

Periorbital Rejuvenation with the Contour TRL™ and ProFractional-XC™ Laser Devices



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INTRODUCTION

Laxity and wrinkles of the lower eyelid skin are common manifestations of photoaging. They often appear earlier on the eyelids than on adjacent facial skin. The pulsed CO₂ laser has been shown to tighten loose skin and reduce wrinkles in the periorbital region (Fitzpatrick 1996). The authors of this study suggested that the improvements were due to tissue-heating effects that vaporized intracellular water and ablated upper-layer tissue, denatured underlying tissue, and induced collagen shrinkage in lower layers. Post-treatment skin tightening was attributed to new collagen synthesis in the lower layers as the treated tissue healed.

Adverse effects of pulsed CO₂ laser treatment, however, are numerous and include edema, persistent erythema, burning, crusting, late or permanent hypopigmentation, prolonged recovery time, acne flares, scars, herpes simplex virus infection, dermatitis, and milia development (Nanni 1998, Khatri 1998, Bernstein 1997, Fleming 1999, Manstein 2004). The severity of these effects may be reduced if treatment is limited to a single pass (Alster 2003).

The Erbium:YAG Laser

Khatri and colleagues (1998) showed that Er:YAG laser-induced improvement in rhytids was comparable to that achieved with CO₂ laser resurfacing. Others showed that healing time, redness, swelling, and the incidence of late hypopigmentation were reduced but with less thermally induced collagen tightening after Er:YAG treatment compared to CO₂ treatment (Hughes 1998, Alster 1999).

The reduced adverse effects associated with Er:YAG resurfacing may be understood from the following considerations. Although the Er:YAG and CO₂ lasers both target water as a skin chromophore (Khatri 1999), the ablative and thermal effects of the two devices are different. The difference is attributed to the 10-fold greater absorption by water of the Er:YAG laser's 2940 nm energy compared to the CO₂ laser's 10,600 nm energy.

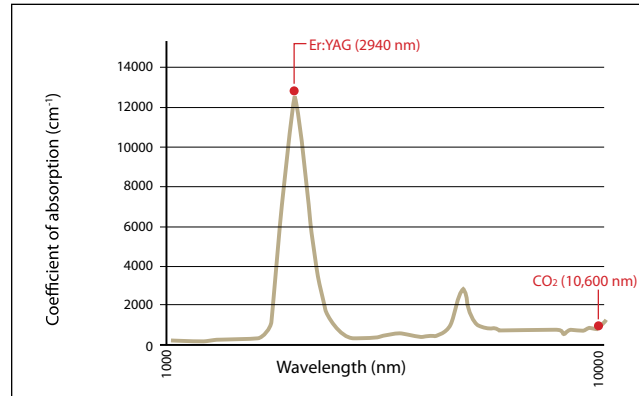


Figure 1

Since the 2940 nm absorption efficiency is so high, nearly all the 2940 nm energy is consumed during ablation, so minimal energy is left for a necrotic effect on the underlying tissue. This is in contrast to CO₂ laser treatment in which, because absorption of the 10,600 nm energy by water is less efficient, more heat is left over after ablation. The result is a larger zone of irreversible thermal necrosis (50-100 μ m) (Newman 2000) underneath the ablated area (Fleming 1999).

Variable pulse. The next step was the development of variable pulse Er:YAG laser technology, which allows the physician to vary the pulse duration so that pulses ranging from purely ablative (short pulse duration) to more thermal (long pulse duration) are available (Newman 2000). The energy delivery mechanism is shown in Figure 2.

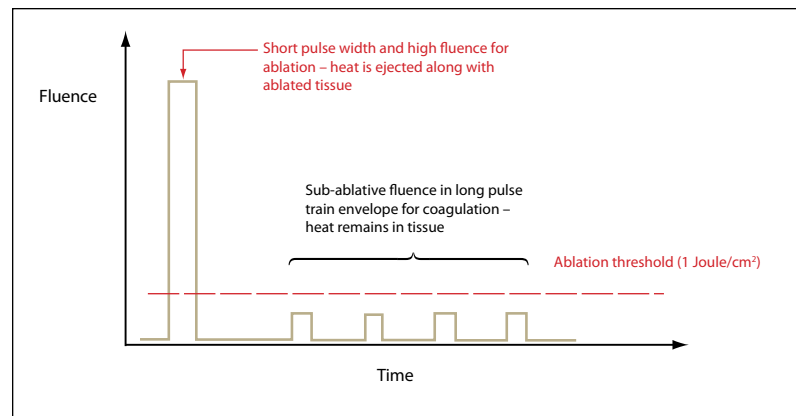


Figure 2

An early study (Newman 2000) showed that variable pulse Er:YAG treatment reduces the duration of post-treatment crusting and decreases erythema compared with a CO₂ laser. Permanent hypopigmentation, hyperpigmentation, and scarring were not observed, and improvement in rhytids approached that of the CO₂ laser (48% vs. 63%).

Modulation. Modulated systems offer both ablation and coagulation capabilities. The dual mode Contour™ (Sciton, Palo Alto, CA) includes two Er:YAG heads, one for short-pulse ablative applications and the other for long-pulse coagulative applications. The dual mode Contour induces controlled thermal desiccation by optical multiplexing, a process in which individual pulses are stacked together to produce short, ablative pulses of high fluence or coagulative micropulses of low fluence. The most recent version of the Contour is the Contour TRL™ (Tunable Resurfacing Laser), a full-field device that offers independent control over the depth of ablation and coagulation. This capability allows the user to control the depth of ablation with or without coagulation, permitting the physician to tailor the tissue effect to the specific needs of each patient.

Fractional. The development of fractional photothermolysis addressed the preferences of patients for minimal downtime and risk. Nonablative fractional photothermolysis has been introduced (Manstein 2004) and reviewed (Geronemus 2006). These lasers produce arrays of tiny thermal wounds at specific depths in the skin without damaging the surrounding tissue. Downtime is reduced and healing is rapid, but the treatment is painful and multiple treatments are required. The development of ablative fractional lasers (Er:YAG and CO₂) addressed the need for increased efficacy and fewer treatments. The ProFractional-XC™ (Sciton) uses an Er:YAG laser, a 430 μm spot size, and treatment density (the number of wounds per unit area of skin) which can be set at 5.5%, 11%, or 22%, with or without depth-selectable tissue coagulation during treatment.

The purpose of this study was to compare the efficacy and safety of the full-field Contour TRL and ProFractional-XC in the rejuvenation of periorbital wrinkles.

METHODS

Eight consecutive patients presenting for facial rejuvenation were offered the option of participating in the study and receiving an additional lower eyelid rejuvenation procedure at no cost. None had been treated by other periorbital rejuvenation methods (e.g., botulinum toxin, fillers) or had undergone a pre-treatment topical regimen or antibiotic prophylaxis. Patients were given antiviral medication (valacyclovir), 1 gram just before the procedure and once daily for 3 days after the procedure. Pre-treatment anesthesia consisted of a mixture of lidocaine (7%), prilocaine (7%), and phenylephrine ointment applied to the periorbital areas without occlusion for 1 hour. Proparacaine ophthalmic solution and artificial tears were added to the eyes and internal eye shields were inserted to permit treatment up to the eyelash margins. After removing anesthetic ointment, all periorbital areas were treated with a 10 micron MicroLaserPeel®, and then a thin layer of the anesthetic ointment was reapplied only to the periorbital areas for 10 minutes, to achieve a denser anesthetic effect. Limiting the “double topical” application to the periorbital area minimized the potential for lidocaine toxicity.

The anesthesia ointment was removed, and then one randomly selected periorbital area of each patient was treated with the full-field Contour TRL and the other with the ProFractional-XC. Chilled air from a Zimmer cooler minimized patient discomfort on both sides during treatment. Settings for the Contour TRL were the following: first pass, 50 microns ablation depth, and second pass, 50 microns ablation depth and 50 microns coagulation. For the ProFractional-XC treatment, patients received three passes at 100 microns ablation depth, level 3 coagulation, and 11% treatment density. Settings for the ProFractional-XC device were selected on the basis of clinical experience and histologic data (Figure 3) of eyelid skin treated with different combinations of ablation depth and coagulation. Post-treatment care was limited to a 48-hour application of petroleum jelly without ice or anti-inflammatory drugs.

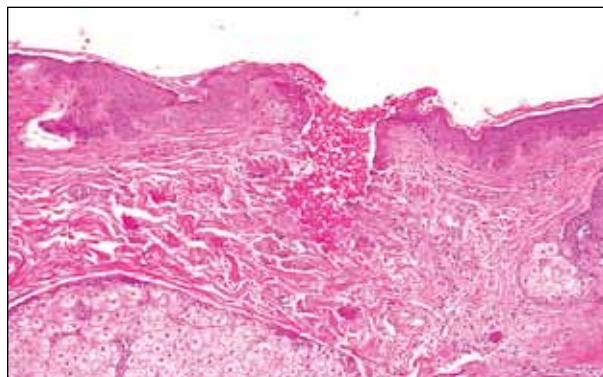


Figure 3. 100X, 150 µm Depth, Coag Level 3

Patients evaluated pain on a 10-point scale in which 1=no pain and 10=intolerable pain. Improvements in periorbital wrinkles were assessed independently by comparison of clinical photographs obtained before and 4 weeks after treatment under identical conditions of lighting and position. Evaluators used a nine-point scale and sample clinical

photographs obtained from Fitzpatrick and colleagues (1996) to evaluate improvements in patients of this study. Scores 1 to 3, 4 to 6, and 7 to 9 corresponded to mild, moderate, and severe elastosis, respectively. An example of a four-part photograph sent to the blinded evaluators is shown in Figure 4. Differences in pre- and post-treatment wrinkle scores were tested for significance by a paired t-test using $P < 0.05$ as the cutoff value. Evaluators were five experienced physicians without knowledge of when photographs were taken (before or after treatment or which technique had been used). Evaluator specialties included cosmetic dermatology (2), aesthetic medicine (1), plastic surgery (1), and obstetrics-gynecology (1).



Figure 4. Example of Images Provided to Blinded Observers Including Normal and Enhanced Color

RESULTS

Seven patients completed the study. The eighth was lost to follow-up. Mean wrinkle scores, resolution times for post-treatment edema and erythema, and pain scores are presented in Table 1.

Table 1. Improvements in wrinkle score before and after treatment (mean \pm SD)

| Treatment Device | Wrinkle Score | | |
|------------------|------------------|-----------------|-----------|
| | Before Treatment | After Treatment | P Value |
| Contour TRL | 5.7 \pm 1.5 | 3.4 \pm 0.9 | 0.004 (s) |
| ProFractional-XC | 5.8 \pm 1.4 | 3.9 \pm 1.5 | 0.018 (s) |

s = significant

Table 2. Comparative resolution times (days) and pain scores (mean \pm SD)

| Parameter | Contour TRL | ProFractional-XC | P Value |
|------------------|----------------|------------------|-----------|
| Edema | 6.4 \pm 2.9 | 4.4 \pm 1.8 | 0.03 (s) |
| Erythema/flaking | 11.2 \pm 3.6 | 4.9 \pm 1.6 | 0.002 (s) |
| Pain | 4.0 \pm 2.4 | 4.5 \pm 2.8 | 0.35 (ns) |

s = significant; ns = not significant

Improvements in wrinkle scores were both clinically and statistically significant by both techniques (Table 1). Five of seven periorbital areas improved by more than 1.5 Fitzpatrick grades for each of the techniques. Adverse effects were limited to edema and erythema/flaking, both of which resolved significantly more rapidly (Table 2) with the ProFractional-XC. Pain scores between the two techniques did not differ significantly.

DISCUSSION AND SUMMARY

The results of this study show that a single treatment with the ProFractional-XC laser device significantly reduces Fitzpatrick wrinkles scores of the periorbital area, improvement is comparable to that obtained with the full-field Contour TRL, and the times for resolution of post-treatment edema and erythema/flaking are significantly less with the ProFractional-XC device. Pain scores did not differ significantly with the two techniques. For the full-field Contour TRL technique, the difference between the pre- and post-treatment mean wrinkle scores ($5.7 - 3.4 = 2.3$) at 4 weeks compares well with the corresponding difference (2.25) for the full-field pulsed CO₂ laser with a mean 74-day follow up (Fitzpatrick 1996). In the study of Fitzpatrick, et al (1996), clinical healing of the skin required “1 to 2 weeks,” and post-treatment erythema persisted an additional 2 to 16 weeks (most frequently 1 month after reepithelialization), longer than the 2 to 8 and 4 to 18 days with the ProFractional-XC and Contour TRL, respectively, of this study (Table 1). Clementoni, et al (2007), in their study with a non-sequential fractional ultrapulsed CO₂ laser resurfacing technique, used a quartile scale to assess improvement, so it is difficult to compare the results of this study with theirs. However, the authors reported an 8-day healing time and erythema that persisted for 17 days, which is comparable to the 18-day maximum resolution time for the Contour TRL-induced erythema and greater than the 8-day maximum for ProFractional-XC-induced erythema of this study. Koltus (2009) and Brightman, et al (2009) treated the periorbital areas of 15 and 20 patients, respectively, with a fractional CO₂ laser. Koltus reported a 21-day mean duration of post-treatment erythema and Brightman and colleagues reported a 3 to 21-day resolution time for edema, erythema, and dryness.

As a result of this study, the author now selects a periorbital rejuvenation technique on the basis of the patient’s requirements for downtime. For example, if the patient has 7 to 10 days to recover, the author suggests full-field ablation with the Contour TRL because this technique provides the most predictable single-treatment results. If the patient has only 3 to 4 days to recover, the author would choose the ProFractional-XC because it provides excellent results in an initial treatment and enhanced benefits with a second treatment 3 to 6 weeks later. The author’s current first-line protocol for lower eyelids (as part of a standard full-face fractional treatment) calls for the ProFractional-XC settings used in this study (3 passes at 100 microns ablation depth, level 3 coagulation, and 11% treatment density). The author has also used the ProFractional-XC to treat patients (notably men) with thicker eyelid skin by increasing the depth by 50 to 75 microns without an increase in complications.

The encouraging results of this study justify additional investigations to more precisely establish the treatment parameters of both devices to further optimize patient outcomes. Combining these techniques with visible (BBL™) or infrared (SkinTyte™) light may also provide more wide-ranging clinical benefits.

Clinical Examples



Post Operative Day 1

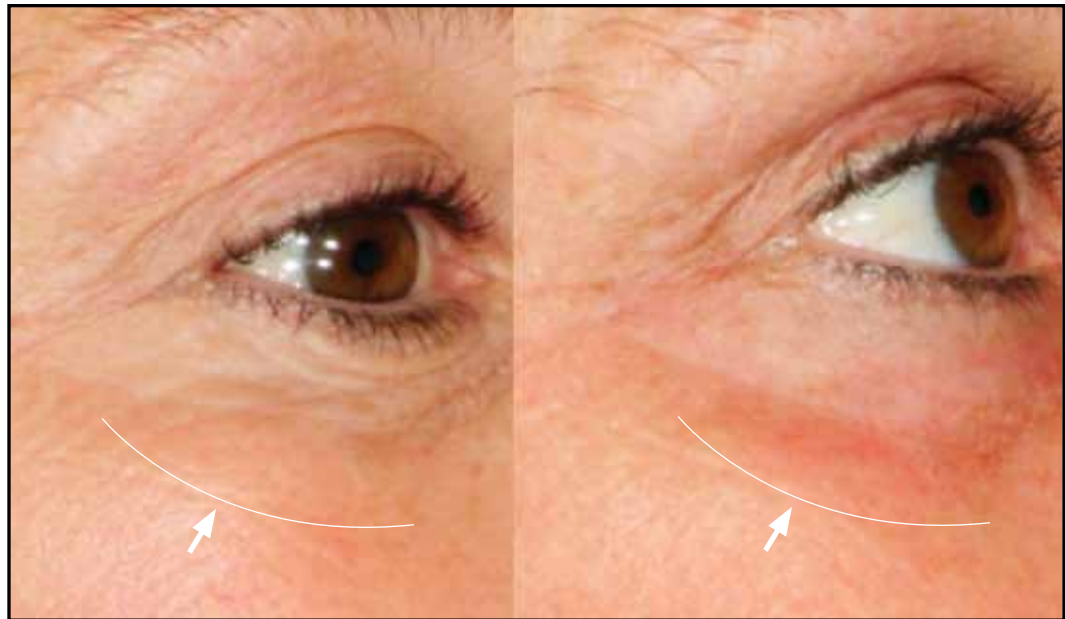


Post Operative Day 3



Post Operative Day 7

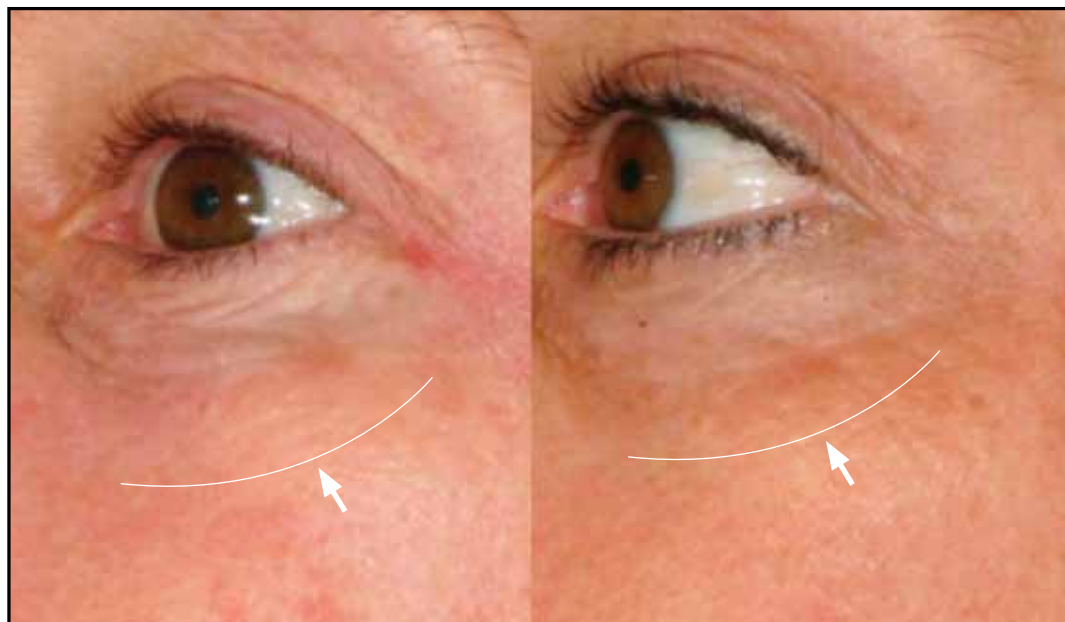
Figure 5. Right Side Periorbital Area: Full Field Resurfacing with Contour TRL
Left Side Periorbital Area: Fractional Resurfacing with ProFractional-XC



Pre-treatment

1 month post-treatment

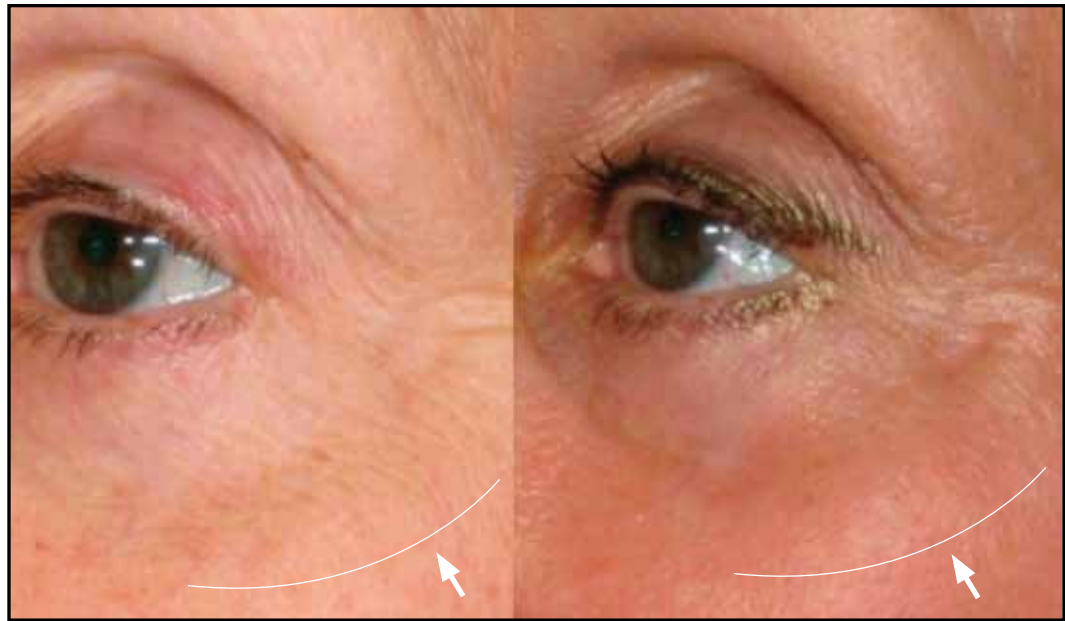
Figure 6a. Full Field Resurfacing with Contour TRL



Pre-treatment

1 month post-treatment

Figure 6b. Fractional Resurfacing with ProFractional-XC



Pre-treatment

1 month post-treatment

Figure 7a. Full Field Resurfacing with Contour TRL



Pre-treatment

1 month post-treatment

Figure 7b. Fractional Resurfacing with ProFractional-XC



Pre-treatment

1 month post-treatment

Figure 7c. Full Face

CONCLUSION

A single treatment with either the full-field Contour TRL or the ProFractional-XC laser device significantly improves wrinkles of the periorbital area. Adverse effects are limited to edema and erythema/flaking. Recovery time and duration of edema and erythema are equal to or less than those reported for the pulsed or fractional CO₂ laser.

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