THE EUROPEAN SOCIETY OF MEDICINE

Published 30 September 2026 Medical Research Archives, Volume 14 Issue 9

EDITORIAL

Combining High-Intensity Focused Ultrasound and Monopolar Radiofrequency: A Multilayer Strategy for Improved Facial Rejuvenation

Yousun Hwang[1], Kyuho Yi[2]

ABSTRACT

OPEN ACCESS

Facial aging is a multilayer process involving changes in the skin, subcutaneous tissue, retaining structures, and deeper soft-tissue planes. High-intensity focused ultrasound and monopolar radiofrequency are widely used nonsurgical modalities for facial tightening and rejuvenation. Although both technologies induce thermally mediated collagen remodeling, they differ substantially in the physical mechanisms by which energy is delivered and distributed within the tissue. High-intensity focused ultrasound produces discrete thermal coagulation zones at predetermined depths, whereas monopolar radiofrequency produces broader and more diffuse thermal effects within the dermis and, depending on device characteristics and treatment parameters, superficial subcutaneous tissue. These differences provide a biological rationale for combining the two modalities as a multilayer treatment strategy rather than regarding them as interchangeable or competing technologies. This review discusses the distinct tissue effects of high-intensity focused ultrasound and monopolar radiofrequency, the rationale for combination treatment, practical considerations regarding treatment sequence and energy selection, and safety considerations related to cumulative thermal exposure, facial volume preservation, and treatment of thin or sensitive anatomical regions. Although the combination may provide complementary and potentially additive clinical effects, prospective comparative studies are required to determine whether combined treatment produces objectively superior outcomes compared with either modality alone.

Keywords: high-intensity focused ultrasound; monopolar radiofrequency; facial rejuvenation

AUTHOR AFFILIATIONS

[1] Haedrin Clinic, Center for Aesthetic Medicine, Seoul, Republic of Korea
[2] Maylin Clinic

Yousun Hwang
Email: clarasong4528@gmail.com

Kyuho Yi
Email: kyuho90@daum.net

DOI
https://doi.org/10.18103/mra.2026.0622

CITATION
Hwang, Y., Yi, K., 2026. Combining High-Intensity Focused Ultrasound and Monopolar Radiofrequency: A Multilayer Strategy for Improved Facial Rejuvenation. Medical Research Archives, [online] 14(9). https://doi.org/10.18103/mra.2026.0622

COPYRIGHT
© 2026 European Society of Medicine. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

ISSN
2375-1924

Introduction

As human life expectancy has increased substantially over recent decades, interest in maintaining health and quality of life throughout aging has grown in parallel with the desire to preserve a youthful appearance. This growing interest is reflected in the rapid expansion of aesthetic medicine. According to the International Society of Aesthetic Plastic Surgery in 2023, 34.9 million aesthetic procedures were performed worldwide, including 15.8 million surgical and 19.1 million nonsurgical procedures, representing an increase of more than 40% over four years. [1]The growing demand for less invasive approaches has contributed to the development of numerous technologies aimed at improving visible signs of facial aging while minimizing downtime and avoiding the complications associated with surgery. [2.]

Although surgical intervention can provide substantial correction of advanced facial laxity,it is generally reserved for patients with severe facial laxity who are willing to accept the greater invasiveness, recovery time, and risk of surgical complications. [3] Among the available nonsurgical treatment modalities, high-intensity focused ultrasound (HIFU) and monopolar radiofrequency (RF) are now widely used for noninvasive facial tightening and rejuvenation.[4] Both modalities induce controlled thermal injury and subsequent collagen remodeling, but they do so through different physical mechanisms and with different patterns of energy distribution.[5]

High-intensity focused ultrasound delivers focused ultrasound energy to predetermined tissue depths and creates defined thermal coagulation zones.[6,7] Monopolar radiofrequency generates heat through tissue resistance to electrical current and produces broader volumetric heating within the dermis and subcutaneous tissue.[8]

Because both treatments are used for skin laxity, they are often regarded as competing or interchangeable modalities. In clinical practice, however, their effects appear to be complementary. High-intensity focused ultrasound may be more effective for focal contraction and structural lifting, whereas monopolar radiofrequency may provide more diffuse tightening and improvement in skin quality.[5,9]

Additionally, facial aging is a multilayer process that involves dermal thinning, collagen degradation, changes in subcutaneous tissue, weakening of supporting structures, and progressive tissue descent.[10] For this reason, treatment with a single energy-based modality may not adequately address every component of facial aging.

Considering their distinct mechanisms and tissue effects, a combination of high-intensity focused ultrasound and monopolar radiofrequency may represent a complementary multilayer strategy for facial rejuvenation.

Facial aging may influence self-perception and psychosocial well-being.[11.]More effective approaches to facial rejuvenation may have value beyond visible improvement alone, potentially contributing to greater satisfaction with appearance and improved psychosocial well-being. [12]

Different Mechanisms, Complementary Effects

The principal strength of high-intensity focused ultrasound is its precision and its ability to deliver thermal energy to defined tissue depths. By selecting an appropriate transducer, the physician can target specific dermal or subdermal planes while largely sparing the epidermis.[13] At the focal point, focused ultrasound creates thermal coagulation zones that induce immediate collagen contraction[14], followed by neocollagenesis and tissue remodeling. [6,15] This selective, depth-specific energy delivery makes focused

ultrasound particularly valuable for areas requiring structural contraction, including the lower face, jawline, brow, and periocular region.[6,16]

In my previous study of direct periocular high-intensity focused ultrasound using Ultraformer MPT (Classys Inc., Korea), [16] 34 Korean women were treated. Improvement was reported by 76% of patients and recognized by clinicians in 59%; mean eyelid length decreased by 0.94 ± 0.34 mm, and no major adverse events were observed

These findings supported the ability of focused ultrasound to produce measurable tissue contraction. However, ultrasound energy is delivered in focal points, with unaffected tissue remaining between individual coagulation zones [5,17]

Monopolar radiofrequency has a different treatment profile. It produces broader, more diffuse heating across the dermis and, depending on the device and treatment parameters, may extend into the superficial subcutaneous layer. This heating causes collagen denaturation, shortening of collagen fibers, and a gradual remodeling process over several months.[18]

Histologic analysis has also demonstrated that while monopolar radiofrequency caused significant neocollagenesis and neoelastogenesis in the upper reticular dermis, these changes by high-intensity focused ultrasound were focal and more prominent in the deep reticular dermis.[5]

Why the Combination May Produce Better Outcomes

The rationale for combining high-intensity focused ultrasound and monopolar radiofrequency is not simply to deliver more heat. The objective is to distribute thermal stimulation across different tissue depths and patterns.

Focused ultrasound may create focal contraction in selected deeper or structurally important tissue planes, such as the superficial musculoaponeurotic system. Monopolar radiofrequency may then provide broader dermal and subdermal heating around and between those focal treatment zones.[5,19]

This distinction is important. Increasing the number of focused-ultrasound shots alone may increase focal treatment density, but it does not necessarily reproduce the broader, diffuse pattern of tissue heating associated with monopolar radiofrequency. Similarly, increasing radiofrequency energy may enhance dermal heating, but may not reproduce the depth-selective coagulation created by focused ultrasound.[5] Using both modalities may allow the physician to address tissue laxity and skin quality without relying excessively on either treatment.

In practical terms, patients may experience improvement not only in lifting but also in elasticity, texture, fine wrinkles, and overall facial integration. A treatment that improves only one feature may be clinically noticeable but still appear incomplete. A multilayer approach may produce a more balanced and natural result.

Practical Considerations for Combined HIFU and Monopolar RF Treatment

Previous articles suggest that the best candidates for both monopolar radiofrequency and high-intensity focused ultrasound treatment are those who have mild to moderate sagging [20,21], and setting a realistic expectation is crucial. In my practice, a topical anesthetic cream containing 5% lidocaine-prilocaine is routinely applied for approximately 30 to 40 minutes. Although topical anesthesia does not eliminate the

deeper pain generated by focused ultrasound, it may provide some surface anesthetic effect, and reduce treatment-related discomfort especially during monopolar radiofrequency treatment. [22,23]

When Ultraformer MPT focused ultrasound (Classys Inc., Republic of Korea) and Volnewmer monopolar radiofrequency (Classys Inc., Republic of Korea) are performed in the same session, treatment parameters should be individualized according to anatomical location, tissue thickness, facial volume, and patient tolerance. In sensitive or thin areas such as the periocular region, I generally use a 2.0-mm, 4-MHz transducer or a 3.0mm transducer at approximately 0.3 J-0.4 J. In areas with greater tissue thickness and laxity, such as the sagging chin and marionette lines, a 4.5-mm transducer may be used at approximately 1.0 J, depending on the individual anatomy and treatment objective. For monopolar radiofrequency treatment, I generally begin at approximately 3.0 J/cm2 and adjust the energy according to tissue characteristics and patient tolerance. In my practice, approximately 300 to 600 shots of each modality may be used for full-face treatment. However, shot number and distribution should be individualized rather than regarded as a fixed protocol.

During monopolar radiofrequency treatment, the grounding pad should be securely applied according to the manufacturer's instructions to ensure a continuous low-resistance electrical return path away from the treatment area.[24] As a precaution, metal accessories should generally be removed before monopolar radiofrequency treatment to minimize the possibility of unintended electrical arcs, burns or disrupted energy transmission [25]

When both modalities are performed during the same session, focused ultrasound may reasonably be performed first. The rationale is that as radiofrequency treatment can produce temporary tissue heating and edema, it could theoretically affect the accuracy and consistency of subsequent ultrasound treatment. In addition, patients often perceive focused ultrasound treatment as the more uncomfortable component of the combined treatment. Performing it first allows this portion of the procedure to be completed while the effect of the topical anesthesia is likely to be greatest. However, this sequencing strategy reflects clinical reasoning and experience rather than an established evidence-based standard.

After focused ultrasound has been delivered to the planned structural targets, monopolar radiofrequency may be used more broadly to promote dermal and subdermal heating and remodeling. Routine reduction of the energy of either modality solely because combination treatment is being performed may not always be necessary. Nevertheless, every treatment should be individualized. For patients who experience extreme pain, treatment energy level should be reduced to a tolerable range

Safety and Cumulative Thermal Exposure

The principal concern with combination treatment is cumulative thermal exposure. Although each device may have an acceptable safety profile when used alone, applying standard monotherapy parameters for both focused ultrasound and monopolar radiofrequency during the same treatment session may create unnecessary thermal exposure. Combination treatment should therefore be performed by practitioners familiar with the tissue effects, anatomical targets, and potential complications of both modalities.

Particular caution is warranted in thin patients and in those with limited facial subcutaneous fat. In such patients, low energy settings, selective treatment areas, and careful treatment planning may help to minimize the possibility of unwanted volume loss or facial hollowing. Conversely, in patients with greater

facial fat, treatment density may be increased when modest reduction of subcutaneous volume is also part of the aesthetic objective. Such adjustments should be anotomically targeted after careful treatment design and planning.

Treatment planning should also reflect regional anatomy. In areas with greater soft-tissue thickness and structural laxity, such as the jowls and submental region, focused ultrasound may be particularly useful because of its ability to deliver focal energy to selected deeper tissue planes. Monopolar radiofrequency can be applied more broadly to areas of diffuse dermal laxity and deterioration in skin quality.

The goal of combination treatment should therefore be to achieve sufficient tightening while preserving facial volume, contour, and natural expression.

Throughout treatment, consistent and complete contact between the handpiece and the skin is essential. Inadequate contact may increase the risk of adverse thermal effects, including burns or blistering.
The optimal sequence and interval for combination treatment therapy have not been established. In my practice, repeat treatment may be considered after approximately 6-12 months according to the degree of laxity, treatment response, and individual aesthetic goals. However, this interval should be regarded as a clinical practice pattern rather than a validated safety standard.

Limitations of the Current Evidence

Although there is a plausible biological and clinical rationale for combining high-intensity focused ultrasound and monopolar radiofrequency, the superiority of combination treatment over either modality alone has not yet been established.

Available studies have generally evaluated high-intensity focused ultrasound and monopolar radiofrequency treatments separately, using different patient groups, treatment protocols, and outcome measures. Their results cannot be directly compared or interpreted as evidence that combined treatment is statistically superior.

For this reason,, the term synergistic effect should be used cautiously. At present, it may be more accurate to describe the modalities as having complementary mechanisms, potentially additive clinical effects, or a potentially synergistic multilayer effect.

A prospective comparative study is needed to confirm whether these theoretical and clinically observed complementary effects translate into superior outcomes. Such a study should compare HIFU alone, monopolar RF alone, and combined treatment using standardized photographs, blinded evaluation, objective measurements, patient satisfaction, and adverse-event monitoring.

Nevertheless, the absence of comparative trials does not eliminate the value of clinical observation and reasoning. Many developments in aesthetic medicine begin with an understanding of tissue anatomy, careful observation, and refinement of technique before being tested in larger controlled studies.

Conclusion

High-intensity focused ultrasound and monopolar radiofrequency should not necessarily be regarded as competing treatments. Although both modalities induce thermally mediated collagen remodeling, they differ substantially in the way energy is delivered to tissue. High-intensity focused ultrasound produces focal

thermal coagulation at selected depths and is useful for structural contraction and lifting. Monopolar radiofrequency generates broader volumetric heating and may improve diffuse skin laxity, elasticity, texture, and tone. Because facial aging involves multiple tissue layers, combining the two modalities may offer a more comprehensive outcome than either treatment alone.

The value of combination treatment lies not in delivering the maximum amount of energy, but in selecting the appropriate modality for each anatomical layer and clinical problem.

Careful patient selection, individualized energy adjustment, avoidance of excessive treatment overlap, preservation of facial fat, and meticulous attention to thin or sensitive areas are essential. Future prospective comparative studies should determine whether the apparent complementary effects translate into objectively superior and durable clinical outcomes.

Until such evidence becomes available, combined treatment may reasonably be regarded as a rational complementary strategy for individualized, multilayer facial rejuvenation.

Conflict of Interest Statement:

The authors declare no conflicts of interest.

Funding Statement:

No external funding was received for this editorial.

Acknowledgements:

None.

References:

1. Triana L, Palacios Huatuco RM, Campilgio G, Liscano E. Trends in surgical and nonsurgical aesthetic procedures: a 14-year analysis of the International Society of Aesthetic Plastic Surgery-ISAPS. Aesthetic Plast Surg.2024;48(20):4217-4227. doi:10.1007/s00266-024-04260-2.
2. Britt CJ, Marcus B. Energy-based facial rejuvenation: advances in diagnosis and treatment. JAMA Facial Plast Surg.2017;19(1):64-71. doi:10.1001/jamafacial.2016.1435
3. Lelli GJ Jr, Lisman RD. Blepharoplasty complications. Plast Reconstr Surg.2010;125(3):1007-1017. doi:10.1097/PRS.0b013e3181ce17e8
4. Sieber DA, Kenkel JM. Noninvasive methods for lower facial rejuvenation. Clin Plast Surg.2018;45(4):571-584. doi:10.1016/j.cps.2018.06.003
5. Suh DH, Choi JH, Lee SJ, Jeong KH, Song KY, Shin MK. Comparative histometric analysis of the effects of high-intensity focused ultrasound and radiofrequency on skin. J Cosmet Laser Ther.2015;17(5):230-236. doi:10.3109/14764172.2015.1022189
6. Wulkan AJ, Fabi SG, Green JB. Microfocused ultrasound for facial photorejuvenation: a review. Facial Plast Surg.2016;32(3):269-275. doi:10.1055/s-0036-1584129
7. Ayatollahi A, Gholami J, Saberi M, Hosseini H, Firooz A. Systematic review and meta-analysis of safety and efficacy of high-intensity focused ultrasound (HIFU) for face and neck rejuvenation. Lasers Med Sci.2020;35(5):1007-1024. doi:10.1007/s10103-020-02957-9
8. Rusciani A, Curinga G, Menichini G, Alfano C, Rusciani L. Nonsurgical tightening of skin laxity: a new radiofrequency approach. J Drugs Dermatol.2007;6(4):381-386.
9. Bonjorno AR, Gomes TB, Pereira MC, et al. Radiofrequency therapy in esthetic dermatology: a review of clinical evidences. J Cosmet Dermatol.2020;19(2):278-281. doi:10.1111/jocd.13206
10. Cotofana S, Fratila AA, Schenck TL, Redka-Swoboda W, Zilinsky I, Pavicic T. The anatomy of the aging face: a review. Facial Plast Surg.2016;32(3):253-260. doi:10.1055/s-0036-1582234
11. Springer IN, Schulze M, Wiltfang J, et al. Facial self-perception, well-being, and aesthetic surgery. Ann Plast Surg.2012;69(5):503-509. doi:10.1097/SAP.0b013e3182223d42
12. Cohen JL, Rivkin A, Dayan S, et al. Multimodal facial aesthetic treatment on the appearance of aging, social confidence, and psychological well-being: HARMONY study. Aesthet Surg J.2022;42(2):NP115-NP124. doi:10.1093/asj/sjab114
13. Gliklich RE, White WM, Slayton MH, Barthe PG, Makin IR. Clinical pilot study of intense ultrasound therapy to deep dermal facial skin and subcutaneous tissues. Arch Facial Plast Surg.2007;9(2):88-95. doi:10.1001/archfaci.9.2.88
14. Wang M, Zhang C, Li Y, Yan Y. Histological changes of porcine animal skin with micro-focused ultrasound. Aesthetic Plast Surg.2024;48(17):3463-3474. doi:10.1007/s00266-024-04037-7
15. Laubach HJ, Makin IRS, Barthe PG, Slayton MH, Manstein D.Intense focused ultrasound: evaluation of a new treatment modality for precise microcoagulation within the skin. Dermatol Surg.2008;34(5):727-734. doi:10.1111/j.1524-4725.2008.34196.x. PMID: 18429926,
16. Hwang Y, Kim JH, Lee HE, et al. Efficacy of high-intensity focused ultrasound for treating upper and lower eyelid sagging. JPRAS Open.2025;48:147-154. doi:10.1016/j.jpra.2025.10.036
17. Fabi SG. Noninvasive skin tightening: focus on new ultrasound techniques. Clin Cosmet Investig Dermatol.2015;8:47-52. doi:10.2147/CCID.S69118

18. el-Domyati M, el-Ammawi TS, Medhat W, et al. Radiofrequency facial rejuvenation: evidence-based effect. J Am Acad Dermatol.2011;64(3):524-535. doi:10.1016/j.jaad.2010.06.045

19. Kwon SH, Ahn GY, Lew BL, Shin JW, Na JI, Huh CH. Clinical implication of the regional thickness of the lower facial skin, superficial fat, and superficial musculoaponeurotic system on high-intensity focused ultrasound treatment. Dermatol Surg.2022;48(5):527-531. doi:10.1097/DSS.0000000000003393

20. Wollina U. Treatment of facial skin laxity by a new monopolar radiofrequency device. J Cutan Aesthet Surg.2011;4(1):7-11. doi:10.4103/0974-2077.79178

21. Contini M, Hollander MHJ, Vissink A, Schepers RH, Jansma J, Schortinghuis J. A systematic review of the efficacy of microfocused ultrasound for facial skin tightening. Int J Environ Res Public Health.2023;20(2):1522. doi:10.3390/ijerph20021522

22. Vachiramon V, Palakornkitti P, Anuntrangsee T, Rutnin S, Visessiri Y, Fabi S. A comparative study of pain perception during the microfocused ultrasound procedure between topical anesthesia and combined topical anesthesia with forced air cooling. J Cosmet Dermatol.2023;22(4):1279-1285. doi:10.1111/jocd.15568

23. Kushikata N, Negishi K, Tezuka Y, Takeuchi K, Wakamatsu S. Is topical anesthesia useful in noninvasive skin tightening using radiofrequency? Dermatol Surg.2005;31(5):526-533. doi:10.1111/j.1524-4725.2005.31155

24. CCordero I. Electrosurgical units—how they work and how to use them safely. Community Eye Health.2015;28(89):15-16.

25. Burlingame BL. Clinical issues—January 2017. AORN J.2017;105(1):110-116. doi:10.1016/j.aorn.2016.11.008