
Treatment of Atrophic Facial Acne Scars with a Dual-Mode Er:YAG Laser

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BACKGROUND. Scar revision with CO₂ and Er:YAG lasers has become popular in recent years. Reports on the newest (modulated, dual-mode) Er:YAG systems have been limited mostly to the treatment of photodamaged skin and rhytides.

OBJECTIVE. To prospectively evaluate the efficacy and safety of a dual-mode 2940 nm Er:YAG laser for atrophic scar revision.

METHODS. Twenty-five consecutive patients with moderate to severe atrophic facial acne scars received treatment with a dual-mode Er:YAG laser. Clinical assessments using a standard grading scale and photographic documentation were performed at 1, 3, 6, and 12 months postoperatively. Postoperative recov-

ery was monitored and the rate of side effects and complications recorded.

RESULTS. Average clinical grading scores reflected good to excellent response of atrophic scars to the dual-mode Er:YAG laser system. Side effects and complications were limited to transient hyperpigmentation and acne flare-ups. No hypopigmentation or scarring was seen. Prolonged erythema (longer than 1 month) was observed in 1 patient (4%).

CONCLUSION. Dual-mode Er:YAG laser skin resurfacing is a safe and effective modality for the treatment of atrophic facial scarring.

E. L. TANZI, MD AND T. S. ALSTER, MD HAVE INDICATED NO SIGNIFICANT INTEREST WITH COMMERCIAL SUPPORTERS.

ATROPHIC SCARRING may result from the destruction of connective tissue by trauma or inflammatory skin disorders. Many different treatment modalities, including chemical peels, surgical excision, punch grafting, dermabrasion, and tissue augmentation with a variety of filler substances have been used to ameliorate atrophic scars with varying degrees of success.¹⁻⁶ Factors limiting the aforementioned techniques include incomplete scar removal, poor intraoperative visualization, transmission of infectious debris, scar worsening, tissue fibrosis, and permanent pigmentary alteration.^{7,8}

Recontouring of atrophic facial scars with CO₂ and Er:YAG lasers has become popular in recent years.⁹⁻²⁰ By following the principles of selective photothermolysis,²¹ these systems have the ability to selectively ablate water-containing tissue and effect reproducible degrees of vaporization, providing surgeons with a greater degree of control than with dermabrasion.^{20,22-25} While CO₂ laser skin resurfacing can effectively improve atrophic facial scars, extended postoperative recovery periods with prolonged erythema have tempered physician enthusiasm for this technique.^{26,27} Moreover, an incidence of delayed permanent hypopigmentation has

been reported in up to 20% of patients treated with CO₂ laser.¹⁷

The short-pulsed Er:YAG laser was developed as a less aggressive alternative to CO₂ laser skin resurfacing. The 2940 nm wavelength emitted by the Er:YAG laser corresponds to the peak absorption coefficient of water and is absorbed 12-18 times more efficiently by superficial, water-containing cutaneous tissue than is the 10,600 nm wavelength of the CO₂ laser.²⁸ With a pulse duration of 250 μsec, a typical short-pulsed Er:YAG laser ablates 10-20 μm of tissue per pass at a fluence of 5 J/cm² and produces a residual zone of thermal damage not exceeding 15 μm (compared to 20-60 μm of tissue ablation and up to 150 μm of residual thermal damage per pass with the CO₂ laser).²⁰ The precise tissue ablation and limited residual thermal damage result in a faster postoperative recovery and improved side effect profile.²⁹⁻³³ However, because of the limited zone of thermal injury, short-pulsed Er:YAG laser resurfacing is hindered by poor intraoperative hemostasis, limited collagen contraction, and substantially less impressive clinical results than with CO₂ laser skin resurfacing.^{14,20}

To overcome the limitations of short-pulsed Er:YAG laser resurfacing, "modulated" or "dual-mode" (short- and long-pulsed) Er:YAG systems have been developed that combine ablative and coagulative pulses producing deeper tissue vaporization, greater contraction of collagen, and improved hemostasis.^{17,33} With pulse durations up to 500 μsec, dual-mode Er:

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YAG lasers can produce a larger zone of residual thermal injury, similar to that of high-energy pulsed and scanned CO₂ lasers. Previous studies using these latter Er:YAG systems specifically on atrophic scars have been limited.

The objective of this study was to prospectively evaluate the efficacy and safety of a dual-mode 2940 nm Er:YAG laser in the treatment of moderate to severe atrophic facial scars.

Materials and Methods

Twenty-five consecutive patients (23 women, 2 men; ages 21–65 years, mean 42.3 years, skin phototypes I–V) with moderate to severe atrophic facial acne scars were included in the study after informed consent was obtained. Patients with a history of isotretinoin use, dermabrasion, phenol peel, or filler (collagen, fat) injections within 3 years of study initiation were excluded from the study. Five patients (20%) reported dermabrasion to the involved areas more than 3 years prior to study initiation. Three patients (12%) had received collagen injections in the remote past. One patient (4%) had undergone a phenol peel more than 5 years prior to study entry.

Each patient received laser treatment to both cheeks, extending from the nasolabial folds to the preauricular and mandibular regions, in an outpatient setting by a single operator (T.S.A.) with a dual-mode sequential ablation/coagulation pulsed Er:YAG laser. Anesthesia was obtained with regional nerve blocks using 1% lidocaine with 1:200,000 epinephrine. For full-face procedures, intravenous anesthesia was administered by a certified nurse anesthetist using a combination of propofol, versed, fentanyl, and ketamine. The laser was calibrated to 90 μm ablation (22.5 J/cm²) with 50% spot overlap and 50 μm coagulation using a square scanning handpiece to vaporize the epidermis in one pass over the entire face. An additional one to two regional passes were delivered using identical laser settings. Laser scans were placed adjacent to one another without overlapping, thereby preventing char formation. Partially desiccated skin was thoroughly removed with saline-soaked gauze between each laser pass. The partially desiccated tissue remaining from the final laser pass was left intact as a biological wound dressing. The laser-irradiated skin showed a clean, pale pink hue with minimal to no bleeding.

Immediately following treatment, Aquaphor ointment was applied to the irradiated skin. Each patient was instructed to perform gentle facial rinses with dilute acetic acid soaks several times a day, followed by liberal ointment application and a cooling masque. Open wound dressings were used to permit early detection of side effects. A 10-day course of prophylactic antiviral treatment (valacyclovir 500 mg twice a day) was initiated on the day of surgery. Patients were followed closely during the first postoperative week, during which time any residual coagulated debris was gently removed with cooled dilute acetic acid compresses. All pa-

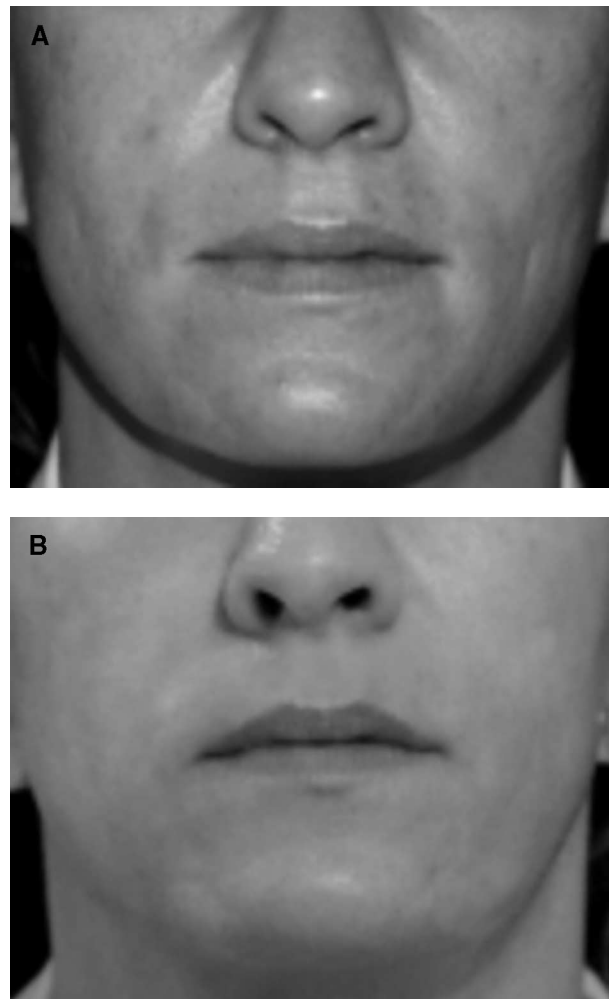


Figure 1. A) Moderate atrophic acne scars at baseline. B) Marked clinical improvement seen 12 months after Er:YAG laser treatment (score 3).

tients were able to apply camouflage makeup within 7–10 days postoperatively.

Clinical documentation was obtained by sequential photographs using identical camera settings, lighting, and patient positioning. Assessments of treated scars compared with baseline pretreatment photographs were performed by two independent medical evaluators at 1, 3, 6, and 12 months after laser skin resurfacing using the following scale: 0, less than 25% improvement; 1, 25–50% improvement; 2, 51–75% improvement; 3, more than 75% improvement. The incidence and duration of side effects and complications were recorded at each postoperative patient visit.

Results

Dual-mode Er:YAG laser resurfacing for atrophic facial acne scars effected an average clinical improvement score of 2.16 (range 1–3) at the 12-month follow-up evaluation (Figures 1 and 2). The average time to re-

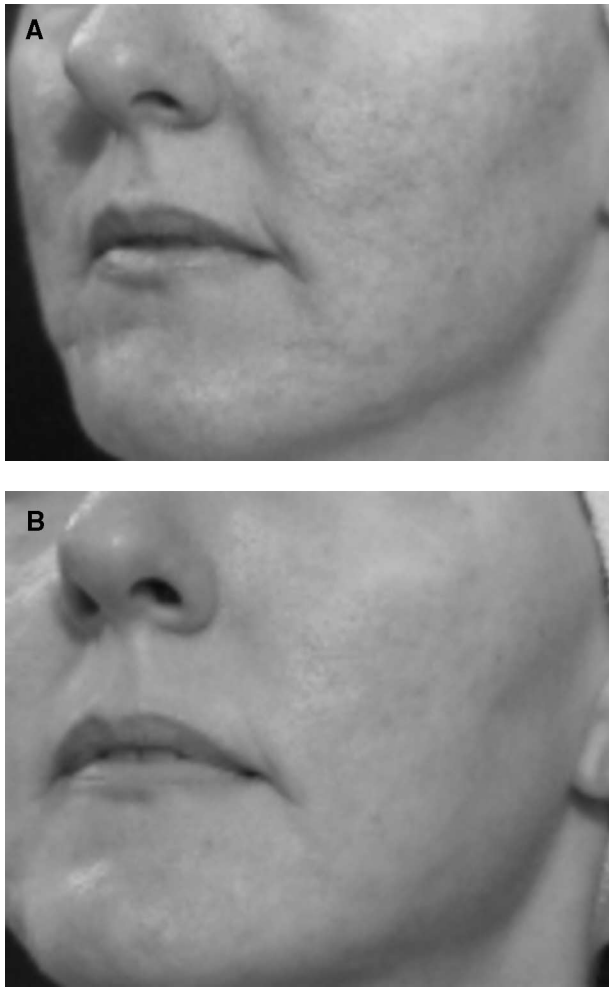


Figure 2. A) Severe atrophic acne scars at baseline. B) Good clinical improvement seen 12 months after Er:YAG laser treatment (score 2).

epithelialization was 5.3 days. Posttreatment erythema (average duration 3 weeks) was seen in all patients studied; however, it persisted longer than 1 month in only one patient (4%). Postinflammatory hyperpigmentation was observed at the 1-month follow-up visit in 11 patients (44%), predominantly in those with darker skin tones. Total resolution of dyspigmentation was noted within an average of 10.6 weeks. Mild acne oc-

curred in 8 patients (32%) during the first postoperative week, presumably due to the use of occlusive ointment. All cases of acne responded without recurrence to oral minocycline (75 mg twice a day for 1 week). Three patients experienced transient milia (12%) requiring no intervention. Dermatitis was noted in 2 patients (8%), both of whom cleared with the use of a mild topical corticosteroid cream. No cases of herpetic or fungal infections were encountered; however, 5 patients (20%) experienced localized superficial bacterial infections that fully cleared on oral ciprofloxacin (500 mg twice a day for 5 days). No hypopigmentation or hypertrophic scarring was observed in any study patient throughout the 12-month study period (Table 1).

Discussion

Cutaneous laser resurfacing represents a major advance in the treatment of atrophic facial scarring. Although previous reports have documented the efficacy of short-pulsed Er:YAG laser resurfacing for the treatment of atrophic scars,³⁴⁻³⁶ few studies have been performed to evaluate the new generation of modulated Er:YAG laser systems for the treatment atrophic facial scarring. Weinstein¹⁸ demonstrated good to excellent results in the majority of study patients treated with a hybrid Er:YAG/CO₂ laser system; however, only 15 of the 78 patients received treatment with the combined Er:YAG/CO₂ modality and no patients were treated with the Er:YAG laser alone (the balance of the patient population being treated solely with the CO₂ system). In the patients treated with the combined modality, the mean time to reepithelialize was 9.6 days and the average duration of erythema was 5.8 weeks. No patient had cosmetically significant hypopigmentation at the 12-month follow-up. Jeong and Kye¹⁹ demonstrated good to excellent results in 26 of 35 patients (74%) treated with a long-pulsed Er:YAG laser for pitted acne scars in Fitzpatrick skin phototypes III-V. Postinflammatory hyperpigmentation occurred in 8 patients (29%) and one case of hypopigmentation was documented in the 3-month follow-up evaluation.

Table 1. Side Effects of Dual-Mode Er:YAG Laser Treatment

Skin type	Number of patients	Prolonged erythema	Hyperpigmentation	Infection	Acne	Milia	Dermatitis	Hypopigmentation	Scarring
I	5	0	0	2	3	1		1	0
II	10	1	1	2	4	2		0	0
III	5	0	5	1	1	0		1	0
IV	3	0	3	0	0	0		0	0
V	2	0	2	0	0	0		0	0
VI	0	0	0	0	0	0		0	0
Total	25	1 (4%)	11 (44%)	5 (20%)	8 (32%)	3 (12%)		2 (8%)	0

The results of the present and previous studies highlight several important issues. First, the duration of the postoperative recovery process and incidence of prolonged erythema may be lower with dual-mode Er:YAG laser skin resurfacing than with CO₂ laser resurfacing for atrophic facial scarring on a pass-per-pass basis at typical treatment fluences and operative technique. Second, transient postinflammatory hyperpigmentation is common and may last significantly longer than that seen after short-pulsed Er:YAG laser resurfacing; however, it may not be as persistent as that experienced after CO₂ laser resurfacing.²⁶ Third, although delayed permanent hypopigmentation was not observed in our patient series, it is not unheard of. Sapijaszko and Zachary noted two patients with hypopigmentation in more than 100 procedures.^{17,37} Last, the average clinical improvement seen following dual-mode Er:YAG laser treatment for atrophic facial scars is slightly less than that seen after CO₂ laser resurfacing as compared to previous studies.¹³ This finding is in agreement with previous clinical and histologic studies comparing the effects of high-energy CO₂ and modulated Er:YAG laser resurfacing.^{38,39} Additional side-by-side comparison studies between dual-mode Er:YAG and CO₂ laser skin resurfacing for the treatment of atrophic facial scarring are necessary to fully delineate the advantages and disadvantages of each technique.

In conclusion, the dual-mode Er:YAG laser is a safe and effective modality for the treatment of atrophic facial scarring. The modulated Er:YAG lasers offer an advantage over short-pulsed Er:YAG resurfacing by effecting better hemostasis and improved clinical outcomes. Although the clinical improvement observed in this study is not equal to the results typically obtained after CO₂ laser resurfacing, dual-mode Er:YAG laser resurfacing is a valuable technique and may be associated with a less complicated postoperative recovery period and less persistent hyperpigmentation, which is of particular value when treating patients with darker skin tones. Although the risk of delayed hypopigmentation is likely lower than that seen observed after CO₂ laser skin resurfacing, additional confirmational studies are warranted to assess its true incidence.

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