Intense Pulsed Light Treatment of Photoaged Facial Skin

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BACKGROUND. **It has been reported that intense pulsed light is efficacious for rejuvenation of photoaged skin, specifically the improvement of appearance of telangiectases and solar lentigines.**

OBJECTIVE. **The objective was to define the treatment variables for photodamaged facial skin using a newer intense pulsed light system.**

METHODS. **Twenty-three female subjects received three treatments using double-stacked pulses with fluences of 24 and 30 J/cm^2. Response to treatment was evaluated using digital photography. Three signs of photoaging were evaluated: surface texture/roughness, mottled hyperpigmentation, and erythema/telangiectases.**

RESULTS. **There was a shift in clinical grading from more to less severe on all three measures of photoaging.**

CONCLUSION. **Intense pulsed light therapy was efficacious in ameliorating the clinical signs of photoaging. The device was well tolerated with minimal side effects.**

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INTENSE PULSED light uses a noncoherent filtered flashlamp that emits broadband light in the 500- to 1200-nm range.[1] Cutoff filters are used to narrow the spectral range for a given chromophore with longer wavelengths penetrating more deeply. Intense pulsed light has been used to treat a variety of dermatologic disorders including erythema/telangiectases,[2] solar lentigines,[3] and photoaged skin.[4,5] We investigated the EsteLux system (Palomar Medical Technologies, Inc., Burlington, MA). This system uses a range of energy fluences that are preset by varying the pulse duration between 10 and 100 msec. There are 10 button settings that yield different fluences on the machine. The button number, i.e., fluence, is chosen to match the subject's phototype and severity of the clinical condition to be treated. Several interchangeable handpieces delivering light of different spectral wavelengths are available for this device. In this study we used the LuxG handpiece, which has a treatment window of 12 × 12 mm and a spectral output of 500 to 690 and 890 to 1200 nm and is currently used to treat vascular and pigmented lesions. We sought to standardize and optimize treatment parameters for three clinical signs of photoaging: namely, surface roughness/texture, hyperpigmentation/solar lentigines, and telangiectases/erythema.

In this study we report that all three measures of photoaging; namely, surface texture/roughness, mottled hyperpigmentation/solar lentigines, and erythema/telangiectases are ameliorated by intense pulse light treatment with the LuxG handpiece. In addition, we see a diminution in the diameter of follicular infundibula referred to as "pore size."

Materials and Methods

Twenty-three female subjects ranging in age from 30 to 60, Fitzpatrick phototype I to III, were enrolled in the study using the EsteLux system with the LuxG handpiece (Palomar Medical Technologies, Inc.). Informed consent was obtained from all study subjects. They qualified for inclusion if they had significant telangiectases either from rosacea or from photodamage and/or mottled hyperpigmentation due to solar lentigines, melasma, or diffuse melanin deposition secondary to photoaging. Any subjects using oral or topical medications that could affect the response to visible light were not included in this study. The use of aspirin and other anticoagulants was also an exclusion criterion.

Evaluation was performed at each visit clinically by two dermatologists. Subjects received three treatments with 2- to 3-week intervals between treatments. Digital photographs using a Canfield setup with twin flashlamps with and without polarizing filters were obtained before treatment, between each treatment, and 1 month after the end of the third treatment from the right and left sides of the face at 45° angles. Clinical grading was performed before and 1 month after three treatments by comparing digital photographs using a rating scale of 0 to 3 for each photoaging parameter: 0 = no findings, 1 = minimal, 2 = moderate, and 3 = severe.

Test spots on the preauricular cheek were performed initially so that fluences ultimately used in the study

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could be narrowed down and also to eliminate the risk of side effects at a given fluence. Subjects were seen immediately after and over the next half-hour and then within 24 to 48 hr to assess any side effects such as vesiculation, crusting, erythema, pigmentary changes, purpura, and discomfort. Test spots were done on all subjects only to evaluate them for side effects, not efficacy. In the initial phase of the study, four subjects received two or three stacked pulses using the machine's 4, 5, and 6 buttons corresponding to fluences of 19, 24, and 30 J/cm^2 and were evaluated at 1 month. We found that triple pulses were not well tolerated and resulted in a higher level of discomfort so we used double pulses in the study. We also found that using the lowest fluence with the number 4 button, 19 J/cm^2, was not effective. Therefore, we performed the study using double-stacked pulses with either the number 5 button at 24 J/cm^2 or the number 6 button at 30 J/cm^2 for three treatments. The delay time between pulses was 2 sec with the number 6 button at 30 J/cm^2 and 1 sec with the number 5 button at 24 J/cm^2. We also found that double-stacked pulses were much more efficacious than single pulses or two nonstacked pulses which were obtained by crossing the subject's cheek in the horizontal axis and following back in the vertical axis. The right side of the face received 24 J/cm^2 and the left side 30 J/cm^2 for three treatments.

Cryogen spray to decrease epidermal thermal damage was applied to the handpiece treatment window before treatment. The cooling system has a color sensing indicator to ensure that the handpiece is adequately chilled. One can achieve approximately 16 to 20 pulses before cryogen needs to be reapplied with the number 5 button and 8 to 10 pulses with the number 6 button. We found that in many subjects application of a chilled roller to the face before treatment decreased discomfort.

The area treated extended horizontally from the preauricular cheek to the nasolabial fold and vertically from the tragus to the mandibular angle. The nose was also treated; however, the chin, forehead, and upper lip were not evaluated in this study. We used eye protection during this study by the use of goggles and the 12 × 12 size handpiece could be placed fairly close to the lower lid margin without risk. Nevertheless, we did note that subjects were more sensitive around the nose, eyelids, and medial cheeks than elsewhere. All subjects were asked to apply a sunscreen and refrain from excessive sun exposure during the course of the study.

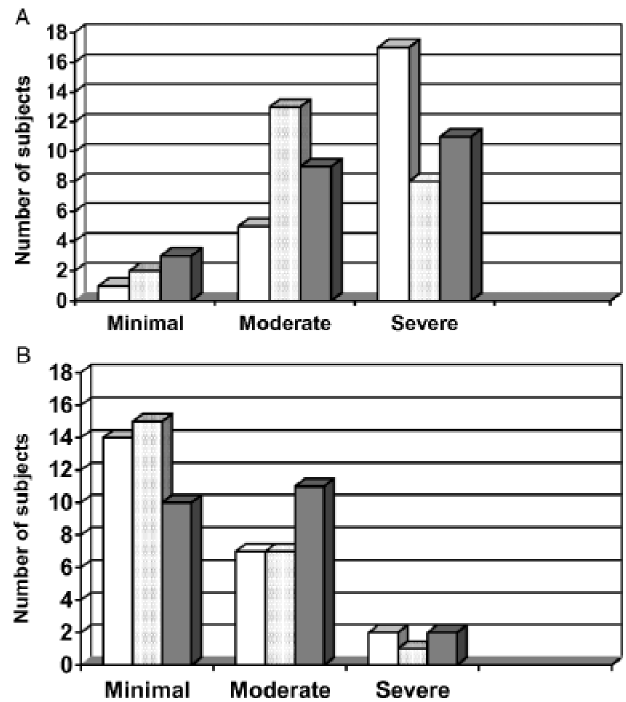

Figure 1. (A) Clinical grading, left (before treatment). (B) Clinical grading, left—30 J/cm^2 fluence (1 month after three treatments). (□) Surface texture; (▒) hyperpigmentation/solar lentigines; (■) erythema/telangiectases.

Results

We observed a diminution of all three measures of photoaging, surface roughness/texture, hyperpigmentation/solar lentigines, and telangiectases/erythema in both the left (Figure 1) and right (Figure 2) sides of the face after three courses of treatment in almost all subjects. This is seen as a shift to more minimal findings from more severe after treatment.

Interestingly, we found that surface texture responded fairly dramatically as seen by increased reflectance at the same settings for digital photography (Figures 3, 4A, and 4B) The subjects reported a significant smoothing after treatments, however, no clinical desquamation was observed. The etiology of this change in surface texture remains unknown but it is most likely due to smoothing of the stratum corneum. While we did not examine "pore" size because not all patients had enlarged pores, we noted that all who did showed significant diminution in the clinical noticeability of pores on digital photography. This is most likely due to smoothing of the ostium of the follicular infundibulum. In addition, nasal trichostasis was improved.

There was a diminution of telangiectases (Figures 4C, 4D, 5, 6C, and 6D) as evidenced by cross-polarized photography, which allows greater visualization of the subsurface vasculature. There was also a decrease in hyperpigmentation and solar lentigines after three treatments (Figures 6A, 6B, and 7). We coincidentally noted that photoepilation is also seen with the LuxG handpiece (not shown).

There was some variability in response to treatment. This may be due to the preexisting level of photodam-

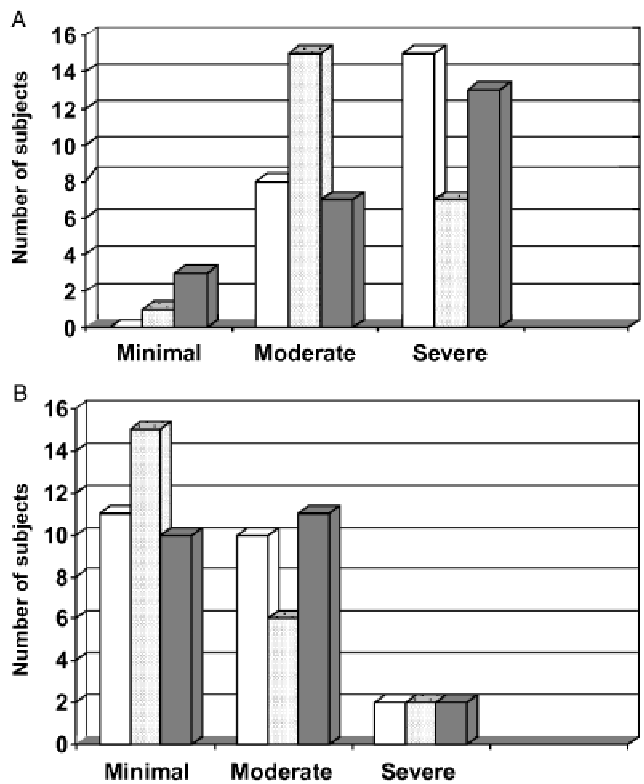

Figure 2. (A) Clinical grading, right (before treatment). (B) Clinical grading, right—24 J/cm² fluence (1 month after three treatments). (□) Surface texture; (▒) hyperpigmentation/solar lentigines; (■) erythema/telangiectases.

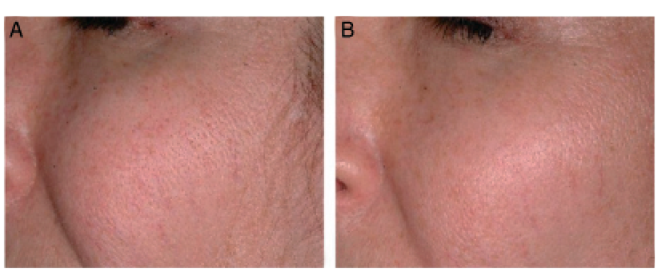

Figure 3. Diminution of surface roughness and follicular pore size (A) before treatment and (B) after treatment.

age and skin phototype. In some subjects, telangiectases resolved more rapidly than hyperpigmentation and in some other subjects, this trend was reversed. We found that the response of pigmentation and telangiectasias/erythema was slightly better using the highest fluence, 30 J/cm² (Figure 1). Nevertheless, the difference was not noticeably significant in many subjects between this and the next highest setting, 24 J/cm² (Figure 2). The operator can choose the higher fluence for treatment of more severely photodamaged skin. There is a tradeoff in that it takes longer to use the number 6 button because of the increased delay time between pulses. Additionally, the subjects experience less discomfort with the lower fluence during treatment. Side effects were limited to focal vesiculation and superficial crusting focally in two subjects that resolved over time. No subject exhibited sustained posttreatment hyperpigmentation or hypopigmentation. Temporary darkening of lentigines is frequently seen after treatment. Immediate blanching of vessels was also noted; however, purpura was not seen. Most subjects reported feeling a sunburn sensation with erythema and warmth lasting a few hours to 1 day after treatment. We noted that the level of discomfort was less with each subsequent treatment. Some subjects did not report any erythema whatsoever nor any posttreatment sensory changes.

Discussion

We have presented data showing the efficacy of the EsteLux system intense pulsed light device with the LuxG handpiece at the fluences of 24 and 30 J/cm² using double-stacked pulses in the treatment of three measures of photoaging: telangiectases/erythema, surface roughness, and mottled hyperpigmentation. This study demonstrated some standardized parameters for treatment using the LuxG handpiece with this device. How long the clinical benefits of treatment are maintained has not been assessed. We expected to see diminution in telangiectases and pigmentation; however, the dramatic change in surface texture using this device was unexpected. Further clinical and basic studies may elucidate the mechanism of this change. As stated earlier, no desquamation was seen clinically.

The device was well tolerated and most subjects were pleased with the results and would recommend it to others. We saw no significant change in periorbital rhytides/fine lines using this device at the above-mentioned fluences for three treatments. This contrasts with some prior studies claiming nonablative treatment of rhytides with intense pulsed light.[4] Nevertheless, it is in consonance with prior published studies showing benefits in texture, telangiectases, and pigmentation.[5] Using fluences of 24 and 30 J/cm² with the double-stacked pulse has a good safety profile and minimizes the risk of epidermal injury. Prechilling the subject's skin and the use of the cryogen undoubtedly is also beneficial in this regard. Although only three treatments were given, we suspect that the use of a fourth and fifth treatment would even further improve the clinical results. Expected temporary side effects such as erythema after treatment of vascular lesions and slight darkening of pigmented lesions after treatment usually rapidly resolved.

We and others have demonstrated that intense pulsed light adds to other techniques in dermatology when considering a course of photorejuvenation.[4,5] There are now a number of manufacturers of intense

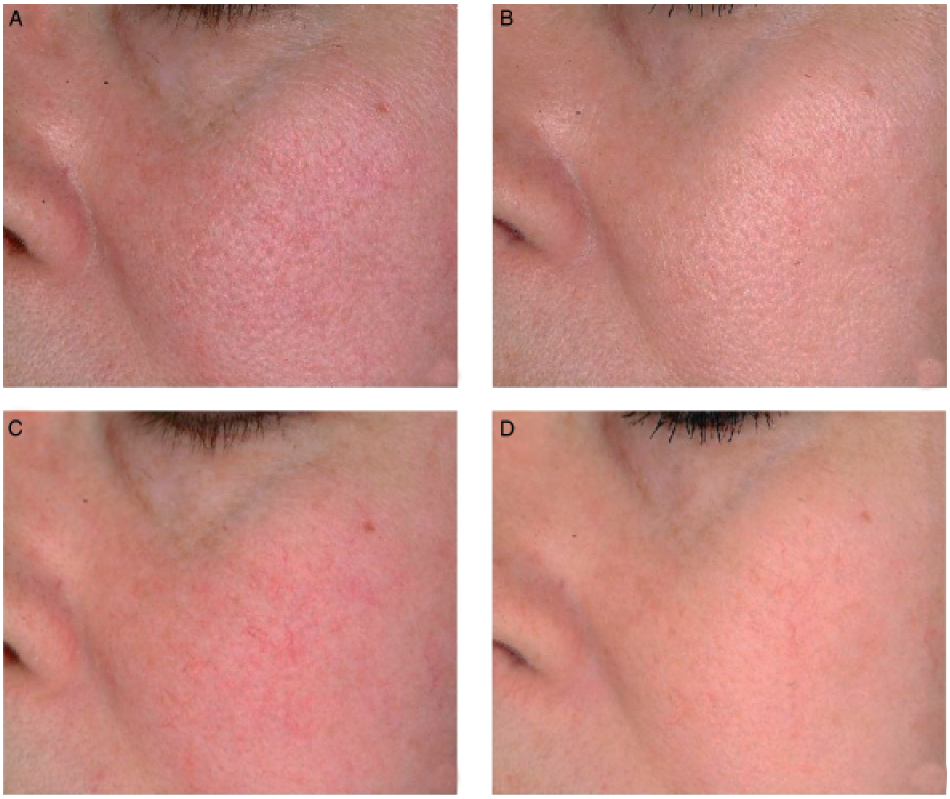

Figure 4. Diminution of surface roughness and follicular pore size (A) before treatment and (B) after treatment. Using cross-polarized filters, diminution of telangiectases and erythema (C) before treatment and (D) after treatment.

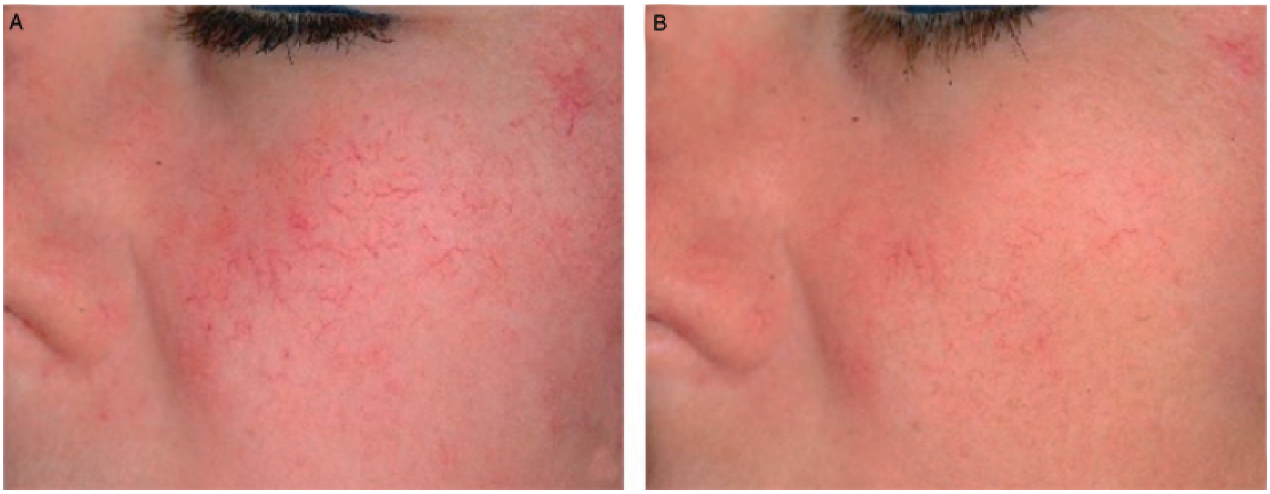

Figure 5. Using cross-polarized filters, diminution of erythema and telangiectases (A) before treatment and (B) after treatment.

pulsed light devices for photorejuvenation. These devices differ in their ability (by using cutoff filters) to deliver different wavelengths, pulse durations, fluences, spot sizes, and cooling devices, as well as differing in cost. Nevertheless, they all have the ability to be tailored to the individual device operator's preferences and individual patient's needs. For example, in one study that used the Vasculight (ESC/Sharplan, Norwood, MA),[4] the treatment fluences varied between 30 and 50 J/cm^2 using double or triple pulses of 2.4 to 4.7 msec with pulse delays of 10 to 60 msec and cutoff filters of 550 or 570 nm. Four to six full-face treatments were administered to 49 subjects at 3-week intervals. Comparing these treatment variables to ours, one can see that they are different yet the clinical improvement is comparable. A retrospective study of 80

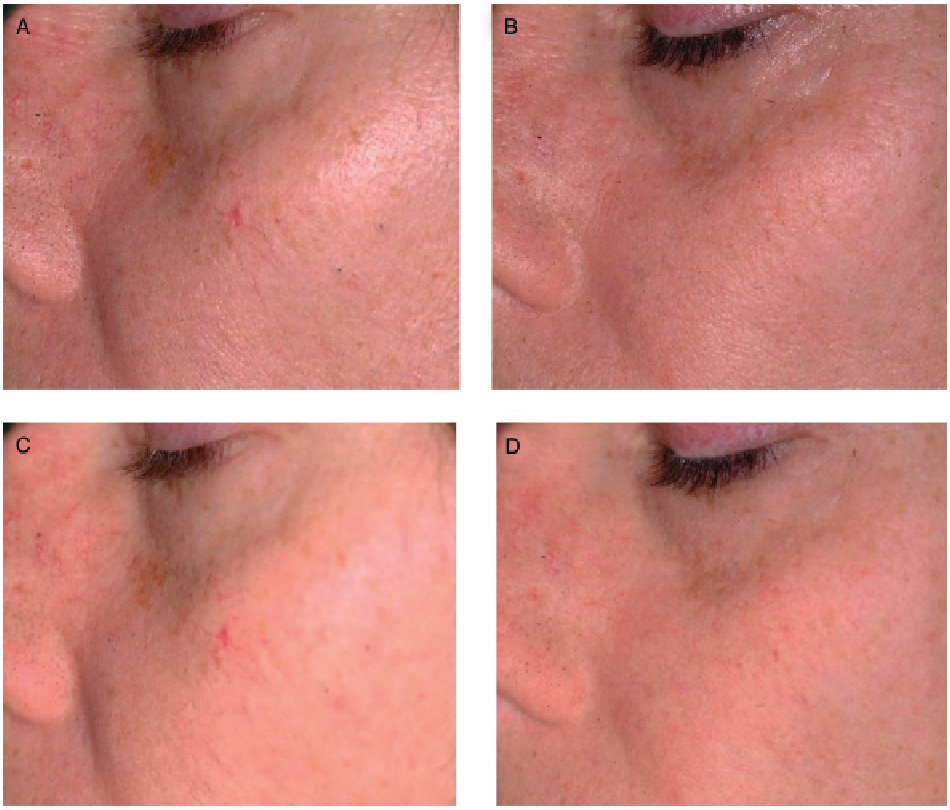

Figure 6. Diminution of mottled hyperpigmentation and solar lentigines (A) before treatment and (B) after treatment. Using cross-polarized filters, diminution of telangiectases and erythema (C) before treatment and (D) after treatment.

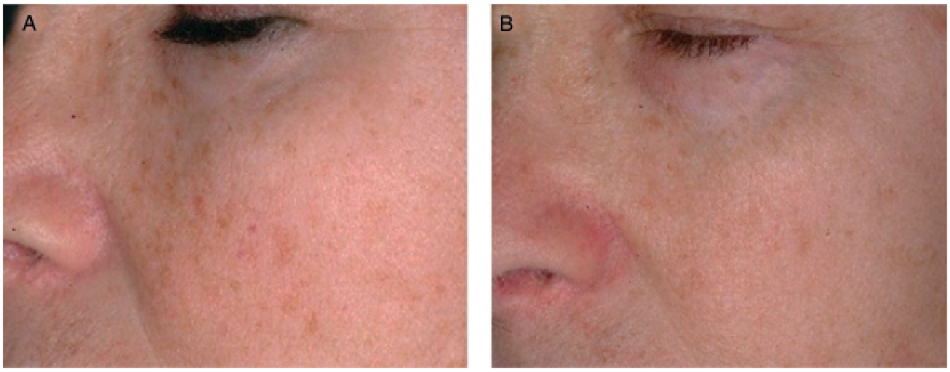

Figure 7. Diminution of solar lentigines and mottled hyperpigmentation (A) before treatment and (B) after treatment.

subjects used the Photoderm VL (Lumenis, Needham, MA),[5] wavelength 550–590 nm, double pulsing with a shorter 2.4-msec pulse, and a 10-msec delay followed by a longer 6.0-msec pulse at fluences of 30 to 44 J/cm^2. The improvements in texture, telangiectases, and pigmentation were comparable to results of our current study.

One can postulate that there are multiple target chromophores within the skin (which include melanin and hemoglobin) and that coagulation due to photothermolysis is seen with subsequent resolution by repair processes. Studies using histology[6,7,8] and videomicroscopy[6] have been reported. More studies along these lines will be helpful to elucidate the mechanism of action of intense pulsed light.

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