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LETTER TO THE EDITOR

Application of Analytic Technique Using Green Light Parallel-Polarized Light Images in Various Skin Diseases

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Dear Editor:

Ordinary photography may not fully represent patients' skin status, but digital photography using a consistent and appropriate light-emitting diode (LED) illuminator could provide more objective and reliable images and colorimetric data[1]. Previous studies have shown that parallel-polarized light (PPL) images taken with green LED show more significant quantitative differences, depending on the state of the skin, than those taken with white LED[2,3]. This study aimed to determine the skin diseases appropriate for an analytic technique using PPL images taken with green and white LEDs.

This study was approved by the Institutional Review Board (IRB) at the Korea University College of Medicine Anam Hospital (IRB ED13197). Between September 2013 and August 2014, 73 subjects were enrolled in a prospective study. Among the subjects, 10 or more had one of the following diseases: acne, atopic dermatitis, nummular eczema, rosacea, seborrheic dermatitis, senile pruritus, and xerotic dermatitis (Table 1). Subjects taking systemic or topical medications that can interfere with the skin status, including diuretics, corticosteroids, retinoids, and H2 antihistamine agents, were excluded. Subjects with underlying conditions that may affect the skin surface, such as pregnancy, nutrient deficiency, thyroid dysfunction, serious diseases (e.g., malignancies), and skin disorders requiring treatment, were also excluded. Subjects were recruited regardless of sex and age.

A digital, single-lens reflex camera (EOS-500D; Canon Inc., Tokyo, Japan) equipped with a macro lens (SP MF 90

Table 1. Demographic data of the patients

Variable	Patient (male/female)	Age (yr)	Disease severity	Dryness	
				Normal	Lesion
Overall	73 (40/33)	47.3±22.2 (17~90)	2.32±0.74	0.15	2.34
Atopic dermatitis	10 (5/5)	24.3±5.08 (19~33)	2.4±0.66	0.1	2.7
Rosacea	12 (2/10)	52.5±18.8 (21~70)	2.42±0.76	0	1.83
Xerotic dermatitis	10 (8/2)	57.6±22.2 (19~90)	2.3±0.78	0.1	2.4
Acne	10 (5/5)	25.3±23.0 (17~44)	1.9±1.04	0	2.2
Nummular eczema	10 (8/2)	51.0±23.7 (17~78)	2.6±0.49	0.3	2.9
Seborrheic dermatitis	11 (7/4)	49.5±22.6 (21~78)	2.27±0.62	0.27	2.36
Senile pruritus	10 (5/5)	69.8±22.4 (45~90)	2.3±0.46	0.3	2.1

Values are presented as number or mean±standard deviation (range).

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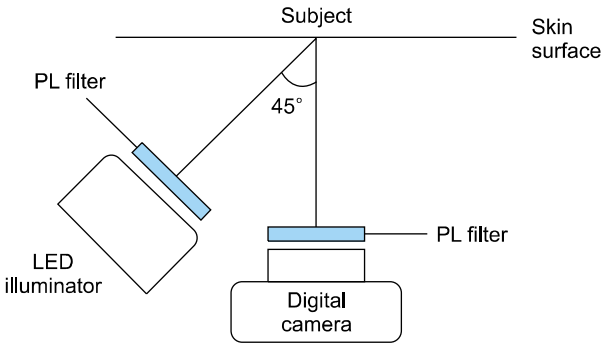

Fig. 1. A schematic diagram of the equipment. PL: polarized light, LED: light-emitting diode.

mm F/2.8 Di Macro 1:1; Tamron Co., Ltd., Saitama, Japan) was used, and a rotatable polarizing filter was placed over the camera lens. The same in-house skin conductance meter as that in the previous study was used[3].

PPL photographs were taken with a polarizing, filtered camera, with green and white LED illuminators attached respectively at each side of the camera at an angle of 45° (Fig. 1). All photographs were obtained under the same conditions, with the same settings and distances with either green or white LED illuminators. Photographs were taken of every skin lesion and surrounding normal skin in each subject.

Disease severity was evaluated using a 5-point investigator's global assessment scale, and dryness was graded for severity with a score from 0 to 6 using the xerosis severity scale[4]. Commission Internationale de l'Eclairage LAB (CIELAB) values were obtained from the PPL images by converting sRGB to CIELAB coordinates based on a previous study[5]. Equations and a matrix conversion were derived using graphics software (Adobe Photoshop Elements; Adobe Systems Inc., San Jose, CA, USA) and a spreadsheet program (Excel 2010; Microsoft Corp., Redmond, WA, USA). Statistical software IBM SPSS Statistics version 21.0 for Windows (IBM Co., Armonk, NY, USA) was used for statistical analyses. All values were tested by Pearson or Spearman correlation with statistical significance set at $p<0.05$.

The results showed that CIELAB values for the green LED correlated overall with disease severity, dryness, and skin conductance values of lesions (Table 2).

In atopic dermatitis, age had a negative correlation with a* ($r=-0.86587$, $p=0.0012$) of lesions for the white LED. In addition, disease severity had a negative correlation with a* ($r=-0.67420$, $p=0.0325$) and a positive correlation with b* ($r=0.67420$, $p=0.0325$) for the green LED. There was a strong correlation for conductance values between normal skin and lesions ($r=0.98780$, $p<0.0001$).

In rosacea, lesion dryness had a positive correlation with disease severity ($r=0.67776$, $p=0.0154$), a negative correlation with L* ($r=-0.71758$, $p=0.0086$), and a positive correlation with a* ($r=0.67941$, $p=0.0151$) for the green LED. As in atopic dermatitis, skin conductance values correlated strongly between normal skin and lesions ($r=0.92240$, $p<0.0001$).

In xerotic dermatitis, disease severity had a positive correlation with dryness ($r=0.98837$, $p<0.0001$) and a negative correlation with skin conductance values of lesions ($r=-0.78377$, $p=0.0073$). Lesion dryness had a negative correlation with L* ($r=-0.69228$, $p=0.0265$) and b* ($r=-0.69228$, $p=0.0265$) and a positive correlation with a* ($r=0.69228$, $p=0.0265$) for the green LED.

Standard digital photography is easily distorted by the environment[5], and interpretation can be subjective. Qualitative and quantitative attributes of clinical photography can vary because of subtle changes in framing, angle, and exposure settings between the subject and the camera[6].

To verify the analytic value of PPL images using green and white LEDs in dermatology, seven diseases were selected using the following criteria: the disease severity should be of relatively wide spectrum; before or during the disease manifestation, the patient's innate factors or characteristics should cause a physiological change in the skin; recovery of the skin condition may not be complete, even with visible improvement; and the recovery of the skin should be directly related to the treatment and prognosis of the disease.

PPL images taken with green LED are statistically correlated with dryness and the skin conductance value of the disease lesion, respectively. Since dryness—a subjective value assessed by the dermatologist—correlated with objective values for skin conductance, visual inspection by dermatologists is probably objective and valid.

In atopic dermatitis, rosacea, and xerotic dermatitis, some values had statistically significant correlations. PPL images taken with green LED were correlated with disease severity or dryness in each disease; this should thus be a valid tool for effectively determining the disease severity. There was a correlation of skin conductance values in atopic dermatitis and rosacea between normal and lesional skin; this implies that normal skin around a lesion may already be affected by the disease or may have similar characteristics despite appearing normal on visual inspection.

Skin hydration level, as an indirect indicator of skin disease progression[7], was measured by skin conductance value and was related to glossiness, dryness, and CIELAB coordinates in some diseases.

In conclusion, the PPL imaging technique with green and

Table 2. Results overall and for each disease

Variable		Age	Dryness*	Disease severity†	Skin conductance values
Overall	Normal	Dryness (r=0.34430, p=0.0027), Green L* (r=−0.31548, p=0.0062), Green a* (r=0.30577, p=0.0081)	Dryness of lesions (r=0.29014, p=0.0122)	Dryness (r=0.24711, p=0.0338)	Skin conductance values of lesions (r=0.93147, p<0.0001)
	Lesions		Green L* (r=−0.49103, p<0.0001), Green a* (r=0.44167, p<0.0001), Green b* (r=−0.27519, p=0.0176), White L* (r=−0.27992, p=0.0157)	Dryness (r=0.63071, p<0.0001), Skin conductance values (r=−0.24457, p=0.0357), Green L* (r=−0.46322, p<0.0001), Green a* (r=0.43071, p=0.0001), Green b* (r=−0.40064, p=0.0004)	Green L* (r=0.32473, p=0.0048), Green a* (r=−0.34669, p=0.0025), Green b* (r=0.30936, p=0.0073)
Atopic dermatitis	Normal				Skin conductance values of lesions (r=0.98780, p<0.0001)
	Lesions	White a* (r=−0.86587, p=0.0012)		Green a* (r=−0.67420, p=0.0325), Green b* (r=0.67420, p=0.0325)	
Rosacea	Normal				Skin conductance values of lesions (r=0.92240, p<0.0001)
	Lesions		Disease severity (r=0.67776, p=0.0154), Green L* (r=−0.71758, p=0.0086), Green a* (r=0.67941, p=0.0151)		
Xerotic dermatitis	Normal				White a* (r=−0.79394, p=0.0061)
	Lesions		Green L* (r=−0.69228, p=0.0265), Green b* (r=−0.69228, p=0.0265), Green a* (r=0.69228, p=0.0265)	Dryness (r=0.98837, p<0.0001), Skin conductance values (r=−0.78377, p=0.0073)	
Acne	Normal				
	Lesions				
Nummular eczema	Normal				Skin conductance values of lesions (r=0.92402, p=0.0001)
	Lesions			White L* (r=−0.71067, p=0.0212), White a* (r=0.71067, p=0.0212)	
Seborrheic dermatitis	Normal		White a* (r=−0.64550, p=0.0319)		
	Lesions		Skin conductance values (r=−0.60744, p=0.0475)	White a* (r=−0.64725, p=0.0313)	
Senile pruritus	Normal				
	Lesions			Dryness (r=0.75698, p=0.0112), Green L* (r=−0.80015, p=0.0054), Green a* (r=0.80015, p=0.0054), Green b* (r=−0.80015, p=0.0054)	

*Xerosis severity scale was used, †5-point investigator's global assessment scale was used.

white LEDs can be an effective tool for analyzing skin status in certain dermatologic diseases. The results showed that dryness and skin conductance values had significant correlations with some L*, a*, and b* with green LED and with disease severity in atopic dermatitis, rosacea, and xerotic dermatitis. CIELAB values from PPL with green LED correlated more than with white LED with regard to skin characteristics. When properly applied, an analytic technique using PPL images with green LED can be utilized for evaluation of various skin diseases and skin characteristics.

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REFERENCES

1. Ahn HH, Kim SN, Kye YC. Digital camera images obtained using a light-emitting diode illuminator and their dermatological applications. Skin Res Technol 2006;12:11-17.
2. Bae EJ, Seo SH, Kye YC, Ahn HH. A quantitative assessment of the human skin surface using polarized light digital photography and its dermatologic significance. Skin Res Technol 2010;16:270-274.
3. Kim DH, Choi JE, Ryu HJ, Seo SH, Kye YC, Ahn HH. Analytic parallel-polarized light imaging technique using various light-emitting diodes: a comparison with skin conductance values. Skin Res Technol 2015;21:158-163.
4. Jennings MB, Alfieri D, Ward K, Lesczczynski C. Comparison of salicylic acid and urea versus ammonium lactate for the treatment of foot xerosis. A randomized, double-blind, clinical study. J Am Podiatr Med Assoc 1998;88:332-336.
5. Rizova E, Kligman A. New photographic techniques for clinical evaluation of acne. J Eur Acad Dermatol Venereol 2001;15 Suppl 3:13-18.
6. Phillips SB, Kollias N, Gillies R, Muccini JA, Drake LA. Polarized light photography enhances visualization of inflammatory lesions of acne vulgaris. J Am Acad Dermatol 1997;37:948-952.
7. Rim JH, Jo SJ, Park JY, Park BD, Youn JI. Electrical measurement of moisturizing effect on skin hydration and barrier function in psoriasis patients. Clin Exp Dermatol 2005;30:409-413.

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Periorbital Lipogranuloma after Autologous Fat Injection for Forehead Augmentation

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Dear Editor:

Autologous fat injection (AFI) for facial augmentation has become a popular cosmetic procedure at local plastic surgery clinics. It is considered safe, with no severe adverse reactions, compared with synthetic filler injection. However, we encountered a patient with a periorbital lipogranuloma, a rare side effect of AFI for forehead augmentation.

A 46-year-old woman presented with swelling on the left

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