutaneous tissue thickness in all study groups after treatment. The biggest difference was observed in the group using endermologie, the thickness

of subcutaneous tissue decreased by more than 35% after the therapy. The treatments also led to changes in the tissue susceptibility to deformation. The conducted therapies resulted in a statistically significant increase in the subcutaneous tissue hardness, as shown by the elastography results. The largest increase in subcutaneous tissue hardness was observed in the endermologie group and the smallest in the mesotherapy group. The results of subcutaneous tissue thickness measurements, as well as ultrasound elastography, significantly correlated with cellulite stage assessed using the Hexsel Dal'Forno & Hexsel and Nürnberger-Müller scales. Analysis of the parameters, which were assessed by palpation, also showed that there was a statistically significant decrease in thigh circumference after therapy in all samples studied. There was also a statistically significant decrease in body mass and thus BMI in the group using endermologie and therapy based on professional cosmetic preparations. In the mesotherapy group, there were no statistically significant differences between body mass and BMI before and after treatment. The therapies also supported cellulite severity reduction, which was assessed using the scales mentioned above. In light of the collected results, it can be concluded that each of the therapies used has high efficacy, although in case of mesotherapy, the changes are slightly smaller compared to cosmetic therapy or endermologie. This result was confirmed by the subjective evaluation of studied women, who found the effects of the treatments very satisfying (7.54 on a 0-10 scale, where 10 meant *"I am very satisfied and notice a big improvement"*). Women considered endermologie the most effective therapy at 8.48 and mesotherapy the least effective at 6.58.

Summary and conclusions

In light of the results, it is clear that ultrasonography is a useful method for assessing cellulite and monitoring the effectiveness of ongoing anti-cellulite therapies. Both classic and high-frequency ultrasonography are used to evaluate cellulite. The most important parameter that we can assess using high-frequency ultrasound is the measurement of the surface area of the bands, subcutaneous tissue growing into the dermis forming the so-called cellulite teeth. In terms of the parameters evaluated by classic ultrasound, both subcutaneous tissue thickness assessment and ultrasound elastography are extremely useful in assessing cellulite. Changes observed with ultrasound correlate with clinical scales for assessing cellulite. Given the relatively small number of papers on the subject, it is necessary to conduct further research on ultrasound imaging of cellulite and expand the knowledge on the parameters, such as echogenicity of the dermis. Nevertheless, given the advantages offered by ultrasound method, it is likely to become more widespread in diagnosing cellulite and evaluating the effectiveness of ongoing therapies.

