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INVITED REVIEW

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Fractional radiofrequency microneedling for skin rejuvenation

Jonathan Cook MD[1] | Jessica Waughtel DO[2] | Krystie P. Lennox PA[3] | Jason N. Pozner MD[1]

[1]Sanctuary Plastic Surgery, Boca Raton, Florida

[2]UPMC Pinnacle, Harrisburg, Pennsylvania

[3]Sanctuary Medical Center, Boca Raton, Florida

Correspondence
Jonathan Cook, MD, Sanctuary Plastic Surgery, Boca Raton, FL 33431.
Email: jonathan@spsboca.com

Abstract

Patients continue to seek aesthetic procedures that treat intrinsic aging, progressive photodamage, skin laxity, and facial rhytids. Using the latest generation of radiofrequency microneedling (RFM) technology, it is possible to achieve elegant results when treating these concerns. In this article, we will discuss the mechanism of RFM, review the improvements in the latest generation of this technology, and consider applications of this device in aesthetic practice.

KEYWORDS

acne scar treatment, microneedling, RF microneedling, skin rejuvenation, skin tightening

1 | BACKGROUND

The development of fractional laser resurfacing was a breakthrough in nonsurgical skin rejuvenation and inspired the development of many energy devices that aim to safely and noninvasively treat the appearance of aging skin. All fractional energy devices work by eliciting a predictable histological response to a controlled injury to the skin. Perhaps the best example of this technique is fractional laser resurfacing, in which ablative and/or nonablative energy is used to create precise zones of thermal damage in the uppermost layers of the skin. This has several effects, including inflammation and collagen contraction within the zone of coagulation, and irreversible damage to dermal collagen within the ablative zone of injury. The fractional application of this selectively-targeted energy results in damage to a controlled portion of the skin surface area—typically no more than 20% to 30%. The remaining undamaged skin and dermal appendages facilitate rapid skin healing, thereby reducing the healing time (or "downtime") when compared with full-field energy delivery.

Similarly, radiofrequency microneedling (RFM) delivers fractional energy though an array of microneedles, but it can reach deeper skin levels than laser resurfacing alone would be able to. In contrast to laser energy, which generates heat through selective photothermolysis (eg, by targeting water as a chromophore in the case of CO_2 and erbium lasers), RFM works by delivering radiofrequency (RF) energy directly to the tissue. The resistance of the dermis and subcutaneous tissues to the flow of RF energy results in the generation of heat,[1-3] and this RF-generated heat has been shown to cause thermal-induced contraction of collagen and restructuring of collagen fibers.[1,4-6] When thermal energy is delivered directly to the reticular dermis, it results in skin tightening and a rejuvenated appearance.[1,4,7-10] There are several RFM devices currently in the market, and all work via the same basic principle: controlling injury to the dermis and epidermis, and delivering energy to stimulate collagen production.

2 | DEVICE

The Genius device by Lutronic Aesthetic (Billerica, MA) is the latest generation of fractional radiofrequency microneedling (FRFM) devices and represents a substantial step forward in multipolar RF technology (Figure 1). The device delivers high-intensity focused radiofrequency energy in a fractional pattern through an array of insulated microneedles. The penetration depth of the microneedles can be adjusted using an on-screen interface and varies from 0.5 to 3.4 mm, enabling a variety of focal RF injuries (Figure 2) to provide a multilayer approach to volumetric treatment. The amount of RF energy delivered can be selected by adjusting the power setting up to 50 W, and the exposure time can be varied from 10 milliseconds to 1 second through the user interface. In contrast, without this level of control, previous generations of RFM devices could potentially result in suboptimal outcomes by creating poorly controlled zones of injury.

FIGURE 1 The Genius device (Lutronic Aesthetic, Billerica, MA)

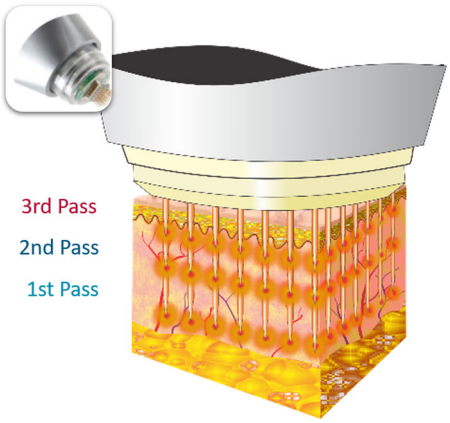

FIGURE 2 Variable treatment depths, to create precise zones of fractional radiofrequency energy delivery

The Genius FRFM device improves upon previous generations of devices in several ways (summarized in Table 1). First, Lutronic has focused considerably on increasing the quality of the needles in the Genius device. They have improved the taper, grind angles, and smoothness of their insulated needles, resulting in improved sharpness and an enhanced ability to penetrate and glide through the tissue. Second, they have developed the handpiece motor to provide high torque delivery of the microneedle array. When combined with the additional sharpness, this enables the FRFM device to quickly and accurately position its active needle tips during treatment. Third, the device measures tissue impedance (the instantaneous resistance of the surrounding tissue to RF energy) 500 times per second and modulates the amount of RF energy delivered to each microneedle tip. This allows the device to provide precise energy delivery across a wide range of tissue impedances. It also enables the device to provide real-time auditory feedback to the provider about the effective placement of the needles within the tissue after each pulse, permitting adjustments to the angle of the handpiece or the pressure applied to the skin, if all needles are not optimally inserted.

There are three different handpieces available at the time of this writing. A 7 × 7 array (49 microneedles) for general use, a 2 × 7 array (14 microneedles) for small areas, and a 9 × 9 array (81 microneedles) for large surfaces like the thighs or abdomen.

In practice, this platform provides an exceptional amount of control for the clinician. By varying the depth of the needles and the energy delivered, the FRFM device can produce a mild skin-tightening effect (with minimal need for anesthesia or recovery time), or, alternatively, the settings can be increased to deliver a greater amount of energy to the reticular dermis. This results in a greater clinical effect, with the trade-off requiring a local facial block

TABLE 1 Technical improvements in the Lutronic Genius device and their clinical significance

Technical improvement	Result	Adverse outcome prevented
Improved needle taper, grind angles, and smoothness Enhanced tissue penetration	Sharper needles	Inconsistent needle depth; potential ripping and tearing of tissue; bleeding, and bruising
High torque handpiece motor	Quick and accurate positioning of needles within the tissue	Erratic, inaccurate needle depth
Real-time tissue impedance monitoring	Modulated, precise RF energy delivery, independent of tissue impedance	Unpredictable RF energy delivery to tissue, which varies by impedance; potential for tissue injury
Real-time auditory feedback	Allows adjustment to handpiece during treatment for optimal needle placement	Ineffective needle positioning, resulting in ineffective treatment or pain

Abbreviation: RF, radiofrequency.

FIGURE 3 The subject is a 70-year-old female shown before, and 2 months after three Genius treatments for acne scarring

(or performing the procedure under general anesthesia). Our experience with FRFM has shown that substantial energy can be safely delivered using the device with topical anesthesia and inhalational anesthesia (Pro-Nox; CAREstream Medical, Surrey, BC, Canada).

3 | APPLICATIONS

The Genius device is our preferred device for treating patients with acne scarring. FRFM technology can be used on all skin types. This is particularly beneficial for our ethnically diverse patient population—many of these patients present concern of hyperpigmentation with the use of other energy devices.[11] Our preferred approach is to perform three or four FRFM treatments, spaced 1 month apart. Patients often report seeing results after the first treatment and typically notice additional improvement after each successive treatment. We find that most patients experience mild edema and erythema after each FRFM treatment, which usually resolves by 1 week after procedure. We have not encountered any long-lasting adverse outcomes of this technology.

We present an example of this treatment course in Figure 3. The subject is a 70-year-old female, Fitzpatrick III, who presented to us for acne scarring. She underwent a total of three sessions of FRFM to the cheeks and chin, 1 month apart. She was observed before, and 2 weeks after her final treatment. All treatments were performed under topical and inhalational anesthesia. Her treatment settings are presented in Table 2. Her treatment result demonstrates improved skin texture, a softened appearance of her acne scars, and a reduction in the visibility of superficial rhytids.

TABLE 2 Genius device settings for the patient shown in Figure 3

Example acne scarring treatment settings			
	Depth, mm	Power, W	Pulse time, ms
First pass	2.0	20	250
Second pass	2.0	16	200
Third pass	1.8	16	150

Note: These settings were used for three treatments, spaced 1 month apart. Each session was performed under topical and inhalational anesthesia.

TABLE 3 "Genius lift" settings for the treatment of the face and neck

The Genius lift			
	Depth, mm	Power, W	Pulse time, ms
Face			
First pass	2.5	20	250
Second pass	2.0	20	200
Third pass	1.5	15	150
Neck			
First pass	1.8	15	180
Second pass	1.5	10	150

Note: These settings are used for three treatments, spaced 1 month apart.

The newest application of the FRFM device in our practice is for skin rejuvenation, using a protocol termed the "Genius Lift." This protocol delivers energy to three separate levels within the dermis, creating precise zones of fractionated injury to affect remodeling. The ideal patient for this procedure is one who has concerns about superficial wrinkles, poor skin texture, and/or mild laxity of the face and neck.

The face is treated with three passes, and the neck is treated with two passes. Each pass utilizes precise settings, which are listed in Table 3. The total energy per area (each cheek or half neck, approximately 80 cm^2) is approximately 300 to 400 J, and subjects typically receive a total of approximately 1 to 1.4 kJ per treatment. We encourage patients to undergo three treatments spaced a month apart, to the lower face and neck.

"The Genius Lift"

These settings reflect the impressive control over energy delivery that is made possible by the device. For a single treatment, we combine various depths, needle energies, and pulse times to create

FIGURE 4 The subject is a 51-year-old female shown before, and 4 months after "Genius Lift" for skin rejuvenation

the desired effect of tissue tightening, improved contour, and reduction in the appearance of superficial rhytids.

We present an example of a patient treated with the "Genius lift" in Figure 4. This subject is a 51-year-old female who presented with dissatisfaction about the aesthetic appearance of her face (Figure 4). She had been treated with full-field Erbium resurfacing 5 years ago, and she had also recieved previous injections of both toxin and hyaluronic acid filler. She underwent a single treatment using the "Genius Lift" protocol (Table 1) and is shown 4 months after this treatment. Her results show an improvement in skin texture, with a subjective smoothing and "plumpness" to the skin, as well as a lightened appearance of superficial lentigines. All patients provided their informed consent for the use of their photographs.

4 | CONCLUSIONS

The Genius device shows promise for a variety of clinical applications and we look forward to future studies that will help quantify outcomes and clarify expectations. In our practice, we have found that FRFM is well-tolerated, causes minimal downtime, and provides impressive results when treating skin laxity and acne scars. We continue to refine our technique and carefully select patients with realistic expectations to optimize results.

CONFLICT OF INTERESTS

Jason N. Pozner is on the Lutronic advisory board and receives equipment. Other authors declare that there are no conflict of interests.

ORCID

Jonathan Cook http://orcid.org/0000-0002-1704-3117

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