

High-Frequency Therapeutic Ultrasound Combined with Microcurrent Stimulation for Facial Skin Rejuvenation: A Case Series

Rayssa de Carvalho Machado¹, Thaís Rodrigues², Fabiele Chieregato², Evelyn Lisandra de Souza³, Hariel Altheman da Silva², Álvaro Martins da Silva Júnior², Fábio Alexandre Pinto², José Ricardo de Souza^{1,2}, Patricia Brassolatti^{1*} 

¹Department of Research, Development and Innovation at Brazilian Medical Equipment Industry - IBRAMED, Amparo/SP, Brazil

²Postgraduate Program in Biomedical Engineering, Universidade Brasil, São Paulo, Brazil.

³Department of Engineering at Brazilian medical equipment company - IBRAMED, Amparo/SP, Brazil

*Correspondence author: Patricia Brassolatti, Department of Research, Development and Innovation at Brazilian Medical Equipment Industry - IBRAMED, Amparo/SP, Brazil; Email: p.brassolatti@ibramed.com.br

Citation: Machado RDC, et al High-Frequency Therapeutic Ultrasound Combined with Microcurrent Stimulation for Facial Skin Rejuvenation: A Case Series. J Dermatol Res. 2026;7(2):1-7.

<https://doi.org/10.46889/JDR.2026.7211>

Received Date: 17-06-2026

Accepted Date: 13-07-2026

Published Date: 20-07-2026



Copyright: © 2026 The Authors. Published by Athenaeum Scientific Publishers.

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

License URL:

<https://creativecommons.org/licenses/by/4.0/>

Abstract

Skin aging is a multifactorial process characterized by structural and functional changes that impair tissue integrity and biomechanical properties, leading to wrinkles, reduced elasticity and skin laxity due to collagen and elastin degradation. As the demand for noninvasive facial rejuvenation continues to grow, therapies that promote tissue remodeling have gained increasing attention. High-frequency therapeutic ultrasound and microcurrent electrical stimulation have demonstrated the potential to stimulate fibroblast activity, enhance cellular metabolism and promote tissue repair. The objective was evaluating the effects of 5 MHz and 10 MHz therapeutic ultrasound, used alone or combined with microcurrent electrical stimulation, on facial skin laxity and wrinkles. For this, a case series was conducted using three therapeutic protocols: 5 MHz therapeutic ultrasound, 10 MHz therapeutic ultrasound and 5 MHz therapeutic ultrasound combined with microcurrent stimulation. Clinical outcomes were assessed before and after treatment using standardized photographs acquired with the three-dimensional Antera® imaging system. Quantitative analyses included wrinkle depth, skin texture and pore appearance. All treatment protocols resulted in improvements in skin quality, with reductions in both superficial and deep wrinkle depth, enhanced skin texture and visible improvement in facial skin laxity. The combination of 5 MHz therapeutic ultrasound with microcurrent stimulation demonstrated additional clinical benefits, suggesting a synergistic effect on tissue remodeling. Therapeutic ultrasound at both 5 MHz and 10 MHz was associated with clinically relevant improvements in facial skin laxity and signs of cutaneous aging. The combination of 5 MHz therapeutic ultrasound with microcurrent stimulation also showed promising results, supporting its potential as a noninvasive approach for

facial skin rejuvenation.

Keywords: Skin Aging; Skin Laxity; Wrinkles; Therapeutic Ultrasound; Microcurrents; Facial Rejuvenation

Introduction

Skin aging is a continuous and multifactorial physiological process that begins at birth and becomes progressively more evident with advancing age. In the skin, this process is manifested by structural and functional alterations that impair its capacity for regeneration and maintenance of tissue homeostasis. The main histological changes include epidermal atrophy, flattening of the dermal-epidermal junction, reduced fibroblast activity and modifications in the composition of the extracellular matrix, resulting in decreased elasticity, loss of tissue firmness, wrinkle formation and the development of skin laxity [1,2].

Skin aging can be classified as intrinsic, also referred to as chronological aging and extrinsic aging, which results primarily from exposure to environmental factors, particularly ultraviolet radiation. Although these processes involve distinct pathophysiological mechanisms, they act synergistically to promote cumulative structural alterations, including disorganization of collagen fibers, degeneration of elastic fibers, reduced skin hydration and impairment of the biomechanical properties of the skin [2,3]. Consequently, there is a progressive loss of tissue support and facial contour, characteristics commonly associated with aesthetic aging.

Historically, plastic surgery, particularly rhytidectomy (facelift surgery), has been considered the gold standard for the treatment of skin laxity and advanced signs of facial aging [4]. However, the growing demand for less invasive procedures associated with lower risks, shorter recovery times and greater patient acceptance has driven the development and application of various technological approaches for skin rejuvenation [5]. Although ablative techniques often produce significant clinical outcomes, their use is frequently associated with adverse effects such as edema, prolonged erythema, pigmentary alterations, infections and extended recovery periods [6,7].

In this context, high-frequency therapeutic ultrasound has been extensively investigated because of its ability to induce mechanical and biological effects within tissues. Its primary mechanisms of action include increased cellular membrane permeability, modulation of metabolic activity, stimulation of protein synthesis, facilitation of calcium ion transport and enhancement of tissue repair processes. Furthermore, therapeutic ultrasound can promote the transdermal delivery of bioactive substances, a phenomenon known as sonophoresis [8-10]. In parallel, microcurrent electrical stimulation has been used as a complementary strategy in facial rejuvenation protocols, as it induces collagen synthesis and reorganization of the extracellular matrix, both essential for maintaining skin firmness and elasticity.

Considering that both high-frequency therapeutic ultrasound and microcurrent stimulation exhibit biological mechanisms capable of promoting tissue regeneration and remodeling, the combination of these modalities may represent a promising strategy for the treatment of skin laxity and wrinkles. However, studies investigating the clinical effects of the combined use of these technologies in skin rejuvenation protocols remain limited. Therefore, the present study aimed to evaluate the effects of 5 MHz and 10 MHz therapeutic ultrasound, either alone or in combination with microcurrent electrical stimulation, on parameters related to skin laxity and facial wrinkles, thereby contributing to the development of evidence-based therapeutic protocols for skin rejuvenation.

Materials and Methods

Study Design and Setting

A descriptive and observational clinical study was conducted in which three participants were evaluated before and after the proposed therapeutic intervention. The study was developed in partnership with IBRAMED, a Brazilian manufacturer of medical and aesthetic equipment.

Participants

Three female participants presenting facial skin morphological alterations associated with aging, including wrinkles and expression lines, were recruited.

Exclusion criteria included:

- uncontrolled diabetes mellitus
- coagulation disorders
- autoimmune diseases
- active infections or dermatitis
- cancer
- pregnancy or lactation
- refusal to provide written informed consent for participation in the study

Clinical Protocol

The treatment protocol was applied according to the safety recommendations provided by the manufacturer. Facial treatment areas were selected based on the individual clinical needs identified during the assessment.

Outcome Assessments

Clinical History Assessment

During the evaluation process, all participants completed a clinical assessment form specifically developed for this study. The form included personal information, lifestyle habits, medication use, inspection findings of the treatment area, history of previous aesthetic procedures performed in the treated region, use of injectable products, skin phototype classification and a patient satisfaction questionnaire regarding the treatment area.

Facial Skin Imaging Analysis

Skin evaluation was performed using photographs obtained with the Antera 3D® digital skin imaging system. Images were acquired from areas of interest, including the forehead, cheeks, nasolabial folds, décolleté and neck. Participants were instructed to remain in an upright standing position with their gaze directed toward the horizon. Images were captured from frontal, 45° and lateral views.

Assessment of Skin Appearance

Improvement in skin photoaging was evaluated using the Global Aesthetic Improvement Scale (GAIS), where 0 = no improvement, 1 = slight improvement, 2 = moderate improvement, 3 = good improvement and 4 = marked improvement.

Assessment of Treatment Tolerability

Pain and thermal sensation during treatment were assessed using a subjective Visual Analog Scale (VAS) ranging from 0 to 10, where 0 = no pain or warming sensation, 1-4 = mild pain or warming, 5-7 = moderate pain or warming and 8-10 = severe pain or warming.

Patient Satisfaction Assessment

Participant satisfaction regarding treatment outcomes and comfort during the procedures was assessed using a 5-point subjective scale, where 1 = very dissatisfied/very uncomfortable, 2 = dissatisfied/uncomfortable, 3 = neither satisfied nor dissatisfied/no opinion, 4 = satisfied/comfortable and 5 = very satisfied/very comfortable.

Results

The results obtained in the facial regions demonstrated reductions in wrinkle depth, improvements in skin texture and a decrease in pore visibility within the treated areas. Fig. 1 illustrates the outcomes achieved following treatment with the combined application of 5 MHz and 10 MHz therapeutic ultrasound on the face. Improvements in tissue texture can be observed in panels A, B, C and D. Panels E and F demonstrate a reduction in pore appearance, while panels G and H show a reduction in wrinkle depth, particularly in deeper wrinkles.

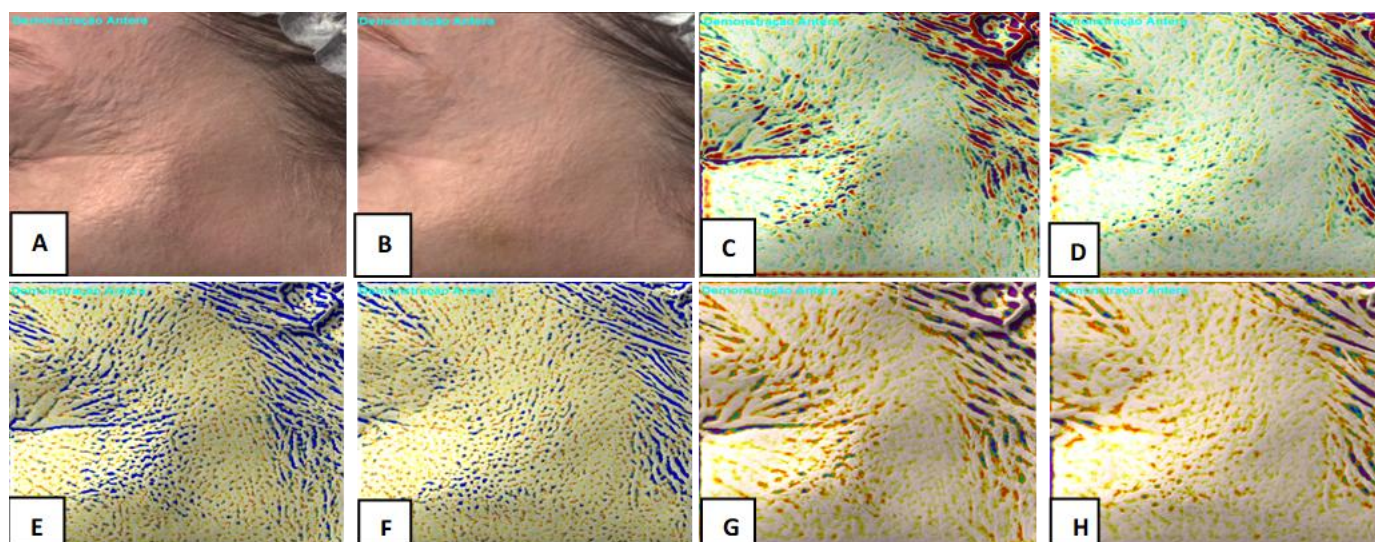


Figure 1: Representative facial images acquired before and after treatment with the combined 5 MHz and 10 MHz therapeutic ultrasound protocol. Unfiltered images are shown before (A) and after (B) treatment. Skin texture analysis images are

presented before (C) and after (D) treatment. Pore analysis images are shown before (E) and after (F) treatment. Wrinkle analysis images are presented before (G) and after (H) treatment, demonstrating improvements in skin texture, pore appearance and wrinkle depth following the intervention.

Fig. 2 presents the results obtained with the same treatment protocol, focusing on the frontal region. Improvements in tissue quality can be observed in panels A, B, C and D. In panels E and F, a reduction in pore visibility can be observed, which also indicates an improvement in overall skin quality. Furthermore, panels G and H demonstrate a reduction in wrinkle depth and increased wrinkle superficialization, particularly in deeper wrinkles.

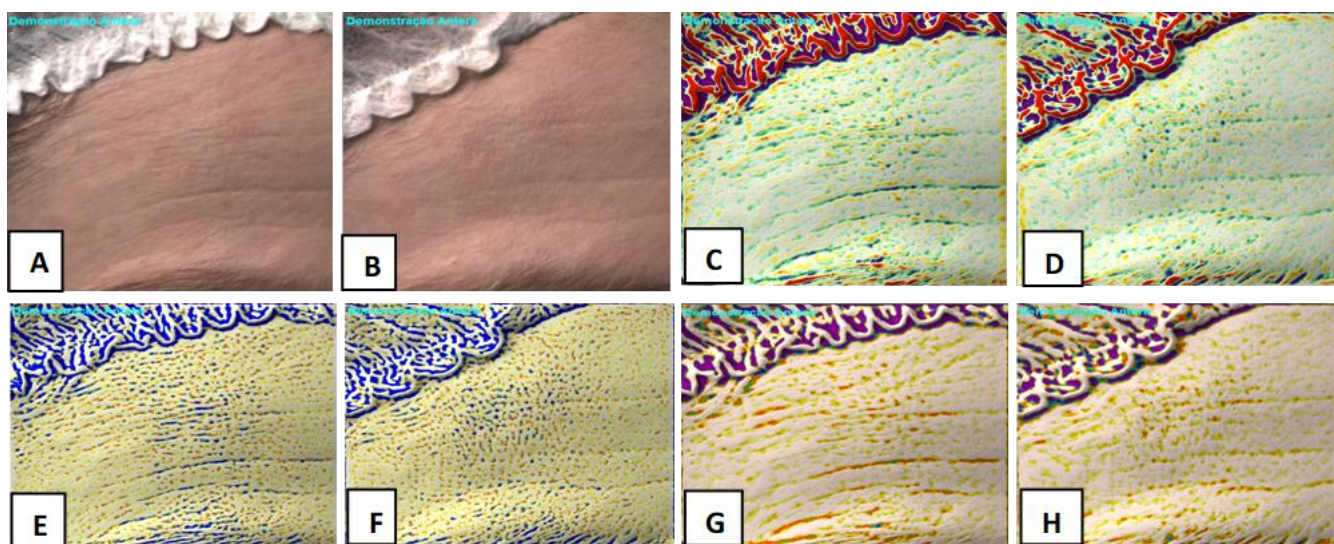


Figure 2: Representative photographs obtained before and after treatment using the protocol combining both therapeutic ultrasound frequencies (5 MHz and 10 MHz). A - Unfiltered image before treatment; B - Unfiltered image after treatment; C - Skin texture filter image before treatment; D - Skin texture filter image after treatment; E - Pore analysis filter image before treatment; F - Pore analysis filter image after treatment; G - Wrinkle analysis filter image before treatment; H - Wrinkle analysis filter image after treatment.

Fig. 3 demonstrates the results obtained following the application of the 10 MHz ultrasound protocol in the periorbital region. Improvements in skin quality can be observed in panels A and B. In panels C and D, the enhancement in skin quality is further confirmed through the use of the texture analysis filter. Panels E and F demonstrate an improvement in local wrinkles, as evidenced by their assessment using a specific wrinkle analysis filter.

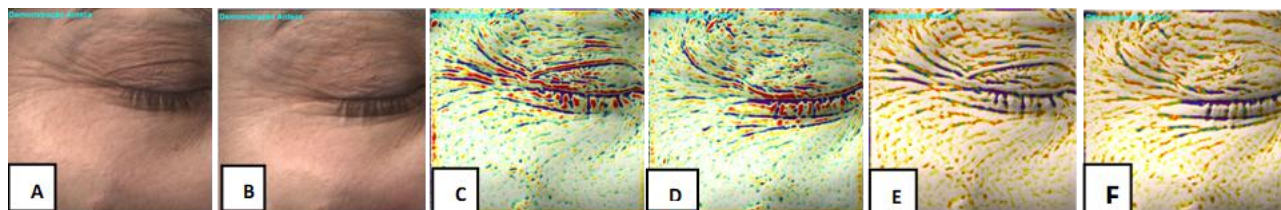


Figure 3: Representative photographs obtained before and after treatment using the 10 MHz therapeutic ultrasound protocol. A - Unfiltered image before treatment; B - Unfiltered image after treatment; C - Skin texture filter image before treatment; D - Skin texture filter image after treatment; E - Wrinkle analysis filter image before treatment; F - Wrinkle analysis filter image after treatment.

Fig. 4 demonstrates the results obtained using the 5 MHz therapeutic ultrasound protocol combined with microcurrent stimulation for the treatment of inner arm skin laxity. Panel A shows the tissue assessment before treatment, whereas panel B shows the tissue after treatment. Panels C and D demonstrate improvements in tissue quality following the treatment protocol. In panels E and F, an improvement in skin laxity can be observed through wrinkle mapping analysis. Furthermore, panels G and H show a reduction in pore visibility, which also reflects an overall improvement in skin quality.

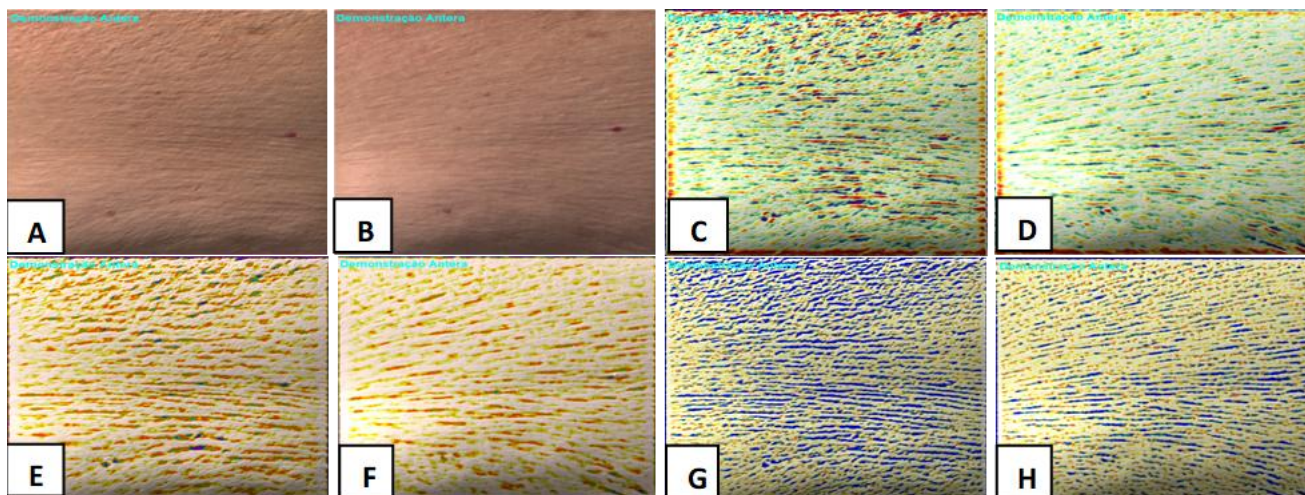


Figure 4: Representative photographs obtained before and after treatment using the protocol combining microcurrent stimulation and 5 MHz therapeutic ultrasound. A - Unfiltered image before treatment; B - Unfiltered image after treatment; C - Skin texture filter image before treatment; D - Skin texture filter image after treatment; E - Wrinkle analysis filter image before treatment; F - Wrinkle analysis filter image after treatment; G - Pore analysis filter image before treatment; H - Pore analysis filter image after treatment.

Discussion

Therapeutic ultrasound is a modality widely used in clinical practice for the treatment of various conditions related to rehabilitation and aesthetics [8,9,11,12]. The depth of ultrasound penetration is directly related to the frequency employed. Higher frequencies exhibit greater absorption in superficial tissues, whereas lower frequencies reach deeper structures. Therefore, 5 MHz and 10 MHz ultrasound frequencies have the potential to act predominantly within the dermis, the region where the principal structural alterations associated with skin aging occur. Preliminary studies suggest that these frequencies may contribute to improvements in skin laxity and wrinkle appearance by stimulating tissue remodeling without inducing significant lipolytic effects.

The basic mechanism of action of ultrasound is described through two distinct pathways. The first involves cavitation induced by mechanical waves, capable of generating rhythmic oscillations of gas microbubbles present in body fluids, leading to changes in cell membrane permeability, increased ion transport, fibroblast proliferation and collagen synthesis. The second involves thermal effects resulting from the absorption of ultrasonic energy and its conversion into heat, promoting vasodilation, increased cellular metabolic activity and enhanced extensibility of collagen fibers. Cell culture studies have demonstrated that Ultrasound (US) induces alterations in cell membranes, increasing membrane permeability and modifying intracellular ionic concentrations, thereby modulating cellular signaling pathways [8,11]. Furthermore, ultrasound has been reported to influence calcium uptake and increase the expression of IL-1 β , IL-8, VEGF, PGE2, COX-2 and FGF, important mediators involved in vasodilation and cellular differentiation processes [2,11].

These physiological effects are highly relevant for the treatment of several conditions, including inflammation, muscle spasm, joint stiffness, tissue repair and skin rejuvenation. However, achieving the desired clinical outcomes requires selecting the appropriate ultrasound frequency according to the target tissue depth. In this context, two relatively new frequencies have emerged in aesthetic practice: 5 MHz and 10 MHz. These higher frequencies are considered particularly suitable for targeting superficial tissues such as the dermis. In addition, the biological effects of microcurrents should also be considered, as they physiologically stimulate cellular bioelectricity. Unlike excitomotor currents, their effects occur predominantly at the cellular level, promoting increased Adenosine Triphosphate (ATP) synthesis, enhanced transmembrane ion transport, stimulation of protein synthesis and activation of fibroblast activity [8,13-17]. These mechanisms may further improve tissue quality when combined with high-frequency ultrasound.

Although the current literature remains limited regarding clinical studies validating these technologies, several authors have reported promising clinical benefits of ultrasound for skin tissues, describing this technology as innovative, safe and associated with a low risk of adverse events [1,9,18]. The present clinical study evaluated three different treatment protocols using 5 MHz and 10 MHz ultrasound frequencies, either individually or in combination, for facial rejuvenation. Significant improvements were observed when comparing pre- and post-treatment assessments, particularly regarding skin texture and the reduction of both superficial and deep wrinkles. In addition, a protocol combining 5 MHz ultrasound with microcurrent stimulation was evaluated specifically for the treatment of inner arm skin laxity, resulting in substantial improvements in tissue condition following treatment. To the best of our knowledge, this is the first clinical study to evaluate the combined effects of these two technologies for skin rejuvenation.

Bani, et al., evaluated tissue changes, particularly those involving collagen fibers, following treatment with 5 MHz ultrasound. The authors observed compaction of collagen and elastic fibers, especially within the reticular dermis, when a power output of 3.0 W was applied. These changes were not significant when half of this power was used. Such findings suggest that the observed effects may be related to the thermal mechanisms of ultrasound, which promote significant local heating, improve tissue circulation and oxygenation and induce collagen remodeling. However, in the present study, significant improvements in skin texture and wrinkle appearance were achieved using lower power settings. Therefore, we suggest that the observed effects may result from the combined contribution of both mechanical and thermal mechanisms generated by the ultrasonic wave.

The literature has also reported beneficial clinical effects of ultrasound in the treatment of rosacea when frequencies between 3 and 5 MHz are employed. Park, et al., reported positive outcomes in patients with rosacea using frequencies close to 5 MHz at an intensity of 2.0 W/cm². Similarly, Meyer-Rogge, et al., investigated the application of dual-frequency ultrasound (3 MHz and 10 MHz) for facial rejuvenation and observed significant improvements in skin aging parameters, including skin texture, fine wrinkles and overall facial appearance, corroborating the findings of the present study. The mechanism proposed by these authors involved the regulation of Matrix Metalloproteinases (MMPs) and Heat Shock Proteins (HSPs), contributing to dermal remodeling without the need for invasive procedures. Interestingly, Sontag, et al., in an experimental cell study, demonstrated that a frequency of 10 MHz was capable of prolonging the activity of HSP72, a protein closely associated with proper collagen folding and tissue quality.

In the present study, the protocol using 10 MHz ultrasound alone in the periorbital region produced significant improvements in wrinkle appearance. Based on its mechanism of action, this frequency acts predominantly on superficial tissue layers, generating both thermal and mechanical effects that are beneficial for improving skin texture and quality. Although direct comparisons with previous studies remain limited, our findings reinforce that 10 MHz ultrasound is a safe modality capable of producing the desired clinical outcomes. This characteristic may represent an important advantage for the treatment of facial regions that cannot be safely treated using microfocused ultrasound.

It is important to emphasize that, although the present study provides clinical evidence supporting the effects of high-frequency therapeutic ultrasound, it is limited by its non-randomized and uncontrolled design. Nevertheless, the findings confirm the safety and efficacy of both 5 MHz and 10 MHz ultrasound frequencies, as well as the combination of 5 MHz ultrasound and microcurrent stimulation, in improving skin texture, wrinkles and tissue laxity.

Conclusion

Based on the results of the present study, it can be concluded that 5 MHz and 10 MHz therapeutic ultrasound are effective for the treatment of facial wrinkles, particularly in the forehead and periorbital regions, while the combination of 5 MHz ultrasound and microcurrent stimulation appears effective in restoring dermal structure and improving skin laxity.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding Statement

This research did not receive any specific grant from funding agencies in the public, commercial or non-profit sectors.

Acknowledgement

The authors have no acknowledgments to declare.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

The project did not meet the definition of human subject research under the preview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement

Informed consent was obtained from all participants included in the study.

Authors' Contributions

All authors contributed equally to this paper.

References

1. Meyer-Rogge D, Rösken F, Holzschuh P, D'hont B, Kruglikov I. Facial Skin Rejuvenation with High Frequency Ultrasound: Multicentre Study of Dual-Frequency Ultrasound. *J Cosmet Dermatol Sci Appl*. 2012;2(2):68-73.
2. Farage MA, Miller KW, Elsner P, Maibach HI. Intrinsic and extrinsic factors in skin ageing: A review. *Int J Cosmet Sci*. 2008;30(2):87-95.
3. Montagner S, Costa A. Bases biomoleculares do fotoenvelhecimento. *An Bras Dermatol*. 2009.
4. Stein MJ, Aston SJ. Ancillary Procedures to Facelift Surgery: What has Changed? *Aesthet Surg J Open Forum*. 2023;5.
5. Bani D, Bencini A, Bergonzi MC, Bilia AR, Guccione C, Severi M, et al. Enhanced intra-cutaneous delivery of a Mn-containing antioxidant drug by high-frequency ultrasounds. *J Pharm Biomed Anal*. 2015;106:197-203.
6. Ghani H, Khan S, Podwojniak A, Mirza FN, Richards E, Ekeh O, et al. Adverse effects associated with ablative lasers when treating common dermatologic conditions: a systematic review of 946 patients. *Laser Ther*. 2023.
7. Shah S, Alam M. Laser resurfacing pearls. *Semin Plast Surg*. 2012;26(3):131-6.
8. ter Haar G. Therapeutic applications of ultrasound. *Prog Biophys Mol Biol*. 2007;93(1-3):111-29.
9. Polat BE, Hart D, Langer R, Blankschtein D. Ultrasound-mediated transdermal drug delivery: Mechanisms, scope and emerging trends. *J Control Release*. 2011;152(3):330-48.
10. Bani D, Calosi L, Faggioli L, Bani D. Autores: Correspondência para.
11. Miller D, Smith N, Bailey M, Czarnota G, Hynynen K, Makin I. Overview of therapeutic ultrasound applications and safety considerations.
12. Sontag W, Kruglikov IL. Expression of Heat Shock Proteins after Ultrasound Exposure in HL-60 Cells. *Ultrasound Med Biol*. 2009;35(6):1032-41.
13. Alster TS, Tanzi E. Improvement of Neck and Cheek Laxity With a Non-ablative Radiofrequency Device: A Lifting Experience. 2004.
14. Watson T. Ultrasound in contemporary physiotherapy practice. *Ultrasonics*. 2008;48(4):321-9.
15. Lucas VS, Burk RS, Creehan S, Grap MJ. Utility of high-frequency ultrasound: Moving beyond the surface to detect changes in skin integrity. *Plast Surg Nurs*. 2014;34(1):34-8.
16. O'Brien Jr WD. Ultrasound-biophysics mechanisms. *Progress in Biophysics and Molecular Biology*. 2007;93(1-3):212-55.
17. Kruglikov IL. Very high frequency ultrasound in aesthetic medicine and surgery: The principles. *J Ästhet Chir*. 2018;11(3):124-9.
18. Bani D, Bencini A, Bergonzi MC, Bilia AR, Guccione C, Severi M, et al. Enhanced intra-cutaneous delivery of a Mn-containing antioxidant drug by high-frequency ultrasounds. *J Pharm Biomed Anal*. 2015;106:197-203.

About the journal



Journal of Dermatology Research is an international, peer-reviewed, open-access journal published by Athenaeum Scientific Publishers. The journal publishes original research articles, case reports, editorials, reviews and commentaries relevant to its scope. It aims to disseminate high-quality scholarly work that contributes to research, clinical practice and academic knowledge in the field.

All submissions are evaluated through a structured peer-review process in accordance with established editorial and ethical standards. Manuscripts are submitted and processed through the journal's online submission system.

Manuscript submission: <https://athenaeumpub.com/submit-manuscript/>