Multicenter Study of the Safety and Efficacy of a 585 nm Pulsed-Dye Laser for the Nonablative Treatment of Facial Rhytides

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OBJECTIVE. The objective of this study was to assess the safety and efficacy of a 585 nm flashlamp pulsed-dye laser for the nonablative treatment of facial rhytides.

METHODS. A multicenter prospective randomized controlled study on 58 volunteers was performed. A split-face approach was adopted, with one periorbital region acting as a control and the other receiving either one or two treatments. Patients were photographed and imaged three-dimensionally before and after treatment. Histologic sections were analyzed.

RESULTS. Three-dimensional topographic evaluation showed improvements of 9.8% (\( p = .0022 \)) and 15% (\( p = .0029 \)) in surface roughness for single and double treatments, respectively. Histology revealed an increase in type I collagen messenger ribonucleic acid expression, type III procollagen, chondroitin sulfate, and grenz zone thickness. Two treatments resulted in greater improvement than one treatment.

CONCLUSION. Clinical improvement was achieved following a single treatment. Further improvement was observed following a second treatment. The subjective evaluation of clinical improvement was consistent with both histologic and topographic quantitative measurements.

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ONE OF the earliest manifestations of skin aging is the appearance of facial rhytides. The severity of the rhytides is dependent on numerous factors, including age, degree of ultraviolet-induced photodamage, and exposure to other external factors, such as pollution, medications, and tobacco use.1–4

Several nonablative laser and light-based technologies have been used for the treatment of facial rhytides, with varying clinical outcomes.5–8 The proposed mode of action of these approaches is the initiation of a wound healing process in response to nonspecific thermal injury to the dermis, the overlying epidermis being protected from damage by concurrent topical cooling.

The use of vessel-specific pulsed-dye lasers has been shown to improve the appearance of facial wrinkles without the need for epidermal protection. In this case, the mode of action is thought to be the stimulation of the microvasculature to release mediators into the extracellular matrix, thereby triggering fibroblast activity and the production of new dermal collagen. The initial study using a 585 nm pulsed light showed cosmetic improvement with transient purpura indicative of vessel rupture.9 More recent studies have shown that with a modified pulse duration specifically tailored to target the healthy microvasculature in the upper dermis, significant cosmetic improvement can be achieved without purpura or significant side effects.10

Purpura-free pulsed-dye laser nonablative therapy, without side effects and pain, is an attractive treatment option. The published literature on these nonablative approaches has, in general, been based on subjective analysis of the treatment outcome, relatively low patient numbers, and limited investigation into the histologic effects of the treatment. The purpose of this study was to qualitatively and quantitatively assess the
degree of clinical improvement using this modality in a multicenter controlled study with a broad patient population.

Materials and Methods

Study Population

Fifty-eight patients were enrolled into this institutional review board–approved study after informed consent was obtained. The patients had skin phototypes I to IV and Fitzpatrick photodamage scores 3 to 9. Twelve patients with varying degrees of periorbital rhytides were enrolled at four clinical sites, and nine patients were enrolled from one site. All subjects were recruited from the existing patient population from each of the centers. Brief medical histories were taken, including the use of concurrent medication and tobacco use. The eligibility criteria for this study are listed in Table 1.

Study Design

The periorbital region was selected as the treatment site. Patients were randomized as to which side of the face received treatment, with the opposite side remaining as an untreated control. All patients received at least one laser treatment to the selected side; further randomization was performed to determine which patients received an additional laser treatment 2 weeks following the initial treatment. Prior to treatment, both periorbital regions were photographed with standard 35 mm film and three-dimensional images taken in vivo using a fringe projection microtopography system (PRIMOS [Phase-shift Rapid In Vivo Measurement of Skin], GF Messtechnik, Tetlow, Germany). Laser treatment was performed using a flashlamp pulsed-dye laser (Nlite, ICN Photonics Ltd, Wales, UK) operating at a wavelength of 585 nm, a pulse duration of 350 μs, and a spot size of 7 mm diameter. Laser irradiation consisted of a single pass at an average energy density of 2.7 J/cm² (range 2.4–2.9 J/cm²), ensuring uniform coverage with minimal overlap. One gauge used for the treatment side allowed the laser light to pass through. The other attenuated 99% of the laser light, for a sham treatment to the control side. Those patients selected to receive an additional treatment did so at the same parameters as the initial treatment. No topical or local anesthesia was used in conjunction with the procedure. Immediate reaction to the treatment was recorded, and at the subsequent follow-up visits, patients were reviewed for signs of adverse effects. Subjects were asked to rate the level of pain: 0 for no pain, 1 for mild pain, 2 for moderate pain, and 3 for severe pain. A similar scale for erythema was used, with 0 for no erythema and up to 4 for severe erythema. Follow-up review visits were undertaken at 30 and 90 days after the last treatment.

Evaluation Procedure

Subjective Photographic Evaluation

Blinded evaluations were performed by four independent physicians on randomized photographs. Patient positioning, camera positioning, and lighting were standardized in all photographs. Each reviewer assessed individual photographs and graded the patients’ wrinkle severity using the Fitzpatrick scale.11 Reviewers also graded (absent, mild, moderate, severe) hyperpigmentation and degree of overall photoaging.

Quality of Life Survey

Subjects were given a survey at both 90 and 180 days after the treatment. They were asked to rate the improvement of both sides of their face using a rating scale of 0 for no improvement, 1 for little improvement, 2 for some improvement, and 3 for significant improvement. They were also asked to rate the side that they thought was most improved, choosing either the left, the right, or neither. For analysis, this was translated into treatment side, control side, or neither side.

Surface Topography

Three-dimensional data of the skin surface obtained using the microtopography system were analyzed. Before and after digital images were software-matched to ensure correct orientation, allowing accurate measurements to be performed on identical anatomic
results in Rz before and after compared with those quantified independently of feature orientation. The differences in Rz before and after were statistically analyzed.

Digital microtopographic systems are capable of quantifying surface changes using various criteria, including surface roughness (Rz).\(^{12}\) Rz is defined as the average deviation from the mean height of a given cross-section. Using 16 radial profile lines, Rz can be quantified independently of feature orientation. The differences in Rz before and after compared with those for the control side were statistically analyzed.

**Histopathologic Examination**

Three-millimeter punch biopsies were taken from sun-damaged preauricular skin prior to laser treatment, immediately post-treatment, and at the 90-day review point following either one or two treatments. Biopsies were obtained from three subjects in the single-treatment group and from the double-treatment group. Harvested samples were fixed in buffered formalin, sectioned and stained with either hematoxylin-eosin or Verhoeff-van Gieson stain, and then evaluated by a microscopist (D.B.B.) blinded to the treatment conditions.

For immunoperoxidase staining, paraffin-fixed sections were deparaffinized, rehydrated, and incubated with a primary monoclonal or polyclonal antibody. A secondary biotinylated antibody was then applied. For colorization, a streptavidin-horseradish peroxidase enzyme conjugate was then added. Stained samples were photographed using a digital camera (DCS 450, Eastman Kodak, Rochester, NY, USA). A blinded analysis was performed, rating the extent of staining and the relative comparison made.

To quantify collagen type I messenger ribonucleic acid (mRNA) (COL1A1), total ribonucleic acid (RNA) was isolated from human skin biopsies using QIAshredders and RNeasy kits (Qiagen, Valencia, CA, USA); 5.5 µg of total RNA was separated using gel electrophoresis, transferred to a filter, and then analyzed by Northern hybridization with a 1.8 kb human COL1A1 complementary deoxyribonucleic acid (cDNA)-[\(^{32}\)P]labeled probe. The [\(^{32}\)P]labeled cDNA-mRNA hybrids were visualized by autoradiography, and the steady-state levels of mRNA were quantified by scanning densitometry. The collagen probe was removed from the filter and was rehybridized with a 1.1 kb human glyceraldehyde-3-phosphate dehydrogenase (G3PDH) cDNA-[\(^{32}\)P]labeled probe (BD Biosciences Clontech, Palo Alto, CA, USA). G3PDH levels were determined by scanning densitometry and were then used to normalize the COL1A1 levels.

**Statistical Analysis**

Topographic measurements taken at baseline and 90 days post-treatment were compared using a paired-sample two-tailed t-test, with significance taken at the standard \(p < 0.05\) point. Data obtained from the blinded photographic evaluation were analyzed using the Wilcoxon signed rank test to quantify the degree of improvement against the known reference scale of wrinkle severity.

**Results**

**Patient Statistics**

This study was composed of 58 subjects, 3 men and 55 women. Of these, 29 individuals underwent two treatments. The ages of the subjects ranged from 34 to 81 years, with a mean age of 54.6 years. There were 30 nonsmokers, 13 former smokers, and 15 current smokers in the study. Thirty-seven of the individuals were reported to have a skin type of II, 19 had a skin type of III, and 2 individuals had a skin type of IV.

Thirty-nine of the 58 subjects reported some level of pain at the first treatment session, whereas 19 reported no pain. Thirty-seven of these individuals rated their pain at level 1, and 2 rated their pain at level 2. At the second treatment, 10 of the 29 subjects reported no pain. Nineteen subjects reported some level of pain, with 18 individuals rating their pain at level 1 and only 1 individual rating the pain at level 2. One individual reported pain at level 1 at the 30-day follow-up.

Whereas 34 subjects reported no erythema, 24 of the 58 subjects reported some level of redness at the first treatment, with 22 rating their redness at level 1 and two rating their redness at level 2. At the second treatment, 13 of the 29 individuals reported redness, all at level 1. One individual reported redness at level 1 at the 30-day follow-up.

**Treatment Side Effects**

The immediate response to the treatment was a slight reddening of the irradiated area that faded within several hours. There were no reported incidences of skin blistering or purpura. Pain was not recorded as significant, and the treatment was well tolerated. Evaluation of the skin appearance at all review points showed no incidences of hyper- or hypopigmentation or any abnormal textural changes.

**Photographic Evaluation**

Only 36 sets of photographs were of sufficient quality to allow grading. There was no difference between the treatment and the control side for hyperpigmentation and erythema at baseline (\(p = .8840\)) and at the 90-day follow-up (\(p = .8382\)). There was also no difference found in the photographic evaluation in respect to
overall photoaging between treatment and control sides both pretreatment \((p = .6190)\) and 90 days post-treatment \((p = .3037)\). Likewise, there was no difference between treatment and control sides for the Fitzpatrick wrinkle severity scores both pretreatment \((p = .3795)\) and 90 days post-treatment \((p = .8327)\).

**Patient Survey**

Significant differences were found in the improvement score from the patient surveys given to the subjects for individuals in the double-treatment group. When asked to rate the improvement of both sides of their face \((0\) for no improvement, \(1\) for little improvement, \(2\) for some improvement, and \(3\) for significant improvement), the score was, on average, 1.72 higher for the treatment side versus the control side at 90 days in the double-treatment group. The Wilcoxon signed rank test found this to be significant \((p = .0002)\). There was also a difference of 0.619 found in the improvement score between the two sides at 180 days, which was also significant \((p = .0234)\). No significant differences were detected in the single treatment group using the Wilcoxon signed rank test, with \(p\) values of .1387 and .7266 for the 90- and 180-day follow-ups, respectively.

When asked to choose whether the treatment side or the control side produced greater improvement or whether there was no difference, subjects in both the single- and double-treatment groups most frequently reported the treatment side to have improved the most at 90 and 180 days post-treatment. For the single-treatment group, 54.55\% of individuals reported the treatment side as most improved at 90 days post-treatment, 36.36\% reported no difference between the two sides, and 9.09\% reported that the control side improved more. This was found to be significant using the chi-square test for equal proportions \((p = .0316)\).

At 180 days, 59.09\% of the single-treatment group reported the treatment side as more improved, whereas 31.82\% and 9.09\% reported that there was no difference between the two sides and that the control side was better, respectively. This was also significant \((p = .0160)\). The differences were even more striking for the double-treatment group: 77.27\% reported the treatment side as more improved 90 days post-treatment, whereas 22.73\% reported no difference between the two sides \((p = .0105)\). No subjects reported that the control side was more improved. At the 180-day follow-up, 75\% of subjects reported the treatment side as being more improved, with 20.83\% and 4.17\% reporting neither side and the control side, respectively \((p < .0001)\). There were no significant differences whether or not the volunteers were smokers.

**Surface Topography**

Three-dimensional data were obtained for 36 of the enrolled subjects. The data from the remaining subjects were not incorporated into the analysis owing to an inability to software-match paired control and treatment topographic images. Table 2 details the surface profilometry measurements for the treatment and control sites for the two subject groups. Pretreatment baseline analysis showed that the difference in \(R_z\) between the control and treatment sites was not statistically significant \((p = .9526)\) in the single-treatment group and \(p = .1909)\) in the double-treatment group).

In the single-treatment group, the \(R_z\) in the treated area decreased by 9.8\% \((p = .0022)\), whereas in the corresponding control area, the \(R_z\) increased by 6.2\% \((p = .1513, \text{nonsignificant})\). In the double-treatment group, the \(R_z\) decreased in the treated area by 15\% \((p = .0029)\), whereas the control area showed no measurable difference \((p = .99)\).

**Histopathologic Evaluations**

Immediately post-treatment, the integrity of the epidermis appeared to be intact and there was no evidence of dermal blood vessel rupture, endothelial damage, or extravasation of cells (Figure 1). This is consistent with the clinical evaluation showing no evidence of skin blistering or purpura immediately following laser irradiation.

Evaluation of the samples taken 90 days following single laser treatment showed no measurable differences in grenz zone thickness, chondroitin sulfate, or type III procollagen staining.

**Table 2. Results of Three-Dimensional Surface Topographic Analysis**

<table>
<thead>
<tr>
<th></th>
<th>Single-Treatment Group ((n = 18))</th>
<th>Double-Treatment Group ((n = 18))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(R_z \text{ Mean} )</td>
<td>(37.069)</td>
<td>(53.255)</td>
</tr>
<tr>
<td>(R_z \text{ SD} )</td>
<td>(37.569)</td>
<td>(40.159)</td>
</tr>
<tr>
<td>(p)</td>
<td>(.0022)</td>
<td>(.0002)</td>
</tr>
<tr>
<td><strong>Pretreatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(183.611)</td>
<td>(218.667)</td>
<td></td>
</tr>
<tr>
<td>(185.833)</td>
<td>(32.654)</td>
<td></td>
</tr>
<tr>
<td><strong>Post-treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(165.611)</td>
<td>(183.833)</td>
<td></td>
</tr>
<tr>
<td>(21.219)</td>
<td>(32.833)</td>
<td></td>
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<tr>
<td><strong>Difference</strong></td>
<td></td>
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</tr>
<tr>
<td>(-21.000)</td>
<td>(-1.644)</td>
<td></td>
</tr>
<tr>
<td>(p = .0022)</td>
<td>(p = .0029)</td>
<td></td>
</tr>
<tr>
<td><strong>Control area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(184.389)</td>
<td>(200.278)</td>
<td></td>
</tr>
<tr>
<td>(71.967)</td>
<td>(73.703)</td>
<td></td>
</tr>
<tr>
<td><strong>Post-treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(195.889)</td>
<td>(200.389)</td>
<td></td>
</tr>
<tr>
<td>(57.569)</td>
<td>(62.239)</td>
<td></td>
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<tr>
<td><strong>Difference</strong></td>
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<td></td>
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<tr>
<td>(-11.500)</td>
<td>(-0.111)</td>
<td></td>
</tr>
<tr>
<td>(p = .1513)</td>
<td>(p = .9902)</td>
<td></td>
</tr>
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</table>

\(R_z\) = surface roughness.
increase in grenz zone thickness (Figure 2). Monoclonal chondroitin sulfate staining showed, on average, a 67% increase in staining immediately below the epidermis-dermis junction (Figure 3). Type III procollagen staining showed an average increase of 104% immediately below the epidermis-dermis junction (Figure 4). Quantification of type I collagen mRNA in treated samples showed a 400% increase in steady-state expression over control samples.

Discussion

Although improvement from nonablative rejuvenation can be subtle and gradual, it is often preferred by patients over ablative carbon-dioxide or erbium:yttrium-aluminum-garnet (YAG) laser resurfacing owing to the significantly reduced discomfort, recovery time, side effects, and complication rates associated with most nonablative treatments. Most lasers and light-based devices for nonablative rejuvenation rely on photothermal conversion of light to heat during the light–tissue interaction, in which specific chromophores are targeted. By knowing certain parameters, such as wavelength, target size, pulse width, absorption, and scattering coefficients, one can predict the approximate subsurface local energy density and ultimately predict the amount of heat generation and peak temperature.13

Thermal injury to the papillary and upper reticular dermis leads to fibroblast activation and synthesis of new collagen and other extracellular matrix components. New collagen formation most commonly occurs
just beneath the epidermis in a zone approximately 100 to 500 μm below the skin surface, just above where the majority of solar elastosis is found in photodamaged skin.14 The wound repair process has three phases: acute inflammation, proliferation, and remodeling. Acute inflammation begins with the release of chemical mediators by mast cells, neutrophils, and monocytes after injury and lasts for 48 to 72 hours. The proliferation phase is marked by the recruitment of fibroblasts, which secrete new dermal matrix molecules, such as hyaluronic acid, fibronectin, proteoglycans, and collagen fibers. This phase lasts approximately 30 days. The remodeling phase may overlap significantly with the proliferation phase. During this last phase, inflammatory cells disappear, collagen fibers mature and increase in their tensil strength, and, lastly, elastic fibers form.15

To initiate this repair process, most nonablative infrared lasers (1,064–1,540 nm) target water, which is found throughout the skin. Through a careful balance of heating and cooling, bulk dermal heat injury without epidermal damage is possible. The 585 nm pulsed-dye laser represents an alternative to dermal remodeling. The chromophore for a 585 nm light is oxyhemoglobin. A 585 nm laser light is absorbed in the upper dermal vascular plexus after passing through the epidermis with little interference. The fluence is not sufficient to cause rupture or coagulation, so no purpura is seen. But it is sufficient to induce a low-grade injury to the vessels, causing modest inflammation to initiate this cascade of repair, ultimately ending in new collagen production.16 Blood vessels are surrounded by a rich population of resident inflammatory cells such as mast cells, and their activation recruits even more inflammatory cells from the intravascular compartment. In contrast to infrared lasers, this modality does not need epidermal cooling. Because there is no bulk heating, the risk of injury to the skin is minimized. This, in turn, leads to less pain than the devices targeting water.13

It is speculated that the shorter pulse width may be more effective than the longer pulse width in collagen production.17 However, because newer pulsed-dye lasers group multiple short pulses to create one long pulse, the effect on skin remodeling may be similar, as observed by some investigators.18

Zelickson and colleagues first assessed the effectiveness of a 585 nm, 450 μs pulsed-dye laser at 3.0 to 6.5 J/cm² using a 7 to 10 mm spot size. Six months after one treatment, 9 of 10 subjects with mild to moderate rhytides showed 50% or more improvement, and 4 of 10 subjects with moderate to severe rhytides also showed improvement.9 However, this produced significant purpura in all patients and hyperpigmentation in some patients. Zelickson and Coles later evaluated a long-pulse 595 nm pulsed-dye laser using a nonpurpuric dose of 4.5 to 7 J/cm² at a 20 to 30 ms pulse width. Although all subjects reported improvement, blinded evaluations of photographic images did not note a statistical improvement.19 Bjerring and colleagues investigated the short-pulse pulsed-dye laser further using a 585 nm laser with a pulse duration of 350 μs (Nlite, ICN Photonics, Costa Mesa, CA, USA). With a 5 mm spot size and a relatively low fluence of 2.4 J/cm², no purpura or dyspigmentation was reported. The study found clinical improvement for class I, II, and III rhytides.10

In sharp contrast, Hohenleutner and colleagues treated 12 subjects at similar parameters but reported very mild improvement in only 1 patient 4 months post-treatment.20 It is quite possible that the difference between these studies is the method of evaluation. Even proponents of nonablative rejuvenation techniques must concede that, in comparison with traditional resurfacing, the improvements can be subtle. Given the inherent limitations of photographic and clinical evaluations, these traditional measurements can be unreliable and sensitive to multiple external factors, such as lighting and skin hydration. Indeed,
many have criticized past studies of nonablative laser rejuvenations in their lack of objectivity and statistical support.21,22

The first objective evidence of nonablative rejuvenation was found under the microscope. Photodamaged skin is characterized histologically by hyperkeratosis, epidermal atrophy, irregular pigmentation, ecstatic blood vessels, elastotic dermal ground substance, and increased mucopolysaccharides.13 The dermis is composed mostly of collagen, elastin, and mucopolysaccharides. Too little or too much of one or more of these components may result in unhealthy-appearing skin. This delicate balance is maintained by a constant flux of fibroblasts, inflammatory cells, and macrophages, which can be influenced by external stimuli. The deliberate tissue wounding by nonablative rejuvenation is a means through which to influence the balance toward the production of new dermal and epidermal proteins through the repair cascade.

Snapshots of these events have been recorded through histology. Several studies documented histologic changes after nonablative rejuvenation using a pulsed-dye laser, including increased epidermal thickness, increased collagen, elastin, and glycoaminoglycans in all.9,16,23 Omi and colleagues took skin biopsies of eight subjects at several time points up to 5 weeks after one Nlite treatment (3.0 J/cm², 5 mm spot) and examined the specimens by electron microscopy.24 Three hours after the treatment, the capillaries showed endothelial cell edema. Neutrophils, monocytes, and mast cells were observed, corresponding to the inflammatory phase of wound healing. Two weeks after treatment, new elastic fibers and collagen fibers were increased around the capillaries. In 4 weeks, interstitial fibrosis was seen around the capillaries. As predicted with such a low fluence, erythrocytes remained intact, and no cellular necrosis was observed. Goldberg and colleagues examined biopsies from pre- and post-treatment skin for collagen fiber size using an electron microscope. At 6 months, there was evidence of increased quantity per unit volume of type I and III collagen.25

Although most histologic studies have been qualitative comparisons between pre- and post-treatment biopsies, Zelickson and Kist further investigated the effects of a 585 nm pulsed-dye laser at the mRNA level through in situ hybridization.23 Using mRNA probes for type I collagen and collagenase, they found a 23% increase and a 40% increase in type I collagen transcripts and collagenase transcripts, respectively. The increase in collagenase is thought to be instrumental in the breakdown and removal of the earlier existing collagen.

Bjerring and colleagues presented biochemical evidence. Forty subjects were treated with Nlite (585 nm, 350 μs, 2.4 J/cm², 5 mm spot). At 72 hours after treatment, suction blisters were raised in 10 subjects. Interstitial fluids were collected and analyzed to determine the concentration of the aminoterminal propeptide of type III procollagen, which is indicative of the type III collagen production rate.16 The remaining 30 subjects were photographed 7, 30, 90, and 180 days post-treatment. Three physicians evaluated the photographs for cosmetic improvement. The study showed an 84% increase in type III collagen production at 72 hours and an average reduction of 1.88 in wrinkle appearance on the Fitzpatrick wrinkle severity scale. The subjects reported little discomfort and no dyspigmentation.10,16

Additional technologies have provided reliable methods to add objectivity to an otherwise subjective evaluation. In vivo analysis using a three-dimensional microtopography imaging system such as PRIMOS provides more consistent and precise measurement than clinical and photographic evaluations. Highly precise microtopography is reconstructed using computerized algorithms to generate a three-dimensional image.12 This technique is an improvement over silicon rubber replicas in capturing surface.26 Most recently, ultrasonography has been employed to provide yet another method of objective evaluation. It was found that after one treatment of Nlite, 10 of 10 patients had increased echogenicity in the dermis, strongly suggestive of new collagen production.27

Although the collective experience thus far has been impressive, as individual studies, most of them have been limited by low patient numbers and few objective data. This study of 58 patients employed both subjective measurement (physician evaluation and patient evaluation) and objective measurement (histology, biochemistry, microtopography). The results further validate the benefit of a 585 nm pulsed-dye laser in rejuvenating photoaged skin. PRIMOS microtopography shows significant improvement in Rz. Histology and biochemical quantification reveal a significant increase in grenz zone thickness, chondroitin sulfate, type III procollagen, and mRNA expression. These markers are typically increased in healing wounds or in response to agents that stimulate new skin formation, such as α-hydroxy acid, retinoids, and ablative resurfacing. It appears that the effect is even more pronounced with two treatments.

The failure of the photographic evaluation to detect changes seen with other measurements is not entirely surprising. Despite the greatest care and the most advanced photographic equipment, some qualities are lost during the translation of a three-dimensional object into a two-dimensional image. This is a problem often encountered in telemedicine. As digital photography continues to progress, someday photographic
evidence may, indeed, match in-person, real-time evaluations.

Perhaps the most important data in this study are patient satisfaction. No cosmetic procedure may be called successful if the patients themselves do not see improvement. Patients in this survey convincingly pointed to the treatment side as the side more improved, even when objective observers failed to accomplish this task through traditional photography. Words may be inadequate to describe exactly what this improvement is, but the patients can feel it. In this case, technology and histology serve to translate such imprecise but perfectly human terms as “smoothness,” “shininess,” “glow,” and “tone” into mechanical terms that we, as scientists, are more willing to accept: Rz, mRNA, procollagen, and so on.

Comfort and safety are paramount in any elective cosmetic treatment. This modality appears to be a very safe treatment. Although erythema was common, it was mild and transient in most cases. There were no reports of blistering, purpura, scarring, or dyspigmentation. Most patients reported no pain or mild pain during the procedure. Although subjects of all skin types were sought, only skin types I to IV were available for the study. With epidermal melanin as a competing chromophore for a 585 nm light in darker skin types, higher fluences may be required to target hemoglobin and, ultimately, to produce the desired clinical outcome. However, it may also place these patients at a greater risk of complications. Further investigation on darker-skinned subjects is needed.

Numerous reports have shown the benefit of a 585 nm pulsed-dye laser in treating hypertrophic scars. Although the target in treating scarring is 585 nm pulsed-dye laser in treating hypertrophic scars, investigation on darker-skinned subjects is needed. Further prospective controlled studies using both photographic evaluations and objective measurements, such as the PRIOMOS device and histologic analysis, have shown favorable outcomes. This is the largest multicenter prospective randomized controlled study on the 585 nm pulsed-dye laser in nonablative rejuvenation reported in the English-language literature to date. It shows an excellent safety profile and is well tolerated by patients. The treatment leads to significant histologic and topographic quantitative changes that correlate with convincing results from a patient satisfaction survey.

References


