

Digital aging : Skin Changes by digital devices

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Introduction:

Visible light is emitted from natural and artificial sources. As a major natural source, solar radiation contains a large proportion of visible light. Visible light exposure from artificial sources can originate from a variety of instruments, including computers, smartphones, televisions, and light-emitting diodes (LEDs).¹ With the rapid technological development of the modern society, skin aging is also connected to digital. In the past, there have been many discussions about extrinsic aging such as sunlight, but recently, aging caused by digital devices such as smartphones has emerged as an issue. Recently, in the UK, it is being pointed out that the selfie craze is the main cause of skin aging, and it is drawing attention. Our previous studies have reported that repeated exposure to blue light energy can cause skin damage including increase of erythema index and melanin index and decrease of skin hydration and transparency.² However, there is no clinical test report on the visible light source emitted by digital devices. In this study, we have studied that the harmful skin effects on visible light source emitted by digital devices.

Materials & Methods:

We developed the visible light device (AMOREPACIFIC, TRUE SYSTEMS, Republic of Korea), which emits 400-800 nm. The device consists of a square shaped output beam with skin LEDs (2 Lines of 3 LEDs) and it can adjust exposure time and light intensity. We recruited subjects with Fitzpatrick skin types III and IV. Clinical evaluations were carried out at baseline, after irradiation with visible light time points. LED has irradiated on skin and after irradiation. Skin hydration, melanin index, erythema index, and skin elasticity were measured using the Corneometer®, mexameter, and cutometer MPA580 (Courage+Khazaka electronic GmbH, Germany) devices, respectively. Skin color (L*, a*, b*) was measured using a spectrophotometer CM-2600d (Minolta, Japan).

This study clinically confirmed the kind of skin changes that occurs upon exposure to visible light. To use light of suitable intensity for clinical use, we designed the light intensity condition, and various skin characteristics were observed under these conditions. we found out that visible light causes skin damage such as changes of skin color, melanin index, skin elasticity and skin aging. Since visible light penetrates from the epidermis to the dermis, it seems to affect aging indicators such as elasticity.

Table 1. The amount of change of skin characteristics with two doses of light

240 J/cm ²	before	after	delta	288 J/cm ²	before	after	delta
L*	67.77	62.85	-4.92	L*	68.45	63.86	-4.59
a*	8.04	12.52	4.48	a*	6.66	10.50	3.84
b*	18.05	15.94	-2.11	b*	18.85	16.42	-2.43
Melanin Index	94.20	111.40	17.20	Melanin Index	104.00	125.80	21.80
Erythema Index	151.60	302.80	151.20	Erythema Index	173.80	275.40	101.60
skin hydration	55.12	50.42	-4.70	skin hydration	61.12	54.92	-6.20
elasticity	0.7948	0.7928	0.00	elasticity	0.8112	0.7352	-0.08
skin keratin	15.90	16.60	0.70	skin keratin	15.90	17.32	1.42

Figure 1. Pigmentation and erythema reaction after visible light (left 240 J/cm², right 288 J/cm²)



Results & Discussion:

After irradiation of visible light, L* and b* values decreased, a* value and skin keratin increased, melanin index and erythema index increased, hydration, elasticity decreased (Table 1). The two doses of visible light (240 J/cm², 288 J/cm²), there were different values for each skin characteristic changes of L* value, a* value, b* value, melanin index, erythema index, skin hydration and elasticity (Figure 1). However, the skin characters showed similar trends at both dose of light. Various skin Characteristics are changed in the 240 ~ 280 J/cm² visible light irradiation condition, but the 288 J/cm² condition, which shows a marked change in skin characteristics, was judged to be suitable for clinical evaluation, and additional clinical trials were conducted under this condition. In addition, when visible light was irradiated to the skin, it appeared that pigmentation and erythema occurred simultaneously.

Conclusions:

In conclusion, we found out that visible light causes skin damage such as changes of skin color, melanin index, skin elasticity and skin aging. Furthermore, we developed a method that could induce skin changes by visible light. In addition, we have developed a clinical device that can cause skin damage using visible light from digital devices. Since the skin is damaged when exposed to visible light emitted from digital devices, it is necessary to develop a visible light blocker to prevent such damage. This method can also quantify the beneficial effect of a cosmetic cream on skin changes. Our method of evaluating the effect of skin changes caused by visible light can be used to effectively design methods for preventing the negative effects of visible light on the skin. It can also be a useful for studying the harmfulness of visible light.

References:

1. In Holton, James R. et al., 2003, *Encyclopedia of atmospheric sciences*. 5, 1859–1863.
2. Hong Li Jo, et al (2021) Efficacy of ethyl ascorbyl ether-containing cosmetic cream on blue light-induced skin changes. *J Cosmet Dermatol.*, 00, 1-10.