Efficacy and safety of shockwaves combined with microwaves in the treatment against cellulite

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Abstract

The successful use of shockwave as Acoustic Wave Therapy (AWT) or EPAT (Extracorporeal Pulse Activating Therapy) in non-invasive treatment of cellulite is well documented. This study focused on efficacy and safety of shockwaves complemented with microwave radiation. Thighs of six women suffering from cellulite in stages II and III were treated 10 times within 4 weeks with ballistic generated shockwave (ZWave, Zimmer, Germany). Reverse sides of thighs were heated by microwave during AWT. Increase of echo density as well as improvement of collagen structure could be shown by Ultrasound documentation within the follow-up. Although efficacy of shockwave treatment is not significant enhanced by supplemented heating, an excellent subjective feeling is verified by all test subjects.

Keywords Cellulite, AWT, microwave, ZWave

Introduction

Orange peel skin affects 80 percent of women suffering from these unaesthetic dimples on their thighs, belly, buttocks and upper arms. The demand for effective but non-invasive methods against cellulite continuously increases. Cellulite can be treated more effectively since the causes for its development are understood. As the septa of women run almost perpendicular to the surface of the skin, enlarged fatty cells push upwards towards the skin surface, causing the feared typical orange peel appearance phenomenon known as cellulite. Consequences are metabolic changes occurring in microcirculation of blood and lymph (1-8). Extracorporeal shockwave lithotripsy (ESWL) has been successfully used since 1980 in medicine for the disintegration of kidney stones (9,10) and extracorporeal Shockwave Therapy (ESWT) for the treatment of orthopaedic conditions of tendon and muscle disorders since 1992 (11-13). There are various physical-technical processes and methods of generating acoustic wave: electrohydraulic (14), electromagnetic, piezoelectric (15) and ballistic principle. The living tissue cells respond to mechanical stimuli induced by acoustic waves with cellular processes like growth, cell migration and protein synthesis. Subsequent biochemical reactions as stimulation of metabolism, blood and lymph circulation as well as mobilizing of fat depots have been shown to reduce fatty acid level (16-18). Moreover, orientation of collagen fibers is reorganized (19). The successful use of shockwave as Acoustic Wave Therapy (AWT) or EPAT (Extracorporeal Pulse Activating Therapy) in treatment of cellulite is well documented (20). The present study investigates the efficacy and safety of ballistically generated shockwaves (ZWave, Zimmer MedizinSysteme GmbH, Germany) in combination with microwave radiation for the treatment and reduction of cellulite.

Material and methods

Six females aged 25 – 55 with cellulite (stage 2-3, Nürnberger and Müller (4)) were treated with the shockwave system ZWave (Zimmer, Germany). Electromagnetically generated acoustic waves were applied with a maximal penetration depth of 35 millimeters. A contact gel as coupling medium ensured the complete energy transfer. Frequencies between 10 and 16 Hz were selected with a total of 2500 (+/-) impulses and energy level averaged between 1 and 2. Thighs of test subjects were treated for 4 weeks a total of ten times. Therapy was performed in accordance with the principles of manual lymph drainage. Right thighs of patients were attended additively with microwaves in the area requiring treatment. Warming of the tissue was achieved by microwaves (unpulsed, averaged 75 Watt) for 7 to 10 minutes. The following parameters were measured at baseline: age, weight [kg], size [cm], BMI [kg/m^2], body fat by impedance analysis [%], degree of cellulite [second and third stadium], circumference of both thighs in specified areas left/right [cm], photographic documentation of treated areas, 20 MHz ultrasound measurement of the skin and documentation of volunteers subjective perception. During each treatment a range of different parameters were

monitored: age, weight [kg], size [cm], BMI [kg/m^2], body fat [%], circumference of both thighs in specified areas left/right [cm], and the documentation of probands subjective perception. In every fifth treatment photographic documentation of treated regions was carried out. After the last treatment measurement data of the following parameters were recorded: age, weight [kg], size [cm], BMI [kg/m^2], body fat by impedance analysis [%], degree of cellulite [second and third stadium], circumference of both thighs in specified areas left/right [cm], photographic documentation of treated areas, 20 MHz ultrasound measurement of the skin, and documentation of volunteers subjective perception. During screening, patients completed also a questionnaire covering: demographics, medical background and potential contraindications to therapy. Satisfaction of test persons as well as clinical evaluation concerning the success of the treatment by the attending physician was requested by a structured questionnaire.

Development of temperature distribution in tissue caused by microwaves:

To a depth of one centimeter tissue is warmed up to 40°C in the focus of microwave radiation, corresponding to the thickness of the subcutaneous fat layer (Study Dr. Klaus Fritz, Landau: Stoßwelle). Temperature in underlying tissue reaches 33 °C, but at least 28°C at a depth of 30 millimeter.

Results

Defined areas in the thighs of six female patients diagnosed cellulite stage 2 (n=4) to 3 (n=2) were treated 10 times with shock waves. Tissue of one side was also heated with microwave radiation. Frequencies between 10 and 19 Hz were selected with an energy level of II to III and 2500 to 4500 shocks. Pulsed microwaves intensity of 75 Watt was applied for 7 to 10 minutes with a distance of 10 centimeter to the skin.

Circumference of the thigh, body fat, BMI

In defined areas of lateral thighs treatment with additional microwave higher circumference reduction (0.16 percent) was attained (fig. 1; table 1, not significant). Changes in levels of body fat (averaged 4.25 %) varied individual in follow up independently from stage of cellulite (fig. 2). No significant changes in BMI (fig. 3) or body weight (fig. 4) were monitored.

Photographical and ultrasound documentation

Relief in defined areas has slightly improved by shock wave treatment both with respectively without heating of tissue at the end of treatment series (fig. 5). At the end of treatment period increased echo density and improved structure of collagen could be shown for shockwaves combined with microwave by ultrasound imaging during course of treatment (fig. 6, 7). However, for all test subjects ultrasonic measurements demonstrably confirmed the increase of echo density as well as the improvement of collagen structure in the presence of tissue heating in the treated area. Average reduction of circumference of 1.68 percent could be obtained without significant differences comparing both procedures (shock waves combined with microwaves: 1.84 percent).

Side effects

During treatment subjective perception of the participants were characterized as positive. No side effects were observed. Heating of treated tissue was perceived mainly as more pleasant. Following the therapy, subjective impressions of skin were smoother and former in areas treated with microwaves.

Subjective perception

This pilot study shows that the treatment has no side effects and is well tolerated by the patients. Subjective perception perceived from patients as more pleasant in the warmed side of thighs. Also skin was described smoother and former already directly after the treatment combined with microwave. The beneficial effect is felt short-term and could not be verified by photographic documentation during the course of treatment.

Discussion

The study's findings show that combination of AWT with microwave is just as efficient treating cellulite as shock wave alone as other studies shown recently. Subjective impressions are more pleasant for shock waves applied in warmed tissue. In contrast to recently described findings, no side effects were determined (21, 22). Ultrasound measurement as a safe, sensitive and accurate method (23, 24) demonstrates significanty increased elasticity of the connective tissue and improves the tightening of the skin. Application of shock waves activates blood circulation, metabolism, neovascularization and production of collagen (25). Lymph draining is accelerated by improved metabolism and circulation. Regardless of the type generating the shock waves similar effects were demonstrated already in several studies. Shock waves generated by linear arranged piezoelectric crystals are focused into tissue by a curved handpiece. By the use of different silicone cones, energy of sound waves can be delivered to a depth of approximately 50 mm below the surface of the tissue (Richard Wolf GmbH, Knittlingen, Germany). Another option to generate shock waves is the principle used in pneumatic hammer: A projectile in the handpiece accelerates a pneumatic pulse to a very high speed for transmission into the area to be treated (26; Storz Medical AG, Tägerwilen, Switzerland). In addition to increased elasticity of tissue and the reduction of cellulite, the reduction of circumference can be achieved by AWT (2 cm). All these techniques generating shockwaves are already being used successfully, but also have limitations. The more dimples are present, the more capacity of appliances are recommended to achieve sufficient significant results due to microtraumas. The combination of shock wave therapy with further applications as heating, cryolipolysis (27), massage (28), infrared, vibration, radiofrequency or vacuum provide opportunities to overcome the limiting factor of AWT.

Conclusion

This pilot study of the shock wave combined with simultaneous heating of the area against cellulite shows that the treatment has no side effects and is well tolerated by the patients. Subjective perception perceived from patients as more pleasant in the warmed side of thighs. Also skin was described smoother and former already directly after the treatment combined with microwave. The beneficial effect is felt short-term and could not be verified by photographic documentation during the course of treatment. For all test subjects ultrasonic measurements demonstrably confirmed however the increase of echo density as well as the improvement of structure of collagen in the presence of tissue heating in the treated area. Average reduction of circumference of 1.68 percent could be obtained without significant differences comparing both procedures (shock waves combined with microwaves: 1.84 percent). Further investigations should be continued based on reproducible, defined and standardized high quality evaluation criteria from the outset like determination of skin thickness, monitoring of ultrasonic density and profilometry. These data will provide statistically significant information about the influence of tissue warming on the success of shock wave therapy against cellulite.

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Legends of Figures and Tables

Figure 1: Reduction of circumference at the end of 10 treatment series with shock waves in percent (+/- microwaves; without microwaves: blue, with microwaves: red)

Figure 2: Changes of body fat (mean values in percent) in course of treatment period

Figure 3: Difference of BMI (in percent) from beginning to end of treatment series

Figure 4: Difference of weight (in percent) from beginning to end of treatment series

Figure 5a: Photo documentation: HA; first treatment session (shockwave: left thigh, shockwave + microwave: right thigh)

Figure 5b: Photo documentation: HA; fifth treatment session (shockwave: left thigh, shockwave + microwave: right thigh)

Figure 5c: Photo documentation: HA; tenth treatment session (shockwave: left thigh, shockwave + microwave: right thigh)

Figure 6a: Ultrasound documentation DermaScan 20 MHz: RK, before treatment series

Figure 6b: Ultrasound documentation DermaScan 20 MHz: RK, at the end of treatment series; improvement of tissue structure, well-defined and smooth border with the subcutis, visible reduction of cellulite

Figure 7a: Ultrasound documentation DermaScan 20 MHz: HA, before treatment series

Figure 7b: Ultrasound documentation DermaScan 20 MHz: HA, at the end of treatment series; improvement of tissue structure, well-defined and smooth border with the subcutis, visible reduction of cellulite

Table 1: Average reduction of circumference [%] in AWT-treated areas of thighs at the end of 10 treatment series with/ without additional microwave heating.

Figures and Tables

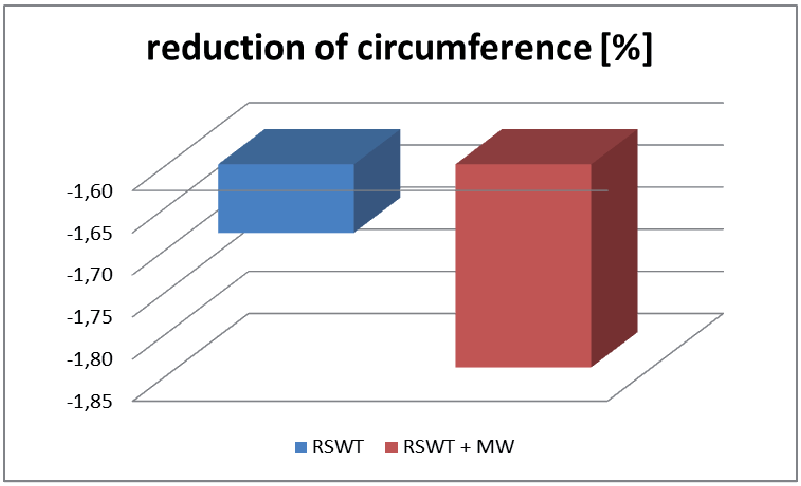

Figure 1

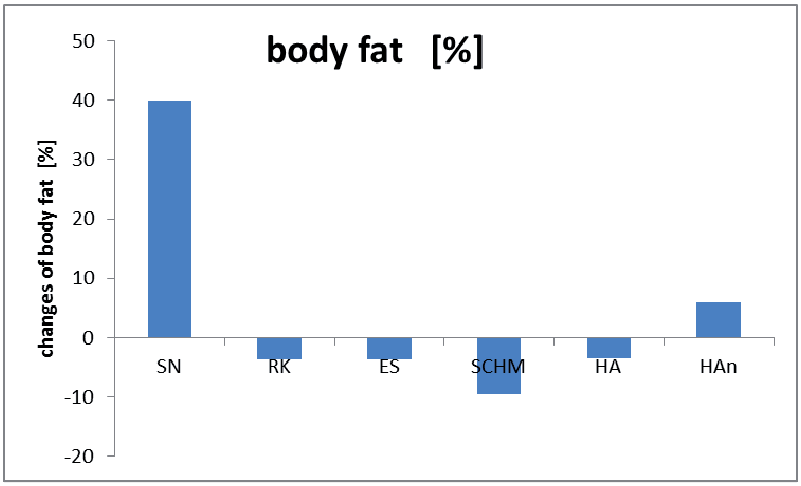

Figure 2

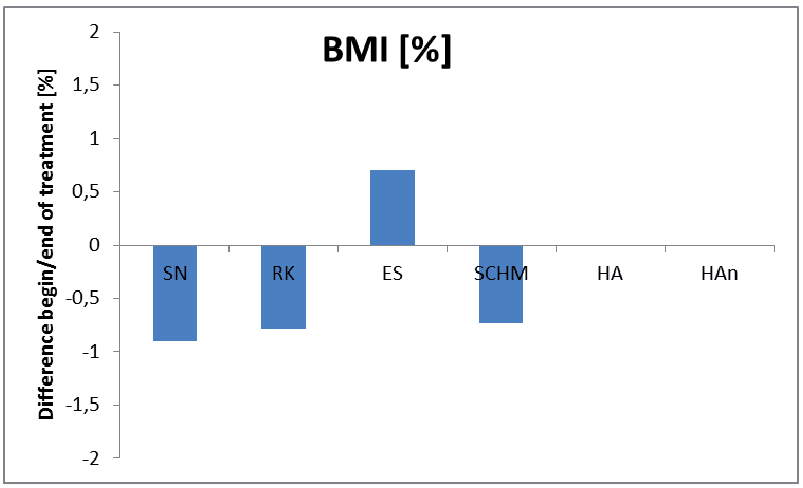

Figure 3

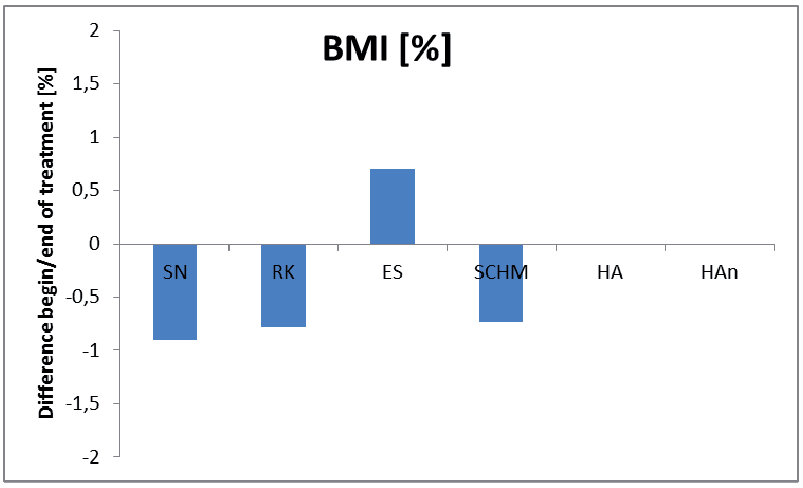

Figure 3

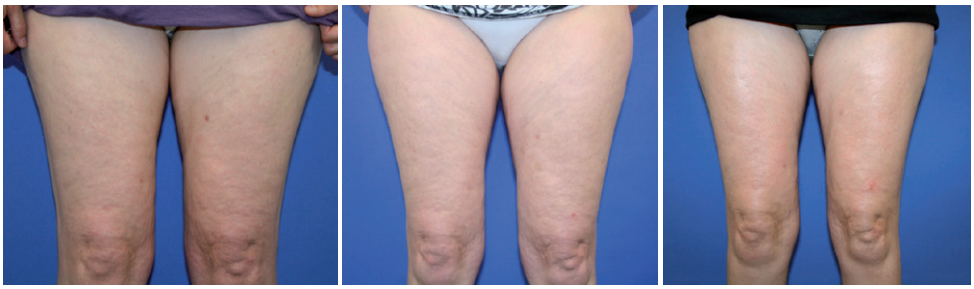

Fig. 5a-c

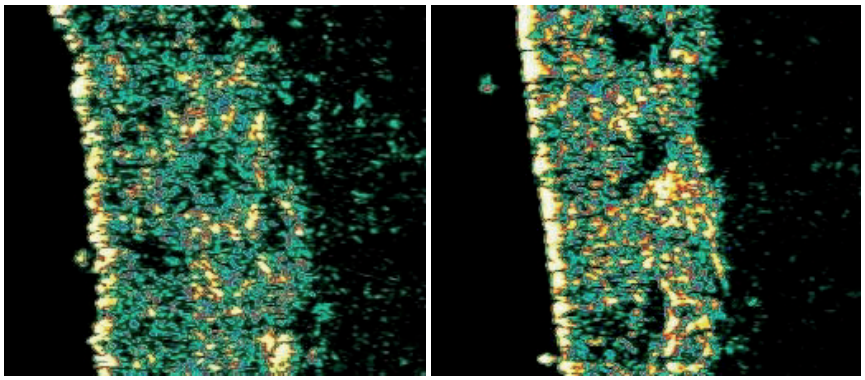

Fig. 6a + b

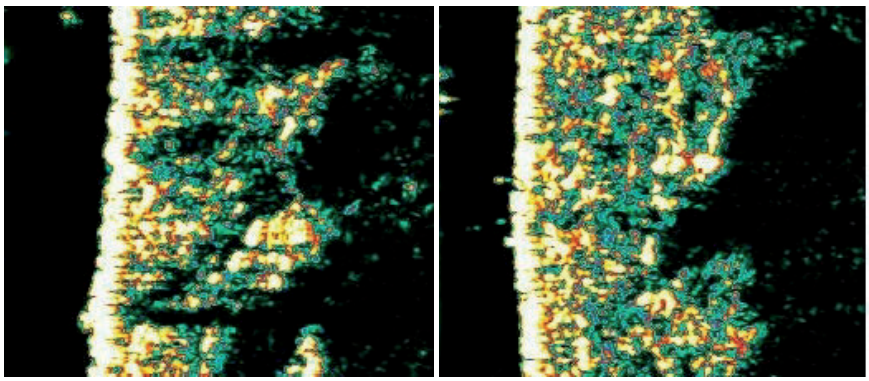

Fig. 7a + b

Reduction circumference [%]	**RSWT**	**RSWT + MW**
SN	-4,10	-4,10
RK	-3,07	-1,53
ES	0	-1,5625
SCH-B M	-2,91	-3,84
HA	0	0
Han	0	0
Mean value	**-1,68**	**-1,84**

Table 1