

Sublative Rejuvenation: Experience With a New Fractional Radiofrequency System for Skin Rejuvenation and Repair

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ABSTRACT

Several laser-based ablative resurfacing and nonablative rejuvenation technologies offer non-surgical options for improving the appearance of the skin. Although efficacy and good safety profiles have been demonstrated, limitations do exist with these systems.

A more recent technology has been developed that employs fractionated bipolar radiofrequency (RF) energy. Referred to as “sublative rejuvenation,” the treatment improves skin appearance while addressing some of the limitations of both ablative resurfacing and nonablative skin rejuvenation.

This article describes the technology and reports on the authors’ experience with it in clinical practice. Unlike fractional ablative laser treatments, which can disrupt 10–70% of the epidermis and most of the effect is in the epidermis, the sublative rejuvenation technique impacts only up to 5% of the epidermis and most of the effect is in the dermis. As a result, healing is rapid and downtime is minimal. The treatment is appropriate for all skin types and is an effective alternative for patients with darker skin who may be at risk for hyperpigmentation from laser treatments.

INTRODUCTION

For patients seeking non-surgical options for improving the appearance of their skin, several laser-based ablative resurfacing and nonablative rejuvenation technologies are available.¹ The principle behind these treatments is similar: creating controlled thermal damage in the dermis stimulates a wound healing response that leads to collagen remodeling.

Although these systems have proven efficacy with good safety profiles, limitations exist. Nonablative systems protect the epidermis with cooling while enabling some thermal injury or direct stimulation in the dermis to initiate neocollagenesis. Although mild-to-moderate improvement in tone and texture, as well as fine lines, has been demonstrated, multiple treatments are needed to reach this goal. Ablative systems yield greater efficacy, but require prolonged downtime and have greater potential for complications.² For instance, the epidermal injury poses a risk of post-inflammatory hyperpigmentation (PIH) for patients with darker skin. Fractionated ablative systems help address some of these issues because they generate thermal injury in a noncontiguous pattern, leaving a portion of the surrounding epidermal tissue intact to promote fastidious healing.^{3–5} However, these systems typically ablate 10–70% of the epidermal surface, proportional to factors such as the energy delivered, density overlap, spot size and coverage ratio, and downtime can still be significant. The energy impact is widest

at the epidermal surface and narrower deeper in the dermis, and the epidermal injury in fractionated systems can still result in PIH for patients with darker skin.

More recent technology, fractionated bipolar radiofrequency (RF) energy, addresses some of the limitations of both ablative resurfacing and nonablative skin rejuvenation. Referred to as “Sublative Rejuvenation™” the treatment is delivered via a handheld applicator with the eMatrix™ system (Syneron Medical Inc., Irvine, CA). This treatment is used for patients with mild-to-moderate tone or texture irregularities such as wrinkles, rhytids, acne scars and other tone or texture irregularities.

Sublative rejuvenation causes limited epidermal disruption—less than 5% of the surface is treated with one pass—which translates to minimal downtime for patients and makes it an optimal choice for darker skin. The bulk of the effect is coagulative and occurs mainly in the mid-dermis, where it has the most effect on wrinkles and scars.

Mechanism of Action

RF-based technologies are capable of producing higher volumetric heating via tissue impedance with subsequent heat diffusion to deeper tissue compared to laser-based technologies. The radiofrequency modality in the bipolar electrode scheme applies the configured energy in a “pyramid” shape, which

creates a predetermined controlled wound with a small epidermal component and larger volume in deeper tissue. Ablative technology commonly forms a conical or columnar injury zone. The term “sublative” is a derivative of “sub-ablative,” referring to the ability to generate heat energy well beneath the ablated

FIGURE 1. The radiofrequency energy produces a pyramid-shaped thermal injury zone, which results in minimal epidermal disruption. The white area represents superficial epidermal heating, and the red zone represents the deeper coagulation. A substantial amount of the heat-derived coagulative damage occurs deeper in the dermis.

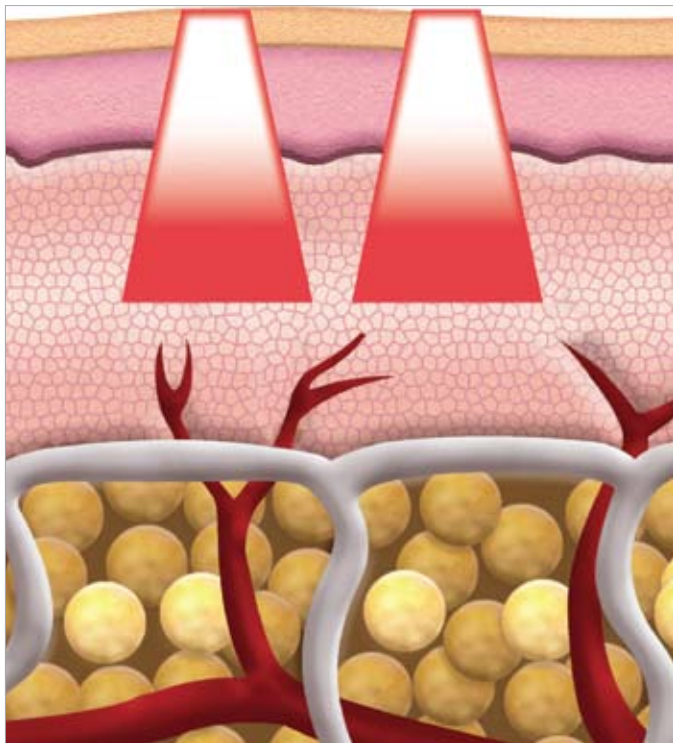
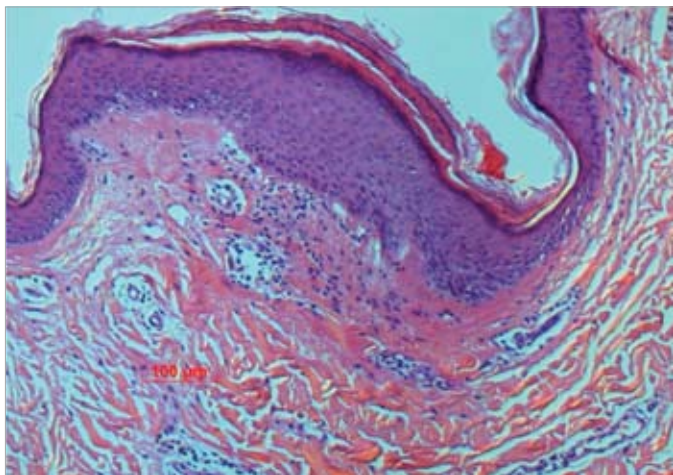


FIGURE 2. Significant leucocytes inflammation and immediate contraction occurs in the dermis as part of dermal remodeling.



zone below the epidermal surface and where the effect is largely caused by a large volume of heated tissue.

The tip of the sublative rejuvenation applicator contains an array of 64 electrode pins, each 200 microns wide, which directly contact the dry stratum corneum of the epidermis. The radiofrequency energy flows between the positively and negatively charged electrode pins to form a closed circuit of bipolar RF current within the tissue that passes through the epidermis deeper into the dermis, delivering 1 MHz of conducted RF current to the tissue. The electric field produces a pyramid-shaped thermal injury zone, with the tip of the pyramid at the epidermal surface branching out to a wider area deeper into the dermis (Figure 1). The RF energy penetrates the dermis with a visible coagulative effect up to 450 μ depth, with only a 200 μ epidermal width of effect.

The variable energy of radiofrequency current can create different spatial and depth impacts with a larger relative area and volume of dermal tissue affected than epidermal tissue. The greatest temperature rise occurs where the electrodes contact the dry skin, causing a visible ablative injury that manifests as a pattern of small pixilated dots on the surface of the skin. These surface wounds and their effect on the dermis promote neocollagenesis, providing rhytid reduction and minimizing dermal atrophic scarring as well as smoothing the skin surface, although much of the effect of the treatment is due to the nonablative heating of the dermis.

In general, applying thermal energy to the skin activates a cascade of physiological healing responses to promote reepithelialization and remodeling of the extra cellular matrix (ECM). With the sublative rejuvenation modality, the major impact occurs with the ECM, while epidermal response is minimized.

The initiating event—in both sublative rejuvenation and ablative skin resurfacing—is local inflammation.⁶ However, in ablative skin resurfacing, a massive destruction of the epidermis results in a healing process that largely involves keratinocyte proliferation and migration and relatively less dermal matrix remodeling. In sublative rejuvenation, a more widely diffused and volumetric impact is formed inside the dermis with minimal involvement of the epidermis in the healing. This is reflected by a healing process that is focused primarily on fibroblast stimulation and ECM dermal remodeling (Figure 2).

Three programs built into the eMatrix system enable the user to adjust the depth and intensity of the dermal heating to achieve desired effects and meet specific patient downtime requirements. Each program has a different RF setting and therefore different heating profile reflected in changes in depth and nature of impact, ranging from ablation to provide a shallow impact, a mid-level impact and the deepest and highest-volume

impact. The epidermal ablation takes place within the first 10 ms of the pulse, and up to another 100 ms of controlled RF current travels between the electrode array to further heat the dermal tissue for optimal remodeling of both collagen and elastin. The three energy settings are: program A (2–8 J), program B (8–16 J), or program C (16–25 J).

The treatment impacts a relatively large volume of dermal tissue while leaving the epidermis minimally affected. Unlike fractional ablative laser treatments, which can disrupt 10–70% of the epidermis, the sublative rejuvenation technique always impacts only up to 5% of the epidermis. As a result, healing is rapid with minimal downtime.

RESULTS

Hruza et al. evaluated the sublative rejuvenation treatment in a study involving 35 subjects, ages 52 ± 8 years with Fitzpatrick skin types II–IV.⁷ Each subject received three treatments on facial areas at one-month intervals. The average treatment energy was 8–20 joules (J) at a 5% density. Histologic examination revealed that the surface lesions where the electrodes contacted dry skin had completely healed within less than 48 hours. No post-inflammatory hyperpigmentation was reported.

The investigators' assessment at one month following the last treatment was that 90% of subjects showed improvement in

FIGURE 3. a) Before treatment; **b)** After treatment. Photos courtesy of George Hruza MD.



smoothness/wrinkling, 87% in skin tightness, and 83% in skin brightness (Figures 3a and 3b). Improvement of 40% or greater in all of these categories was seen in over half of the subjects. The authors also observed the overall appearance of tighter and smoother skin. The greatest improvement was observed in the periorbital areas and the least change was seen in the perioral areas.

The subjects' evaluation correlated closely with the investigator assessment. In total, 80% of the subjects were satisfied with the treatment: 40% were somewhat satisfied, 17% were satisfied, and 23% were very or extremely satisfied.

Practice Considerations

Pain Level

In the Hruza study most (87%) of the subjects reported only minimal pain and discomfort during the treatment. This is consistent with the experience in using this treatment in practice, based on patient feedback. The authors usually apply a topical anesthetic prior to the procedure, but in some cases have performed the treatment without an anesthetic.

Downtime

A key advantage of the treatment is the minimal downtime. Patients will usually exhibit some erythema and edema for a few to several hours immediately following the procedure. The superficial ablation points, mirroring the electrode pattern, heal within the first one to three days. Patients may experience some roughness as the tiny scabs develop, but they can usually wear makeup within a day of the procedure. No special post-procedure care is required. As with all patients, the use of sunscreen is recommended.

Safety

The authors' patients have not experienced any complications that may occur with more ablative resurfacing, such as hyperpigmentation, acne flares, infection, prolonged erythema or scarring.

Treatment Course

The manufacturer suggests a course of three treatments, four to six weeks apart, but the authors adjust the number of treatments based on the severity of the skin condition and the patient's objectives. The authors find that an effective treatment protocol for moderate to severe wrinkles or acne scars involves five to six monthly treatments. The treatments can typically be completed in 15–20 minutes. With the minimal downtime and short procedure duration, the course of treatment is relatively convenient for patients to comply with.

Results/Patient Satisfaction

The treatment is not appropriate for superficial pigment changes, since very little surface ablation occurs. The authors can see

noticeable improvement in deep and/or dynamic wrinkles and scars, and many patients are commenting on the overall smoothing effect the treatment produces. The vast majority of patients are extremely, very or somewhat satisfied with the results.

Darker Skin

The ability to treat all skin types, including darker skin, is a significant advantage. Optical energy from laser or other light-based technologies tends to be absorbed by the melanocytes in darker skin types, causing hyper- and/or hypopigmentation. Also, the wider impact of optical energies at the skin's surface presents a risk for darker-skinned people. However, the minimal impact at the skin's surface as well as the fact that RF energy does not target a chromophore makes the treatment appropriate for all Fitzpatrick skin types. RF wounding creates a different biologic response with no prolonged erythema, which is associated with hyperpigmentation in darker skin.

The Authors' Experiences/Techniques

Lori Brightman, MD

For acne scarring that is more superficial, rolling scars, Dr. Brightman uses program C, 18–25 J. On average, these patients will require three to five treatments once monthly, depending on severity of scarring. One unique feature Dr. Brightman has noted is the treatment concomitantly diminishes telangiectasia. Many acne scarring patients have scattered fine telangiectasia from long-term topical retinoid use, prior corrective procedures for their scarring or natural wound healing response to the scars themselves. Sublative rejuvenation has been effective for my patients in treating both issues. This treatment regimen has been used on Fitzpatrick skin types I–IV without any noted cases of post-inflammatory hyperpigmentation.

For facial rejuvenation, including tone, texture and rhytids, Dr. Brightman chooses a regimen based on the degree of improvement needed and the patient's personal goals. For example, she will treat a patient with mild photodamage using program A or B, with perhaps two to three treatments needed. For a patient with more moderate sequelae from UV exposure, she will use program C, and likely perform two to four treatments once monthly.

Dr. Brightman has also used fractional RF to help improve the appearance of striae. She has treated abdominal striae on program C, 25 J, treatments one month apart. The number of treatments is dependent on the width and degree of atrophy of striae. Results show decreased atrophic appearance and improvement in the cigarette paper-like appearance of the striae. Again, she also notes improvement in the telangiectasia within the striae rubra.

On average, a patient treated with program A or B can be makeup-ready in one to two days. The rough texture of the healing pinpoint spots can still be appreciated, but it is coverable with

makeup nonetheless. A patient treated on program C is usually makeup-ready by day two to three. Again, the healing pinpoint scabs may be appreciated, but a more opaque foundation can cover the areas. Regardless of treatment regimen, for all of her patients, Dr. Brightman suggests washing twice daily with a nonabrasive noncomedogenic cleanser such as Cetaphil Daily Cleanser and using TNS Ceramide or Control Tactics for the recovery period along with sunscreen use.

Mitchel Goldman, MD

Dr. Goldman has found the majority of acne scar patients have improved with the combination Matrix IR/sublative RF treatment. Patients have four to five treatments, spaced one month apart. The treatment begins with the IR head used at maximum settings of 70 J/cm² and 100 J/cm² RF energy. Two passes to each depressed acne scar is completed—this results in mild erythema and slight edema of the treated areas, which resolves over the next 30–90 minutes. Patients find the IR head more uncomfortable, so Dr. Goldman has used a 20/6/4% BLT topical numbing cream prior to treatment.

Next, the nonablative RF resurfacing is used to field treat the entire acne scarred area. In most cases (skin types I–III, sometimes IV), Dr. Goldman will start at maximum settings of program C and 25 J/cm². If patients are skin type IV/V, he starts at 21 J, and then treats at 25 J for the second treatment on. He has not noted a disappearance in erythema/telangiectasia, even after specifically treating these lesions. However, three patients of Mexican descent have commented after the first treatment that their hyperpigmentation has greatly improved. Almost unanimously, by treatment three, most patients report the texture of their skin is smoother and softer to touch. Physicians/PAs also report this finding on physical examination. For higher skin types (IV), the RF woundscabs seem to last longer—appearing the next day and lasting three to five days, as opposed to showing up at day 2 after treatment and disappearing in one to two days. These are camouflaged by makeup in most cases, and no patients, including males, have been concerned enough by the pattern left by the RF head to discontinue treatment.

The IR/RF system seems to be most effective for shallow, rolled acne scars. Some traumatic/surgical scars around the face have also improved in texture/appearance. Usually, this is a well-tolerated procedure. The IR portion is always the more uncomfortable of the two. The RF portion requires frequent cleaning of the tip as well prepping the face prior to treatment.

Amy Taub, MD

Dr. Taub uses sublative rejuvenation for mild to moderate photodamage focused on rhytides and firming, but also uses it in combination with IPL with bipolar radiofrequency. She does not find programs A or B to be as effective as program C so she uses program C. If the patient is skin type I–III and is not tanned, Dr. Taub

will typically start immediately with 25 J and 5% for three treatments. For skin types IV–V, she starts at 17–19 J and increases by 2 J per treatment. For acne scarring, she uses the same parameters, but the patients typically require five treatments (Figures 4a and 4b). Dr. Taub has also been using this in combination with a fractional diode laser with bipolar RF and getting good results even with ice pick scars. Dr. Taub believes that, for skin types I–III, a higher energy than 25 J will be necessary to achieve significant improvement in moderate-to-severe acne scarring.

One of the unique features of this modality is the fact that it is not necessary to do the entire face to get a blended look. Just an aesthetic subunit can be done without fearing any demarcation line. Dr. Taub believes that the entire subunit should be treated because some of the benefit seen is from tissue tightening. This is useful for periorbital areas, cheek acne scars, forehead lines of expression, etc. Dr. Taub would like to see a smaller tip to be able to do upper and lower eyelids; she thinks this would be an excellent modality for the fine wrinkling that is often seen there and is so hard to treat. Postoperatively, she prefers a bland zinc oxide-based sunscreen for all skin types. She usually recommends growth factors, either TNS Recovery Complex or Neocutis Biorestorative Gel BID during, after and between all the treatments to enhance collagen production. Dr. Taub has not treated any skin type VI but sees no reason not to do so with the same parameters used for skin type IV–V.

CONCLUSION

Sublative rejuvenation strikes a balance between downtime and noticeable improvement that many patients are seeking. It results in low epidermal disruption with high dermal remodeling. The bulk impact of coagulation and residual heating occurring deep within the dermis generates significant collagen contracture and remodeling, leading to the appearance of

FIGURE 4. a) Before treatment; **b)** After treatment. Photos courtesy of Amy Forman Taub MD.



smoother, more luminous skin. Moreover, the treatment is appropriate for all skin types, and offers an effective alternative for patients with darker skin who may be at risk for hyperpigmentation from laser treatments.

Future developments with this technology may bring even greater results for a broad base of patients. For example, the ability to measure skin impedance and adjust energy levels accordingly may allow higher energy levels to be used on patients who are deemed appropriate.

DISCLOSURES

Dr. Brightman has received honoraria and travel expenses for lectures and meeting attendance for Syneron Medical Ltd.

Dr. Goldman has received funding and the loan of the Matrix RF system from Syneron to conduct clinical studies.

Dr. Taub has received honoraria as well as travel expenses and equipment in return for being an investigator and speaker for Syneron Medical Ltd.

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