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Combined Treatment for Facial Rejuvenation Using an Optimized Pulsed Light Source Followed by a Fractional Non-Ablative Laser

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Background: Combination laser treatments can potentially increase the effectiveness of treatment without the additional downtime associated with another procedure.
Objective: To assess the effectiveness and safety of combining non-ablative fractional treatments with optimized intense pulsed light.
Methods and Materials: Ten subjects (Group A) received full face treatments with a non-ablative fractional either followed or preceded by an optimized intense pulsed light source. Twenty-six subjects (Group B) received only full face treatments with the same non-ablative, fractional laser device.
Results: For Group A, the overall average Fitzpatrick Wrinkle Scale for all patients improved from 6.3 ± 1.1 at baseline to 5.9 ± 0.8 one month following one treatment for an average improvement of 0.4 ± 0.6 ($P < 0.10$ paired t-test $n = 9$). The average pigment improvement score was 1.8 ± 0.9 on a 4-point scale. In Group B, the average Fitzpatrick Wrinkle Scale improved from 6.0 ± 1.6 at baseline to 5.2 ± 1.4 at 3 months for an average improvement of 0.8 ± 0.7 ($P < 0.001$, $n = 26$ paired t-test). The average pigment improvement score was 1.4 ± 1.0 ($P < 0.001$, t-test, $n = 26$). Adverse events were similar in the two groups.
Conclusion: The combination of an optimized intense pulsed light source with a non-ablative fractional laser during the same treatment session is safe and effective. Lasers Surg. Med. 45:405–409, 2013.

Key words: combination; non-ablative; fractional; intense pulsed light; IPL; facial rejuvenation; laser

INTRODUCTION

Non-ablative fractional facial rejuvenation to improve skin texture and discoloration typically requires multiple treatments to achieve optimal results. Non-ablative fractional photothermolysis creates columns of thermally denatured skin within the dermis, while leaving the stratum corneum intact [1]. These columns of tissue damage are surrounded by islands of healthy skin resulting in a much safer and quicker healing process when compared to traditional ablative skin resurfacing. However, multiple treatment sessions are required to achieve optimal results [2]. The entire process takes several months with a few days of downtime after each treatment. While the downtime is significantly shorter than with ablative skin resurfacing lasers, recovery times after treatment may take up to a week. Studies have shown that the epidermis is almost normalized at day 3 and completely regenerated by day 7 [3,4]. Combining the treatment with other lasers could potentially increase the effectiveness of treatment without the additional downtime associated with another procedure. In particular, optimized intense pulsed light (OPL) utilizes a dual-band output spectrum to safely and effectively treat blood vessels with a wider purpura free margin as compared to pulsed-dye lasers [5]. OPL is a form of IPL with a spectral pulse shape and fluence matching for vascular targets. In this study, we sought to determine whether combining non-ablative fractional treatments with optimized pulsed light treatments would lead to more improvement in wrinkles and pigment than non-ablative skin resurfacing treatments alone, without an increase in side effects.

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METHODS

A total of 36 subjects were enrolled into two separate treatment arms. All subjects provided signed, informed consent under IRB approved protocol.

Group A

Group A consisted of ten subjects, who each received full face treatments with a non-ablative fractional either followed or preceded by an optimized intense pulsed light source. The order of the treatments was randomized.

A topical anesthetic consisting of benzocaine 12%/lidocaine 8%/tetracaine 4% was applied for 30–45 minutes before procedure. A 1,540 nm erbium glass laser was used for the non-ablative fractional treatments (Icon, Palomar Medical, Burlington, MA). The standard 15 mm XF (extra fast) optic with an average microbeam spot size of 275 μm was used at a fluence of 50 mJ/microbeam and a pulse width of 15 milliseconds. Two passes with 50% overlap across and 50% overlap down were used, yielding eight applications per skin site at an estimated coverage of 5% per application. A complete treatment thus resulted in eight total applications of the 1,540 nm laser for a total of 40% coagulation coverage. The handpiece was maintained at skin temperature or below. A pitch of 1 mm between microbeam in a 15 mm diameter hexagonal array was utilized resulting in 122 microbream/cm^2 per application. The optimized pulsed light source (MaxG, Palomar Medical, Burlington, MA) was utilized with a setting of 30–36 J/cm^2 and a 20 milliseconds pulse width. A single pass with 0–10% overlap was used with areas of focal increased dyspigmentation receiving an extra pass at the discretion of the clinician.

Group B

Twenty-six subjects were enrolled in Group B. Subjects received full face treatments with the same non-ablative, fractional laser device. This group did not receive treatment with an optimized pulsed light source. A topical anesthetic consisting of benzocaine 12%/lidocaine 8%/tetracaine 4% was applied for 30–45 minutes before procedure. Areas with mild wrinkles first received one pass with 50% overlap in both directions, or four applications per skin site, using the 10 mm optic at 70 mJ/microbeam and a pulse width of 15 milliseconds. A second pass with 50% overlap in both directions was then used with the 15 mm optic at 12–15 mJ/microbeam. Areas with moderate to deep wrinkles first received the XD (extra deep) optic at 70 mJ/microbeam without overlap using an average of nine passes (range 6–10) and then two passes with the 10 mm diameter optic with 50% overlap in both directions. The 10 mm diameter optic has 100 microbeam/cm^2 and provides 4% coverage (240 μm diameter damage column) per application. For a 50% overlap in both directions, each pass thus yields 16% coagulation damage coverage. The 15 mm diameter optic has 320 microbeam/cm^2 and yields 3% coagulation (125 μm diameter damage column) coverage per application or 12% per 50% overlap pass. The XD optic has 25 microbeam/cm^2 and gives 2% coagulation (290 μm diameter damage columns) coverage per pass. The total treatment coverage for mild wrinkles areas was 16% (10 mm) plus 12% (15 mm optic). For moderate to deep target wrinkles areas (eye, upper lip, glabella) total treatment coverage was 32% (10 mm optic) plus 18% (average, range 12–20%) using the XD optic.

All photos were taken with controlled lighting conditions using a Canfield research photo platform with a Nikon D90 camera, 60 mm optic with linear polarizer and two flash units 45° right and left of the subject.

Three board certified dermatologists, who were not involved in the treatments ranked before and after photos using a validated image set for wrinkles and pigment. The raters were blinded to the order of the before and after photo status as the pretreatment and post-treatment photos were randomized side by side for comparison. The photos were ranked on the Fitzpatrick Wrinkle Scale (FWS 1–9) [6] and Pigment Improvement Score (PIS 0–4 scale) (see Table 1).

RESULTS

The demographics were similar in the treatment groups (Table 2).

Group A

In Group A, where the subject had full face treatments with a non-ablative fractional either followed or preceded by an optimized intense pulsed light source, one subject was lost to long-term follow-up. At least two of three blinded graders correctly identified the post-treatment photo with 60% accuracy. Seven of the nine patients (78%) that finished the study had improvement in the Fitzpatrick Wrinkle Scale. The overall average Fitzpatrick Wrinkle Scale for all patients improved from 6.3 ± 1.1 at baseline to

TABLE 1. Pigment Improvement Score

Score	Improvement	
0	0%	No improvement
1	1–24%	Trace to mild improvement of some lesions
2	25–49%	Moderate response: Some lesions lighter
3	50–74%	Good response: Most lesions much lighter
4	75–100%	Excellent response: Most or all lesions much lighter or gone

TABLE 2. Demographics

	Group A: 1,540/OPL	Group B: 1,540/XD
N	10	26
Female	10 (100%)	26 (100%)
Caucasian	10 (100%)	26 (100%)
Age	58.3 ± 8.0	59.6 ± 6.8
Fitzpatrick skin type		
I	0	1 (4%)
II	5 (50%)	13 (50%)
III	5 (50%)	11 (42%)
IV	0	1 (4%)

5.9 ± 0.8 one month following one treatment for an average improvement of 0.4 ± 0.6 ($P < 0.10$, $n = 9$ paired t-test). All of the patients had improvement in their pigmentation. The average pigment improvement score was 1.8 ± 0.9 on a 4-point scale ($P < 0.0001$, $n = 9$ paired t-test).

Group B

In Group B, where the subject received full face non-ablative, fractional laser treatments, at least two of three blinded graders correctly identified the post-treatment photo with 80% accuracy. Twenty-two of the 26 patients (85%) that finished the study had improvement in the Fitzpatrick Wrinkle Scale. The average Fitzpatrick Wrinkle Scale improved from 6.0 ± 1.6 at baseline to 5.2 ± 1.4 at 3 months for an average improvement of 0.8 ± 0.7 ($P < 0.001$, $n = 26$ paired t-test) (see Fig. 1).

Twenty-three of the 26 subjects (88%) who received full face non-ablative, fractional laser treatments had improvement in pigmentation. The average pigment improvement score was 1.4 ± 1.0 ($P < 0.001$, t-test, $n = 26$) (Fig. 2).

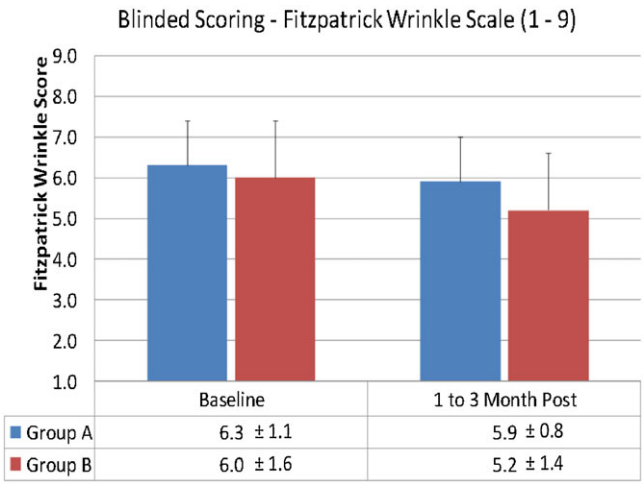

Fig. 1. Fitzpatrick Wrinkle Scale at baseline and after treatment.

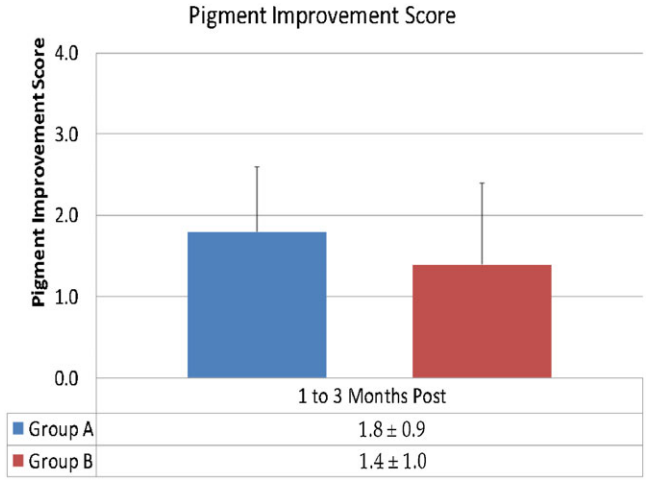

Fig. 2. Pigment Improvement Score at baseline and after treatment.

Adverse events were very similar in both treatment groups, but subjects in Group B had a slightly higher incidence (Table 3) of side effects. All subjects experienced edema and erythema immediately after treatment, which steadily resolved after treatment. Sloughing or flaking was noted in both groups and is an expected side effect after this facial rejuvenation procedure. Other side effects that were noted in Group B and not Group A included bronzing, petechiae, dryness, hyperpigmentation, and herpes simplex infection. Most side effects had resolved after 1 week and all resolved by 1 month. Hyperpigmentation is not typical after fractional non-ablative resurfacing and is typically seen in <1% of those treated [7]. In this case, the patient was treated with an older fractionated laser with more aggressive settings. The manufacturer recommended settings and the device have all since been updated so we believe that this adverse event is highly unusual. No hypopigmentation, bleeding, or scarring was noted in any subjects. The procedures were both well tolerated with similar pain scores between the two groups. On a scale of 1–10, pain scores in Group A were rated 1.7 ± 1.3 for treatment with the OPL and 4.5 ± 0.8 for the non-ablative fractional laser. Group B, who

TABLE 3. Adverse Events

Adverse event	Group A: n (%), ($n = 10$)	Group B: n (%), ($n = 26$)
Erythema	10 (100%)	26 (100%)
Edema	10 (100%)	26 (100%)
Sloughing/flaking	4 (40%)	18 (69%)
Bronzing	0 (0%)	5 (19%)
Hyperpigmentation	0 (0%)	3 (12%)
Petechiae	0 (0%)	3 (12%)
Dryness	0 (0%)	2 (8%)
Herpes simplex virus	0 (0%)	1 (4%)

Fig. 3. Patient had notable improvements in pigment and wrinkles after just one treatment consisting of an optimized IPL followed by the 1,540 nm fractional non-ablative procedure.

received only the non-ablative fractional laser reported a pain score on average of 4.0 ± 1.3.

DISCUSSION

Both subjects treated in Group A, who had full face treatments with a non-ablative fractional either followed or preceded by an optimized intense pulsed light source, and subjects treated in Group B, who received full face non-ablative fractional laser treatments, had notable improvements in pigment and wrinkles after just one treatment. Subjects in Group B had a 25% better wrinkle improvement when compared to Group A. On the other hand, subjects in Group A, the group treated with the addition of an optimized pulsed light source had better pigment improvement. The improvement in overall appearance after treatment in Group A was impressive as viewed by the blinded investigators (Fig. 3).

We found that in Group A, the order of treatment with the optimized intense pulsed light had no effect on the degree of improvement in either pigment or wrinkles. One could hypothesize that increased dermal edema following intense pulsed light treatment would lead to an increased amount of target chromophore for the fractional laser with potentially increased effects and improvement in wrinkles. This however was not seen in our study. Treating with the optimized pulsed light before the non-ablative fractional laser though was better tolerated and preferred by both subjects and clinicians. The non-ablative fractional laser treatment causes increased erythema and likely leads to greater absorption of the optimized IPL, leading to the increase in discomfort. Figure 4 shows a typical postprocedure timeline after a patient is treated with this combination.

This study is not without limitations. Treatments were all performed at a single center. The number of subjects in both study arms was relatively small, particularly in the optimized IPL and non-ablative fractional group. Furthermore, the design of this study was ambitious with varying parameters within the two treatment groups. While the non-ablative fractional laser parameters were somewhat different between the two groups, the rationale was to compare the combination treatment (Group A) to the best available, single non-ablative fractional treatment, replacing the OPL treatment with an XD optic treatment targeting deeper wrinkles. In retrospect, the study would have been more powerful had it been designed to focus on only a couple of variables. Nonetheless, the findings validate the concept of using multiple treatment modalities during the same visit to optimize outcomes.

A wide array of lasers and other light sources have been used in combination to treat photoaging [8]. There are only a few studies though that have validated specifically the use of non-ablative fractional in combination with topical therapies and other laser sources [9–11]. A recent article by Kearney and Brew [12] was the first to describe the

Fig. 4. A typical time course after combination treatment. At day 3, there is darkening of the treated areas, followed by superficial sloughing of these lesions. By 1 week, the treatment area has largely recovered and a 1 month a significant improvement in pigment.

combination of intense pulsed light and non-ablative fractional photothermolysis. They showed an apparent synergistic effect when the two lasers were combined in a single session. The findings in their study, similar to ours, prove that combining these two laser modalities in a single session can be performed safely with little additional downtime and provide impressive results. Further reports describing combination treatments will help further evolve our field and improve patient outcomes.

CONCLUSION

The combination of an optimized intense pulsed light source with a non-ablative fractional laser during the same treatment session is safe and effective. With this combination treatment, practitioners will hopefully be able achieve more dramatic results after just one treatment session. Furthermore, multiple treatment sessions should optimize results even further.

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