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REVIEW ARTICLE

Dermatologic facial applications of Morpheus8 fractional radiofrequency microneedling

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Abstract

Dermatologic patients are expressing increasing interest in minimally invasive procedures to address a wide range of common concerns from skin laxity to acne and scarring. Fractional radiofrequency (RF) microneedling offers an effective method for addressing a variety of dermatologic conditions with reduced downtime compared with historically more invasive procedural approaches. This article aims to describe the technology utilized in fractional RF microneedling (Morpheus8, InMode Aesthetics) and its studied applications in dermatology for treatment of the face.

KEYWORDS
microneedling, radiofrequency, resurfacing, skin aging, skin laxity

1 | INTRODUCTION

Radiofrequency (RF) technology employs low-frequency electromagnetic waves in the range of 100 kHz to 5 MHz, which create an electromagnetic field within the skin when delivered via alternating current.[1,2] This electromagnetic field generates thermal heating of the dermis and promotes neocollagenesis, elastin formation, and angiogenesis in the healing process.[3] Pulsatile RF waves impart differential heating across distinct tissue types according to Ohm's law, where ($energy = current^2 \times impedance \times time$).[4] As different tissue types demonstrate unique impedance to electrical currents based on density and water content, RF energy can be adjusted for the target tissue (e.g., fat vs. dermis).[2] For example, adipose tissue is less conductive than water (higher impedance) and leads to the generation of temperatures higher than those generated by muscle over a set time period. Soft tissue temperatures of 50°C and skin surface temperatures of 40–42°C induce the production of collagen, elastin, and blood vessels.[4] Compared with laser technology relying on chromophore targeting, RF is chromophore-independent and can deliver energy into the dermis with less risk of post-inflammatory hyperpigmentation resulting from epidermal injury, and therefore is safely applicable in all skin types.[3,4]

RF microneedling allows for variable depth delivery of heat, thus broadening the range of anatomical locations and tissue types that can be effectively treated. Fractional RF microneedling (Morpheus8, InMode Aesthetics) provides fractional treatment of the skin, leaving untreated segments of skin dispersed among treated segments to decrease time required for healing. Inducing micro-injury to the cutaneous tissue spurs new formation of collagen, elastin, and blood vessels that result in dermal contraction and thickening, while retaining a fraction of the skin as untreated to expedite healing of treated areas from adjacent tissue.[3,5]

The Morpheus8 handpiece includes interchangeable tips with varied pin configurations including 12- or 24-pin microneedle tips for use on the face. Standard Morpheus8 tips (discussed in this article) have 24 pins insulated at the tips allowing for energy at the deepest point of the skin, capable of up to 4 mm penetration with an additional 1 mm of tissue heating ability.[6] The partially insulated tips allow the use of high energy and bulk heating with minimal inadvertent epidermal heating. Morpheus8 Prime tips are ideal for small, delicate areas, or sharp facial contours. The smaller tip surface area provides precision treatment with 12 semi-insulated pins, similar to the standard tips but with a smaller footprint for use in sensitive regions such as the periorbital area, upper lip, and forehead when needed. Morpheus8 Resurfacing tips are designed for superficial skin resurfacing with 24 blunt, uncoated (non-insulated) pins with a depth of 0.5 mm. The non-insulated needles of the resurfacing tip allow for RF energy to be emitted over the entire surface area. Variable depths (0.5–4 mm) on these handpiece tips enable customizable treatment for delicate, thinner-tissue regions of the face such

as the periorbital area and areas with more subcutaneous adiposity as in the jowls and submental region.[6]

The Morpheus8 system has dual treatment modes for further customization of treatment. Cycle mode involves microneedles penetrating and retracting from the skin with each energy pulse. In fixed mode, microneedles are inserted into the skin with energy delivered at a fixed repetitive pulse rate by footswitch activation, followed by retraction from the skin and cessation of energy delivery upon footswitch release. Fixed mode can be utilized for pulse stacking when targeting adipose tissue remodeling in the lower face, such as the jowls or submental area.[3,6]

Fractora is a similar, earlier technology from InMode for fractional RF microneedling, but involves manual pulses.[7] Compared to manual stamping with Fractora, auto-ejection of microneedles with Morpheus8 provides improved control and precision for selective depth targeting and allows for even distribution of bulk heating. Morpheus8 pins are also capable of subdermal adipose remodeling due to increased pin depth compared with the Fractora microneedle tip.

While alternative modalities targeting undesired adiposity can result in increased skin laxity posttreatment,[8,9] the adjustable treatment depth and energy output of Morpheus8 provide the added benefit of simultaneous skin tightening and subdermal fat reduction for contouring.[10] The fractional RF microneedling technology of Morpheus8 is a versatile treatment modality capable of skin resurfacing, tightening, and subdermal adipose remodeling with a strong safety profile in all skin types, making it widely appealing to both clinicians and patients.

2 | DERMATOLOGIC APPLICATIONS OF RF MICRONEEDLING FOR FACIAL TREATMENT

2.1 | Skin aging and laxity

In the process of aging, skin loses thickness and elasticity as a result of collagen and elastin degeneration and impaired production over time.[11] Skin laxity may be especially apparent on the face due to a confluence of factors including ultraviolet exposure, facial movement and expression, and change in facial fat distribution with aging. As aptly discussed by Dayan et al.,[12] RF technology addresses the treatment gap specific to those candidates who have skin laxity deemed too mild to require a more invasive traditional facelift, those who have had a prior facelift but desire additional skin tightening, and those aiming for alternatives to invasive surgical procedures.

RF microneedling is best studied in the context of skin laxity and adipose remodeling. Several studies have demonstrated effective skin tightening with enduring results and high subject satisfaction. In a study of patients with premature redevelopment of facial skin laxity within 5 years of surgical facelift, combined use of InMode AccuTite RF-assisted lipolysis and Morpheus8 fractional RF microneedling resulted in significant clinical improvement in jowl and neck laxity as assessed by blinded investigators as well as marked improvement by self-assessment in a majority of subjects.[13] A larger study of 247 patients evaluated combination treatment with bipolar RF (InMode FaceTite) and fractional bipolar RF (InMode Fractora) and found statistically significant improvement in Baker Face/Neck classification rating in 100% of subjects.[12] In addition, 93% of subjects reported satisfaction with posttreatment improvement in facial laxity.[12]

In our largely nonsurgical aesthetic-based practice, RF microneedling fulfills the need of those who (1) are not interested in injectables including filler or neuromodulator products and (2) those who have existing filler but remain unsatisfied with their skin laxity, texture, and/or quality. In the age of excessive and improperly placed filler used to achieve facial lifting and tightening, the demand for RF technology has exponentially increased in those for whom additional volume is not recommended.

In our clinical practice, Morpheus8 RF microneedling is popular for both the younger and the older male and female demographic with a high satisfaction rate. The Morpheus8 24-pin microneedling tip is used on the face and jawline to achieve skin tightening and facial remodeling according to the protocol delineated in Table 1 in our Fitzpatrick I-IV patients. Generally, delicate bony areas of the face including the forehead, periorbital, zygomatic, nasal, and perioral regions are treated with at least two passes at decreasing depths (2 mm followed by 1 mm) and lower energy levels in the range of 15 to 25. To achieve both skin tightening and/or subdermal adipose reduction in areas such as the mandibular cheek, jowls, and submental region (Figure 1), several passes (5 to 7) are used at varied depths of 1 to 4 mm and higher energy levels ranging from 20 to 45.

Typically, our goal is to achieve at least 500 pulses when treating the face; however, in patients with severe rhytides and laxity and who are tolerating the procure well, we will treat up to 1000 pulses. Scientifically and clinically, it is ideal to treat several depths (1–3 mm) to most effectively improve skin laxity.

2.2 | Skin resurfacing

In addition to addressing skin laxity by targeting the dermis and subdermis with the traditional 24-pin microneedling Morpheus8 tip, the recently launched 0.5 mm resurfacing tip is ideal in candidates who aim to achieve epidermal resurfacing including improvement in shallow acne scars, fine lines, skin texture, and large pores. In our clinical practice, the 0.5 mm resurfacing tip is an easily added adjunct to the traditional 24-pin tip which has a depth range of 1–4 mm. This is largely used in our acne and acne scarring patients as detailed in their respective sections below.

2.3 | Acne vulgaris

Acne vulgaris is among the most frequently encountered concerns in dermatology patients. While a broad range of treatment modalities from topical to systemic to light-based therapies are available for acne, these may be poorly tolerated due to skin sensitivity, side effects, or difficulty in regimen adherence. RF microneedling offers

TABLE 1 Generalized Morpheus8 settings for Fitzpatrick I-IV skin types for skin laxity

Facial subunit	Depth	RF energy levels	Mode	Stacked
Periorbital	1st pass: 2 mm *	20	Cycle	Yes
	Will repeat if deep			
	2nd pass: 1 mm *	15	Cycle	Yes
	Will repeat above two passes if severe laxity and rhytides present			
Zygoma	1st pass: 2 mm	20	Cycle	No
Infraorbital (including nasolabial fold)	1st pass: 2 mm	20–30	Cycle	Yes
	2nd pass: 1 mm	15–25	Cycle	Yes
Mandibular (soft tissue area between zygoma and mandible)	1st pass: 2 mm	20–30	Cycle	Yes
	2nd pass: 3 mm	30–40	Cycle	Yes
	3rd pass:2 mm	20–30	Cycle	Yes
	4th pass: 3 mm	30–40	Fixed	Yes
	5th pass: 1 mm	15–20	Cycle	No
Jowl (adipose tissue)	6th pass: 4 mm	40–45	Cycle	Yes
	7th pass: 4 mm	40–45	Fixed	Yes
Perioral	1st pass: 2 mm	20–25	Cycle	No
	2nd pass: 1 mm	15–20	Cycle	No
	Will repeat If deeper rhytides and actinic texture change			
Nasal	1st pass: 2 mm	20–25	Cycle	No
	2nd pass:1 mm	15–20	Cycle	No
Forehead	1st pass: 2 mm	20–25	Cycle	Yes
	2nd pass:1 mm	15–20	Cycle	Yes
	Will repeat if deeper rhytides and texture change			
Jawline (soft tissue underneath)	1st pass: 3 mm	30–40	Cycle	Yes
	2nd pass:2 mm	30–35	Cycle	Yes
	3rd pass:1 mm	20–25	Cycle	Yes
Submental (adipose tissue)	4th pass: 3 mm	40–45	Fixed	Yes
	5th pass: 4 mm	40–24	Fixed	Yes
	Will repeat if targeting fullness and adipose tissue			

a noninvasive approach with little to no downtime or risk of adverse effects in acne patients who have exhausted or desire an alternative to traditional acne treatments. RF microneedling is thought to be beneficial in acne vulgaris by decreasing sebum production following micro-insults to sebaceous glands and promoting dermal and follicular epithelial remodeling.[14] In practice, target depths of 0.5–2 mm are utilized to target the sebaceous gland depth of approximately 1 mm.

Fractora, the predecessor to InMode's Morpheus8 fractional RF microneedling technology, has been evaluated in acne patients. In a retrospective analysis of eight subjects undergoing four treatments with Fractora fractional RF at monthly intervals, 100% of subjects experienced improvement in acne severity with decrease in inflammatory lesion burden and reduction in acne scarring with decreased histological scar depth.[15] Four of the aforementioned subjects were reevaluated at 1–2 years posttreatment for long-term efficacy of fractional RF in treatment of acneic lesions and scarring, with some subjects undergoing an additional 1–3 fractional RF sessions following the initial four-treatment regimen. Long-term follow-up analysis demonstrated durable improvement in active acne lesions and in severity of acne scarring.[16]

A study of 18 Korean patients with moderate inflammatory acne found 88% to have clinical improvement following two RF microneedling sessions at 1-month intervals, with no subjects experiencing worsening of acne severity.[14] A similar evaluation of 25 subjects with moderate-to-severe acne vulgaris treated with RF microneedling three times at monthly intervals demonstrated decrease in both inflammatory and non-inflammatory acne lesions and statistically significant reduction in sebum production ($p < 0.05$).[17]

Morpheus8 has become a popular and effective option for our patients who are not able to tolerate topical prescription acne medications, are not responding to topicals and/or prefer to avoid prescription oral medication. Fractional RF microneedling has been shown to provide reduction in both number and severity of

FIGURE 1 Skin laxity before and after. Note improvement in texture with reduction of rhytides and skin tightening with improvement in jowl and jawline contour

inflammatory acne lesions in as few as two treatment sessions (Figure 2).[14] In addition, RF microneedling is a well-tolerated treatment approach for acne in darker IV-VI skintypes with less potential for hyperpigmentation compared to CO_2 fractional ablative laser.[18]

2.4 | Scarring

Post-traumatic, post-procedural, and acne scarring are common aesthetic concerns bringing patients to dermatologic evaluation. Scar formation results from dense, thickened collagen and decreased vascularity at the site of prior skin insult and can manifest as either hypertrophy or atrophy at the healed site with tethering to deep dermal structures causing inconsistent skin texture. RF microneedling disrupts the preexisting abnormal collagen structure and stimulates neocollagenesis and angiogenesis to establish a more regular dermal matrix.[19]

Among all types of scarring, treatment of acne scarring via RF microneedling is best characterized in the literature. Boxcar (U-shaped) and rolling (M-shaped) acne scars have been found to be amenable to RF microneedling, while icepick (V-shaped) acne scars show less improvement following treatment.[19] RF microneedling has also been studied with adjuvant therapies for acne scarring, including subcision[20] and topical polylactic acid;[21] in both cases, combination therapy was found to be superior to RF microneedling alone for treatment of atrophic acne scarring.

In our experience, treating several depths targeting the epidermis, dermis, and subdermis yields optimal results (Figure 3). In these cases, we add the resurfacing tip and treat superficially at 0.5 mm depth in addition to 1–3 mm depths with multiple stacked passes at high energy levels (above 30).

2.5 | Periorbital treatment

Skin laxity, infraorbital fat pad prolapse, and impaired lymphatic drainage contribute to aesthetic concerns of periorbital edema and undereye discoloration. Fractional RF microneedling is thought to stimulate vascular endothelial growth factor, which has been shown to promote lymphangiogenesis and angiogenesis in animal models.[22] Stimulation of lymphatic and blood vessel formation helps to improve drainage and localized edema, especially in the periorbital region. Thermal energy generated by RF has been demonstrated to have no disruptive effect on preexisting lymphatics and vascular perfusion[23] and is safe for use in the periorbital region for skin tightening, targeting of infraorbital fat, and promoting lymphatic drainage.

FIGURE 2 Acne vulgaris and acne scarring before and after. Note reduction of inflammatory papules and improvement in skin texture and enlarged pores. There is also notable improvement in rolling, boxcar, and icepick acne scarring

A randomized split-face study conducted in a population of 15 Chinese subjects compared fractional RF microneedling technology to non-ablative fractional erbium-doped glass 1565 nm laser treatment of the infraorbital region at monthly intervals for a total of three treatments.[24] Clinical response was evaluated by two blinded investigators and by facial imaging analysis, with similar improvement in volume elevation, elevation area, and maximum depth as well as depth and length of orbital fat following both fractional RF microneedling and non-ablative fractional laser. Subject satisfaction rate was greater than 47%.[24] While both treatments yielded similar improvement in undereye bags, fractional RF microneedling may be more widely suitable for patients of all skin types given risk of post-inflammatory hyperpigmentation following laser therapy in darker-skinned patients.

Morpheus8 has become a popular periorbital treatment with high satisfaction in our practice due to ease of treatment for both the patient and the clinician. In our experience, treating several depths targeting the dermis and subdermis with multiple passes yields optimal results (Figure 4). While topical anesthesia is utilized on most of our patients undergoing periorbital RF microneedling, we have found that injecting 1–2 cc of lidocaine with epinephrine superficially around the eye further eases discomfort. In these cases, we use the 12-pin microneedling Prime tip and treat on the orbital bone while stretching the upper and lower eyelids. Typically, our protocol includes two passes at 2 mm depth with 20–25 energy and two passes at 1 mm depth with 15–20 energy. Our goal is to achieve at least 100 pulses on each eye. Although downtime with RF microneedling is

FIGURE 3 Scarring before and after. Note softening and smoothing of the scar texture on the upper lip, central forehead, and lateral canthus

FIGURE 4 Periorbital treatment before and after. Note improvement in fine periorbital rhytides, reduced infraorbital skin laxity with smoothing and improvement of edema in the tear trough region

lower compared with other energy-based devices, pinpoint bruising and swelling is more common in this area after treatment.

2.6 | Rosacea

Rosacea is characterized by chronic cutaneous inflammation of the central face with several clinical presentations including erythematotelangiectatic, phymatous, and papulopustular. Treatment of rosacea varies according to the clinical phenotype and encompasses a wide range of interventions including lifestyle modification for trigger avoidance, topical or systemic antibiotics, immunomodulators, and laser and light-based therapies.[25] Fractional RF microneedling technology has been reported as an effective treatment for rosacea in a prospective, randomized split-face trial, specifically for the papulopustular subtype.[26]

Immunohistochemical analysis following fractional RF microneedling in rosacea subjects demonstrated reduced expression of mediators of inflammation, innate immunity, and angiogenesis in treated compared with non-treated skin, suggesting that decrease in cutaneous inflammation and blood vessel formation underlie clinical improvement in erythema.[26,27]

Given that most of our patients exhibit overlap of multiple rosacea variants (Figure 5), we treat those with the papulopustular subtype with Morpheus8 in addition to traditional intense pulsed light (IPL) (Lumecca, InMode) that targets and ablates dermal blood vessels. Notably, in our experience, patients treated with IPL monotherapy demonstrate less improvement compared to those treated with combination therapy, as there appears to be a synergistic effect of fractional RF microneedling and IPL in treatment of rosacea.

2.7 | Applicability of fractional RF microneedling in patients with melasma

Melasma is a disorder of facial hyperpigmentation seen most frequently in female patients with skin of color. Therapies targeting hyperpigmentation in melasma must be used judiciously due to risk of hyperpigmentation and worsening of melasma in patients of darker skin tones. RF microneedling is thought to improve melasma by way of reduced inflammation, angiogenesis, and mast cell activity resulting from dermal remodeling and formation of microperforations to allow melanin clearance from the skin.[27,28]

While limited studies have been published on RF microneedling for treatment of melasma,[28,29] as Tan et al.[27] described in their recent comprehensive review of RF microneedling, it is important to note that in our clinical practice, we are confident that melasma does not worsen in our RF-treated patients, as this is often a concern given the thermal energy generated by RF. Melasma patients have demonstrated improvement in hyperpigmentation after Morpheus8 as part of a multimodal therapeutic strategy with concurrent use of treatments ranging from topical to oral medication in addition to sun protection. Additional high-quality studies are needed to confidently recommend fractional RF microneedling as a therapeutic option for melasma.

2.8 | Applicability of fractional RF microneedling in Fitzpatrick IV–VI skintypes

Historically, thermal energy and light-based treatment modalities have been limited to use in lighter skin types due to increased risk of post-inflammatory hyper- or hypopigmentation and scarring. Fractional RF therapies mitigate this risk by reducing the fraction of skin surface area treated and sparing areas to provide a starting point for expedited healing posttreatment. Battle et al. evaluated 35 subjects with Fitzpatrick type VI skin undergoing a series of three fractional RF treatments with the InMode Fractora device at 4-week intervals.[30] Subjects demonstrated improvement in

FIGURE 5 Rosacea before and after. Note improvement in erythema, telangietasias and papules over the nasal dorsum, nasal tip and malar cheeks

several components of facial skin texture including rhytides, pores, acne scarring, and active acne lesions, with continued improvement through 12-week follow-up. No subjects experienced adverse effects of posttreatment pigment alteration or scarring.[30]

The ability to treat darker skin types with Morpehus8 has been a great asset in our clinical practice with high satisfaction rates for treatment of skin laxity, skin tone, acne, acne scarring, pseudofolliculitis barbae, and striae. While the risk of post-inflammatory hyperpigmentation is low, it is important to note that energy settings at superficial depths such as 1 mm should be set 20%–30% lower and the 0.5 mm resurfacing tip should be used with caution or avoided in V–VI skin types.

While energy-based treatments for darker skin types have previously been scarce due to concern for these adverse outcomes, fractional RF microneedling has been shown to be safe and effective in Fitzpatrick type VI patients and is a promising therapeutic option when used appropriately in patients of darker skin.

2.9 | Peri-procedural anesthesia for fractional RF microneedling

Patient comfort is critical to good outcomes, necessitating a reliable anesthesia protocol for fractional RF microneedling treatment at high energy settings. In our practice, 23% lidocaine with 7% tetracaine in a plasticized gel base is applied in office for 1–2 h prior to the procedure. We have had success with section-by-section removal of topical numbing gel immediately prior to treatment of a specific area to maximize anesthetic efficacy compared to removal of numbing gel from the entire face before treatment commences. Of note, thorough removal of topical anesthetic with alcohol on a gauze pad is critical to avoid product inadvertently being pushed into the dermis with microneedles, potentially causing a hypersensitivity reaction. In addition, we offer inhaled nitrous oxide to ameliorate procedure-associated discomfort and anxiety. This protocol has been highly effective with excellent patient satisfaction, and very rarely do we need to utilize nerve blocks or any form of sedation.

3 | CONCLUSIONS

Fractional RF microneedling offers a versatile treatment modality for a wide range of dermatologic concerns and is safe for use in patients of all skin types. The adjustable depth and microneedle pin configurations available with the InMode Morpheus8 allow clinicians to address varied tissue targets and regions of concern on the face. The ease of use for practitioners, minimal posttreatment recovery time and enduring results make fractional RF microneedling an increasingly attractive option for patients desiring minimally invasive options. This technology boasts a growing range of applications with study-proven efficacy and an excellent safety profile that is likely to encourage continued and broadened use in the field of aesthetic dermatology.

CONFLICT OF INTEREST

SZF serves as a consultant for InMode Aesthetics, CellFX, GlacialRX and Procter & Gamble. AJH has no conflicts of interest to declare.

ETHICS STATEMENTS

The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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