

Second-Generation 1,550-nm Fractional Photothermolysis for the Treatment of Acne Scars

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BACKGROUND AND OBJECTIVES Acne scars affect the entire population, causing significant distress and concern. Previous treatments for acne scars have yielded varying degrees of success and associated side effects. Fractional photothermolysis has been shown to improve scars, including surgical scars, hypopigmented scars, and atrophic acne scars. The newest system has the option of increased fluences for greater depth of penetration and variable treatment coverage. Our aim was to determine the efficacy and safety of the second-generation erbium-doped 1,550-nm fractional photothermolysis laser (1,550-nm Fraxel SR laser, Reliant Technologies Inc.) in the treatment of all types of acne scars and of all severities.

STUDY DESIGN/MATERIALS AND METHODS Twenty-nine patients (20 females and 9 males, ages 15–65 years), Fitzpatrick Skin Types I to V, were treated with two to six treatments with the second-generation erbium-doped 1,550-nm fractional photothermolysis laser at 1-month intervals. Fluences ranged from 35 to 40 mJ/microthermal zone. Treatment levels varied from 7 to 10 and “Advanced Level 1,” corresponding to treatment coverage of 20% to 35%. Patients were graded on a 4-point scale by three independent physicians using digital photography.

RESULTS The majority of patients achieved a 50% to 75% improvement in facial and back acne scarring (18 of 29 patients). Five patients had an improvement of greater than 75% in acne scarring, 5 patients had a 25% to 50% improvement in acne scarring, and 1 patient had less than a 25% response to treatment. The patients’ degree of satisfaction paralleled the physicians’ assessment. Side effects were minimal and no posttreatment pigmentary changes were noted.

CONCLUSION Fractional photothermolysis is a safe and efficacious treatment modality for the treatment of all types of acne scars of all severities. No adverse effects were noted, including in patients with Fitzpatrick Skin Types III to V.

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Acne scars affect patients of all ethnic backgrounds, male and female. Treatment of acne scarring includes subcision, medium-depth chemical peels, fillers, carbon dioxide and erbium laser technology, nonablative laser treatment, dermabrasion, punch excision, and fat grafting.¹ These treatments have resulted in varying degrees of success and associated side effects.

Fractional photothermolysis has been shown to improve surgical scars² and hypopigmented scars,³

as well as atrophic acne scars.^{4–6} This technology has also been shown to markedly improve recalcitrant postinflammatory erythema.⁷ Fractional photothermolysis creates hundreds to thousands of microscopic thermal zones (MTZs), or columns of thermally injured skin, while sparing the surrounding tissue. The pixilated nature of treatment and the functionally unimpaired stratum corneum allow for rapid tissue healing.^{8–9} The first-generation fractionated erbium-doped laser (Fraxel SR750, Reliant Technologies Inc., Mountain View, CA) has been

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reported to result in a 51% to 75% improvement in 90% of 53 patients with mild to moderate atrophic acne scars.⁴ Additionally, fractional photothermolysis has been reported to result in a 51% to 75% improvement in 6 of 7 patients with hypopigmented scars on the face with minimal side effects.³

The second-generation erbium-doped 1,550-nm laser (Fraxel SR1500, Reliant Technologies Inc.) has an increased depth of penetration due to the potential for increased fluence (up to 70 mJ). Five percent to 45% of the skin surface can be treated by selecting the appropriate treatment level. We report the safe and efficacious use of the second-generation erbium-doped 1,550-nm fractional photothermolysis laser in all types of mild to severe acne scars.

Materials and Methods

Twenty-nine patients (20 females and 9 males, ages 15–66 years), Fitzpatrick Skin Types (FST) I to V, with mild to severe facial and back acne scarring of all types (icepick, boxcar, rolling) were treated with the erbium-doped 1,550-nm fractional photothermolysis laser with a 15-mm handpiece. Severity of scarring ranged from mild to severe. The acne scars were located on the face and back. Exclusion criteria included history of hypertrophic scarring or keloid formation and isotretinoin use within 6 months before treatment.

Before treatment procedure, the affected areas were cleansed with a mild soap. Triple anesthetic cream (10% benzocaine, 6% lidocaine, 4% tetracaine; New England Compounding Center, Framingham, MA) was applied to the treatment area. One hour later, the triple anesthetic cream was removed and an FDA-certified water-soluble tint (OptiGuide Blue, ScholAR Chemistry, West Henrietta, NY) was applied to the treatment area (prior to July 2007). The tint allowed for 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. Ointment (LipoThene, Lipothene Inc.,

Pacific Grove, CA) was applied over the OptiGuide Blue to allow the laser handpiece to guide smoothly over the treatment area. Energy settings ranged from 35 to 40 mJ/MTZ. Treatment levels varied from 7 to 10 and "Advanced Level 1," corresponding to treatment coverage of 20% to 35%. A cold-air cooling device (Zimmer MedizinSystems, Irvine, CA) was used at a setting of 5 for all patients. Eight to 10 passes were performed on all patients. A total of two to six treatments were performed at 1-month intervals. During all treatments, pain was assessed as "mild, moderate, or severe." Fluence and treatment level were increased based on patient pain tolerance (but all settings fell in the ranges listed above). Patient tolerance of the treatments tended to improve with successive treatments and settings were adjusted accordingly.

After treatment, the dye was removed with a gentle cleanser and the patient was given sunscreen to apply. Posttreatment instructions included the use of a mild soap, sunscreen in the morning, and a non comedogenic moisturizing cream in the evening twice daily for three days. Patients with a history of herpes labialis were treated with valacyclovir (Valtrex, Glaxo SmithKlein, Research Triangle Park, NC), 500 mg twice daily for 3 days starting one day prior to treatment.

Digital photographs using identical patient positioning were obtained at baseline, before each treatment, and 1 month after the final treatment. Patients were graded on a 4-point scale by three independent physicians using a quartile grading scale (1 = 1% to 25%, 2 = 26% to 50%, 3 = 51% to 75%, 4 ≥ 76%). One of the physicians (AG) was completely blinded in that she did not treat any patients. All grading physicians were blinded to the total number of treatments and which photographs were baseline and follow-up. This scale was also used to assess patient satisfaction at each treatment and during the follow-up visit. Side effects such as postinflammatory erythema and pain were ranked as none, mild, moderate or severe.

Informed consent was obtained from all subjects. The study protocol conformed to the guidelines of the 1975 Declaration of Helsinki.

Results

At least 50% to 75% improvement in facial and back acne scarring was seen in 23 of 29 patients (Figures 1–4). Five patients had an improvement of greater than 75% in acne scarring, 18 patients had an improvement of 50% to 75% of acne scarring, 5 patients had a 25% to 50% improvement in acne scarring, and 1 patient had less than a 25% response to treatment (Figure 5). Clinical improvement tended to increase with each treatment. The patients' degree of satisfaction paralleled the physicians' assessment.

Side effects were mild: no oral analgesic or anxiolytic medications were required; discomfort was rated as mild to moderate during the laser treatments. Moderate erythema and edema were noted in most patients and tended to resolve within 2 to 5 days. There were no pigment changes, or scarring. Follow-up from the last treatment ranged from 1 to 6 months (mean follow-up 2 months).

Discussion

We report the safe and efficacious use of the second-generation erbium-doped 1,550-nm SR fractional photothermolysis laser for the treatment of acne scars. This report is consistent with previous reports of the first-generation fractional photothermolysis laser for the treatment of atrophic acne scars and hypopigmented scars.^{3,4,10,11} The higher fluence of the second-generation laser allows deeper penetration into the dermis as well as a microthermal zone (MTZ) with a wider circumference,¹² presumably eliciting a greater amount of collagen remodeling through more extensive dermal heating.

In our experience, patient erythema was noted to a greater extent compared to treatment with the first-generation fractional photothermolysis model. This observation may be related to increased fluences used with the newer device and therefore the increased laser penetration into the dermis, resulting in greater tissue damage. Patient edema also persisted longer (2 to 5 days). Edema and erythema were not graded as part of the study but appeared to



Figure 1. Patient at baseline (A) and 1 month after three treatments with fractional photothermolysis (B). Settings used were energy of 40 mJ, treatment level ranging from seven to nine, eight treatment passes during each treatment. Note improvement of pitting and boxcar scars of forehead and cheeks.

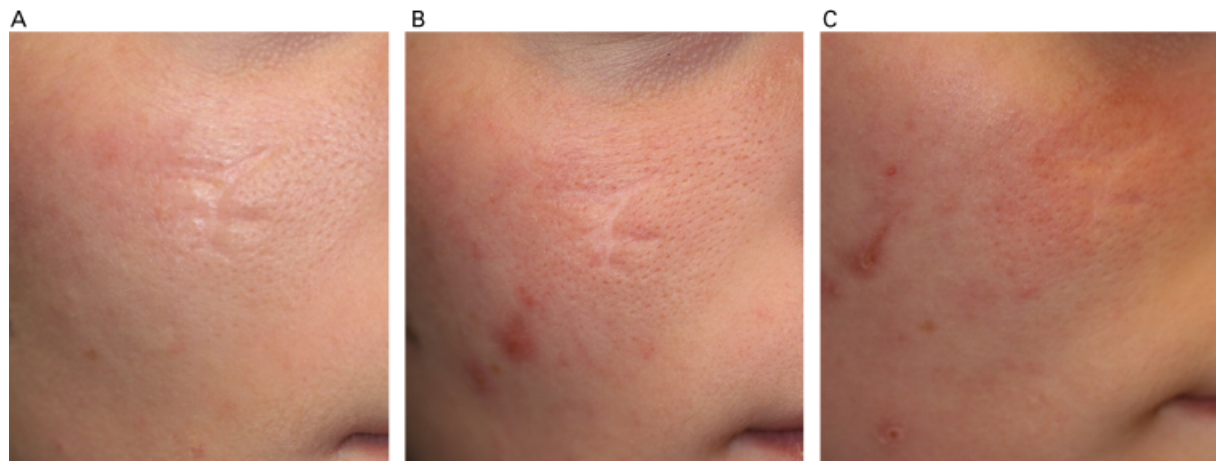


Figure 2. Patient's right cheek. Note improvement from baseline (A) after only one treatment (B). One month after three treatments (C), the scar is nearly gone. Settings were as follows: energy of 40 mJ, treatment levels ranging from eight to nine, eight treatment passes during each treatment.

correlate linearly with the fluence and treatment coverage (treatment level). However, none of the patients reported the side effects as severe and no additional anxiolytic or pain-relieving medications were required. No pigment changes were noted in the patients, including those with FST V. Therefore, this report further supports the use of fractional photothermolysis in patients with FST III to V.

Fractional photothermolysis with the erbium-doped 1,550-nm laser is an efficacious treatment for acne scarring. An advantage of fractional photothermolysis is that results are seen without significant side effects, as occurs with ablative resurfacing with CO₂

and erbium lasers.^{13–15} An additional advantage of 1,550-nm fractional resurfacing is the ability to safely treat both facial and nonfacial lesions, as demonstrated in our patient with acne scarring on the back. Results appear to surpass those reported using nonablative technology such as the 585-nm pulsed dye laser, the 1,064-nm Q-switched Nd:YAG, the 1,320-nm Nd:YAG, and 1,450-nm diode laser.^{16–24}

In summary, second-generation 1,550-nm fractional photothermolysis is a safe and effective modality for the treatment of all types of acne scarring. We found the laser to be safe in patients with FST I to V. We

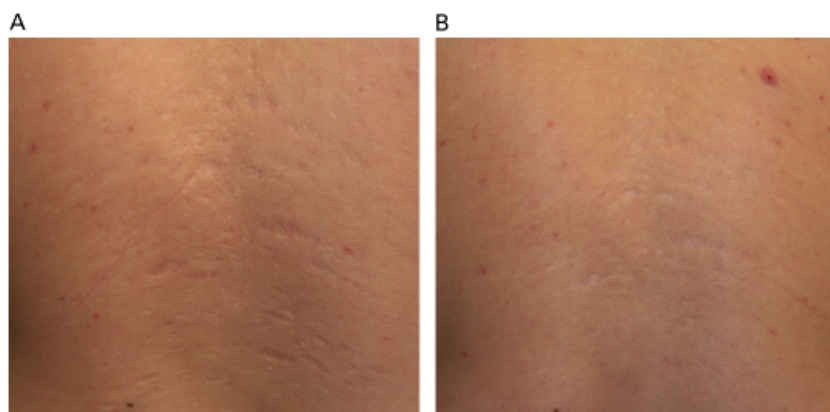


Figure 3. Patient's back at baseline (A) and 1 month after four treatments with the second-generation erbium-doped 1,550-nm fractional photothermolysis laser (B). Note the dramatic improvement in the depth of the boxcar acne scars. Energy: 40 mJ, treatment levels ranged from five to seven, eight treatment passes performed during each treatment.

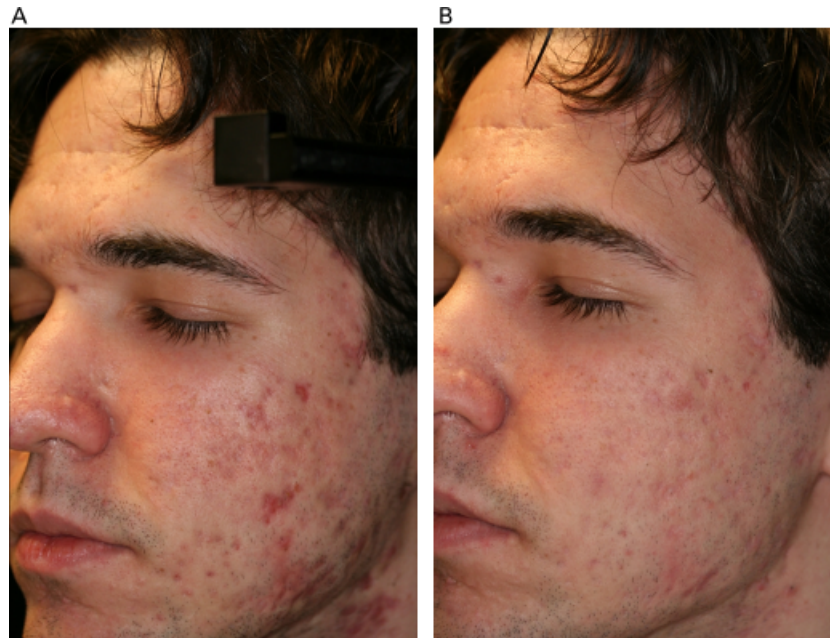


Figure 4. Patient's left profile at baseline (A) and 1 month after six treatments with the second-generation erbium-doped 1,550-nm fractional photothermolysis laser (B). There is marked improvement of boxcar and icepick scarring, as well as improvement in postinflammatory erythema. Energy: 40 mJ, treatment levels ranged from 8 to 10, eight treatment passes performed during each treatment.

also anticipate continued improvement over the course of several months after completion of the treatment protocol secondary to thermally induced

collagen remodeling, which has been reported with other nonablative devices.¹⁷

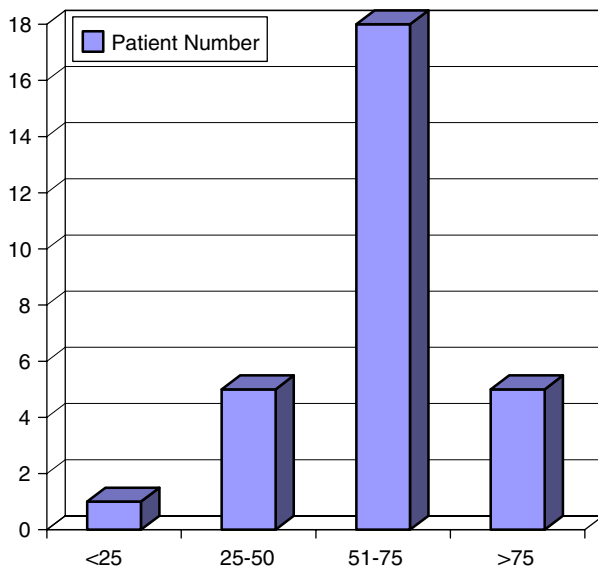


Figure 5. Improvement of acne scars after two to six treatments of the second-generation erbium-doped 1,550-nm fractional photothermolysis laser.

References

1. Chrastil B, Friedman PM. Treatment of atrophic acne scars. In: Bedlow J, McKenna J, editors. London and European Dermatology Review 2007, Vol. II. London: Touch Briefings; 2007. p. 25–6.
2. Behroozan DS, Goldberg LH, Dai T, Geronemus RG, Friedman PM. Fractional photothermolysis for the treatment of surgical scars: a case report. *J Cosmet Laser Ther* 2006;8:35–8.
3. Glaich AS, Rahman Z, Goldberg LH, Friedman PM. Fractional photothermolysis for the treatment of hypopigmented scars. *Dermatol Surg* 2007;33:289–94.
4. Alster TS, Tanzi EL, Lazarus M. The use of fractional laser photothermolysis for the treatment of atrophic scars. *Dermatol Surg* 2007;33:295–9.
5. Rahman Z, Tanner H, Jiang K. Treatment of atrophic scars with the 1,550 nm erbium-fiber fractional laser [abstract]. *Lasers Surg Med* 2006;38, abstract 76.
6. Fisher GH, Skover G, Geronemus RG. Treatment of facial acneiform scars with fractional photothermolysis [abstract]. *Lasers Surg Med* 2006;38, abstract 75.
7. Glaich AS, Goldberg LH, Friedman RH, Friedman PM. Fractional photothermolysis for the treatment of postinflammatory erythema resulting from acne vulgaris. *Dermatol Surg* 2007;33:842–6.

8. Manstein D, Herron GS, Sink RK, et al. Fractional photothermolysis: a new concept for cutaneous remodeling using microscopic patterns of thermal injury. *Laser Surg Med* 2004;34:426–38.
9. Geronemus RG. Fractional photothermolysis: current and future applications. *Lasers Surg Med* 2006;38:169–76.
10. Hasegawa T, Matsukura T, Mizuno Y, et al. Clinical trial of a laser device called fractional photothermolysis system for acne scars. *J Dermatol* 2006;33:623–7.
11. Kim KH, Fisher GH, Bernstein LJ, et al. Treatment of acneiform scars with fractional photothermolysis. *Lasers Surg Med* 2005;37:93.
12. Bedi VP, Chan KF, Sink RK, et al. The effects of pulse energy variations on the dimensions of microscopic thermal treatment zones in nonablative fractional resurfacing. *Lasers Surg Med* 2007;39:145–55.
13. Bernstein LJ, Kauvar AN, Grossman MC, Geronemus RG. The short- and long-term side effects of carbon dioxide laser resurfacing. *Dermatol Surg* 1997;23:519–25.
14. Nanni CA, Alster TS. Complications of CO₂ laser resurfacing: an evaluation of 500 patients. *Dermatol Surg* 1998;24:315–20.
15. Tanzi EL, Alster RS. Side effects and complications of variable-pulsed erbium:YAG laser skin resurfacing: extended experience with 50 patients. *Plast Reconstr Surg* 2003;111:1524–9.
16. Patel N, Clement M. Selective nonablative treatment of acne scarring with 585 nm flashlamp pulsed dye laser. *Dermatol Surg* 2002;28:942–5.
17. Friedman PM, Jih MH, Skover GR, et al. Treatment of atrophic facial acne scars with the 1,064-nm Q-switched Nd:YAG laser: six-month follow-up study. *Arch Dermatol* 2004;140:1337–41.
18. Friedman PM, Skover GR, Payonk G, Geronemus RG. Quantitative evaluation of nonablative laser technology. *Semin Cutan Med Surg* 2002;21:266–73.
19. Bhatia AC, Dover JS, Arndt KA, et al. Patient satisfaction and reported long-term therapeutic efficacy associated with 1,320 nm Nd:YAG laser treatment of acne scarring and photoaging. *Dermatol Surg* 2006;32:346–52.
20. Rogachefsky AS, Hussain M, Golderbg DJ. Atrophic and a mixed pattern of acne scars improved with a 1,320-nm Nd:YAG laser. *Dermatol Surg* 2003;29:904–8.
21. Tanzi EL, Alster TS. Comparison of a 1,450-nm diode laser and a 1,320-nm Nd:YAG in the treatment of atrophic facial scars. *Dermatol Surg* 2004;30:152–7.
22. Sadick NS, Schechter AK. A preliminary study of utilization of the 1,320-nm Nd:YAG laser for the treatment of acne scarring. *Dermatol Surg* 2004;30:995–1000.
23. Bellew SG, Lee C. Improvement of atrophic acne scars with a 1,320 nm Nd:YAG laser: retrospective study. *Dermatol Surg* 2005;31:1218–21.
24. Jih MH, Friedman PM, Goldberg LH, et al. The 1,450-nm diode laser for facial inflammatory acne vulgaris: dose-response and 12-month follow-up study. *J Am Acad Dermatol* 2006;55:80–7.

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