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Prospective Pilot Study on Low-Frequency Electrical Muscle Stimulation for Noninvasive Gluteal Contouring

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Abstract

Objective: This paper aims to evaluate the feasibility, safety, and preliminary clinical effectiveness of low-frequency electrical muscle stimulation (EMS) for noninvasive gluteal contouring. **Methods:** Twenty adult participants (25 - 55 years) dissatisfied with their gluteal contour were enrolled in a prospective single-arm pilot study. Each participant received 10 weekly EMS sessions using the TONE-PRO device. Objective outcomes included changes in gluteus maximus thickness measured by standardized ultrasonography and changes in waist-to-hip ratio (WHR). Subjective outcomes were assessed using the Global Aesthetic Improvement Scale (GAIS). Safety was evaluated through structured adverse event monitoring. **Results:** Mean gluteus maximus thickness increased progressively during treatment, reaching +2.01 ± 0.83 mm after 10 sessions ($P < 0.001$), with maintenance at 1-month follow-up (+2.05 ± 0.88 mm vs baseline, $P < 0.001$). WHR decreased significantly from baseline ($P < 0.001$). Both patient and investigator GAIS scores demonstrated progressive aesthetic improvement. No serious adverse events occurred. **Conclusion:** In this exploratory pilot cohort, low-frequency EMS was associated with measurable increases in gluteal muscle thickness and favorable aesthetic outcomes with a reassuring safety profile. Controlled studies are required to confirm durability and comparative efficacy.

Keywords

Electrical Muscle Stimulation, Gluteus Maximus, Body Contouring, Waist-to-Hip Ratio, Noninvasive Aesthetics

1. Introduction

Electrical muscle stimulation (EMS) is a modality that delivers low-frequency electrical impulses through surface electrodes, triggering involuntary skeletal muscle contractions via peripheral motor nerve depolarization. Initially developed for rehabilitation purposes, including prevention of muscle atrophy, neuromuscular re-education, and recovery following injury—EMS has progressively expanded into the aesthetic domain [1].

The global demand for noninvasive body contouring has increased substantially in recent years. Patients increasingly seek procedures that offer visible improvement with minimal downtime and reduced procedural risk. While surgical gluteal augmentation techniques, including implants and autologous fat grafting, can provide significant volumetric enhancement, they are associated with operative risks, anesthesia exposure, recovery time, and potential complications. These considerations have stimulated interest in alternative noninvasive approaches.

Traditional body contouring technologies have primarily focused on adipose tissue reduction through cryolipolysis, radiofrequency, ultrasound, or laser-based systems. However, body contour is determined by a complex interplay between subcutaneous fat distribution, muscular architecture, skeletal structure, and skin quality. Enhancement of underlying muscle tone and projection may therefore represent an alternative strategy for selected patients. Waist-to-hip ratio (WHR) is a widely used anthropometric parameter reflecting body fat distribution and is considered a relevant indicator of both metabolic risk and body contour aesthetics [2]-[6].

The gluteus maximus is the largest and one of the most aesthetically defining skeletal muscles of the human body. It contributes not only to hip extension and locomotion but also to posterior body contour and perceived projection. Subtle increases in muscle thickness may translate into visible contour enhancement, particularly in individuals with low to normal body mass index.

Unlike voluntary contraction, which follows a physiologic pattern of progressive motor unit recruitment, electrical stimulation may activate motor units in a less selective and potentially more synchronous manner. This pattern of activation has been hypothesized to induce neuromuscular adaptations when applied repetitively over time. However, objective imaging-based documentation of EMS-induced gluteal morphological changes remains limited.

This prospective pilot study was designed to assess whether a structured series of low-frequency EMS treatments could produce measurable changes in gluteus maximus thickness, influence waist-to-hip ratio (WHR), and generate favorable subjective aesthetic outcomes while maintaining a reassuring safety profile.

Over the past decade, the aesthetic medicine landscape has shifted toward procedures that offer measurable improvement while minimizing downtime and procedural risk. Patients increasingly seek interventions that align with lifestyle flexibility, safety perception, and incremental enhancement rather than dramatic transformation. In this context, technologies that modulate muscular architecture

represent an emerging category distinct from traditional fat-reduction modalities.

While adipose tissue reduction remains central to body contouring, muscle volume and tone contribute significantly to the external silhouette. The gluteal region, in particular, derives much of its projection from the gluteus maximus muscle mass. Even subtle increases in muscular thickness may influence the curvature and posterior contour of the hip.

In rehabilitation and sports medicine literature, repetitive electrical stimulation has been associated with neuromuscular adaptations including improved motor unit synchronization, altered fiber recruitment patterns, and enhanced contractile efficiency. Although the magnitude of structural hypertrophy induced by low-frequency stimulation remains debated, cumulative exposure may result in measurable increases in muscle cross-sectional dimensions.

Importantly, EMS-induced contractions differ from voluntary exercise. Electrical stimulation may activate deeper muscle fibers that are not consistently recruited during habitual daily activity. This characteristic may theoretically contribute to localized muscular conditioning even in individuals who are not engaged in structured resistance training.

Recent studies have demonstrated that non-invasive neuromuscular stimulation technologies can induce supramaximal muscle contractions leading to measurable hypertrophic changes and improved body contour [7] [8]. Similar neuromuscular stimulation approaches have also been applied in facial aesthetic treatments, demonstrating improvements in muscle tone and contour [9] [10].

Ultrasound measurement of muscle thickness is widely used as a non-invasive method to evaluate skeletal muscle morphology and hypertrophic adaptations [11].

In aesthetic practice, the clinical objective is not athletic performance but contour refinement. Therefore, even modest structural change may be clinically meaningful if it translates into perceptible contour enhancement. Objective imaging is essential to distinguish true structural modification from subjective perception alone.

The present pilot investigation therefore aimed not only to assess patient satisfaction but to document quantifiable ultrasonographic changes in gluteal muscle thickness under standardized treatment conditions.

Study Rationale and Objective

Despite increasing clinical adoption of electrical muscle stimulation technologies for aesthetic body contouring, objective imaging-based evidence supporting structural muscular adaptation in aesthetic indications remains limited. Most available reports rely primarily on subjective patient satisfaction or photographic assessment, which may not fully capture underlying anatomical changes.

The present pilot study was therefore designed as an exploratory investigation aimed at documenting measurable ultrasonographic changes in gluteus maximus muscle thickness following a standardized course of low-frequency electrical mus-

cle stimulation. The intention was not to establish definitive efficacy, but rather to generate preliminary objective data capable of informing future-controlled investigations and guiding clinical positioning of EMS technologies within noninvasive body contouring practice.

The primary hypothesis of this prospective pilot study was that repeated low-frequency electrical muscle stimulation (EMS) applied to the gluteal region would induce measurable hypertrophic changes in the gluteus maximus muscle and lead to improvement in gluteal contour. Muscle thickness measured by ultrasound was selected as a surrogate marker of structural muscle adaptation, as ultrasound-based thickness assessment is a validated, non-invasive method for evaluating muscle hypertrophy and morphological change. In the context of aesthetic body contouring, increased gluteus maximus thickness is expected to translate into enhanced gluteal projection and improved body proportions, which may also be reflected by changes in the waist-to-hip ratio (WHR).

2. Materials and Methods

2.1. Study Design

This investigation was conducted as a prospective, single-center, single-arm pilot study designed to evaluate feasibility, safety, and preliminary efficacy. The study was exploratory in nature and aimed to generate hypothesis-forming data.

2.2. Ethical Considerations

The protocol was reviewed and approved by the Institutional Ethics Committee of the Central Hospital of Dalian University of Technology. The study adhered to the principles of the Declaration of Helsinki. All participants provided written informed consent for treatment and anonymized data use. The study was conducted in accordance with institutional ethical standards and national research regulations.

2.3. Participants

Twenty adults aged 25 - 55 years who expressed dissatisfaction with their gluteal contour were enrolled. Inclusion criteria required stable weight for at least three months prior to enrollment and agreement not to initiate new exercise or weight-loss regimens during the study.

Exclusion criteria included:

- Implanted pacemakers or electronic medical devices;
- Prior gluteal surgery or implants;
- Active dermatologic conditions in the treatment area;
- Pregnancy or breastfeeding;
- Significant systemic disease.

Baseline demographics included a mean age of 29.8 ± 4.1 years and mean BMI of 20.61 ± 2.54 kg/m^2, reflecting a predominantly normal-weight population. Baseline characteristics are summarized in **Table 1**.

Table 1. Baseline demographics.

	Female	Male	Total
Age	29.75 ± 3.96	30.0 ± 4.58	29.8 ± 4.08
Height (cm)	165.0 ± 2.55	177.25 ± 1.92	166.7 ± 7.36
Weight (kg)	53.50 ± 3.48	74.25 ± 5.72	58.9 ± 11.4
BMI	19.81 ± 1.20	23.62 ± 1.65	20.61 ± 2.54
Waist	65.44 ± 1.68	75.33 ± 0.61	67.17 ± 5.40
Hip	93.25 ± 2.43	106.75 ± 2.77	96.40 ± 7.36
Gluteus maximus thickness (left)	30.15 ± 3.00	35.70 ± 1.10	31.01 ± 3.57
Gluteus maximus thickness (right)	30.88 ± 3.24	36.65 ± 0.70	31.44 ± 3.57

Participants were recruited from patients presenting to an aesthetic dermatology practice seeking non-invasive body contouring treatments. Potential participants were screened consecutively for eligibility according to predefined inclusion and exclusion criteria. Baseline characteristics recorded included age, sex, body mass index (BMI), and relevant medical history. Participants were also asked about habitual exercise level, particularly gluteal-targeted resistance training, and any significant body weight changes within the previous three months.

2.4. Treatment Protocol

All treatments were administered using the TONE-PRO low-frequency EMS device (InMode Ltd., Yokneam, Israel). Each participant underwent 10 treatment sessions delivered once weekly. Each session lasted 30 minutes.

Stimulation parameters were standardized:

- Frequency: 8 Hz;
- Pulse width: 0.02 - 0.4 ms;
- Biphasic waveform.

Four applicators were positioned bilaterally over the gluteus maximus based on anatomical landmarks. Intensity level was gradually increased within patient tolerance to achieve visible and palpable muscle contraction.

The EMS device delivered low-frequency electrical stimulation designed to induce visible supramaximal contractions of the gluteus maximus muscle. Stimulation intensity level was gradually increased during each session to the highest level tolerated by the participant while maintaining comfort and sustained muscle contraction. Treatment parameters included progressive intensity titration, controlled contraction-relaxation cycles, and session durations consistent with the manufacturer's recommended protocol.

Participants received a total of 10 treatment sessions performed once weekly. Adherence to the treatment schedule was recorded, and any need for temporary parameter adjustment due to discomfort was documented. No participants required discontinuation of treatment.

Participants were monitored during each session for comfort and safety.

Participants were instructed to maintain their usual dietary habits and physical activity levels throughout the study period and were specifically advised not to initiate new gluteal strengthening exercises or structured lower-body training programs during the treatment course. Body weight was recorded at baseline and at the final follow-up visit to monitor potential confounding effects of weight change on body contour measurements.

2.5. Imaging Assessment

Muscle thickness was measured using high-frequency ultrasonography. Participants were positioned prone with muscles relaxed. Standardized anatomical reference points between the posterior superior iliac spine and greater trochanter were used.

Three measurements per side were recorded and averaged. The same experienced sonographer performed all assessments to minimize inter-operator variability.

2.6. Outcome Measures

2.6.1. Primary Endpoint

Change in gluteus maximus thickness at 1-month follow-up compared to baseline.

2.6.2. Secondary Endpoints

- Change in waist-to-hip ratio (WHR);
- Global Aesthetic Improvement Scale (GAIS) scores;
- Safety outcomes.

WHR was calculated as waist circumference divided by hip circumference.

2.7. Safety Monitoring

Adverse events were assessed at each visit. Events were categorized by severity and duration. Particular attention was paid to skin injury, prolonged pain, burns, and neuromuscular dysfunction.

2.8. Statistical Analysis

Data were expressed as mean ± standard deviation with 95% confidence intervals. Repeated measures ANOVA with correction for multiple comparisons were performed. Statistical significance was set at $P < 0.05$.

Statistical analyses compared baseline measurements with post-treatment assessments obtained at the 1-month follow-up. Continuous variables were analyzed using paired t-tests or repeated-measures ANOVA where appropriate. Exact P-values were calculated and statistical significance was defined as $P < 0.05$. In addition to mean changes, 95% confidence intervals and standardized effect sizes (Cohen's d) were calculated to better describe the magnitude of observed treatment effects.

2.9. Standardization and Reproducibility Measures

To enhance measurement reliability, ultrasound evaluations were conducted un-

der strictly standardized conditions. Participants were instructed to avoid strenuous lower-body exercise 48 hours prior to each imaging session. Measurements were performed with muscles in a relaxed state to minimize transient contraction-related variability.

Anatomical reference points were marked during baseline assessment to ensure consistent probe placement at subsequent visits. Images were digitally archived for comparison. Averaging of three independent measurements per side was performed to reduce random error.

Treatment sessions were delivered by trained clinical personnel using a predefined stimulation protocol. Device settings were not altered between sessions except for incremental intensity adjustment within patient tolerance. Participants were instructed to maintain stable weight and avoid initiating new gluteal exercise programs during the study period to minimize confounding factors.

These procedural controls were implemented to improve internal consistency and support reproducibility in future investigations.

3. Results

All 20 participants completed the treatment course and follow-up.

3.1. Gluteus Maximus Thickness (Figure 1)

A progressive increase in muscle thickness was observed:

- After 5 sessions: +0.65 ± 0.47 mm ($P < 0.001$);
- After 10 sessions: +2.01 ± 0.83 mm ($P < 0.001$);
- 1-month follow-up: +2.05 ± 0.88 mm vs baseline ($P < 0.001$).

Effect size analysis indicated a large treatment effect. All participants demonstrated measurable increases.

No statistically significant asymmetry between left and right measurements was observed.

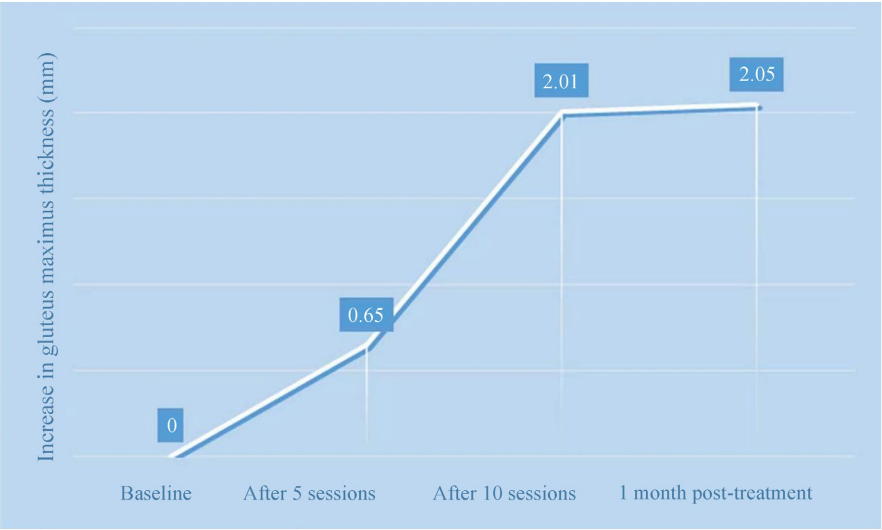


Figure 1. Gluteus maximus thickness changes.

3.2. Waist-to-Hip Ratio (Figure 2)

Mean WHR improved from 0.70 ± 0.05 at baseline to 0.67 ± 0.03 after 10 sessions ($P < 0.001$) and remained stable at follow-up.

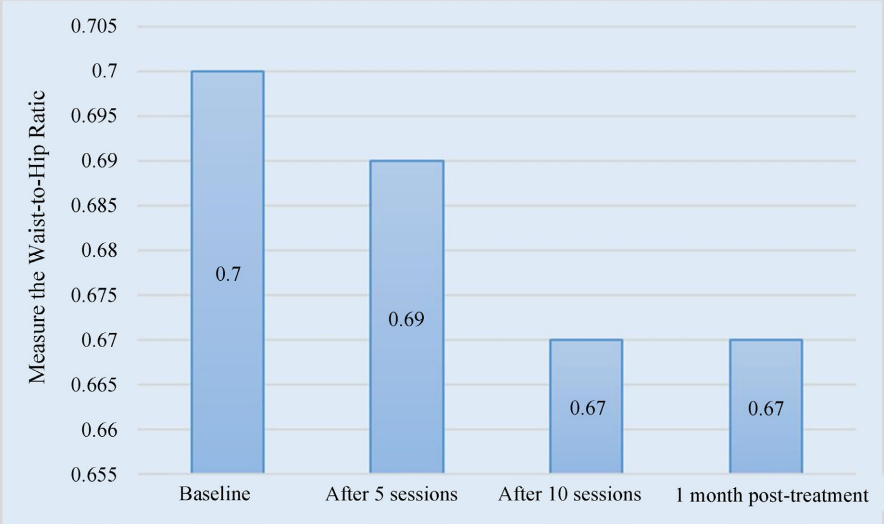


Figure 2. WHR changes.

3.3. Subjective Outcomes

Both participants and investigators reported progressive improvement. At 1-month, mean participant GAIS score indicated noticeable improvement, corroborated by investigator assessment. Subjective outcomes are presented in **Table 2**.

Table 2. Subjective GAIS evaluation.

GAIS grade	After 5	After 10	1 M FU
Subjects	0.25 ± 0.62	0.80 ± 0.97	1.0 ± 0.85
Investigator	0.50 ± 0.50	1.20 ± 0.73	1.3 ± 0.76

3.4. Safety

No serious adverse events occurred. Mild transient muscle soreness was reported in 20% of participants and resolved within 48 hours. No skin burns, erythema beyond transient redness, or treatment discontinuations occurred.

3.5. Clinical Interpretation of Structural Changes

The observed mean increase of approximately 2 mm in gluteus maximus thickness represents a measurable structural modification within a relatively short treatment window. When expressed as a percentage relative to baseline values, this corresponds to an estimated 8 - 10% increase in thickness across the cohort.

Although modest in absolute terms, even small structural changes in a superficially located muscle such as the gluteus maximus may contribute to perceptible contour modification due to its anatomical prominence. No participant demon-

strated regression below baseline at any time point.

Inter-individual response variability was observed, as expected in biological systems. Participants with comparatively lower baseline muscle thickness appeared to exhibit slightly greater proportional increases, although the study was not powered for stratified statistical analysis.

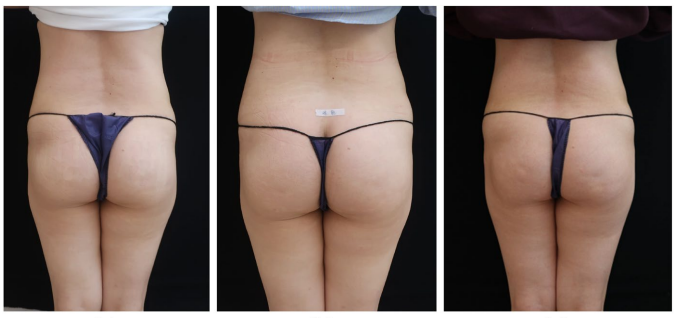
The stability of measurements at one-month follow-up suggests short-term persistence of structural adaptation. However, the trajectory beyond this period remains unknown. Representative clinical cases illustrating treatment outcomes and corresponding ultrasound findings are shown in **Figures 3-6**.

Clinical Cases

Clinical outcomes and ultrasound findings of a 46-year-old female patient one month after completing 10 treatment sessions:

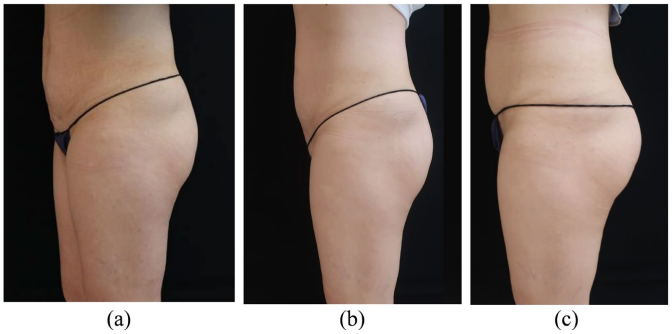
(a) (b) (c)

Figure 3. Right lateral view: (a) Baseline; (b) After 10 Tx; (c) 1 M FU



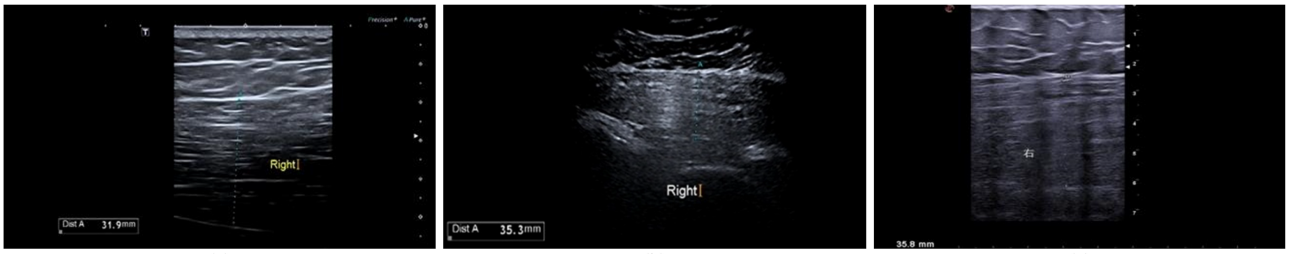
(a) (b) (c)

Figure 4. Posterior view: (a) Baseline; (b) After 10 Tx; (c) 1 M FU.



(a) (b) (c)

Figure 5. Left lateral view: (a) Baseline; (b) After 10 Tx; (c) 1 M FU.



(a) (b) (c)

Figure 6. Ultrasound evaluation of gluteus maximus thickness. (a) Baseline 31.99 mm; (b) After 10 Tx.—35.3 mm; (c) 1 M FU—35.8 mm.

4. Discussion

This prospective pilot study demonstrates that low-frequency EMS was associated with statistically significant increases in gluteal muscle thickness and improvements in contour-related parameters.

4.1. Mechanistic Considerations

Electrical stimulation induces motor neuron depolarization, leading to repeated muscle contractions. Repetitive stimulation may enhance neuromuscular efficiency and potentially stimulate adaptive responses. Whether the measured thickness increase represents true hypertrophy, increased intramuscular fluid content, or neuromuscular conditioning cannot be determined from the present design.

4.2. Clinical Interpretation

The approximately 2 mm increase in muscle thickness is modest but consistent. For a superficial and anatomically prominent muscle such as the gluteus maximus, even small structural changes may influence contour perception.

EMS should not be considered a volumetric augmentation procedure comparable to surgical techniques. Rather, it may serve as a noninvasive option for patients seeking gradual contour refinement.

The increase in gluteus maximus thickness observed at follow-up may reflect early hypertrophic adaptation to repeated supramaximal muscle contractions induced by EMS. However, it should also be acknowledged that short-term increases in muscle thickness measured by ultrasound may partially reflect transient physiological changes such as localized edema or inflammatory response following repeated muscle activation. Nevertheless, the consistency of the measurements across participants suggests that structural muscle adaptation likely contributed to the observed findings.

4.3. Comparison with Other Modalities

Most noninvasive body contouring devices focus on adipose reduction. EMS represents a complementary approach targeting muscular architecture rather than fat volume. A multimodal strategy may provide synergistic effects in selected patients.

4.4. Patient Selection

The study population consisted primarily of normal-weight individuals. EMS may be most suitable for patients with low to moderate adiposity seeking subtle projection enhancement. In individuals with significant adipose thickness, muscular conditioning alone may not produce visible contour change.

4.5. Safety Considerations

The absence of serious adverse events supports the favorable safety profile of low-frequency EMS when applied within standardized parameters. Continued post-treatment monitoring and larger datasets are warranted to confirm long-term safety.

4.6. Clinical Positioning within Noninvasive Body Contouring

Noninvasive gluteal enhancement occupies a unique position within aesthetic medicine. Unlike adipose reduction technologies, which aim to decrease volume, EMS-based systems focus on muscular conditioning. These approaches are not mutually exclusive and may be complementary in selected patients.

For individuals with relatively low subcutaneous fat thickness, muscular conditioning may contribute to visible projection and contour enhancement. In patients with higher adiposity, muscle thickening alone may not translate into substantial external contour change without concurrent fat modulation.

Expectation management is therefore critical. EMS should be positioned as a modality capable of incremental refinement rather than dramatic volumetric augmentation comparable to surgical fat grafting or implants.

4.7. Durability Considerations

Skeletal muscle is responsive to both training stimulus and detraining. Without ongoing stimulus, adaptations may partially regress over time. It is therefore plausible that maintenance sessions may be necessary to sustain structural changes. Longitudinal studies extending beyond three to six months are required to clarify durability.

4.8. Safety and Risk Profile

The favorable safety findings observed in this cohort align with the established safety record of low-frequency electrical stimulation in therapeutic contexts. The absence of burns, neuromuscular injury, or significant discomfort supports its noninvasive positioning.

No serious adverse events were observed during the study period. Treatments were well tolerated, and reported sensations were consistent with expected muscle contraction and transient stimulation-related discomfort.

Nevertheless, continued surveillance in larger populations is essential to confirm long-term safety, particularly in diverse patient groups.

4.9. Broader Implications

As aesthetic medicine continues to evolve toward minimally invasive and nonin-

vasive strategies, technologies targeting muscular architecture may expand. Integration of objective imaging metrics strengthens the scientific credibility of such approaches and differentiates structural adaptation from purely subjective satisfaction.

These findings are consistent with previous reports demonstrating that repeated neuromuscular stimulation can induce measurable structural muscle adaptations and improvements in body contour. Similar muscle thickness changes following neuromuscular stimulation or electromagnetic stimulation have been previously reported in aesthetic body contouring studies [1] [2].

5. Limitations

This study has limitations:

- Absence of a control or sham group;
- Small sample size;
- Short follow-up duration;
- Ultrasound measurement variability;
- Lack of functional strength assessment.

Larger randomized controlled trials with extended follow-up are necessary to validate findings. An important limitation of this study is the relatively short follow-up period of one month after treatment completion. While the results suggest early improvements in gluteal contour and muscle thickness, longer follow-up studies are necessary to determine the durability of these effects and to assess whether maintenance treatments may be required to sustain the aesthetic outcome.

6. Conclusions

Low-frequency electrical muscle stimulation was associated with measurable increases in gluteus maximus muscle thickness, improvement in waist-to-hip ratio, and high patient satisfaction within this prospective pilot cohort, while maintaining a favorable safety profile.

Beyond quantitative findings, the results support the concept that modulation of muscular architecture may represent a complementary pathway within noninvasive body contouring, distinct from traditional adipose-focused approaches. Even modest structural muscular adaptations may translate into clinically perceptible contour refinement in appropriately selected patients.

Given the exploratory nature and limited sample size of the present investigation, these findings should be considered hypothesis-generating rather than definitive evidence of efficacy. Larger randomized controlled studies with extended follow-up will be necessary to clarify durability of results, optimal treatment protocols, and patient selection criteria.

Nevertheless, this study provides preliminary objective imaging data supporting the role of low-frequency EMS as a safe and potentially valuable component of modern noninvasive gluteal contouring strategies.

As noninvasive aesthetic medicine continues to evolve, objective evaluation of muscle-targeted technologies may contribute to a broader understanding of body contouring beyond adipose reduction alone.

Conflicts of Interest

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

References

[1] Kloth, L.C. (2005) Electrical Stimulation for Wound Healing: A Review of Evidence from *in Vitro* Studies, Animal Experiments, and Clinical Trials. *The International Journal of Lower Extremity Wounds*, **4**, 23-44. https://doi.org/10.1177/1534734605275733

[2] Haufs, M.G. and Zöllner, Y.F. (2020) Waist-Hip Ratio More Appropriate than Body Mass Index. *Deutsches Ärzteblatt International*, **117**, Article No. 659. https://doi.org/10.3238/arztebl.2020.0659a

[3] Harris, E. (2023) Study: Waist-to-Hip Ratio Might Predict Mortality Better than BMI. *JAMA*, **330**, 1515-1516. https://doi.org/10.1001/jama.2023.19205

[4] Widjaja, N.A., Arifani, R. and Irawan, R. (2023) Value of Waist-to-Hip Ratio as a Predictor of Metabolic Syndrome in Adolescents with Obesity. *Acta Biomedica*, **94**, e2023076.

[5] Cao, Q., Yu, S., Xiong, W., Li, Y., Li, H., Li, J., *et al.* (2018) Waist-Hip Ratio as a Predictor of Myocardial Infarction Risk: A Systematic Review and Meta-Analysis. *Medicine* (*Baltimore*), **97**, e11639. https://doi.org/10.1097/md.0000000000011639

[6] Gao, F., Wan, J., Xu, B., Wang, X., Lin, X. and Wang, P. (2020) Trajectories of Waist-To-Hip Ratio and Adverse Outcomes in Heart Failure with Mid-Range Ejection Fraction. *Obesity Facts*, **13**, 344-357. https://doi.org/10.1159/000507708

[7] Kinney, B.M. and Lozanova, P. (2019) High Intensity Focused Electromagnetic Therapy Evaluated by Magnetic Resonance Imaging: Safety and Efficacy Study of a Dual Tissue Effect Based Non-Invasive Abdominal Body Shaping. *Lasers in Surgery and Medicine*, **51**, 40-46. https://doi.org/10.1002/lsm.23024

[8] Kavanagh, S., Newell, J., Hennessy, M. and Sadick, N. (2012) Use of a Neuromuscular Electrical Stimulation Device for Facial Muscle Toning: A Randomized, Controlled Trial. *Journal of Cosmetic Dermatology*, **11**, 261-266. https://doi.org/10.1111/jocd.12007

[9] Frank, K., Kaye, K.O., Casabona, G., Glaue, E., Zeng, R., Moellhoff, N., *et al.* (2025) Effect of Synchronized Radiofrequency and High-Intensity Facial Electrical Stimulation (HIFES) of the Upper Face. *Aesthetic Surgery Journal*, **45**, 525-530. https://doi.org/10.1093/asj/sjaf009

[10] Hwang, U.J., Kwon, O.Y., Jung, S.H., Ahn, S.H. and Gwak, G.T. (2018) Effect of a Facial Muscle Exercise Device on Facial Rejuvenation. *Aesthetic Surgery Journal*, **38**, 463-476. https://doi.org/10.1093/asj/sjx238

[11] Abe, T., Loenneke, J.P., Thiebaud, R.S. and Loftin, M. (2014) Morphological and Functional Relationships with Ultrasound Measured Muscle Thickness of the Upper Extremity and Trunk. *Ultrasound*, **22**, 229-235. https://doi.org/10.1177/1742271X14554678