Treatment of Acne Scars on Darker Skin Types Using a Noninsulated Smooth Motion, Electronically Controlled Radiofrequency Microneedles Treatment System

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BACKGROUND Noninvasive technologies for treating acne scars use radiofrequency (RF)-emitting microneedles for both mechanical disruption of fibrotic strands and heat-mediated collagen remodeling.

OBJECTIVE Efficacy and safety evaluation of electronically controlled noninsulated RF microneedling system on acne scars in patients with dark skin.

METHODS Nineteen patients, 24 to 51 years old, skin types III to V, with acne scars were enrolled in the study. Each patient had 3 treatment sessions at monthly intervals using a multisource RF treatment platform with a microneedle RF applicator. Efficacy was evaluated by the Goodman and Barron's Global Qualitative Acne Scarring System.

RESULTS No bleeding points occurred during treatments. Post-treatment erythema was observed immediately after the treatment and lasted up to 10 hours after the treatment. Improvement of at least 1 acne scar grade was noted in 11 of 19 patients (57.9%) after 1 month and in 9 of 9 patients (100%) after 3 months.

CONCLUSION The tested noninsulated electronically controlled RF microneedles were found to be safe and efficient in the treatment of atrophic acne scars in skin types III to V with minimal pain or downtime.

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Acne is a common disease affecting a significant proportion of the population, mostly teenagers and young adults aged 11 to 30 years.[1–3] The severity of the acne scars depends on the severity and type of active acne in the individual patient and the personal skin healing ability. Scars originate at the site of tissue injury inducing loss or excess of collagen, and skin retracting resulting in atrophic of hypertrophic scarring.[4,5] Acne scars have multiple morphologies, and often require different technical approaches to achieve optimal cosmetic outcomes, especially in subjects with dark skin. Atrophic acne scars are subclassified into ice pick (60%–70% of total scars), boxcar (20%–30%), and rolling scars (15%–20%). The 3 different types of atrophic scars can be observed in the same patient.[1] Goodman and Baron[6] proposed a qualitative scarring grading system. According to this classification, 4 different grades can be used to identify an acne scar (Table 1).

There are several common modalities of treatment for postinflammatory atrophic acne scars such as chemical peels, dermabrasion, microdermabrasion, laser treatments, dermal grafting, punch techniques, needling, and combinations of the above. However, some of these techniques might be riskier in darker skin types due to postinflammatory hyper- and hypopigmentation and scarring.

Mechanical skin needling is a technique for acne scars treatments, where a roller or matrix of sharp needles is used to puncture the affected area. The

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TABLE 1. Qualitative Scarring Grading System

Grades of Postacne Scarring	*Level of Disease*	*Clinical Features*
1	Macular	These scars can be erythematous, hyper- or hypopigmented flat marks. They do not represent a problem of contour like other scar grades but of color
2	Mild	Mild atrophy or hypertrophy scars that may not be obvious at social distances of 50 cm or greater and may be covered adequately by makeup or the normal shadow of shaved beard hair in men or normal body hair if extra facial
3	Moderate	Moderate atrophic or hypertrophic scarring that is obvious at social distances of 50 cm or greater and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extra facial, but is still able to be flattened by manual stretching of the skin (if atrophic)
4	Severe	Severe atrophic or hypertrophic scarring that is evident at social distances greater than 50 cm and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extra facial and is not able to be flattened by manual stretching of the skin

Adapted from Goodman and Baron.[6] Permission to reprint courtesy of *Dermatologic Surgery*.

dermis penetration depth usually varies from 0.5 to 2.0 mm for facial treatments,[7] and on penetration, pinpoint bleeding may appear. Micro bruises because of microneedle puncturing initiate a cascade effect that results in collagen production. This method is considered to be safe for all skin types.[8,9]

Another technique for treating acne scars involves using radiofrequency (RF)-emitting microneedles. This method uses RF energy emitted through needles, creating 2 main effects on the skin: (1) mechanical disruption of the dermal fibrotic strands responsible for downward skin retraction of atrophic scars and (2) delivery of RF energy into the dermis triggering collagen remodeling to replace fibrotic scars tissue with new healthier pliable collagen fibers.

The first generation of RF microneedle systems used insulation covering most of the needle length leaving a small part of the tip noninsulated. With insulated needles, multiple passes with different depth are required to cover several layers of the tissue. Moreover, when using long needles depth (>2.0 mm), there is no coagulation at the upper layers of the skin, thus many bleeding points may appear on the surface of the skin, causing microbruises similar to non-RF microneedle treatments. In contrary, the newer noninsulated microneedle-based systems use proprietary electronics taking advantage of the natural skin impedance difference between the epidermis and the dermis. In addition to full protection of the epidermis, these electronically controlled noninsulated needles allow a 7 to 10 times larger tissue volume to be treated in each pass. Allowing the RF to flow through all dermal layers at once, electronically protecting the epidermis, results in faster treatment of upper and lower dermis without any damage to the epidermis. Another significant advantage of the electronically controlled noninsulated needles is their ability to coagulate throughout the whole needle, eliminating microbleeding during the treatment that is associated with noninsulated needles.[10]

The microneedle applicator used in this study uses a sterile treatment tip with a matrix of 5 by 5 noninsulated gold-plated microneedle electrodes (max diameter of 300 μm at their base gradually tapered to an extra sharp edge). The applicator uses a step motor, which smoothly inserts the microneedles into the skin up to a depth of 3.5 mm (increments of 0.1 mm). Two additional treatment parameters that can be controlled by the physician are power

TABLE 2. Patients' Data

				Qualitative Scarring Grading	
No.	*Gender*	*Age*	*Skin Type*	*Baseline*	*Follow-up*
1	Male	33	V	4	3
2	Male	48	V	2	1
3	Male	51	III	3	2
4	Male	33	V	3	2
5	Female	31	V	4	3
6	Female	33	V	3	2
7	Male	34	V	4	3
8	Female	33	III	2	2
9	Male	36	V	4	3
10	Male	26	III	4	3
11	Male	36	V	4	3
12	Female	36	V	3	3
13	Male	33	V	3	3
14	Female	38	V	2	2
15	Male	33	V	4	3
16	Male	32	V	4	3
17	Male	24	V	3	3
18	Male	27	V	4	3
19	Male	32	V	4	3

(0–25 W) and pulse duration (50–200 milliseconds, at increments of 30 milliseconds).[11]

The aim of the present study was to evaluate the efficacy and safety of RF microneedling on dark skin, photo types III to V for treatment of acne scars.

Materials and Methods

Healthy patients (n = 19, 14 men and 5 women, aged 24–51 years, average 34.16 ± 6.44 years, skin type III–V) with acne scars were enrolled in the study. Inclusion criteria were the presence of depressed acne scars, patients older than 18 years, and the ability to comprehend and provide informed consent. Exclusion criteria were history of keloids, pregnancy or breastfeeding, clotting disorders, heart disorders, and refusal of post-treatment assessment. All patients paid for their treatments.

Each patient had 3 sessions at monthly intervals using a multisource RF platform (EndyMed PRO; EndyMed Medical Ltd, Caesarea, Israel). The applicator used for the treatment is microneedles skin remodeling handpiece (Intensif; EndyMed Medical). An additional 2 follow-up visits were conducted at 1 and 3 months after 3 sessions.

As a preparation to each session, the face was cleaned and disinfected, photos were taken, and a thick layer of topical anesthesia (EMLA, 5% lidocaine) was applied for 40 minutes. Topical anesthesia was removed and treatment was performed. Treatment parameters on cheeks were as follows: power, 15 to 25 W (average 20.19 ± 2.22); pulse duration, 110 to 140 milliseconds; and needle depth, 2.0 to 3.0 mm (average, 2.47 ± 0.20). Post-treatment topical hyaluronic acid gel was applied on the treated area for all patients.

Efficacy, using aesthetic improvement was evaluated by Goodman and Barron's Global qualitative Acne Scarring System,[6] and adverse events were assessed at physical examination before each session and during follow-up visits, 1 and 3 months after completing 3 sessions. The physician recorded any incidences of burns, erythema, edema

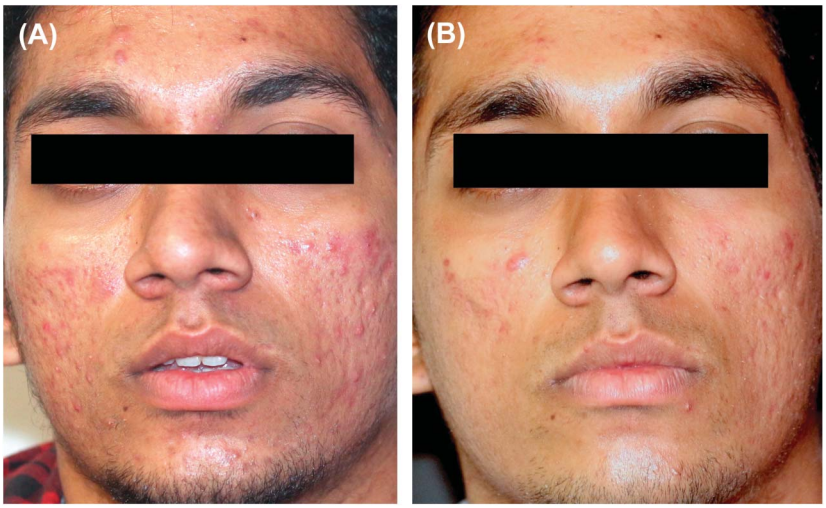

Figure 1. The 26-year-old man treated with 3 sessions of Intensif microneedling (pulse duration, 140 milliseconds; power, 19 to 20 W; and needle depth, 2.5 mm). Acne scar grading was decreased from Grade 4 to 3. (A) Before the treatment and (B) 1-month follow-up after 3 sessions.

post-treatment, and pain was assessed according to the patients' feedback.

Results

All 19 patients completed a series of 3 treatment sessions using a nonablative, coagulative microneedling skin remodeling applicator. Patient skin types were III to V (Table 2). Treatment parameters were chosen by the physician according to the patient's skin condition.

No bleeding points occurred during treatments. Post-treatment erythema was observed immediately after the treatment and lasted up to 10 hours after the treatment. Sixty percent of the patients had no to mild erythema and 65.3% had no to mild edema. Approximately 29.5% of patients had moderate erythema after treatment and only 2 of 19 patients (10.5%) had significant erythema. In 1 patient, the treated area was edematous after his last session. The significant edema and erythema in this patient was probably due to high parameters used (20–21 W and 140 milliseconds) and individual skin sensitivity.

Dyschromia improvement was also observed in 9 patients (47.4%). Postinflammatory hyperpigmentation (PIH) was observed in 1 of 19 patients (5.3%). PIH resolved spontaneously after 4 weeks. Microcrusting appeared on the patients' face for 2 to 3 days post-treatment. No infections or other complications were reported. Before treatment, 52.6% of subjects' scars were graded as severe (Grade 4), 31.6% moderate (Grade 3), and 15.8% mild (Grade 2). Improvement of at least 1 acne scar grade was noted in

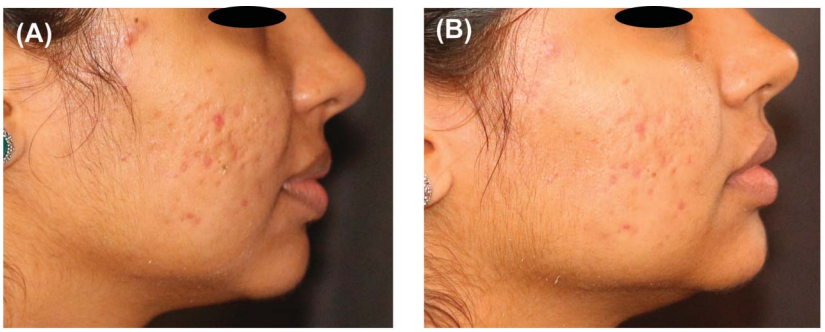

Figure 2. The 36-year-old woman treated with 3 sessions of Intensif microneedling (pulse duration, 140 milliseconds; power, 18 to 21 W; and needle depth, 2.5 mm). Acne scar grading was decreased from Grade 3 to 2. (A) Before the treatment and (B) 1-month follow-up after 3 sessions.

11 of 19 patients (57.9%) after 1 month and in 9 of 9 patients (100%) who were examined after 3 months (Table 2; Figures 1 and 2).

Discussion

RF microneedling should be considered as a first-line option in acne scar treatment, especially on darker skin types. Skin needling combined with RF triggers the cascade of growth factors release which stimulates the wound healing response in the skin. The process triggers a collagen-remodeling phase where new collagen is produced. This phase continues for 3 to 6 months after the last treatment session.

The risk of pigmentary disorders as a complication of treatment for acne scarring is directly related to the patient's skin type.[12] A recent study using insulated microneedle RF system reported PIH in 2 of 20 patients (10%) and aggravating of active acne in 1 patient (5%).[13] This current study shows that RF microneedling using noninsulated needles has minimal impact on epidermal melanocytes and potentially lower risk of PIH, even in individuals with darker skin. Interestingly, this study found improvement in skin dyschromia in 47.4% of our patients.

Lee and colleagues[14] showed 50% or more improvement in 55.6% of all patients for inflammatory acne vulgaris and its related dermatologic conditions, such as acne scars and enlarged facial pores. This study performed on dark skin types (III–V) showed an improvement of 50% or more in 78% of all patients. Interestingly, dyschromia was also improved in 47.4% of the patients. We can hypothesize that this effect was due to destruction of "dropped" dermal melanosomes and enhanced dermal remodeling post-treatment. Cho and colleagues[15] used fractional microneedle RF device with 49 electrodes and found improvement in 73% of patients after 2 treatment sessions. Naouri and colleagues[16] used noninsulated microneedle RF handpiece on 20 patients and found an average improvement of 6.25 (scale of 1–10). Chandrashekar and colleagues[17] treated 31 patients, skin Types III to V, with a system with noninsulated RF microneedles. Their data showed improvement in all patients, good or very good in 12%, moderate in 58%, and minimal in 29%.

Subject satisfaction in patients treated in our study was very high. This can be explained by minimal treatment discomfort, low downtime, and the visible post-treatment and long-term results of this specific treatment modality.

RF microneedling requires multiple treatments, and the treatments require time before results are seen due to a long process of collagen remodeling, which starts 2 to 6 weeks post-treatment. The platform used in this study may also enable the physician to combine several modalities such as noninvasive skin tightening for collagen remodeling and fractional skin resurfacing. Improved appearance of acne scars as a result of using a combination of energy-based modalities should be studied in the future.

Conclusion

The data received in this study demonstrate that 3 sessions of noninsulated, smooth motion, microneedling RF system tested can significantly improve acne scars in darker skin types III to V, with minimal downtime and low risk for postinflammatory hyperpigmentation.

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