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Treatment of Facial Rhytides with a High-Energy Pulsed Carbon Dioxide Laser

Facial rhytides are a common problem that often presents for treatment. Because of the tendency for rhytides to involve delicate tissue areas, traditional treatment modalities have been limited by complications of scarring or pigmentary alterations. With the advent of the new-generation high-energy pulsed carbon dioxide lasers, skin requiring resurfacing can now be treated successfully with minimal risk and side effects.

This study included 259 patients with facial rhytides (104 perioral, 83 periorbital, 53 glabellar, and 17 forehead). Each patient received treatment with a high-energy pulsed CO\textsubscript{2} laser system, and individual responses were evaluated independently by two blinded assessors at 1, 4, 8, 12, and 24 weeks postoperatively. While clinical response rates were uniformly excellent, they varied in different locations. On average, there was a 90 percent improvement in all areas under study. The periorbital regions responded best, an average 93 percent improvement being seen. The facial rhytides with the lowest response rates (86.8 percent) were those which were most severe and those caused by excessive muscle movement (i.e., frown lines at the glabella). No incidences of scarring were noted, but erythema persisting 1 to 3 months (mean 2.2 months) following laser irradiation was typical. Transient postinflammatory hyperpigmentation of 3 months' average duration was seen in 30 percent of patients and was not limited to those individuals with darker skin tones.

The high-energy pulsed carbon dioxide laser is a safe and effective treatment for facial rhytides. Treatment can be delivered in an outpatient setting without the need for general anesthesia, and preliminary evidence suggests long-lasting results. (Plast. Reconstr. Surg. 98: 791, 1996.)

Traditional treatments for facial rhytides have included face lifting procedures and blepharoplastics, alone or in combination with chemical peels and dermabrasion. Unfortunately, these procedures were limited in their ability to treat fine rhytides located around the eyes and mouth because of their tendency to cause pigmented changes, scarring, and/or ectropion.\textsuperscript{1-4}

The etiology of fine facial rhytides is multifactorial, including repetitive muscle movements (i.e., frowning, smiling, squinting) and smoking. The majority of these wrinkles, however, can be attributed to cumulative photodamage with a resulting loss of dermal elasticity.

While CO\textsubscript{2} laser cutaneous resurfacing is not a new technique, older continuous-wave CO\textsubscript{2} laser systems were unable to limit thermal injury only in their intended targets.\textsuperscript{5-7} Thus scarring continued to be a concern. Even with the advent of the "superpulsed" CO\textsubscript{2} laser systems, heat conduction to normal surrounding skin remained a problem.\textsuperscript{8-13} The newest generation of high-energy pulsed ("ultrapulse") CO\textsubscript{2} lasers imparts minimal thermal injury to uninvolved skin by producing high-energy bursts that allow maximal lesional ablation without significant heat conduction. Their use is therefore ideally suited for delicate tissue areas with a high risk of scarring. This study was initiated to determine the effectiveness of a high-energy pulsed CO\textsubscript{2} laser in the treatment of various facial rhytides.

Patients and Methods

All individuals who presented to the Washington Institute of Dermatologic Laser Surgery for resurfacing of facial rhytides between September 1, 1994, and December 31, 1994, were entered into the study. A total of 259 subjects (mean age 50.1 years) were included in the study (Table I). All skin phototypes were included. Patients were excluded if collagen or substances had been injected subcutaneously in the previous 6 months or if Accutane had been administered within the last 2 years. All patients
TABLE I
Patient Characteristics

<table>
<thead>
<tr>
<th>Location</th>
<th>Number</th>
<th>Females</th>
<th>Males</th>
<th>Mean Age</th>
<th>Mild (&lt;1 mm)</th>
<th>Moderate (1-2 mm)</th>
<th>Severe (&gt;2 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perioral</td>
<td>104</td>
<td>103</td>
<td>1</td>
<td>52.0</td>
<td>29 (28%)</td>
<td>52 (50%)</td>
<td>23 (22%)</td>
</tr>
<tr>
<td>Periorbital</td>
<td>83</td>
<td>79</td>
<td>4</td>
<td>48.7</td>
<td>33 (40%)</td>
<td>45 (54%)</td>
<td>5 (6%)</td>
</tr>
<tr>
<td>Glabella</td>
<td>53</td>
<td>51</td>
<td>2</td>
<td>48.5</td>
<td>11 (21%)</td>
<td>33 (62%)</td>
<td>9 (17%)</td>
</tr>
<tr>
<td>Forehead</td>
<td>19</td>
<td>17</td>
<td>2</td>
<td>49.8</td>
<td>5 (26%)</td>
<td>11 (58%)</td>
<td>3 (16%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>259</td>
<td>250</td>
<td>9</td>
<td>50.1</td>
<td>78 (30%)</td>
<td>141 (54%)</td>
<td>40 (15%)</td>
</tr>
</tbody>
</table>

consented to have their lesions photographed prior to laser treatment and again 1, 4, 8, 12, and 24 weeks following surgery.

The same experienced laser surgeon (Alster) performed all procedures using a high-energy pulsed CO₂ laser (Coherent Laser Corporation, Palo Alto, Calif.). Anesthesia was obtained through appropriate nerve blocks (via first, second, and/or third trigeminal branches) using 1% lidocaine with 1:100,000 epinephrine rather than intraleisional injections in order to avoid distortion of the rhytides. The laser was calibrated in the ultrapulse setting at 500 mJ energy and 5 to 7 W power using a 3-mm spot through a collimated handpiece. Laser pulses were delivered in an adjacent, nonoverlapping fashion within appropriate cosmetic units for each lesion. Following each laser pass, the coagulated skin was wiped clean with saline-soaked gauze. Additional laser passes (range one to five) were delivered until the rhytides were no longer detectable or until a yellowish skin discoloration appeared (indicating reticular dermal penetration).

Postoperatively, patients were instructed to gently rinse the laser-irradiated areas with cool water and to apply topical antibiotic ointment several times daily for 1 week. Ice packs and acetaminophen were prescribed to alleviate associated swelling and discomfort, particularly in the first 24 to 48 hours following treatment. Those patients with a history of oral herpes simplex received prophylactic acyclovir for 7 days following surgery. Patients returned in 1 week for clinical evaluation and removal of residual cutaneous crusting with hydrogen peroxide.

Patients were evaluated independently by two blinded observers at 1, 4, 8, 12, and 24 weeks following laser treatment. The degree of improvement was determined as the percentage reduction in clinical rhytides relative to the normal surrounding skin in gradations of 10 percent, with a 100 percent rating designated when the laser-treated skin texture appeared indistinguishable from that of the normal, untreated surrounding skin. Photographs of laser-irradiated sites were obtained at these same time intervals using identical lighting, patient positioning, camera settings, and film-processing techniques. Patients were evaluated for the degree of erythema present within the irradiated sites and the appearance of any side effects, such as scarring, infection, or pigmentary alteration.

RESULTS

All patients responded favorably to laser treatment, with an average clinical improve-

![Fig. 1. A 72-year-old woman with perioral rhytides of moderate severity before (above) and 10 weeks following (below) one treatment with the high-energy pulsed CO₂ laser.](image-url)
TABLE III
Side Effects Following Laser Treatment

<table>
<thead>
<tr>
<th>Location</th>
<th>Duration of Erythema</th>
<th>Hyperpigmentation</th>
<th>Hypopigmentation</th>
<th>Infection</th>
<th>Scarring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perioral</td>
<td>2.36 mos.</td>
<td>31%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Periorbital</td>
<td>1.86 mos.</td>
<td>31%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Glabella</td>
<td>2.47 mos.</td>
<td>32%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Forehead</td>
<td>2.11 mos.</td>
<td>26%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2.20 mos.</td>
<td>30.8%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
DISCUSSION

The recent development of high-energy pulsed carbon dioxide lasers has generated much renewed enthusiasm for cutaneous resurfacing. These newer pulsed laser systems have virtually eliminated the risk of scarring that continued to be apparent in older continuous-wave CO\textsubscript{2} laser systems. By limiting the thermal conduction to the specified target, adjacent normal skin is spared from injury.

This large-scale study demonstrates the clinical advantages of utilizing a high-energy pulsed system in skin regions traditionally thought to be too delicate for vigorous treatment (i.e., peri-orbital and perioral areas). Similar results (without significant adverse sequelae) have not been obtained using chemical peeling techniques, dermabrasion, or even older "superpulsed" CO\textsubscript{2} laser systems. Alster\textsuperscript{14} achieved significantly improved results with fewer laser passes using the Ultrapulse CO\textsubscript{2} laser compared with the Surgipulse CO\textsubscript{2} laser in the treatment of periorbital rhytides. The improved efficacy of the Ultrapulse system appeared to be related to its superior ability in achieving the critical irradiances required for char-free tissue ablation.

In conclusion, a high-energy pulsed CO\textsubscript{2} laser system such as the Ultrapulse CO\textsubscript{2} laser optimizes laser-tissue interaction critical for successful cutaneous resurfacing and can provide excellent clinical results. While the new laser systems can effectively ablate skin in traditionally delicate areas, it is clear that the procedure is operator-dependent and should therefore be approached cautiously.

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REFERENCES