OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE

Cosmetic

Ultrasonographic Measurement After Multilayer Stimulation for Body Fat Reduction and Muscle Strengthening: A Pilot Study

Kyung-Tae Bae, MD*
Hye-Won Jung, BS†
Dong-Shin Lee, BS†
Jovian Wan, MBChB‡
Kyu-Ho Yi, MD, PhD§¶

Background: Demand for noninvasive body contouring is rising as patients seek alternatives to liposuction. We evaluated a device combining electrical muscle stimulation, radiofrequency, and vacuum technology for abdominal fat reduction and muscle enhancement.

Methods: In a prospective study, 20 adults (15 women, 5 men; 28–50 y; body mass index [BMI] 22–28 kg/m^2) received 16 sessions over 8 weeks (two 30-min sessions/wk) targeting the abdomen. Outcomes at baseline and 1 month posttreatment included ultrasonographic abdominal fat and muscle thickness, waist circumference, BMI, standardized photography, and patient-reported satisfaction. Safety and downtime were documented.

Results: At 1 month, mean abdominal fat thickness decreased by 0.61 cm (95% confidence interval [CI], 0.48–0.74; $P < 0.001$), and muscle thickness increased by 0.24 cm (95% CI, 0.17–0.31; $P < 0.001$). Waist circumference reduced by 2.13 cm (95% CI, 1.81–2.45; $P < 0.001$), and BMI changed by −0.53 (95% CI, −0.59 to −0.54; $P < 0.001$). Standardized images and patient ratings indicated improved contour and skin elasticity. The treatments were well tolerated, with high satisfaction and minimal downtime.

Conclusions: Combined electrical muscle stimulation, radiofrequency, and vacuum therapy produced significant reductions in abdominal fat and waist size, increased muscle thickness, and improved perceived contour with favorable tolerability. These findings support this multimodal, noninvasive approach as a promising option for abdominal shaping. *(Plast Reconstr Surg Glob Open 2025;13:e7175; doi: 10.1097/GOX.0000000000007175; Published online 11 November 2025.)*

INTRODUCTION

The global prevalence of obesity has increased dramatically in recent years, reaching alarming levels worldwide. Obesity and overweight conditions now affect a significant portion of the population across various regions, with a growing number of men and women classified as obese or overweight. This trend underscores the urgent need for effective interventions to address the rising burden of obesity on a global scale.[1,2]

In response to the rising incidence of obesity and the growing demand for effective fat reduction methods, there has been a significant shift toward noninvasive treatments. Specifically, there is an increasing interest in techniques that offer rapid and noninvasive solutions for improving abdominal contour. Since 2012, the demand for noninvasive body contouring solutions has surged by 217.3%.[3]

Noninvasive body contouring treatments have emerged as promising alternatives to invasive procedures, offering advantages such as efficacy, minimal recovery time, and cost-effectiveness. Although these

*From the *It's Me Clinic, Sejong, South Korea; †Weero Inc., Suwon, South Korea; ‡Medical Research Inc., Wonju, South Korea; §You and I Clinic, Seoul, South Korea; and ¶Division in Anatomy and Developmental Biology, Department of Oral Biology, Human Identification Research Institute, BK21 FOUR Project, Yonsei University College of Dentistry, Seoul, South Korea.*

Received for publication January 3, 2025; accepted August 14, 2025.

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

DOI: 10.1097/GOX.0000000000007175

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

treatments may not provide the immediate results seen with invasive methods like liposuction, they are increasingly preferred by patients seeking to avoid surgical risks and costs. When properly used, noninvasive treatments have demonstrated substantial clinical efficacy and safety.[4]

Recent advancements have introduced electrical muscle stimulation (EMS) devices as a novel and efficient approach to augment traditional fitness and rehabilitation methods.[5] EMS uses high-intensity electrical stimulation to induce muscle contractions, thereby enhancing muscle strength and promoting hypertrophy. This process increases muscle fiber size and improves blood flow, facilitating the removal of metabolic waste and delivery of nutrients. Regular EMS sessions have been shown to enhance capillary flexibility and blood flow, resulting in improved body composition, limb strength, and overall physical performance.[6,7]

Bipolar radiofrequency (RF) technology is increasingly favored for its safety and effectiveness in noninvasive body contouring. This technology selectively targets subcutaneous fat tissues with thermal energy while preserving the epidermis, dermis, and underlying muscles. RF lipolysis aims to disrupt fat cells through thermal energy, leading to the release of fatty acids and glycerol. These byproducts are metabolized, with fatty acids undergoing β-oxidation and glycerol being converted into glucose through gluconeogenesis. Some of these byproducts are eliminated via the lymphatic system, liver, or kidneys, resulting in reduced body fat and improved body contour.[7,8] Noninvasive RF devices are effective in inducing adipocyte apoptosis and significantly reducing abdominal circumference and subcutaneous fat layer thickness, making them valuable for targeted fat reduction and body contouring.[9]

Suction lymphatic massage, using vacuum pressure, enhances lymphatic flow and aids in the removal of waste products and metabolic byproducts. Commonly reported benefits include improved tissue firmness and enhanced skin elasticity.[10] This technique optimizes metabolic activities by facilitating the removal of fatty acids and waste products generated from lipolysis, thereby reducing edema and improving skin and muscle condition.

The noninvasive energy-based device used in this study integrates RF, EMS, and vacuum technologies. This combination affects dermal cells and fibers, promoting fibroblast regeneration and leading to skin tightening and improved cellulite appearance. The suction technology lifts the skin, allowing RF heating to penetrate subcutaneous tissues more effectively at depths of 5–25 mm. This study aimed to evaluate multilayer changes using this integrated device and to assess its efficacy through ultrasonographic measurements.[11,12]

Takeaways

Question: Can a noninvasive device combining electrical muscle stimulation (EMS), radiofrequency (RF), and vacuum technology effectively reduce abdominal fat and enhance muscle thickness?

Findings: This prospective observational study involved 20 Asian patients who underwent 16 sessions of combined EMS, RF, and vacuum treatments over 8 weeks. Ultrasonographic measurements revealed a 26.27% reduction in abdominal fat thickness and an 18.83% increase in muscle thickness, with high patient satisfaction and minimal recovery time.

Meaning: The combined use of EMS, RF, and vacuum technologies offers a safe, effective, and noninvasive solution for fat reduction and muscle enhancement, presenting a promising alternative for body contouring.

MATERIALS AND METHODS

This prospective, single-center, nonrandomized pilot study was conducted from April 15, 2024, to June 15, 2024, in accordance with the principles of the Declaration of Helsinki. Given the nature of the investigation, institutional review board review was deemed unnecessary and waived. Written informed consent was obtained from all the participants before enrollment.

As this was a pilot study, a formal power calculation was not performed. The sample size of 20 participants aligns with previously published exploratory studies aimed at feasibility and preliminary efficacy evaluation.

Participants included 20 healthy Asian adults (15 women and 5 men) aged between 28 and 50 years. Eligibility criteria required a body mass index (BMI) between 22 and 28 kg/m^2, absence of recent abdominal treatments, and no known metabolic or cardiovascular disease. This BMI range was intentionally selected to target individuals with moderate abdominal fat levels who were likely to benefit from noninvasive contouring treatments. Exclusion criteria included pregnancy, lactation, implanted electronic devices, active infections, and dermatologic conditions in the treatment area.

The eMVFit System (Weero Co. Ltd, South Korea) was used to administer combined EMS (15–2080 Hz), bipolar RF (1 MHz), and vacuum suction. Each 30-minute session was performed twice weekly for 8 weeks, totaling 16 sessions per participant. Handpieces were secured over the abdominal region using medical straps to maintain contact and stability. The system's integrated sensors maintained temperatures at 43°C at the epidermis and up to 45°C in deeper tissues.[13]

Baseline and posttreatment standardized digital photographs were captured using a Canon EOS 5D Mark IV (Canon, Inc., Tokyo, Japan) for comparative analysis. Participants were positioned 90 cm away from the camera under consistent lighting conditions, with two 5500K softbox lights placed at 45-degree angles. Additionally, cross-sectional ultrasound imaging (GE Logiq P9; GE Healthcare, Chicago, IL) was performed using a standardized scanning protocol to evaluate changes in abdominal muscle and fat layers throughout the treatment period (Fig. 1). (**See figure, Supplemental Digital Content 1**, which displays the standardized anteroposterior photographs that document abdominal contours of a 40-year-old woman before therapy [A] and after the final session [B], and of a 20-year-old woman before therapy [C] and 1 month after the therapy [D], captured under fixed lighting, distance, and posture. Both subjects exhibit flattening of the lower abdomen and improved waist definition, visually corroborating the ultrasonographic changes, **https://links.lww.com/PRSGO/E374**.) Participants were instructed to maintain their regular diet and exercise habits throughout the study period and to report any significant changes.

The handpiece was specifically designed to target the abdominal and flank areas, with a focus on the rectus abdominis, external oblique muscles, and regions with significant cellulite. (**See figure, Supplemental Digital Content 2**, which displays the schematic panels that illustrate the multimodal handpiece: pretreatment tissue showing thick fat and weak muscle [A]; concurrent delivery of RF heating, EMS, negative-pressure vacuum, and epidermal cryoprotection [B]; and immediate postremoval status [C] with reduced adiposity and tighter musculofascial layer. The sequence highlights how simultaneous thermal, mechanical, and neuromuscular stimuli synergistically remodel the abdominal soft tissue, **https://links.lww.com/PRSGO/E375**.) It delivered RF, EMS, vacuum, and cooling protection functions simultaneously to ensure comprehensive treatment. The combination of RF and EMS resulted in a synergistic effect, with electrical stimulation inducing muscle contractions that improved muscle recovery and volume. This integration promoted the expression of myogenic satellite cells, leading to muscle hypertrophy and fiber development.[14,15]

The device used a 1-MHz high-frequency current, providing consistent heating with a standard voltage known for its stability. A central infrared (IR) sensor monitored the real-time skin surface temperature and impedance, ensuring precise control and safety throughout the treatment.[16] The suction inlet lifted the skin layers to allow more targeted heating of subcutaneous fat and facilitated rapid lymphatic drainage of apoptotic fat cells. The device maintained the temperature continuously at the practitioner-set limit (maximum epidermal temperature of 43°C), as monitored by a thermal-imaging camera (FLIR-T62101, Sweden) (Fig. 2). On reaching the target temperature, the system automatically deactivated to prevent overheating, ensuring safe and effective treatment.

Among the 4 available modes—contouring mode, cellulite mode, muscle toning mode, and body tightening mode—this study used 2 modes: contouring mode (1 MHz bipolar RF, EMS 15–100 Hz) and muscle toning mode (1 MHz bipolar RF, EMS 1030–2080 Hz). Multiple handpieces (M1–M4) were applied to the abdominal area, targeting the rectus abdominis and external oblique muscles, with participants positioned supine. A gel pad was used as a conductor, and the handpieces were secured with a specialized belt to ensure stability during treatment. The intensity was set between 90% and 110%, and no topical anesthetic was applied. Participants were instructed to drink 1 L of water before the procedure and to continue hydrating after the treatment to promote lymphatic drainage and optimal blood circulation.

Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences, version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics were calculated for all variables and presented as mean ± SD. Changes in muscle thickness, fat thickness, waist circumference, body weight, and BMI from baseline to posttreatment were analyzed using paired t tests. Statistical significance was set at a P value of less than 0.05.

RESULTS

All 20 participants completed the treatment regimen and follow-up evaluations. Significant changes were observed 1 month after the treatment. The average subcutaneous fat thickness decreased by 0.61 cm (95% confidence interval [CI], 0.48–0.74; $P < 0.001$). Rectus

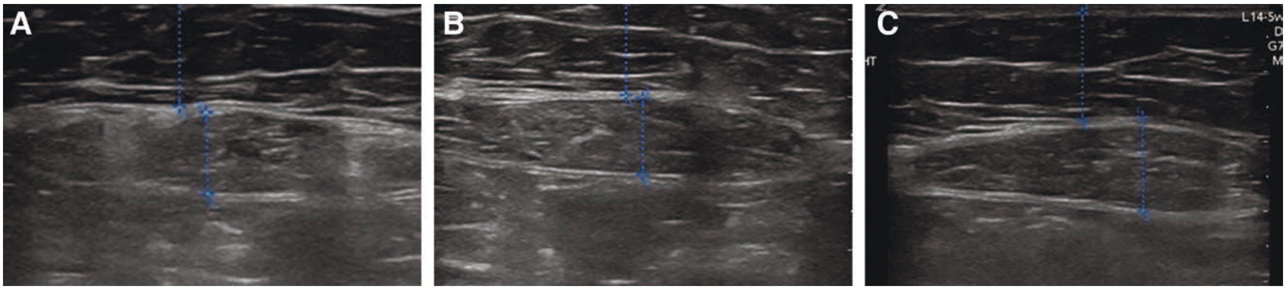

Fig. 1. Longitudinal ultrasound assessment of the anterior abdominal wall during multimodal body contouring (RF–EMS). Standardized high-resolution B-mode scans (identical probe position and depth) depict the rectus abdominis (RA) and overlying subcutaneous adipose tissue (SAT) across treatment timepoints, allowing visualization of changes in RA thickness and SAT thickness consistent with muscle hypertrophy and adipose reduction. High-resolution ultrasound scans obtained with the Zone SmartCart Diagnostic System display rectus abdominis and subcutaneous fat at baseline (A, female patient aged 40 y; April 15, 2024), immediately after the fourth RF-EMS session (B, June 15, 2024), and at 1-month follow-up (C, July 15, 2024), using identical probe position and depth. Across the series, rectus thickness increases and fat layer thins, illustrating progressive myofascial hypertrophy and lipolysis.

abdominis muscle thickness increased by 0.24 cm (95% CI, 0.17–0.31; $P < 0.001$). Waist circumference was reduced by 2.13 cm (95% CI, 1.81–2.45; $P < 0.001$). BMI decreased by 0.53 points (95% CI, 0.39–0.67; $P < 0.001$).

Photographs and ultrasonographic imaging demonstrated visible and measurable improvements in abdominal contour. Patient satisfaction was high; 94.5% of participants rated their improvement as either "good" or "very good." The numerical data are presented in Tables 1, 2. Table 2 also includes individual-level changes in BMI for all participants. Table 3 presents the distribution of patient-reported satisfaction levels.

No adverse events or complications were reported throughout the treatment and follow-up period. All patients resumed daily activities immediately after the procedure.

DISCUSSION

The integration of EMS, bipolar RF lipolysis, and suction lymphatic massage as a combined treatment modality remains relatively underexplored in the existing literature. Nonetheless, based on the mechanisms underlying these technologies, it was anticipated that their synergistic application would significantly enhance body contouring outcomes. This study demonstrated that this combination effectively achieves concurrent fat reduction and muscle strengthening, resulting in a firmer and smoother body shape. Furthermore, the approach offers benefits such as improved skin elasticity, reduced waist circumference, and overall enhanced body contour.[17]

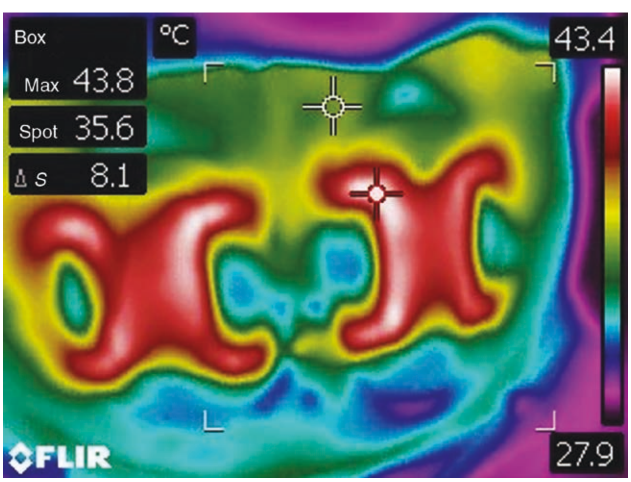

Fig. 2. Thermal-imaging frames captured with an FLIR-T62101 camera reveal uniform dermal warming during active RF delivery, whereas epidermal temperature is stabilized at approximately 43°C by the integrated cooling module. This confirms safe, targeted energy deposition sufficient for adipocyte apoptosis without superficial thermal injury.

Treatment sessions of 15, 30, 45, or 60 minutes allowed targeting of various body areas, facilitating a broad range of contouring improvements. RF technology heated fat cells to 45°C, inducing lipolysis and adipocyte apoptosis. EMS and suction promoted muscle and nerve stimulation, motor point activation, and lymphatic drainage. The synergistic effects of these technologies were evident: RF elevated muscle temperature, enhancing muscle stimulation through thermal effects, whereas EMS facilitated rapid muscle growth, leading to increased muscle volume after the treatment.

The combined use of EMS and RF has been validated in multiple clinical studies, showcasing their effectiveness in improving body contour, promoting muscle growth, and reducing fat. Dayan et al[18] demonstrated that simultaneous application of EMS and RF significantly enhanced myogenic satellite cell expression, leading to the production of heat shock proteins, muscle hypertrophy, and muscle fiber development. EMS alone resulted in an average subcutaneous fat reduction of 19.6% and an average muscle thickness increase of 15.1%, underscoring its substantial effectiveness. These findings highlight the superior efficiency of combined treatments over standalone therapies, emphasizing the synergistic benefits of the integrated approach.[18]

The simultaneous use of RF and EMS effectively promotes both fat reduction and muscle strengthening, making it highly effective for body contouring. Muscle contractions induced by EMS improve muscle elasticity and volume while contributing to localized fat reduction. This dual action enhances overall body contouring results, offering a comprehensive solution by targeting both muscle and fat simultaneously.[19] The concurrent application of neuromuscular stimulation from EMS and RF heating raises the surface temperature, leading to significant changes in muscle that positively impact fat reduction, breakdown, and muscle hypertrophy. This combined effect has been reported to enhance muscle volume and strength while targeting subcutaneous fat layers, making it a potent approach for body contouring and physique enhancement.[20]

Moreover, simultaneous application of RF and EMS enhances blood circulation in muscles and fascia, and the combination of tissue heating and muscle stimulation significantly promotes muscle protein synthesis. This process is crucial for muscle hypertrophy by substantially

Table 1. Anthropometric and Ultrasonographic Measurements Before and After Treatment (Mean ± SD)

Parameter	Pretreatment, Mean Â ± SD	Posttreatment, Mean Â ± SD	Change, 95% CI	Change, %	P
Rectus abdominis thickness, cm	(1.27, 0.19)	(1.51, 0.22)	0.24 (0.20 to 0.28)	18.83	<0.001
Subcutaneous fat thickness, cm	(2.32, 0.48)	(1.71, 0.39)	−0.61 (−0.68 to −0.54)	−26.27	<0.001
Waist circumference, cm	(72.62, 6.84)	(70.48, 6.57)	−2.13 (−2.39 to −1.89)	−2.94	<0.001
Body weight, kg	(68.73, 9.28)	(67.15, 8.96)	−1.58 (−1.99 to −1.17)	−2.30	0.002
BMI, kg/mÂ²	(24.84, 1.62)	(24.24, 1.54)	−0.60 (−0.75 to −0.45)	−2.41	0.003

Table 2. Individual Patient Data

Patient	Age, y	Sex	Pre-BMI, kg/m²	Post-BMI, kg/m²	Prefat, cm	Postfat, cm	Premuscle, cm	Postmuscle, cm	Prewaist, cm	Postwaist, cm	BMI Change, kg/m²
1	32	F	23.8	23.1	2.45	1.76	1.18	1.42	69.5	67.2	−0.7
2	45	F	25.2	24.6	2.38	1.82	1.25	1.48	73.4	71.5	−0.6
3	36	M	26.8	26.2	1.98	1.45	1.52	1.86	82.1	79.8	−0.6
4	41	F	24.7	24.2	2.22	1.61	1.3	1.54	71.8	69.7	−0.5
5	38	M	26.1	25.6	2.35	1.72	1.45	1.7	79.3	77	−0.5
6	29	F	22.9	22.4	2.1	1.52	1.22	1.46	68.4	66.1	−0.5
7	44	F	25.5	25	2.4	1.89	1.34	1.59	75	72.8	−0.5
8	35	M	24.4	23.9	2.3	1.68	1.28	1.5	74.1	71.8	−0.5
9	31	F	23.3	22.8	2.25	1.55	1.26	1.49	70.3	68.1	−0.5
10	39	F	24.1	23.5	2.2	1.5	1.24	1.48	71.2	69.1	−0.6
11	46	M	27	26.4	2.6	1.92	1.58	1.81	84.2	81.5	−0.6
12	33	F	24.6	24.1	2.28	1.63	1.29	1.54	72.6	70.5	−0.5
13	42	F	25.4	24.8	2.41	1.72	1.33	1.59	74.8	72.6	−0.6
14	37	M	26.5	25.8	2.55	1.85	1.5	1.73	80	77.6	−0.7
15	40	F	24	23.5	2.23	1.6	1.27	1.5	70.8	68.5	−0.5
16	30	F	23.2	22.6	2.18	1.56	1.2	1.43	69	66.9	−0.6
17	43	M	26.2	25.6	2.48	1.78	1.46	1.68	78.6	76	−0.6
18	34	F	24.5	23.9	2.33	1.62	1.31	1.55	72.9	70.6	−0.6
19	28	F	23	22.4	2.15	1.48	1.23	1.46	68.5	66.1	−0.6
20	42	F	24.3	23.8	2.27	1.69	1.21	1.46	71.2	69.1	−0.5

F, female; M, male.

Table 3. Patient Satisfaction Assessment

Satisfaction Level	After Final Treatment	One Month After the Treatment
Slightly improved (<25%)	0 (0%)	0 (0%)
Moderate improvement (25%–50%)	2 (10%)	1 (5.5%)
Good improvement (51%–75%)	14 (70%)	10 (50%)
Very good improvement (>75%)	4 (20%)	9 (44.5%)

increasing heat shock protein expression, essential for muscle growth and recovery. The synergistic effect of RF and EMS not only stimulates muscle contraction but also optimizes the cellular environment for improved muscle development and fat reduction.[21] Additionally, the combined use of RF and EMS positively impacts the nervous system's activation, leading to enhanced muscle strength and improved neuromuscular function, which contributes to better muscle contractions and overall strength, alongside muscle hypertrophy and fat reduction.[22]

Suction lymphatic massage, whether used alone or with RF technology, has proven effective in smoothing cellulite and promoting lymphatic circulation, aiding in waste removal from the body. This technique improves overall body contour by enhancing tissue drainage and reducing fluid retention.[23] When combined with RF lipolysis, suction massage effectively reduces cellulite appearance and improves fat distribution, leading to smoother skin texture and more even fat distribution. The negative-pressure vacuum technology used allows controlled epidermal and dermal folding between electrodes, ensuring efficient energy delivery with reduced risk of epidermal damage compared with traditional methods.

Additionally, suction lymphatic massage has proven highly effective in combating cellulite by softening the connective tissue between fat cells. This process facilitates the breakdown and elimination of fat, resulting in improved skin texture and a reduction in the dimpled appearance associated with cellulite. Suction massage thus significantly enhances body contouring treatments.[21] Negative-pressure vacuum technology allows controlled folding of the epidermis and dermis between the 2 electrodes of the bipolar current. This enables treatment of both superficial and deeper dermal layers with reduced energy levels compared with traditional methods. This approach minimizes the risk of epidermal damage by avoiding the need for skin folding under vacuum, ensuring efficient energy distribution and enhancing both safety and effectiveness.[23] Combining suction massage with RF lipolysis optimizes body fat reduction and skin improvement. The synergistic effect of RF-induced fat breakdown and suction-enhanced lymphatic drainage accelerates fat removal while improving skin texture and firmness. This integrated approach leads to more pronounced and comprehensive body contouring results.[16]

In this study, the integration of EMS, RF, and suction lymphatic massage technologies proved effective not only in enhancing metabolism and reducing edema but also in providing complementary benefits. EMS boosts metabolic rate through muscle contractions, RF facilitates fat breakdown, and suction massage improves lymphatic circulation, thereby optimizing the removal of metabolic waste and toxins from the body. This comprehensive strategy enhances body contouring outcomes by targeting fat reduction, muscle enhancement, and lymphatic drainage simultaneously.

Importantly, we observed a statistically significant decrease in BMI across all 20 participants, with an average reduction of 0.56 points (95% CI, −0.59 to −0.54; $P < 0.001$). Although the primary intent of the treatment was not weight loss, this modest yet consistent reduction in BMI suggests potential auxiliary metabolic benefits. These may stem from improved muscle mass, increased energy expenditure, or fat redistribution. Such findings support the idea that multimodal aesthetic treatments may contribute to broader physiological improvements in individuals with mild to moderate abdominal adiposity.

As a well-tolerated and effective alternative for weight loss and body contouring, the combination of these technologies provides an efficient approach to fat reduction and muscle hypertrophy. However, it is important to emphasize that this approach should not be considered a treatment for obesity, which requires comprehensive lifestyle modifications, including diet, exercise, and potentially medical or surgical interventions. The technique presented in this study is primarily intended for localized body contouring and aesthetic enhancement rather than weight management or obesity treatment. This study introduced a synergistic treatment method that leverages the combined effects of EMS, RF, and suction lymphatic massage to achieve optimal fat reduction and muscle enhancement, offering a comprehensive solution for body contouring and physique improvement.[24,25]

This study marks the first use of EMS, bipolar RF lipolysis, and vacuum lymphatic massage in combination. Our hypothesis that this integrated approach would yield exceptional synergistic effects for noninvasive fat reduction, cellulite improvement, and body contouring was confirmed by the experimental results. The use of bipolar RF with impedance check and temperature control functions, combined with EMS, ensured safe and effective thermal energy delivery during treatment, leading to muscle hypertrophy and increased fat breakdown. When paired with vacuum lymphatic massage, this approach extends into a novel concept for noninvasive obesity treatment, offering a comprehensive and synergistic method for enhancing body contour and overall physical appearance.[18]

This pilot study has several limitations. The small sample size (N = 20) and short follow-up period (1 mo) limit the generalizability of the results and do not allow assessment of long-term efficacy. The study's focus on the abdominal area means that results may not be applicable to other body regions. Additionally, although participants were instructed to maintain their regular lifestyle habits, we cannot rule out that some weight loss may have occurred due to increased awareness of body image during the study period, which could have contributed to the observed improvements. The lack of a control group also prevents definitive attribution of all observed changes to the treatment alone. Although BMI reduction was statistically significant, unmonitored lifestyle factors such as diet and physical activity may have contributed to the change. Future controlled studies are warranted to isolate the effects of the treatment. Future research should address these limitations with larger sample sizes, longer follow-up periods, multiple treatment areas, more comprehensive monitoring of lifestyle factors, and ideally, randomized controlled trial designs.

Nevertheless, this study highlights the innovative potential of noninvasive slimming devices. By simultaneously achieving fat reduction and muscle enhancement through new technologies, the promising results emphasize the transformative possibilities of this combined approach. Future research should further explore the potential of this technology combination and its broader clinical applications, paving the way for more effective solutions in noninvasive body contouring.[26]

CONCLUSIONS

This pilot study demonstrates that combined RF, vacuum, and EMS therapies effectively promote fat reduction, increase muscle thickness, and improve body contour with high patient satisfaction. The eMVFit device delivered these outcomes with minimal recovery time and excellent safety. These noninvasive treatments should be viewed as complementary to healthy lifestyle habits rather than replacements for them. Future research with larger sample sizes and extended follow-up is needed to establish long-term efficacy across diverse patient populations.

Kyu-Ho Yi, MD, PhD
Division in Anatomy & Developmental
Biology, Department of Oral Biology
Human Identification Research Institute, BK21 FOUR
Project, Yonsei University College of Dentistry
50-1 Yonsei-ro, Seodaemun-gu
Seoul 03722, South Korea
E-mail: kyuho90@daum.net

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

PATIENT CONSENT

All participants provided written informed consent for the use of their clinical data and images in this study, with the understanding that these data and images may be published in academic journals.

ETHICAL APPROVAL

This pilot study was reviewed and deemed exempt from full ethical review by the local institutional review board, as it involved noninvasive procedures without collection of identifiable sensitive information.

REFERENCES

1. Tham KW, Abdul Ghani R, Cua SC, et al. Obesity in South and Southeast Asia—a new consensus on care and management. *Obes Rev.* 2023;24:e13520.
2. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in underweight and obesity from 1990 to 2022: a pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. *Lancet.* 2024;403:1027–1050.
3. Djalalinia S, Yoosefi M, Shahin S, et al. The levels of BMI and patterns of obesity and overweight during the COVID-19 pandemic: experience from the Iran steps 2021 survey. *Front Endocrinol (Lausanne).* 2022;13:1043894.

4. Mazzoni D, Lin MJ, Dubin DP, et al. Review of non-invasive body contouring devices for fat reduction, skin tightening and muscle definition. *Australas J Dermatol*. 2019;60:278–283.
5. Cook J, DiBernardo BE, Pozner JN. Bipolar radiofrequency as an adjunct to face and body contouring: a 745-patient clinical experience. *Aesthet Surg J*. 2021;41:685–694.
6. Kemmler W, Shojaa M, Steele J, et al. Efficacy of whole-body electromyostimulation (WB-EMS) on body composition and muscle strength in non-athletic adults. A systematic review and meta-analysis. *Front Physiol*. 2021;12:640657.
7. Granat MH, Ferguson AC, Andrews BJ, et al. The role of functional electrical stimulation in the rehabilitation of patients with incomplete spinal cord injury—observed benefits during gait studies. *Paraplegia*. 1993;31:207–215.
8. Rossi AB, Vergnanini AL. Cellulite: a review. *J Eur Acad Dermatol Venereol*. 2000;14:251–262.
9. Honigman RJ, Phillips KA, Castle DJ. A review of psychosocial outcomes for patients seeking cosmetic surgery. *Plast Reconstr Surg*. 2004;113:1229–1237.
10. Moortgat P, Anthonissen M, Meirte J, et al. The physical and physiological effects of vacuum massage on the different skin layers: a current status of the literature. *Burns Trauma*. 2016;4:34.
11. Mulholland RS. Non-surgical body contouring: introduction of a new non-invasive device for long-term localized fat reduction and cellulite improvement using controlled, suction coupled, radiofrequency heating and high voltage ultra-short electrical pulses. *J Clin Exp Dermatol*. 2012;3:245.
12. Sadick NS, Mulholland RS. A prospective clinical study to evaluate the efficacy and safety of cellulite treatment using the combination of optical and RF energies for subcutaneous tissue heating. *J Cosmet Laser Ther*. 2004;6:187–190.
13. Weiss R, Weiss M, Beasley K, et al. Operator independent focused high frequency ISM band for fat reduction: porcine model. *Lasers Surg Med*. 2013;45:235–239.
14. Yoshihara T, Naito H, Kakigi R, et al. Heat stress activates the Akt/mTOR signalling pathway in rat skeletal muscle. *Acta Physiol (Oxf)*. 2013;207:416–426.
15. Halevy O, Krispin A, Leshem Y, et al. Early-age heat exposure affects skeletal muscle satellite cell proliferation and differentiation in chicks. *Am J Physiol Regul Integr Comp Physiol*. 2001;281:R302–R309.
16. Hellman J, Mulholland RS. Retrospective analysis of treatment results by non-invasive radiofrequency (RF) device with standard and high voltage RF electrical pulses coupled with suction for fat reduction and cellulite improvement. *J Cosmet Dermatol Sci Appl*. 2021;11:279–292.
17. Gold M, Kleinrock ML, Utley C, et al. Nonsurgical fat reduction: cryolipolysis, RF skin tightening, HIFEM, and injectable lipolysis. *Dermatol Rev*. 2021;2:196–204.
18. Dayan E, Chilukuri S, Bucky L, et al. Combination non-invasive radiofrequency and electrical muscle stimulation: a synergistic combination for body contouring. *J Cosmet Dermatol*. 2022;21:S29–S36.
19. Vranis N, Ghavami A, Rohrich R, et al. Radiofrequency and electrical muscle stimulation: a synergistic treatment that achieves lipolysis and circumferential waist reduction in non-invasive body contouring. *Aesthet Surg J Open Forum*. 2024;6:ojae042.
20. Manuskiatti W, Nanchaipruek Y, Gervasio MK, et al. Combination of monopolar 2 MHz radiofrequency and electrical multidirectional stimulation for reducing abdominal circumference and enhancing the muscle definition in subjects with overweight range body mass index. *Lasers Surg Med*. 2022;54:1198–1206.
21. Jacob C, Kent D, Ibrahim O. Efficacy and safety of simultaneous application of HIFEM and synchronized radiofrequency for abdominal fat reduction and muscle toning: a multicenter magnetic resonance imaging evaluation study. *Dermatol Surg*. 2021;47:969–973.
22. Nishikawa Y, Watanabe K, Takahashi T, et al. The effect of electrical muscle stimulation on quadriceps muscle strength and activation patterns in healthy young adults. *Eur J Sport Sci*. 2021;21:1414–1422.
23. Chang P, Wiseman J, Jacoby T, et al. Noninvasive mechanical body contouring: (endermologie) a one-year clinical outcome study update. *Aesthetic Plast Surg*. 1998;22:145–153.
24. Ersek RA, Mann GE, II, Salisbury S, et al. Noninvasive mechanical body contouring: a preliminary clinical outcome study. *Aesthetic Plast Surg*. 1997;21:61–67.
25. Kutlubay Z, Songur A, Engin B, et al. An alternative treatment modality for cellulite: LPG endermologie. *J Cosmet Laser Ther*. 2013;15:266–270.
26. Adatto MA, Adatto-Neilson RM, Morren G. Reduction in adipose tissue volume using a new high-power radiofrequency technology combined with infrared light and mechanical manipulation for body contouring. *Lasers Med Sci*. 2014;29:1627–1631.