

Resurfacing of Atrophic Facial Acne Scars with a High-Energy, Pulsed Carbon Dioxide Laser

TINA S. ALSTER, MD
TINA B. WEST, MD

BACKGROUND. Treatment of atrophic acne scars has been limited to the use of such traditional treatments as dermabrasion and chemical peels for many years. Recently, the addition of high-energy, pulsed carbon dioxide (CO₂) lasers to the treatment armamentarium has created renewed enthusiasm for cutaneous resurfacing due to their ability to create specific thermal injury with limited side effects.

OBJECTIVE. To determine the effectiveness of a high-energy, pulsed CO₂ laser in eliminating atrophic facial scars and to observe for side effects.

METHODS. Fifty patients with skin phototypes I-V and moderate to severe atrophic facial acne scars were included in the study. Each patient received one high-energy, pulsed CO₂ laser treatment using identical laser parameters by the same experienced laser surgeon. Baseline and 1-, 4-, 8-, 12-, and 24-week postoperative photographs and clinical assessments were obtained in all

patients. Textural analyses of skin before and after laser irradiation were obtained in 10 patients to confirm clinical impressions. Clinical evaluations were conducted independently by two blinded assessors.

RESULTS. There was an 81.4% average clinical improvement observed in acne scars following laser treatment. Skin texture measurements of laser-irradiated scars were comparable to those obtained in normal adjacent skin. Side effects were limited to transient hyperpigmentation lasting an average of 3 months in 36% of patients. Prolonged erythema (2 months average) was usual and considered to be a normal healing response. No hypertrophic scarring was observed following laser treatment.

CONCLUSION. High-energy, pulsed CO₂ laser treatment can safely and effectively improve or even eliminate atrophic facial scars and provides many benefits over traditional treatment methods. *Dermatol Surg* 1996;22:151-155.

Atrophic facial scars occur frequently, most often as a consequence of severe acneiform episodes during the teenage years. Many patients seek treatment for the disfigurement caused by the obvious variations in skin texture. Various treatment modalities, alone and in combination, have been used to treat atrophic scars, including dermabrasion, excisional surgery with closure, punch grafting and elevation, collagen implants, silicone injections, chemical peeling, and laserabrasion.¹⁻⁶ Each of these treatments has been limited by side effects, most notably, scarring and pigmentary alteration. With the recent development of high-energy, pulsed carbon dioxide (CO₂) lasers that minimize thermal injury to uninvolved adjacent tissue structures, the risk of complications following laser treatment can be significantly reduced.^{7,8} The aim of this study was to evaluate the efficacy of a high-energy, pulsed CO₂ laser in the treatment of moderate to severe atrophic facial scars.

From the Washington Institute of Dermatologic Laser Surgery and Georgetown University Medical Center (TSA); and the Washington Hospital Center (TBW), Washington, DC.

Address correspondence and reprint requests to: Tina S. Alster, MD, 2311 M Street, NW, Suite 200, Washington, DC 20037.

Materials and Methods

Fifty patients (44 females, 6 males; ages, 21-69 years; mean, 40.2 years) with moderate to severe atrophic facial scars were included in the study. Skin phototypes ranged from I to V (Table 1). No patients had received Accutane treatment within the previous 2 years. Twelve patients (22%) had received prior dermabrasion to the involved areas. Ten patients (20%) had collagen or silicone injections in the remote past.

All patients received laser treatment to both cheeks extending from the nasolabial folds to the preauricular area and jawline in an outpatient setting with a high-energy, pulsed CO₂ laser (Coherent Laser Corporation, Palo Alto, CA). The laser was calibrated in the Ultrapulse mode at 500 mJ and 5-7 W, using a 3-mm spot delivered through a collimated hand-piece. Laser pulses were placed adjacent to one another without overlapping, thereby preventing char formation. Anesthesia was obtained with regional trigeminal and lateral branch nerve blocks using 1% lidocaine with 1:100,000 U epinephrine, rather than with local infiltration in order to avoid distention of the tissues. After each laser pass, the residual coagulated skin was removed with saline-soaked gauze. Additional laser passes (range, 2-5 passes) were delivered according to the clinical response observed. Treatment endpoints were readily determined in the bloodless field by relative effacement of the scars or the appearance of yellowish discoloration within the laser-irradiated tissue (possibly suggesting deeper penetration to the reticular dermis or cumulative thermal damage).

Immediately following treatment, a topical antibiotic (Bacitracin or Polysporin) ointment was applied. The patient was instructed to gently rinse the face with cool water several

Table 1 Patient Characteristics and Clinical Response to Laser Treatment

Skin Phototype	Number of Patients	Previous Dermabrasion	% Clinical Improvement	Hyperpigmentation	Hypopigmentation
I	5	0	80-90 (84.0)	0	0
II	29	9	70-90 (81.4)	8	2
III	12	2	70-90 (81.7)	2	1
IV	3	0	70-90 (80.0)	1	0
V	1	1	70 (70.0)	1	0
Total (Average)	50	12	70-90 (81.4)	12	3

times daily, followed by antibiotic ointment application. Ice packs and round-the-clock acetaminophen were prescribed for the first 24-48 hours to reduce swelling and discomfort. Patients with a history of oral herpes simplex received prophylactic Acyclovir for 1 week. Patients were evaluated at 7 days postoperatively at which time any residual coagulated debris was cleansed with hydrogen peroxide. All patients were able to apply sunscreen and camouflage makeup with instruction by 7-10 days postoperatively.

Sequential photographs using identical lighting, patient positioning, photographer, camera settings, and film processing were taken of all treatment areas prior to, and 1, 4, 8, 12, and 24 weeks following, laser irradiation. Evaluations of each patient's clinical response to treatment were made independently by two blinded nurse assessors. The degree of improvement was determined as the percent reduction in clinical scarring relative to the normal surrounding skin in gradations of 10%, with a 100% rating designated when the laser-treated skin texture appeared indistinguishable from that of the normal untreated surrounding skin. The degree of erythema and/or presence of hyperpigmentation (or other side effects) was noted at each visit.

Textural analyses of rubber silicone skin surface casts (Sy-ringe Elasticon; Healthco International, Marlborough, MA) before and after laser treatment were obtained in 10 patients using a computer-generated optical profilometry program.⁹ The textural measurements (Ra values) obtained from the surface impressions objectively reflect skin surface markings, with fewer markings (lower Ra values) noted across the surface of scars.

Results

There was an average clinical improvement of 81.4% (range, 70-90%) (Table 1 and Figures 1 and 2). No hypertrophic scarring or additional fibrotic tissue changes were observed in laser-irradiated skin. In fact, patients reported an increase in pliability and smoothness in treated skin. The improvement in skin texture was confirmed by optical profilometry measurements of silicone rubber skin surface casts (Figure 3). Erythema lasting an average of 2 months (range, 6 weeks to 3 months) was typical following laser treatment. The incidence of hyperpigmentation (36% overall) was slightly more prevalent in patients with darker skin tones, but was observed in all skin phototypes following laser irradiation. When present, it was initially noted within 3-4 weeks following laser treatment and persisted for 3 months, despite the use of a twice daily topical bleach-

ing regimen consisting of a mixture of 4% hydroquinone cream with sunscreen and 1% hydrocortisone cream. Residual hypopigmentation was observed in three patients who had received prior dermabrasion. The hypopigmentation did not appear worse following laser irradiation of the areas. Milia formation within laser-irradiated skin was observed in seven patients (14%). No bacterial or viral infections were experienced.

Figure 1. Severe atrophic scars in a 42-year-old woman A) before and B) 8 weeks following high-energy, pulsed CO₂ laser treatment showing 80% clinical improvement.



A



B

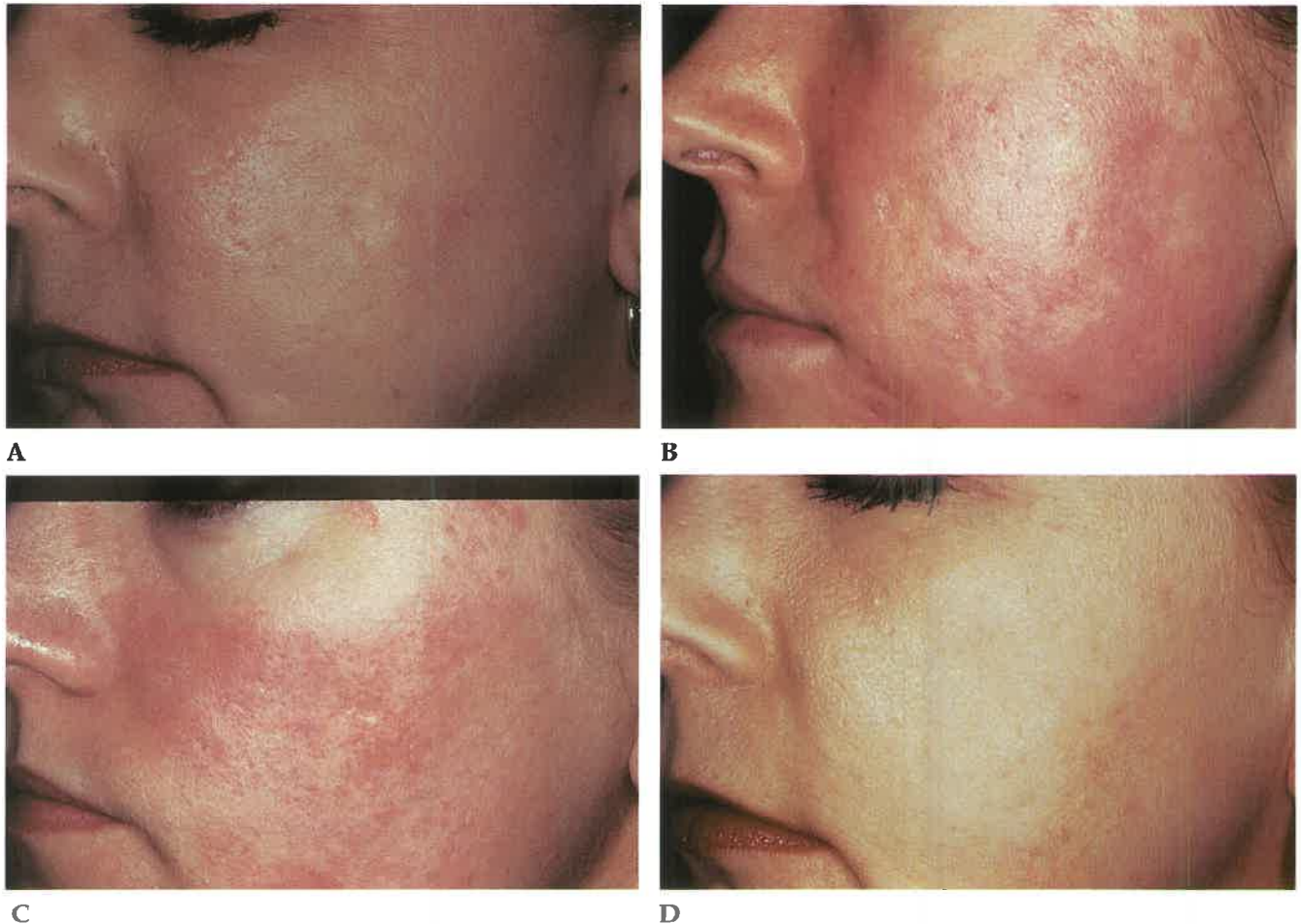


Figure 2. Twenty-nine-year-old woman with moderate atrophic scars A) before laser treatment and B) 1 week, C) 1 month, D) and 2 months after laser treatment.

Discussion

Due to the recent introduction of the newest high-energy, pulsed CO₂ laser technology, previous reports of its use in atrophic scarring have been limited. Fitzpatrick⁷ showed impressive clinical results in a small series of cases using energies ranging from 250 to 500 mJ and 2–5 W power. Weinstein and Alster⁸ also reported excellent scar responses at 500 mJ and 5–10 W.

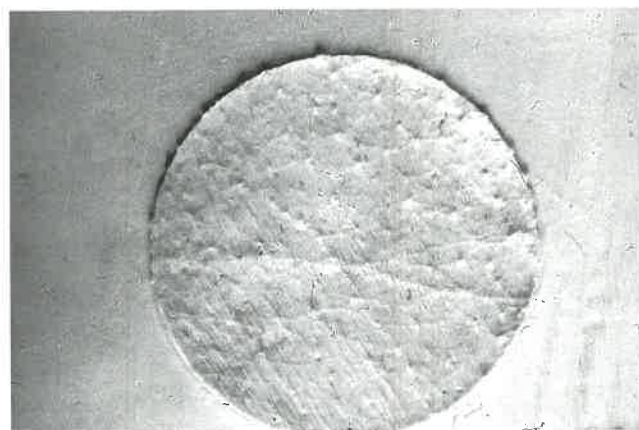
The obvious advantage of the high-energy, pulsed CO₂ laser system over its predecessors (ie, superpulsed CO₂ lasers or scanned continuous wave CO₂ lasers) lies in its ability to limit heat conduction to the surrounding skin.^{10–14} Thus, scarring and other pigmentary/textural changes are minimized following laser irradiation. In a clinical comparison, the ultrapulse high-energy, pulsed CO₂ laser yielded slightly improved responses with fewer laser passes than the Surgipulse high-energy CO₂ laser in the treatment of periorbital rhytides.¹⁵ The fact that the fibrotic tissue present in scars does not absorb laser energy as well as the surrounding normal skin raises concerns about the absolute number of laser passes required to achieve the desired effect. The need

to perform several passes over a scarred area may increase the risk of scarring due to the accumulated thermal tissue injury. Thus, a laser that can maximize tissue vaporization per pulse is desirable. The ultrapulse high-energy CO₂ laser system is best able to accomplish this, as the majority of the energy delivered exceeds the critical irradiance needed to effect tissue vaporization.

The results of this study demonstrate several important issues. First, the clinical improvement seen following high-energy, pulsed CO₂ laser treatment is substantial (average, 81.4%) and apparently long-standing (all patients were followed for 6 months without return or worsening of scars). Second, hyperpigmentation is common (36% of patients), lasts an average of 3 months, and can be seen in any skin type. Third, close follow-up is needed after laser treatment in order to maximize patient satisfaction and achieve the ultimate clinical results seen (ie, hasten clearing of hyperpigmentation by topical hydroquinone preparations). Last, it is important to be experienced in the actual laser procedure with regard to selecting the appropriate laser parameters for different cosmetic regions and skin types, determining



A



B

Figure 3. Silicone rubber skin surface casts of atrophic cheek scars A) before and B) 6 months after high-energy, pulsed CO₂ laser cutaneous resurfacing.

the number of laser passes required during treatment, and in "sculpting" or "feathering" edges of scars.

In conclusion, the high-energy, pulsed CO₂ laser is an ideal tool for resurfacing atrophic facial scars. Because of its precision and limited thermal injury, diffi-

Commentary

The article by Alster and West on resurfacing of facial acne scars with the CO₂ laser really represents more than just another article hyping or trying to cash in on the latest improvements in laser technology. Resurfacing, after all, is not a new technique. Although the first article describing CO₂ resurfacing was published in 1990, the procedure had already been in use and verbally reported on some three to five years earlier. Resurfacing of peri-oral wrinkles with the laser alone or in conjunction with a chemical peel followed shortly thereafter.

This article brings into focus several very important points. The first and perhaps most important is that the advances in laser technology have truly simplified perfor-

cult skin types and cosmetic areas can be treated with minimal risk of untoward complications, such as scarring or permanent pigmentary alteration.

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mance and minimized adverse sequelae to the patient. Although conventional CO₂ lasers had been used successfully for resurfacing, the procedures were very technique dependent. Good results really required appropriate hand speed and a sort of sixth sense of how not to deliver an inordinately large amount of thermal damage to tissue. Current technology with both high energy pulsed CO₂ lasers and "soft touch" scanning devices has made these procedures significantly more user-friendly, while at the same time lessening the chances of undesirable results to the patient.

The second important point brought out by this article is that techniques such as resurfacing have multiple applications. The current blitz on resurfacing of wrinkles is certainly

targeting high profits for both manufacturer and physician alike. Unfortunately, this type of publicity can cause one to lose sight of the importance of the procedure itself. Resurfacing of facial scarring is clinically significant and of tremendous importance to patients who suffer from the sequelae of some earlier inflammatory condition or physical trauma. Other clinically important roles for resurfacing exist as well.

Today's technology has at least temporarily shifted the spotlight back onto the CO₂ laser. It can make these proce-

dures safer, simpler, and almost idiot-proof. However, as physicians we should not take too much for granted and not view all at face value. The proper use of such technology still requires good medical judgement, an appropriate level of training, and the surgical skill to be able to offer the patient options to resurfacing, as well as the ability to correct mistakes or unwanted sequelae should they occur.

*John Louis Ratz, MD, FACP
New Orleans, Louisiana*

