Fractional Resurfacing for the Treatment of Hypopigmented Scars: A Pilot Study

Adrienne S. Glaich, MD,* Zakia Rahman, MD,† Leonard H. Goldberg, MD, FRCP,*‡ and Paul M. Friedman, MD*§

BACKGROUND Treatments for hypopigmented scars have shown limited efficacy and variable safety profiles.

OBJECTIVE This study evaluated the safety and efficacy of fractional resurfacing (1,550-nm Fraxel SR laser, Reliant Technologies, Mountain View, CA) for the treatment of hypopigmented scars on the face in seven patients.

MATERIALS and METHODS Seven patients with hypopigmented scars on the face received between two and four successive treatments at 4-week intervals with the 1,550-nm Fraxel SR laser. Energy settings ranged from 7 to 20 mJ and a total density of 1,000 to 2,500 microthermal zones per square centimeter. Digital photographs were taken before each treatment and at 4 weeks after the last treatment. Independent physician clinical assessments were performed.

RESULTS Independent physician clinical assessment 4 weeks after the final Fraxel SR laser treatment revealed improvements of 51% to 75% in hypopigmentation in six of seven patients. One patient had only 26% to 50% improvement in hypopigmentation. Additionally, clinical improvements were noted in the overall texture of the treated skin. The patient's degree of satisfaction paralleled the physician's assessment of improvement. All patients reported improvement in hypopigmentation lasting greater than 3 months after the last treatment. Side effects were limited to mild pain during the treatment and mild posttreatment erythema and edema, which resolved in 2 to 4 days.

CONCLUSION Fractional resurfacing is a potentially effective modality for the treatment of hypopigmented scarring on the face. No adverse effects were observed.

Adrienne S. Glaich, MD, Zakia Rahman, MD, Leonard H. Goldberg, MD, FRCP, and Paul M. Friedman, MD, have indicated no significant interest with commercial supporters.

Treatments for hypopigmented scars have shown limited efficacy and variable safety profiles. These treatment modalities include cosmetic tattooing, medium-depth chemical peels, carbon dioxide and erbium laser resurfacing, dermabrasion, skin grafting, cosmetic camouflage, and various forms of phototherapy and laser therapy.[1–13] There is a great need for a safe and effective treatment for both the color and the texture of hypopigmented scars. This study evaluated the safety and efficacy of fractional resurfacing (1,550-nm Fraxel SR laser, Reliant Technologies Inc., Mountain View, CA) for the treatment of hypopigmented scars on the face.

Materials and Methods

Seven patients (ages 32–48 years; Fitzpatrick skin types I–IV) with moderate to marked hypopigmented scarring on the cheeks and jawline were treated with the 1,550-nm-wavelength erbium-doped fiber Fraxel SR laser. The scarring resulted from inflammatory acne in six patients and a gas fire in one patient (hypopigmented scars present for 5–20 years). Patient exclusion criteria included a history of keloid formation or oral isotretinoin use within 6 months before treatment.[14] The treatment area was thoroughly cleansed with a mild soap before each procedure. Various topical anesthetic creams

*DermSurgery Associates, Houston, Texas; †Department of Dermatology, Stanford University Medical Center, Stanford, California; ‡Department of Dermatology, Weill Cornell Medical College, The Methodist Hospital, Houston, Texas; §Department of Dermatology, University of Texas Medical School, Houston, Texas

 • Published by Blackwell Publishing •
ISSN: 1076-0512 • Dermatol Surg 2007;33:289–294 • DOI: 10.1111/j.1524-4725.2007.33058.x

[six patients with triple anesthetic cream under occlusion (10% benzocaine, 6% lidocaine, 4% tetracaine; New England Compounding Center, Framingham, MA) and one patient with both 5% LMX (Ferndale Laboratories, Inc. Ferndale, MI) and 7% lidocaine/7% tetracaine (Central Avenue Pharmacy, Pacific Grove, CA)] were applied to the treatment area on the face for 1 hour before treatment. Once the topical anesthetic was removed, OptiGuide Blue, a US Food and Drug Administration-certified water-soluble tint, was applied to allow the laser's intelligent optical tracking system to detect contact with the skin and to adjust the treatment pattern with respect to hand piece velocity. Before treatment was initiated, LipoThene ointment (LipoThene, Inc., Pacific Grove, CA) was applied over the OptiGuide Blue to allow the laser handpiece to glide smoothly over the skin surface.

Two to four treatment sessions at 4-week intervals were performed at pulse energies of 7 to 20 mJ and a total density of 1,000 to 2,500 microthermal zones (MTZs)/cm^2 per treatment session in conjunction with the use of a skin-cooling device (Zimmer MedizinSystems, Irvine, CA). There is an inverse correlation between the energy and the density settings such that as the treating physician increases the energy, the density is decreased. The laser parameters for each treatment session are displayed in Table 1. Treatment parameters were selected to deliver high pulse energies to maximize penetration depth for optimum results and adjusted based on each patient's pain threshold. The density was decreased as the pulse energy increased to minimize excessive heat delivered to small areas.

No oral analgesic or anxiolytic medications were used. The treatment response was assessed by comparing pre- and posttreatment clinical photographs. Patients were evaluated after each procedure by an independent physician evaluator using a quartile grading scale: grade 1, less than 25% = minimal to no improvement; grade 2, 26% to 50% = moderate improvement; grade 3, 51% to 75% = marked improvement; and grade 4, more than 75% = near total improvement.[15]

TABLE 1. Treatment Parameters Ranged from Pulse Energies of 7 to 20 mJ and Total Densities of 1,000 to 2,000 MTZs

Patient No.	*Treatment No.*	*Pulse energy*	*Density*
1	1	7	2,000
	2	7	2,000
	3	7	2,000
	4	7	2,000
2	1	10	2,000
	2	11	2,000
	3	11	2,000
	4	11	2,000
3	1	8	2,000
	2	10	2,000
	3	20	1,125
	4	N/A	N/A
4	1	13	2,000
	2	11	2,000
	3	N/A	N/A
	4	N/A	N/A
5	1	8	2,000
	2	8	2,000
	3	10	1,000
	4	10	2,000
6	1	12	2,000
	2	18	1,250
	3	19	1,250
	4	20	1,250
7	1	13	2,000
	2	18	1,250
	3	18	1,250
	4	16	1,250

Results

Follow-up results at 4 weeks after the last treatment revealed that six of the seven patients demonstrated marked clinical improvements of 51% to 75% in hypopigmentation. One patient had only 26% to 50% improvement in hypopigmentation and will return for additional treatments. A mean grade of 2.9 for clinical improvement of hypopigmented scarring was achieved based on physician's clinical assessment using the quartile grading scale (Table 2). The patients' degree of satisfaction paralleled the physician's assessment. All patients reported

TABLE 2. Improvement of Hypopigmented Scarring Four Weeks after the Final Treatment with Fractional Resurfacing*

Patient No.	*Percentage of improvement*	*Improvement grade*
1	51–75	3
2	51–75	3
3	26–50	2
4	51–75	3
5	51–75	3
6	51–75	3
7	51–75	3
Mean		2.9

*Grade 1, less than 25% = minimal to no improvement; grade 2, 26% to 50% = moderate improvement; grade 3, 51% to 75% = marked improvement; and grade 4, more than 75% = near total improvement.

improvement in hypopigmentation lasting greater than 3 months after the last treatment.

Figure 1 demonstrates a clear improvement in hypopigmented scars (resulting from a gas fire) seen at baseline (Figure 1A) compared with that seen at 4 weeks after four treatment sessions (Figure 1B). The clinical improvement in this patient was 75%. Figures 2 and 3 represent patients who showed a marked clinical improvement in hypopigmented acne scars 1 month after four treatment sessions.

Side effects were limited to mild pain during treatment and mild posttreatment erythema and edema which resolved in 2–4 days. No long-term adverse events were observed.

Discussion

This report demonstrates that fractional resurfacing is a potentially effective treatment modality for hypopigmented scars. Most patients received marked (51%–75%) clinical improvements in their facial hypopigmented scars. No adverse effects were observed, and the safety profile appears to be fairly broad.[16]

Fractional resurfacing is an innovative technology that uses advanced fiber laser technology to resurface skin without breaking the skin's protective outer barrier.[17–23] The 1,550-nm wavelength utilized in fractional resurfacing creates thousands of MTZs of tissue damage that are surrounded by untreated tissue, limiting the amount of injury to the treatment zone and shortening the migratory paths for keratinocytes resulting in rapid epidermal repair and re-epithelialization that occurs within 24 hours.[24] This substantially reduces the risk of infection or excess thermal injury.

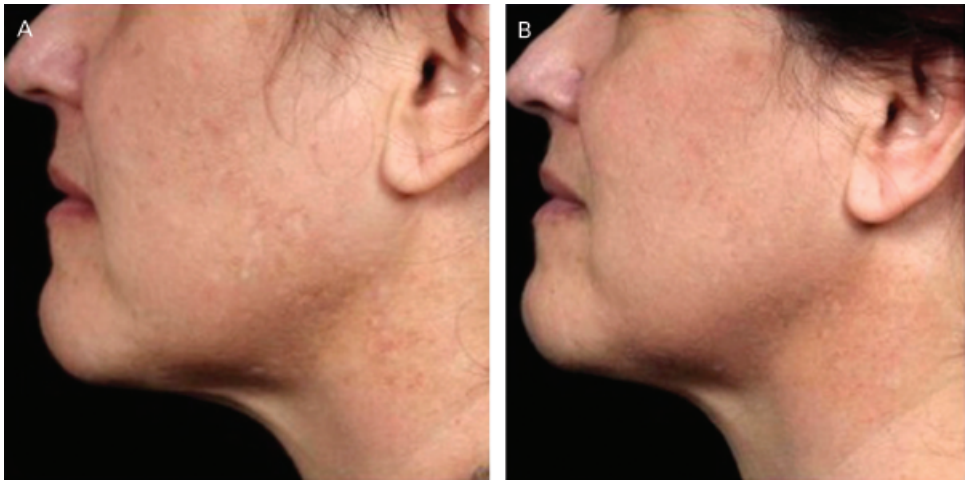

Figure 1. (A) Hypopigmented scars in the left cheek before treatment with fractional resurfacing. (B) Follow-up 4 weeks after four treatment sessions at a pulse energy of 7 mJ and final density of 2,000 MTZs/cm^2. Both the physician and the patient reported a 75% improvement in pigmentation.

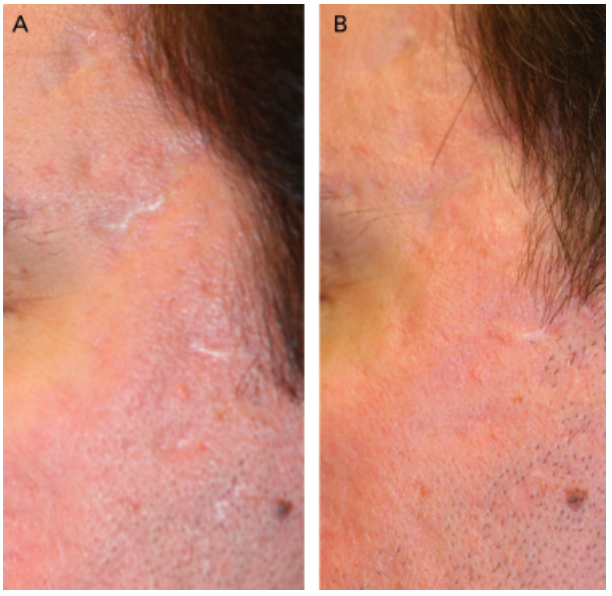

Figure 2. (A) Hypopigmented facial acne scars on the left temple and left cheek at baseline. (B) Marked improvement in pigmentation 1 month after four fractional resurfacing treatments at pulse energies ranging from 12 to 20 mJ and total densities ranging from 1,000 to 2,000 MTZs/cm^2.

In theory a treatment that increases melanin production could correct hypopigmentation regardless of whether it is caused by hypomelanocytosis, hypomelanosis, or optical factors. It is possible that fractional resurfacing causes normal melanocytes from surrounding tissue to repopulate this newly resurfaced tissue—resulting in increased overall pigmentation. We postulate that by treating the edge of the hypopigmented scar and leaving short migratory pathways for healing, the melanocytes can migrate from the pigmented, normal skin into the hypopigmented, scarred area. This results in a blending of the border and minimizes the appearance of the hypopigmented scar. Histologic studies are needed to further elucidate the healing process and confirm the movement of melanocytes into the treated area.

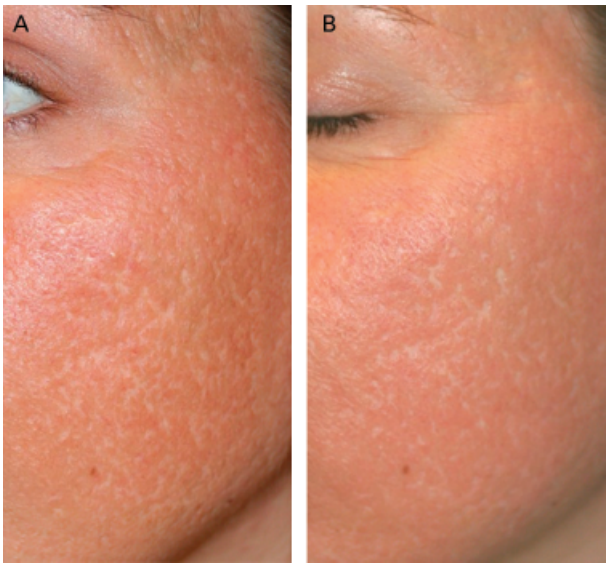

Figure 3. (A) Hypopigmented facial acne scars on the left cheek before treatment with fractional resurfacing. (B) Four weeks after four treatment sessions at pulse energies of 13 to 18 mJ and total densities of 1,000 to 1,250 MTZs/cm^2. Both the physician and the patient reported a marked improvement in pigmentation.

Fractional resurfacing may also improve the texture of the scar and correct atrophy through remodeling and up-regulation of collagen production. Smoothing out the texture of the scar and the surrounding normal skin gives the illusion of color, thereby lessening the prominence of the hypopigmented scars.

In this pilot study, fractional resurfacing resulted in marked clinical improvement in hypopigmented facial scars in the majority of patients as measured by physician assessment of clinical photographs after two to four treatment sessions. The preliminary results are encouraging because past treatment modalities for repigmentation of hypopigmented scars have yielded limited benefits. Additional studies with larger patient groups and longer-term follow-up are required to further assess the permanence of pigmentation after fractional resurfacing of hypopigmented scars and to define the optimal treatment parameters.

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Address correspondence and reprint requests to: Paul M. Friedman, MD, DermSurgery Associates, 7515 S. Main Street, Suite 210, Houston, TX 77030, or e-mail: pmfriedman@dermsurgery.org.

COMMENTARY

The observations of improved pigmentation in hypopigmented scars treated with the Fraxel laser as reported by Drs. Glaich, Rahman, Goldberg, and Friedman are significant in that they confirm anecdotal observations of other physicians treating scarring with the Fraxel. The improvement may be subtle, but even so, is significant in reducing the stark contrast of sharply defined hypopigmentation versus the brown pigmentation of melanin. I agree that the likely mechanism of improvement is the combination of short migratory pathways for melanocytes at the edges of microthermal zones plus the improvements in texture from neocollagenesis. The potential for dramatic improvement through these mechanisms is limited, so full repigmentation of scars should not be expected with treatments of this type. Even small improvements in these scars is welcomed by all, however. Loss of pigmentation secondary to scarring or altered responsiveness of melanocytes is a common problem that does not have a solution at this time. This is an

area of research and development that has not been very productive to date. Possibly the small improvements seen with this technique may open new avenues for significant improvement with this and other new techniques utilizing a similar approach.

RICHARD E. FITZPATRICK, MD
Carlsbad, CA