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Comparative Three-dimensional Analysis of Facial Lifting Effects across Five Aesthetic Units following Continuous Radiation 115-Watt 6.78-MHz Monopolar Radiofrequency Therapy

JongSeo Kim, MD

Background: Modern aesthetic trends favor noninvasive facelift procedures, shifting away from traditional surgery. This study explores the three-dimensional evaluation of facial lifting across aesthetic units using the VolNewMer (VNM) device after continuous 115-W 6.78-MHz monopolar radiofrequency (RF) therapy.
Methods: A cohort of 30 Korean women underwent VNM treatment with a detailed protocol, including energy levels, cooling techniques, and stem cell media application. Lifting amount was analyzed using a three-dimensional scanner with computer program in five specific areas, including the forehead, lateral orbital rim, mid-face, low-face, and neck areas. The changes in Global Aesthetic Improvement Scale for skin texture, tightening, and lifting were surveyed.
Results: Immediate and sustained improvement was observed in the mid-cheeks and lower face area. The lifting amount of facial mid-cheek areas was 1.88 ± 0.76 mm, whereas the lifting amount of lower face areas was 1.79 ± 0.91, lateral orbital rim areas was 1.62 ± 0.99, forehead areas was 1.46 ± 1.26, and neck areas was 2.66 ± 1.40 mm immediately after the procedure. The lifting amount of mid-cheek areas was 1.93 ± 0.90 mm, whereas lower face areas was 1.67 ± 1.04, lateral orbital rim areas was 1.58 ± .072, forehead areas was 1.31 ± 0.73, and neck areas was 2.80 ± 0.78 mm 1 month after the procedure.
Conclusions: RF treatment is emerging as a recommended noninvasive procedure for facial lifting. VNM-RF treatment showed a significant lifting effect immediately after the procedure, and the lifting effect continued 1 month later ($P < 0.05$). Global Aesthetic Improvement Scale skin texture was more satisfying 1 month later than immediately after, suggesting a potential correlation with collagen regeneration, indicating a lasting effect over time. *(Plast Reconstr Surg Glob Open 2024; 12:e6137; doi: 10.1097/GOX.0000000000006137; Published online 6 September 2024.)*

INTRODUCTION

In the field of aesthetics and plastic surgery, traditional facelift procedures are declining due to their long recovery times. Instead, there is growing interest in noninvasive methods for enhancing skin elasticity and achieving facelifts. This shift extends to plastic surgery, with increasing demand for procedures that minimize downtime and discomfort while delivering facial lifting results.[1] Noninvasive techniques such as radiofrequency (RF), high-frequency microwaves, high-intensity focused ultrasound, and thread lifting materials are gaining traction.[2] RF technology, in particular, is gaining popularity for its safe and effective skin rejuvenation capabilities.[3,4] As RF devices evolve, research in beauty and dermatology continues to drive significant advancements. The author conducted a statistical analysis to measure lifting in five aesthetic units to determine the significance of the outcomes (Figs. 1 and 2).

From the Kim-Jongseo Plastic Surgery Clinic, Seoul, Republic of Korea.

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METHODS

Study Protocol, Participant Demographics, and Ethics Compliance

Recognizing the significance of maintaining comprehensive data for both patients and operators, the author

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diligently captured 3D photographs of all patients before and after the RF procedure. A retrospective study was conducted on 30 of 98 patients who received RF- energy-based medical devices treatment from January to December 2023, securing sufficient 3D data. This study protocol complied with the ethical guidelines of the 1975 Declaration of Helsinki and applicable local regulations. The study involved a cohort of 30 individuals who attended the author's clinic and had not undergone cosmetic procedures such as energy-based medical devices, filler, and botulinum toxin treatment in the preceding 6 months. The participants were Korean women aged 32–79 years.

Treatment Procedure

Each patient underwent treatment using the "VolNewMer" (VNM: Classys, Seoul, Korea) device with 4 cm^2 V-tips, administering a total of 300 shots to the entire face. The RF energy intensity from the high-frequency equipment was set to a maximum level of 5, 115 J, 28.75 J per cm^2.

Initially, patients received treatment with 50 shots at level 5 for the entire face without moving the tip (stacking-static mode), using a cooling mode. Following three passes across the entire face, if the patients reported excessive heat sensation, the skin was cooled for 1 minute using a cooling spray gun (TargetCool, Recens-Medical, Ulsan, Korea). The CO_2 spray gun uses a high-purity-CO_2–filled aluminum cartridge designed to filter potential impurities from the cartridge. When using energy levels 5 or 4, frequent cooling of the epidermis was implemented to apply robust energy to deeper areas. Upon completion, cooling was reduced, allowing the epidermal temperature to rise gradually. Efforts were made to use level 5 energy whenever possible.

To alleviate heat discomfort, the "sliding-spreading mode" was used, involving movement the V-tip during the treatment. This mode aimed to mitigate pain and heat sensations associated with the intense energy at level 5. The sliding-spreading technique, coupled with level 5, was applied for 50 shots. If heat discomfort persisted, the skin underwent an additional 1-minute cooling session using the liquefied CO_2 cooling spray.

Subsequently, 50 shots at level 4 were administered utilizing the "stacking-static technique." Following this, the sliding technique with level 4 was performed for an additional 50 shots. Finally, 100 shots at level 3, with cooling mode off, were administered using the same method.[4] The total radiated energy amounted to 28,500 J for the whole face (115 J × 100 + 95 J × 100 + 75 J × 100 = 28500 J).

Takeaways

Question: How can I achieve the maximum effect while using the maximum energy and reducing the patient's pain when performing non-invasive 115-W 6.78-MHz monopolar radiofrequency treatment?

Findings: Using the VolNewMer device on 30 Korean women, this study demonstrated significant immediate and 1-month postprocedure improvements in mid-cheek (1.88–1.93 mm), lower face (1.79–1.67 mm), lateral orbital rim (1.62–1.58 mm), forehead (1.46–1.31 mm), and neck (2.66–2.80 mm) lifting. The sliding-spreading technique and varied energy levels enhanced patient comfort.

Meaning: These findings highlight the effectiveness of radiofrequency lifting for sustaining lifting and enhancing skin texture up to 1 month after the procedure, suggesting continuous collagen regeneration and lasting benefits.

Evaluation of Efficacy

To evaluate the efficacy of the VNM-RF energy-based device in facial lifting and skin tightening, a 3D-scanner

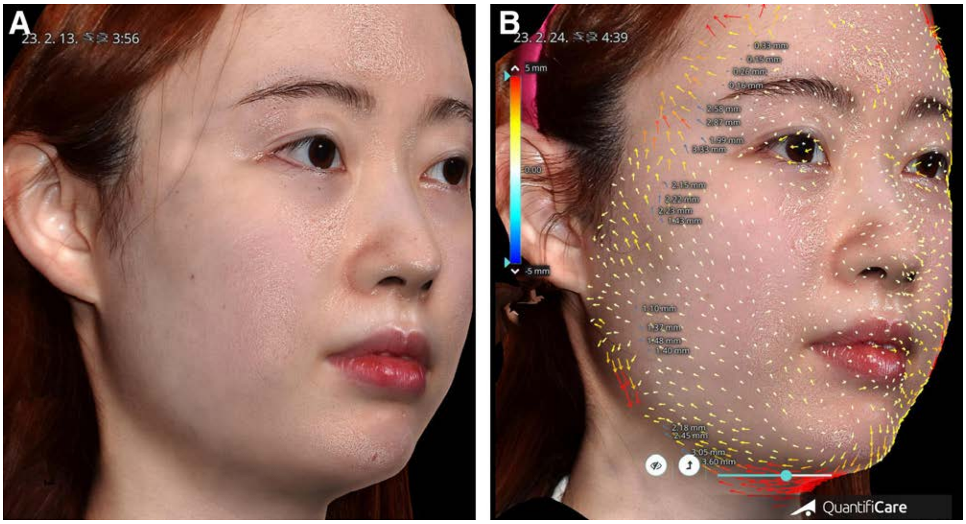

Fig. 1. The evaluation of lifting amount on five face areas. A, Before the treatment. B, After the treatment using VNM RF device. The lifting amount was measured on forehead, lateral eye, mid-face, low-face, and neck areas after the RF treatment. The face was lifted, and lifting amount was calculated by 3D scanner with computer analysis. Red arrows indicate lift by 5mm, orange arrows indicate 3–4 mm, and yellow arrows indicate 1–2 mm than before.

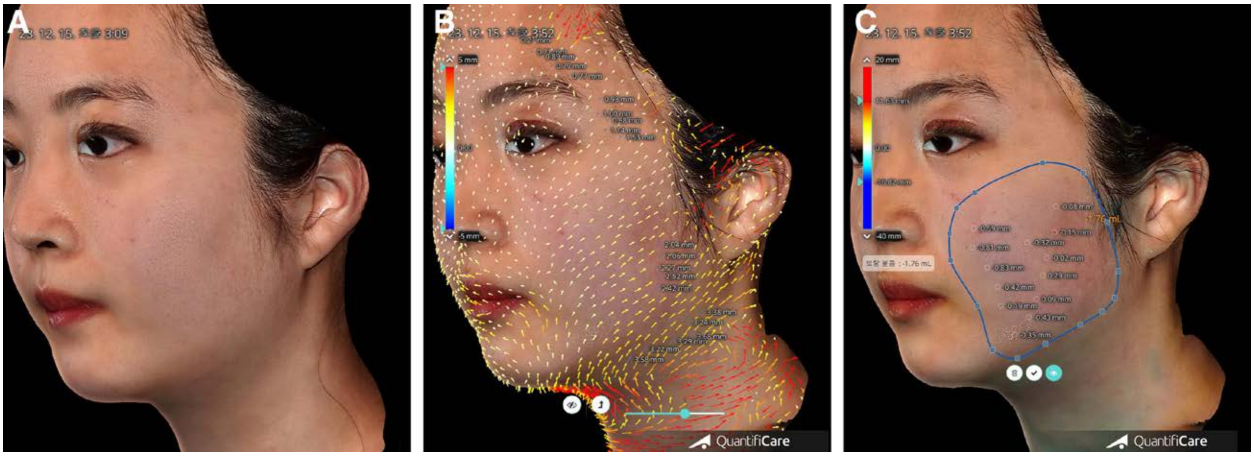

Fig. 2. Analysis of lifting amount using 3D-scanner analysis immediately after treatment for 32-year-old woman. A, Before the treatment. B, Immediately after the treatment. A noticeable improvement is evident, showing lifting face. Notably, the treatment yields remarkable results in five specific areas, including the forehead, lateral orbital rim, mid-face, low-face, and neck areas. Each arrow indicates lifting amount. Yellow arrows show lifting by 2–3 mm, and red arrows show lifting by 5 mm. C, Immediately after the treatment. The nasolabial fat compartment area was reduced by 0.81 mm and 0.59 mm, and the jowl area was reduced by 0.35 mm and 0.43 mm.

image (3D LifeViz mini: Quantificare, Sophia Antipolis, France) was used. The lifting amounts on faces were measured immediately postprocedure and at 1 month later on each of five points in five aesthetic units: mid-cheek, lower face, lateral orbital rim, forehead, and neck areas. (Fig. 1)

Statistical Analysis

A statistical analysis was conducted to evaluate the effectiveness of RF treatment in lifting facial tissue, using data from 30 participants. The initial analysis involved a one-sample *t* test to compare the mean lifting effect posttreatment with a hypothesized mean difference of 0.95 at a significance level of 0.05. However, the Kolmogorov-Smirnov test indicated nonnormal data distribution. Consequently, the analysis was revised using the Mann-Whitney U test, suitable for nonnormal data. The results, consistent with the initial *t* test, confirmed significant differences in lifting effects between pretreatment, immediate posttreatment, and 1-month posttreatment. Python's SciPy library was used for this analysis.

Postprocedure Care

Following the procedure and 3D imaging, 1 mL of adipose derived stem cell media serum product (Reteenage Extra Gold stem ample; Reteenage, Seoul, Korea)[5] was sprayed using a medical device called Jet Clear (Eunsung Global, Korea) under very high pressure try to penetrate even a small amount of serum into the epidermis. The treated area was then covered with plastic wrap, maintained for 10 minutes. The cosmetic product contains freezing dry powder of stem cell conditioning media and 1% hyaluronic acid, aiding in rapid recovery of epidermis postthermal damage.[5]

Follow-Up Assessment

At 1-month postprocedure, patients visited the clinic without applying makeup, sunscreen, moisturizer, or any other facial products, and 3D photographs were taken using the same 3D-scanner.

Global Aesthetic Improvement Scale

The Global Aesthetic Improvement Scale (GAIS) was used immediately and after 1-month for a comprehensive evaluation of the effects of the RF device on skin texture, skin tightening, and face lifting (very much improved: 5, much improved: 4, improved: 3, no change: 2, worse: 1).

RESULTS

The mean age of 30 participants was 49.8 ± 14.36 years (ranging from 32 to 79). Immediately after the procedure, the mid-cheek areas experienced a lifting of 1.88 ± 0.76 mm, whereas the lower face areas had a lifting amount of 1.79 ± 0.91 mm. Additionally, the lateral orbital rim areas showed a lifting of 1.62 ± 0.99 mm, the forehead areas had a lifting of 1.46 ± 1.26 mm, and the neck areas exhibited a lifting of 2.66 ± 1.40 mm. (Figs. 2–5) [**See Video 1 (online),** which displays 3D analysis for lifting and facial shape before and after the treatment in the same patient of Figs. 2, 3.] [**See Video 2 (online),** which displays a 3D analysis to compare the facial shape, especially the lower face, before and immediately after treatment for the same patient in Fig. 4.] [**See Video 3 (online),** which displays a 3D analysis to compare the facial shape, especially the mid-face, before and immediately after treatment for the same patient in Fig. 4.]

The mean lifting effect of mid-cheek after RF treatment is approximately 1.88mm. The variance of the lifting effect is approximately 0.59. In observation count, there are a total of 150 observation points (each five points in 30 subjects). The Pearson correlation coefficient for the lifting effects is not applicable. The hypothesized mean difference is 1mm. The degrees of freedom for the *t* test is 53. The t-statistic is approximately 8.45, indicating a significant result at a significance level of 0.05. In the $P(T \leq t)$ one-tailed test, the *P* value for the one-tailed test is 1.0684 E-12, which is very small, leading to rejection of the null hypothesis. In the t-critical one-tailed test, the t-critical value for the one-tailed test is approximately 1.67. In the

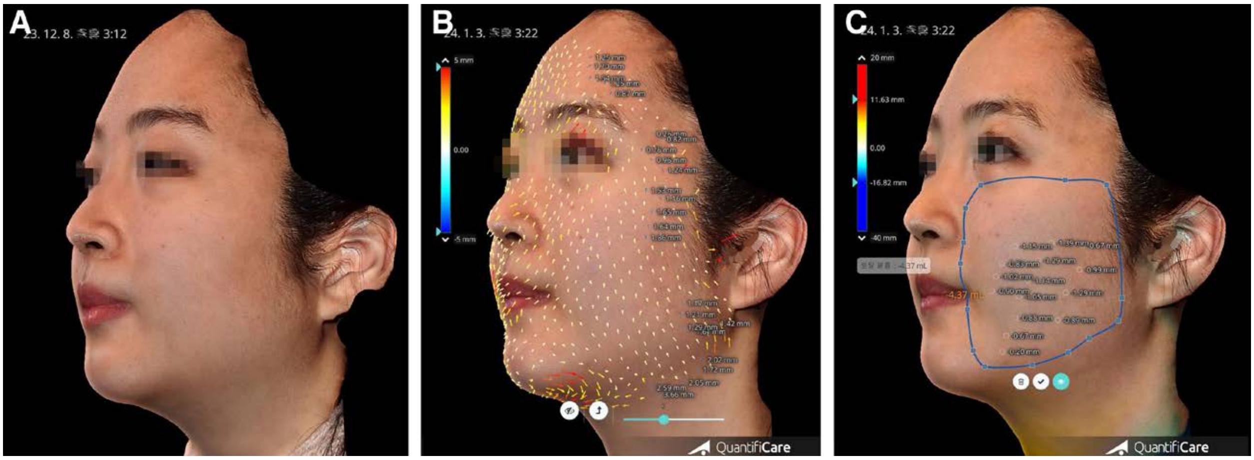

Fig. 3. Visual evidence in 3D analysis of effective lifting after 1 month for a 32-year-old woman. A, Before treatment. B, one-month after the procedure. The red and orange arrow markings indicated areas where more pronounced lifting has taken place, demonstrating the effectiveness using 3D-scanner analysis. C, The nasolabial fat compartment area was reduced by 0.88 mm and 0.67 mm, and the jowl area was reduced by 1.02 mm and 0.90 mm. Volume reduction in the nasolabial fat compartment and jowl fat area showed better changes after 1 month than immediately after.

P(T≤t) two-tailed test, the *P* value for the two-tailed test is 2.1369E-11, indicating rejection of the null hypothesis. In the t-critical two-tailed test, the t-critical value for the two-tailed test is approximately 2.01. Using the given data, the Mann-Whitney U test was performed to determine if there are significant differences between the pretreatment (0), immediate posttreatment, and 1 month posttreatment lifting results. Python's SciPy library was used for this analysis.

The lifting amount of mid-cheek areas was 1.93 ± 0.90 mm, whereas lower face areas was 1.67 ± 1.04, lateral orbital rim areas was 1.58 ± .072, forehead areas was 1.31 ± 0.73, and neck areas was 2.80 ± 0.78 mm immediately after the procedure. (Figs. 3, 4) All five aesthetic units were lifted statistically significantly even after 1-month.

The statistical results of mid-face lifting amount were as follows:

Pretreatment versus immediate posttreatment: U-Statistic=0.0, $P = 2.01e\text{-}12$.

Pretreatment versus 1-month posttreatment: U-Statistic=0.0, $P = 4.89e\text{-}11$.

Both comparisons show extremely small *P* values ($P < 0.05$), indicating significant differences between pretreatment and both immediate posttreatment and 1-month posttreatment lifting results. Thus, significant improvements were observed in lifting immediately and 1 month after treatment.

Among all areas that completed the 1-month follow-up, mid-face and neck areas demonstrated slightly more substantial improvement in lifting compared with immediate results. However, improvement of lifting on forehead, lateral orbital rim, and lower face areas demonstrated less improvement than initial result of lifting. Skin tightening and lifting amounts were mostly more pronounced 1 month after the procedure than immediate. Skin texture showed improvement at the 1-month assessment compared with the immediate postprocedure evaluation (Fig. 6).

The GAIS scores for skin texture, skin tightening, and face lifting showed improvements immediately after the procedure but a gradual decrease in tightness and lifting over time. However, skin texture continued to improve. GAIS scores immediately after the procedure were 3.56 ± 0.50 for skin texture, 4.52 ± 0.50 for skin tightening, and 5.56 ± 0.50 for face lifting. After 1 month, the scores were 4.40 ± 0.76, 3.64 ± 0.70, and 3.32 ± 0.62, respectively. This indicates that skin tightening and lifting were less effective after 1 month, whereas skin texture improved more over time (Fig. 7).

DISCUSSION

The widespread use of heating therapies in various medical fields highlights the growing reliance on thermal interventions, driven by technological advancements rather than a full understanding of biothermomechanics.[6] This lack of detailed quantification of physical and chemical processes hinders the identification of optimal interventions, leading to trial and error and extensive clinical studies.[6] Despite significant knowledge of cellular and tissue responses to high temperatures, diverse literature and gaps in understanding fundamental processes remain challenging.[6] This review discusses the kinetics of thermal collagen denaturation, stressing the need for researchers to integrate findings from diverse sources.[6] It emphasizes the importance of detailed quantification of lifting amounts and understanding the biomechanical properties of skin and thermal injury effects. The study provides insights into the mechanisms of thermal effects on skin biomechanics and explores the kinetics of thermal collagen denaturation, considering the reversible or irreversible nature of collagen shrinkage.

Thermal skin injuries, such as burns, cause tissue damage that is not fully understood, particularly regarding their impact on the biomechanical properties of skin.[7] This study examined hyperthermic-induced changes in

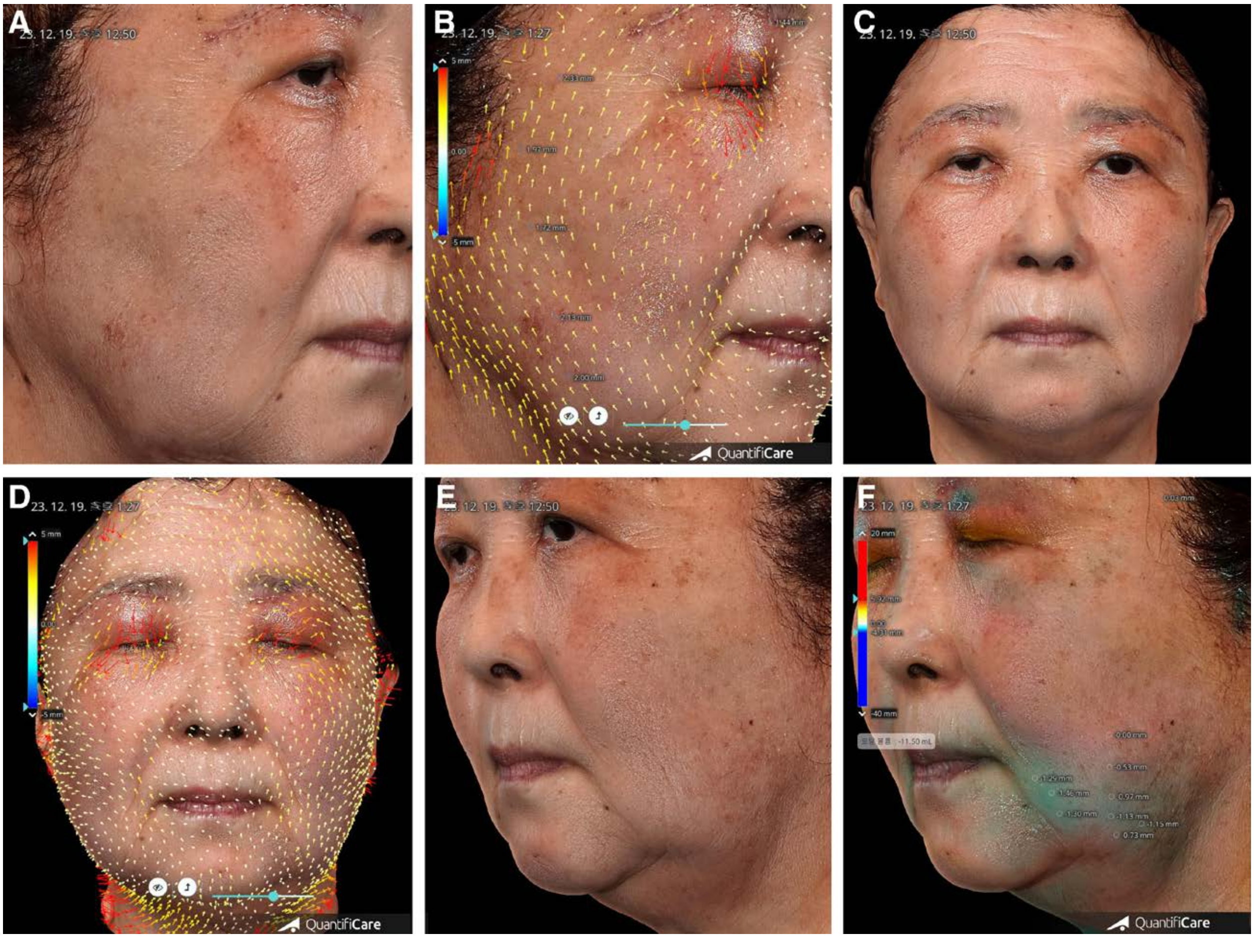

Fig. 4. Analysis of lifting amount using 3D-scanner analysis immediately after treatment for a 74-year-old woman. A, Before the treatment, right oblique view. B, Immediately after the treatment. Each arrow indicated lifting amount. Red arrow indicates lifting more than 5 mm. Notably, the treatment yields remarkable results in five specific areas, including the forehead being lifted by 0.44 mm, lateral orbital rim by 2.33 mm, mid-face by 0.97 mm, low-face by 2.00 mm and neck area by 2.23 mm. C, Before the treatment, frontal view. D, Immediately after the treatment. Notably, the treatment yields remarkable results in five specific areas, including the lateral orbital rim being lifted by 2.30 mm, mid-face by 0.97 mm, low-face by 1.30 mm, and neck area by 2.10~3.11 mm. E, Before the treatment. F, Immediately after the treatment. The anterior part of jowl area was reduced by 1.29 mm, 1.46 mm, 1.30 mm0.35 mm and the posterior part of jowl area was reduced by 0.97 mm 1.13 mm 1.15 mm and 0.73 mm.

skin firmness, pliability, retraction, and elasticity, which varied with temperature fluctuations.[7] These changes were linked to increased blood flow, reversible fluid content changes, and thermal contraction and expansion of collagen and elastic fibers, which can lead to irreversible damage.[7] For effective RF treatment on the face, heating should be stopped before irreversible damage occurs. However, if no premonitory symptoms appear, additional heating may be required to achieve the desired effect.

Wound healing is a fundamental biological process, and thermal injury significantly challenges this process.[8] Using thermal energy for tissue shrinkage can result in high cell death and matrix alterations, leading to prolonged healing times.[8] This study underscores the importance of understanding the biological events associated with thermal energy application and cautions against overemphasis on immediate capsular shrinkage.[8] Thermal modification of connective tissues may act as a low-level stimulant for biologic repair rather than an aggressive primary shrinkage mechanism.[8] Collagen undergoes denaturation from a crystalline structure to a random gel-like state under thermal stress, with mechanical alterations due to relaxed triple helices and residual tension from crosslink.[8] These changes exhibit viscoelastic behaviors in the skin.[8] The reversibility or irreversibility of collagen shrinkage depends on factors like collagen content, temperature, exposure time, and mechanical stress.[8–10]

A study by Hecht et al investigated the short-term tissue response of joint capsules to monopolar RF energy, focusing on RF power settings and heat loss in heat distribution and morphological changes.[9,11] This research enhances understanding of thermal effects on tissues and their clinical implications. The study analyzed joint capsule response to five RF power settings at 65°C in 12 mature Hampshire sheep, using monopolar RF energy under arthroscopic control.[9] Power settings were 0, 10, 15, 20, 25, and 30 watts (N = eight/group).[9] Histologic analysis at 7 days postsurgery showed thermal damage at

Fig. 5. Analysis of lifting amount using 3D-scanner analysis immediately after treatment for a 44-year-old woman. A, Before treatment. B, Immediately after the treatment. C, Immediately after the treatment with arrow markings for lifting amount.

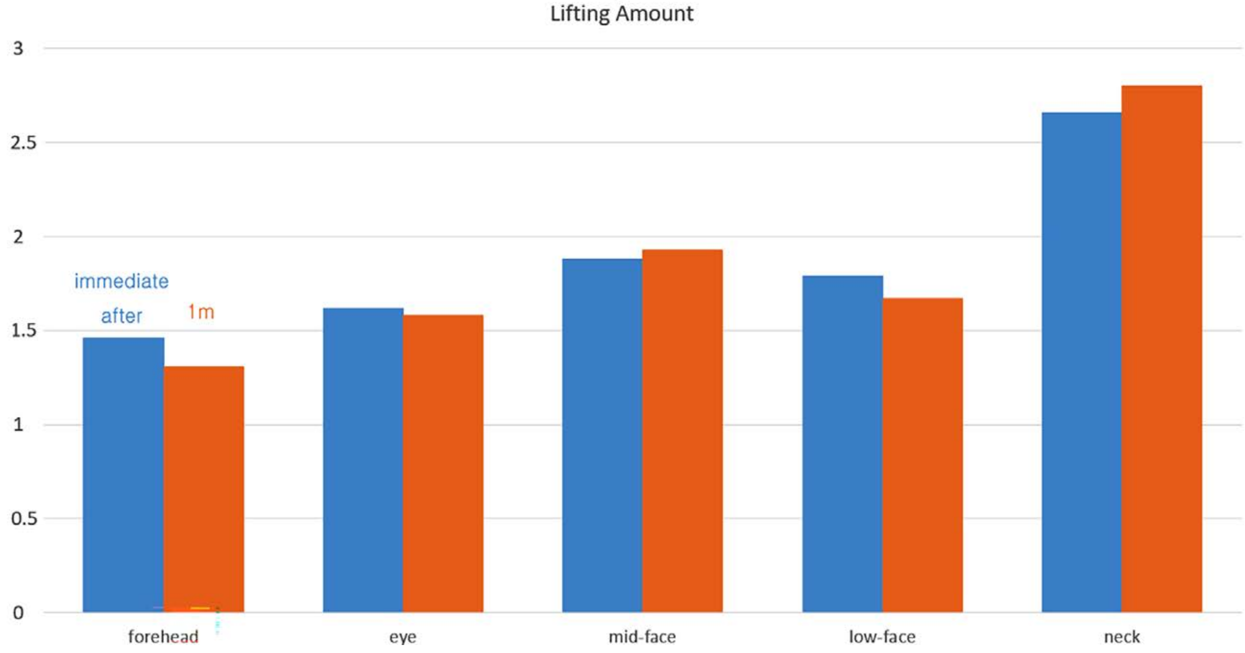

Fig. 6. Comparing of lifting amount before and after 1-month in 3D analysis. In the mid-face and neck areas, the degree of lifting increased or was maintained after 1 month, whereas in the forehead and lower face areas, the degree of lifting decreased after 1 month.

all power settings, with lesion characteristics corresponding to RF power. Tissue damage included inflammatory cell infiltration, collagen fusion, fibroblast pyknosis, myonecrosis, and vascular thrombosis, whereas regenerative processes were indicated by synovial hyperplasia, fibroblast proliferation, and rowing of sarcolemmal nuclei.[9] The study highlighted the role of RF power settings and heat loss through lavage solution in heat distribution and morphological changes in the joint capsule.[9]

Post-RF therapy skin response occurs in two phases: immediate collagen contraction and subsequent remodeling, akin to squid collagen's response to hot water.[12] Immediate contraction enhances skin elasticity, setting the stage for delayed remodeling.[12] The delayed phase involves comprehensive collagen remodeling, including fibroblast activation, cytokine release, and angiogenesis.[13] This process, akin to a performance's second act, rejuvenates skin progressively over time. Lifting was less at 6 months compared with immediately after treatment, but tissue remodeling improved skin texture.[14] Wrinkles improved more at 1 month posttreatment in a previous study.[14] However, tissue remodeling did not increase lifting degree after 3 or 6 months.

Optimizing RF therapy requires a delicate balance between applying adequate energy and avoiding excessive heat.[12] Similar to cooking squid, excessive heat can lead to adverse effects like skin toughness and burns. Therefore,

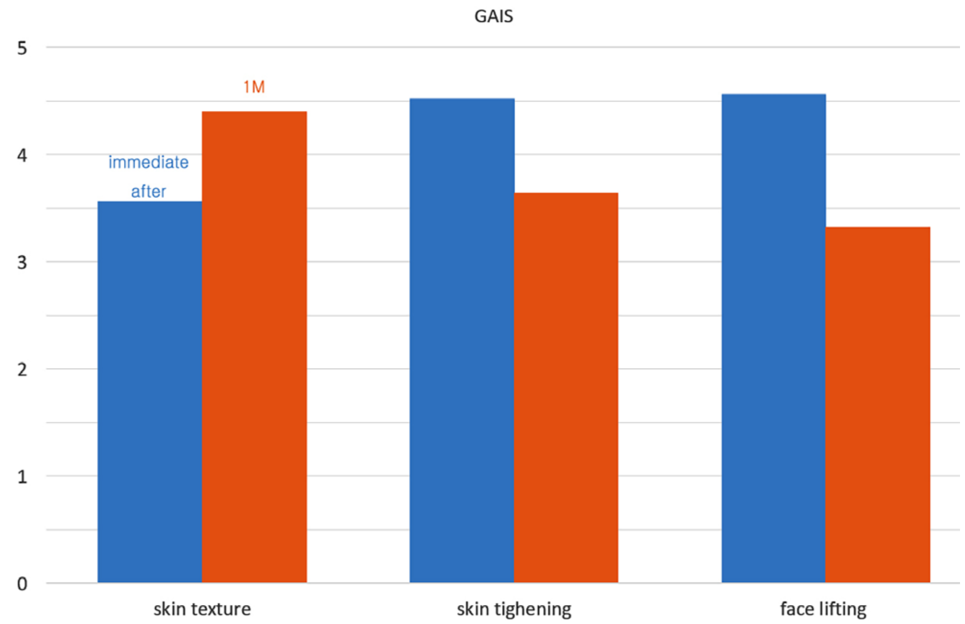

Fig. 7. The changes in GAIS for skin texture, tightening, and lifting. This graph depicts the average GAIS scores for a group of 30 participants. The blue color represents GAIS immediately and red, after 1-month, and skin texture exhibited higher satisfaction after 1-month than immediately after. This suggests a potential correlation with collagen regeneration, indicating the ongoing effects of the treatment over time. However, skin texture and lifting exhibited higher satisfaction immediately after the procedure.

heat should be applied carefully until the skin is appropriately moistened, with patient discomfort guiding the process. Skin temperature, critical for treatment, is measured methodically using a noncontact method, with an 8-degree increase serving as the standard endpoint.[12] RF therapy's profound impact on skin rejuvenation is tied to its dual-phase response involving immediate contraction and delayed remodeling of collagen. Precise management of thermal dynamics and cellular responses highlights RF therapy's commitment to promoting skin health. Balancing energy application ensures optimal outcomes and prevents adverse effects, highlighting RF technology's therapeutic potential in dermatology.

Comparing VNM and Thermage in high-frequency RF therapy reveals distinct advantages of VNM due to its effective use of 115-W 6.78-MHz monopolar RF technology and continuous water-cooling system.[1] VNM's continuous stable water-cooling allows deeper penetration of heat compared with gas-cooling systems, whereas its ergonomic design and tip options ensure optimal contact with the skin.[1,15] Incorporating golden technology further enhances treatment effectiveness, whereas safety features like a sensor halting energy emission ensure patient safety.[15] Clinical applications of RF therapy, especially VNM, show promise in treating wrinkles and fine lines, with significant reduction observed around the eyes of middle-aged women.[1] RF therapy addresses intrinsic and extrinsic aging processes through collagen-inducing and remodeling effects, as supported by histologic and immunostaining evaluations.[16–18] VNM's unique features make it a valuable tool for noninvasive skin rejuvenation procedures, offering transformative potential in addressing various skin concerns.

Collagen Contraction in Dermis, Muscle and Fat

High-frequency RF therapy acts by inducing contraction of the collagen coils in the dermis, enhancing the elasticity of the facial skin. Reflecting on 25 years of experience in high-frequency therapy, the author posits that the dermis, rich in collagen fibers, experiences the most significant improvement in skin elasticity and facial soft tissue elasticity. Below the dermis, there exists subcutaneous fat, followed by the SMAS layer or facial muscle layer, and further below, deep-seated fat. It is essential to note that applying thermal treatment to the facial muscle layer does not contribute to elasticity enhancement. During RF treatment, the SMAS layer, positioned in deeper regions less amenable to thermal influence, poses challenges in applying heat for skin elasticity or facelift treatments. To enhance facial muscle elasticity, concurrent use of EMS low-frequency therapy is recommended.

Strategic Considerations in Targeting Facial Fat Compartments and Customizing RF Treatments and Anatomical Insights for Diverse Facial Profiles

It is theoretically feasible to apply heat to subcutaneous fat or deep-seated fat layers for elasticity or lifting through high-frequency therapy. To maximize heat delivery to the subcutaneous fat layer, frequent strong cooling of the dermal layer during the procedure can be used. Applying RF therapy to the fat layer may induce fibrosis to a certain extent and also results in a reduction of fat. The facial subcutaneous fat layer is subdivided into various fat compartments, some of which need preservation, whereas reducing others can contribute to creating a more beautiful and youthful face. Notably, nasolabial fat compartments, resistant to volume reduction with age, contribute to deepening nasolabial folds. Therefore, applying intense high-frequency therapy to induce fibrosis and decrease volume in nasolabial fat compartments is desirable. Jowl fat, descending and influencing facial aging, can also be addressed effectively through robust high-frequency therapy to reduce fat volume or induce fibrosis. However, caution is advised for lean individuals, as preserving fat beneath the zygomatic bone is crucial to prevent exacerbating submalar hollowing. It is essential to recognize that, when applying high-frequency radiation uniformly to the face, it may worsen submalar hollowing in lean individuals. Therefore, meticulous facial observation and anatomical understanding are crucial to ensuring the preservation of skin elasticity in lean individuals. Volume reduction in the nasolabial fat compartment and jowl fat area showed better changes after 1 month than immediately after (Figs. 3, 4). (**Videos 1–3**.)

CONCLUSIONS

The neck area exhibited the most significant lifting effect, whereas the forehead area showed the least improvement. This discrepancy can be attributed to the author's focus on intensively treating the jawline and neck, areas where patients typically desire the most lifting. Conversely, the curved shape and thin skin of the forehead area posed a higher risk of burns, limiting the author's ability to administer intensive and prolonged treatment, resulting in a less effective lifting outcome. In the dynamic landscape of aesthetic and plastic surgery, there is a notable shift away from traditional facelift surgery towards noninvasive methods prioritizing minimal downtime and discomfort. RF technology has emerged as a leading contender in this transition, offering a safe and effective solution for skin rejuvenation. This study, utilizing the innovative VNM device, provides valuable insights into the 3D evaluation of facial lifting following continuous radiation of 115-W 6.78-MHz monopolar RF therapy. By implementing a meticulous treatment protocol involving a combination of energy levels, a decreasing energy level technique, CO_2 gas cooling, and the application of stem cell media, patient comfort was ensured, and the effectiveness of RF therapy was enhanced while minimizing epidermal damage.

The integration of a 3D scanner and the GAIS facilitated objective and comprehensive assessments, thereby bolstering the scientific validity of our findings. Notably, the lifting effect was objectively measured immediately postprocedure and persisted for 1 month without any adverse effects. Regular VNM-RF lifting procedures are deemed safe and painless, and are recommended for preventing facial sagging in patients.

JongSeo Kim, MD
Kim-Jongseo Plastic Surgery Clinic
842 Nonhyeon-ro, Gangnam-gu
Seoul, Republic of Korea
E-mail: plastic@surgery.co.kr

DISCLOSURE

The author has no financial interest to declare in relation to the content of this article.

PATIENT CONSENT

Patients provided written consent for the use of their images.

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