

Effective Treatment of Facial Redness Caused by Atopic Dermatitis Using Intense Pulsed Light Systems

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BACKGROUND Patients with facial atopic dermatitis (AD) experience psychological and social distress.

OBJECTIVE To evaluate the safety and the efficacy of intense pulsed light (IPL) treatment in patients with facial AD.

MATERIALS AND METHODS Eleven patients (9 men, 2 women; aged 14–39) with mild to moderate refractory facial AD were included in this study. In three separate sessions at 2-week intervals, the whole face was exposed to an IPL device using a 590-nm cut-off filter. Objective clinical response was examined using the Eczema Severity Score (ESS), a polarization color imaging system, and two dermatologists' evaluations. Data on quality of life were evaluated using the Dermatology Life Quality Index (DLQI).

RESULTS The ESS in 11 patients with facial AD was significantly lower 4 weeks after the third treatment ($p=.005$). Scaling ($p=.003$); edema, induration, and papules ($p=.011$); erythema ($p=.009$), and lichenification ($p=.008$) improved significantly. The erythema scale, examined using the polarization color imaging system, also decreased significantly ($p=.04$). No patients showed any noticeable side effects. Mean DLQI score improved significantly after the completion of therapy (from baseline to 4 weeks after the last IPL treatment; $p=.005$).

CONCLUSION IPL treatment could be used as an adjunct modality for the treatment of refractory facial AD with minimal side effects.

The authors have indicated no significant interest with commercial supporters.

Atopic dermatitis (AD) is a chronic, relapsing inflammatory skin disease that usually starts early in life and can persist into adulthood. Patients with facial AD experience psychological and social distress, because lesions on the face are highly disabling and difficult to treat.^{1–3}

Facial redness in dermatology has a broad spectrum of etiologies, including steroid dermatitis, rosacea, seborrheic dermatitis, and AD.^{4,5} Because facial skin is thinner than skin in other areas, the repeated use of topical steroids on the face makes skin more susceptible to steroid-induced side effects such as atrophy, telangiectasia, perioral dermatitis, and rosacea.^{6,7} Although topical tacrolimus or pimecrolimus have been reported to effectively

control eczema and pruritus in patients with facial AD who are dependent on topical steroids,⁸ its effect on the underlying distended vasculature is minimal. Thus, the management of facial redness in atopic dermatitis remains a difficult challenge.⁵

Recently, a pilot study showing the positive effect of pulsed-dye laser (PDL) treatment on localized areas of chronic atopic dermatitis has been reported. A decrease in dermal inflammatory infiltrates by reducing the underlying vasculature has been suggested as the mechanism of PDL treatment of eczema.⁹ Intense pulsed light (IPL) for the treatment of vascular and pigmented lesions has been used as a safe and effective treatment of erythemato-telangiectatic rosacea through ablating abnormal

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vessels followed by a reduction of inflammation.¹⁰ Therefore, IPL treatment might also be considered as one of the treatment options for facial AD. In this study, we evaluated the safety and efficacy of IPL treatment in patients with facial AD using objective and quantitative means.

Patients and Methods

Eleven patients aged 12 and older (9 male, 2 female; aged 14–39; Fitzpatrick skin type IV) with refractory facial AD who had been suffering from persistent erythema on the face for more than 3 years were included in this study. All patients fulfilled the Hanifin and Rajka diagnostic criteria for AD¹¹ and had mild to moderate facial AD (facial investigator's global assessment (IGA) score of 2 or 3).¹² Patients who had active lesions of AD with oozing or weeping were excluded, as were those who had received any systemic treatment other than oral antihistamines 1 month before IPL treatment. Patients were instructed to stop topical treatments, including corticosteroids and calcineurin inhibitors, 1 week before treatment and to use only a moisturizer (Physiogel, Stiefel Inc., Coral Gables, FL) on the face during the study period to promote wound healing and prevent dryness. Consent forms were obtained from all subjects, and the Institutional Review Board of Severance Hospital approved the protocol.

The entire face was completely cleaned with a mild soap. Patients with a history of herpes virus infection were prophylactically prescribed oral acyclovir for 3 days. The whole face, except for periorbital, perinasal, and perioral areas, was twice exposed to an IPL device (Broadband light (BBL), Sciton Inc., Palo Alto, CA) using a 590-nm cut-off filter (590–1,200 nm) at a fluence of 12 to 13 J/cm². The pulse duration was 30 ms with a 20-ms intervening delay. Subjects were advised to avoid sun exposure for 48 hours after the treatment. Subjects were treated a total of three times at 2-week intervals. They were also recommended to avoid overexposure to sunlight and to use a broad-spectrum sunscreen during and after the treatments.

Photographic documentation using identical camera settings, lighting, and patient positioning were obtained at baseline, before each treatment session, and 4 weeks after the final treatment. An Eczema Severity Score (ESS) based on a modification of the validated Eczema Area and Severity Index (EASI) was applied for the objective clinical assessments of facial eczema.^{9,13} The ESS (0–108) was calculated by multiplying a proportional score from 0 to 6 (0 = no eruption, 1 = <10%, 2 = 10–29%, 3 = 30–49%, 4 = 50–69%, 5 = 70–89%, 6 = 90–100% of face) after summing the scores of six clinical signs (erythema; edema, induration, or papules; excoriation; oozing, weeping, or crusting; scaling; and lichenification (graded from 0 to 3: 0 = absent, 1 = mild, 2 = moderate, 3 = severe)), with a maximum score of 18. A polarization color imaging system (Derma Vision, OptoBioMed Co., Kangwon, Korea)¹⁴ was used to evaluate changes of the erythema scales (100–1,000) in treated sites at each follow-up visit. Two blinded dermatologists assessed the severity of eczema and erythema based on a quartile grading scale (grade 4 = >75% improvement, grade 3 = 50–75% improvement; grade 2 = 25–50% improvement, grade 1 = 0–25% improvement, and grade 0 = <0% improvement from baseline) in a nonchronological order without knowing time sequences in the photos after IPL treatments. Patients were asked about their overall rates of satisfaction using a 10-point visual analogue scale (0 = lowest, 10 = highest). These evaluations were performed at each treatment session and follow-up visit. Patients also reported on the side effects of the treatment. Data on quality of life (QOL) were evaluated using the Korean version of the Dermatology Life Quality Index (DLQI) before initial treatment and 4 weeks after the third treatment.¹⁵ Written permission from the copyright owner of the DLQI was obtained. The DLQI score was calculated by summing the score of each question, with a maximum score of 30.

The effects of IPL treatments for facial redness caused by AD were evaluated based on statistical

analysis using the Wilcoxon signed rank test for nonparametric analysis to compare the changes of eczema and erythema from baseline to the follow-up visit. Statistical significance was defined as $p < .05$.

Results

Demographics

Eleven patients were enrolled in this study (2 female, 9 male; mean age 25.8, range 14–39). The disease duration of AD was 15.7 years (range 4–38). Eight patients had mild facial AD of IGA 2, and three had moderate facial AD of IGA 3. The mean head and neck EASI score was 2.1 ± 0.6 , and the overall EASI score was 15.6 ± 9.1 .

Treatment Outcomes

Follow-up results collected 1 month after the final treatment revealed that the mean score reflecting erythema of the lesions fell from 2.7 to 1.7; edema, induration, or papules from 1.3 to 0.5; excoriation from 0.5 to 0.1; oozing, weeping, or crusting from 0.4 to 0.1; scaling from 1.4 to 0.3; and lichenification from 1.7 to 1.1 (Table 1). The ESS in 11 patients with refractory facial AD decreased significantly from 20.8 at baseline to 9.1 four weeks after the third treatment ($p = .005$) (Figure 1A). The components of the ESS that showed statistically significant

improvement 4 weeks after the third IPL treatment were scaling ($p = .003$); edema, induration, or papules ($p = .011$); erythema ($p = .009$); and lichenification ($p = .008$).

The erythema scale according to a polarization color imaging system decreased significantly after three sessions of IPL treatments ($p = .04$) (Figure 1B). The clinical assessment of severity of eczema and erythema by two blinded dermatologists showed improvement of grade 1 in three of 11 patients, improvement of grade 2 in four, and improvement of grade 3 in four 4 weeks after the last treatment. The mean overall rate of patient satisfaction using a 10-point visual analogue scale was 6.4 ± 2.4 (Table 2, Figures 2 and 3).

Safety

Although three patients with facial AD of IGA score 3 experienced a mild flare of AD immediately after IPL treatment, the treatment was generally well tolerated. All patients complained of dryness of varying degrees, particularly for 3 to 4 days after each IPL treatment, although the dryness was alleviated with the use of moisturizer alone. No patients showed any noticeable side effects, such as infection, scarring, or severe aggravation of AD, except for

TABLE 1. Assessments of Clinical Signs Constituting Eczema Severity Scores (ESSs) at Baseline and 4 Weeks After the Third Intense Pulsed Light Treatment on Refractory Facial Atopic Dermatitis

	Before Treatment	4 Weeks After Third Treatment	p-Value
ESS (range 0–108)	20.8	9.1	.005
Erythema (range 0–3)	2.7	1.7	.009
Edema, induration, or papules (range 0–3)	1.3	0.5	.01
Excoriation (range 0–3)	0.5	0.1	.10
Oozing, weeping, or crusting (range 0–3)	0.4	0.1	.18
Scaling (range 0–3)	1.4	0.3	.003
Lichenification (range 0–3)	1.7	1.1	.008
Involved area (range 0–6)	3.5	3.3	.08

The ESS (0–108) was calculated by multiplying a proportional score from 0 to 6 (0 = no eruption, 1 = <10%, 2 = 10–29%, 3 = 30–49%, 4 = 50–69%, 5 = 70–89%, 6 = 90–100% of face) after summing the scores of six clinical signs [erythema; edema, induration, or papule; excoriation; oozing, weeping, or crusting; scaling; and lichenification (graded from 0 to 3: 0 = absent, 1 = mild, 2 = moderate, 3 = severe), with a maximum score of 18.

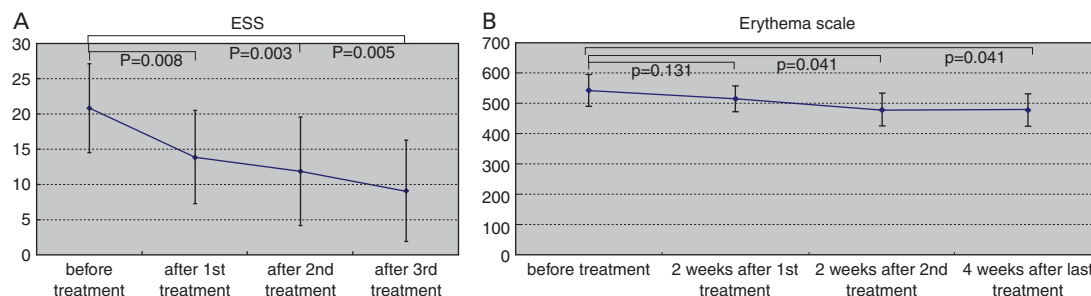


Figure 1. Change in eczema severity scores (A) and erythema scale examined using the color imaging system (B) at each follow-up visit after intense pulsed light treatment.

transient erythema and edema that disappeared within a few days of treatment.

decreased significantly after IPL treatments ($p = .007$, $.02$, $.01$, and $.02$, respectively) (Figure 4).

Quality of Life

The questionnaire about QOL in our study showed that AD had a moderate effect on the QOL of six AD patients and a very large effect on the QOL of five patients before treatment. The mean DLQI score was significantly better after the completion of therapy ($p = .005$). The scores in subcategories of DLQI, including symptoms and feelings, leisure, work and school, and personal relationships,

Discussion

The head and neck distribution in AD is most often seen in adolescents and young adults.¹⁶ A number of associated factors, including mites, fungi such as *Malassezia* and *Candida*,^{17–20} ultraviolet radiation,²¹ topical application of steroids, and contact dermatitis due to cosmetics and detergents, have been suggested as possible causes of facial redness in patients with AD,²² but the mechanism behind the

TABLE 2. Visual Analogue Scales of Eczema and Erythema Assessed by Two Blinded Dermatologists and Overall Patient Satisfaction

Patient Number	Sex/Age	Severity of Eczema and Erythema Assessed by Two Blinded Dermatologists (After First/Second/Third Treatment; 0–4)	Overall Patients' Degree of Satisfaction (After First/Second/Third Treatment; 0–10)
1	F/27	1/0/1	4/2/3
2	M/21	2/2/3	6/6/10
3	M/39	1/2/2	6/6/8
4	M/20	1/3/3	5/7/7
5	M/14	2/3/3	3/6/7
6	M/33	1/1/2	7/8/8
7	F/24	0/1/1	3/6/3
8	M/35	1/2/3	5/6/8
9	M/28	0/1/1	3/4/3
10	M/28	3/1/2	5/7/7
11	M/17	1/1/2	7/5/6

Two blinded dermatologists' evaluated improvement from baseline of eczema and erythema based on a quartile grading scale (grade 4 = >75% improvement, grade 3 = 50–75%, grade 2 = 25–50%, grade 1 = 0–25%, grade 0 = <0%). Overall patient degree of satisfaction was evaluated using a 10-point visual analogue scale (0 = lowest, 10 = highest).

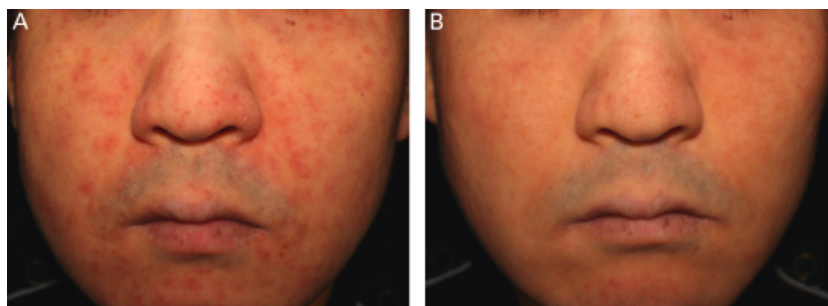


Figure 2. Facial atopic dermatitis in a 28-year-old man before (A) and 2 weeks after (B) first intense pulsed light (IPL) treatment. The intensity of eczema and erythema shows marked improvement (grade 3, 50–75%) in the cheek areas treated with IPL.

facial redness caused by AD cannot be explained on the basis of one factor alone.

It is important to discontinue or taper the use of topical steroids for the treatment of facial redness caused by AD, because the long-term use of topical steroids is closely associated with facial redness. In addition, aggravating factors such as sweating, ultraviolet radiation, and allergens or irritants should be avoided, and nonirritant, mild soaps are recommended. Antifungal treatment in patients with AD who are affected mainly in the head and neck areas has been reported to decrease *Malassezia* colonization and improve clinical severity.^{23,24} Recently, topical calcineurin inhibitors such as pimecrolimus cream and tacrolimus ointment have also been found to be effective in patients with head and neck AD intolerant of or dependent on topical steroids,^{2,8,25,26} although the effectiveness

of various treatments for recalcitrant facial AD is limited.

The histopathologic findings of intractable facial erythema in adult patients with AD show a mixture of eczematous and steroid-induced rosacea-like changes.²⁷ In addition, AD facial skin is frequently lichenified and pigmented because of repetitive eczematous changes and scratching. The residual erythema, pigmentation, and lichenification due to recurrent eczema do not resolve well or quickly.

An IPL device that emits polychromatic light in a broad wavelength of 515 to 1,200 nm allows the optimal wavelength spectrum to penetrate to the depth of target tissue with various cut-off filters.²⁸ IPL systems in which shorter wavelengths are filtered reduce the absorption of melanin, and eventually the incidence of strong side effects such as

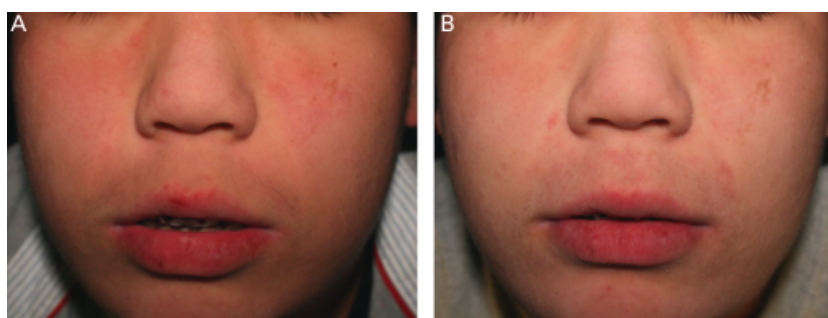


Figure 3. Facial atopic dermatitis in a 14-year-old boy before (A) and 4 weeks after (B) three intense pulsed light (IPL) treatments. The intensity of eczema and erythema shows marked improvement (grade 3, 50–75%) in the cheek areas treated with IPL.

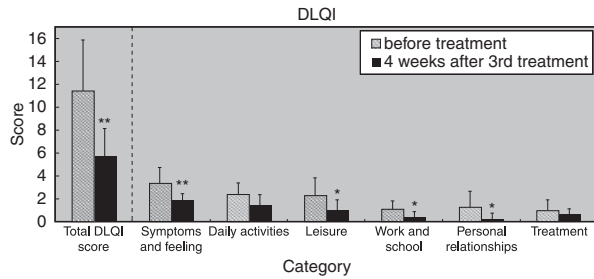


Figure 4. Evaluation of Dermatology Life Quality Index at baseline and 4 weeks after third intense pulsed light treatment on refractory facial atopic dermatitis (** $p < .01$; * $p < .05$).

blistering and scarring could be decreased.²⁹ In addition, the time delay within an individual single pulse allows the epidermis to cool, resulting in selective thermal damage.³⁰ Therefore, the IPL parameters used in our study, including a 590-nm cut-off filter and pulse duration of 30 ms with an intervening 20-ms delay, made it possible to treat the facial redness caused by AD effectively without noticeable side effects.

The activation of endothelial cells and the release of mediators from recruited inflammatory cells typically accompany eczematous lesions. One pilot study that showed the positive effects of PDL on small areas of chronic AD suggested that PDL that can target dermal vasculature might have an effect on cutaneous immunologic activation in AD.⁹ Our rationale for using an IPL system on facial AD was that IPL treatment has advantages over PDL, for example, no down-time due to bruising, and could lead to decreases of the underlying vasculature, ultimately resulting in a decrease in dermal infiltrates. In addition, because facial redness from telangiectasia induced by the long-term use of topical steroids is similar to rosacea lesions, we hypothesized that an IPL system might be a promising modality for the treatment of facial redness caused by AD. The IPL system has also been used effectively for non-ablative skin rejuvenation and the treatment of pigmented lesions.^{28,31} Therefore, we postulate that an IPL system might improve the lichenification and postinflammatory hyperpigmentation that fre-

quently accompanies AD because of persistent scratching through collagen remodeling and targeting melanin.

Loss of function in the filaggrin gene is associated with AD, and this contributes to the impaired epidermal barrier in AD.³² IPL treatment could increase the breakdown of the epidermal barrier in AD.

Although three patients in our study with moderate facial AD of IGA score 3 experienced mild aggravation of AD immediately after IPL treatment, symptoms were alleviated with the use of moisturizer alone. Swelling and erythema usually resolved within 2 days, and the dryness that all patients experienced to varying degrees, particularly for 3 to 4 days after every IPL treatment, also responded to moisturizer use. Otherwise, major adverse events, including infection, blistering, and scarring, were not observed.

Patients with facial AD often have a lack of confidence regarding their appearance and withdraw from interpersonal relationships. The questionnaire about QOL in our study showed that AD had a moderate effect on the QOL of six patients and a very large effect on the QOL of five patients at the time of enrollment. The mean DLQI score improved significantly after the completion of therapy, suggesting that IPL treatment plays a role in the improvement of refractory facial AD, resulting in the improvement of QOL.

Limitations of our study include that it was a pilot study with a small sample size, the lack of controlled and comparative design, and the lack of long-term follow-up. In addition, because tremendous daily variability in AD severity and the placebo effect of IPL treatment might influence the result of this study, more randomized, controlled studies with long-term follow-ups should be performed to confirm the effect of IPL treatment on the red face in AD. However, IPL treatment for patients with facial AD has not been attempted previously, and to our knowledge, this is the first study to evaluate the effects of IPL in the treatment of refractory facial AD. Our study

suggests that IPL treatment could be used as an adjunct modality for the treatment of refractory facial AD with minimal side effects, particularly in patients with AD with mild facial eczema and patients with facial AD with persistent erythema and postinflammatory hyperpigmentation.

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