Press Release

Keio University

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Keio University School of Medicine

Violet Light Exposure Can Be a Preventive Strategy Against Myopia Progression
- Violet light to suppress myopia progression -

Hidemasa Torii and colleagues in a research group comprising Keio University School of Medicine's Department of Ophthalmology (Professor Kazuo Tsubota) and Laboratory of Photobiology (Principal investigator: Project Lecturer Toshihide Kurihara) have discovered for the first time in the world that violet light (VL, 360−400 nm wavelength) suppresses myopia progression (Note 1) through *in vivo* testing using chicks and clinical studies in humans.

The cause of the onset and progression of myopia is unknown, and it is now reported that the myopic population of the world continues to increase and that the world's myopic population will be about 5 billion in 2050. To date, it has been pointed out by multiple epidemiological studies and *in vivo* tests that outdoor activities suppress myopia progression, but the protective mechanism of outdoor activities against myopia progression was still unclear.

The group focused on violet light, which is abundant in outdoor environments, and carried out research using a chick myopia model. Through that model, myopic progression of chicks exposed to violet light was suppressed, and early growth response 1 (*EGR1* [ZENK, zif268]), a gene known to suppress myopia progression, was confirmed to be upregulated in chicks exposed to violet light. This clarified the possibility that *EGR1* is involved as a mechanism of the violet light suppression of myopia progression. In addition, the research also suggests that those wearing contact lenses that transmit violet light suppress myopia progression more than those wearing contact lenses or glasses that do not transmit violet light, suggesting that myopia progresses when wearing glasses that do not transmit violet light. Furthermore, the LEDs and fluorescent lamps often used today contain little violet light, and it was found that violet light does not pass through materials such as the UV-protected eyeglasses and window glass. That is, in modern society there is a lack of violet light, which may be related to the global increase in myopia.

Through research on myopia onset and myopia progression as well as new therapeutic developments, it is expected that the results of this research may help to halt future myopic population growth.

The results of this research will be published in the February 2017 issue of "*EBioMedicine* " (Note 2).

1. Research Background

The cause of the onset and progression of myopia (short-sightedness) is unknown, and the prevalence of myopia is increasing worldwide. If it continues to increase at its current rate, it is forecast that the world's myopic population will be about 5 billion in 2050. Myopia has been increasing worldwide, especially over the past 50 years, and it seems that environmental changes may be a bigger factor than genetic changes. Among environmental factors, outdoor activities have attracted attention in recent years in the suppression of myopia progression, but the protective mechanism against myopia progression of outdoor light, vitamin D, and exercise, among others, was still unclear.

2. Research Significance and Future Development

This research group has discovered, for the first time in the world, that violet light (VL, 360-400 nm wavelength), which hardly exists indoors and can only be found in outdoor environments, suppresses myopia progression.

The group conducted three studies to elucidate the progression mechanism of ever-increasing myopia. The group carried out *in vivo* tests and investigated the VL transmittance of eyeglasses and

contact lenses in clinical research. They then compared the degree of progression of myopia and examined how much VL exists indoors and in outdoor environments.

First, *in vivo* tests were conducted using a chick myopia model. Through that model, myopic progression of chicks exposed to VL was suppressed, and early growth response 1 (*EGR1* [ZENK, zif268]), a gene known to suppress myopia progression, was confirmed to be upregulated in chicks exposed to VL. This clarified the possibility that *EGR1* is involved as a mechanism of the VL suppression of myopia progression. (Fig. 1)

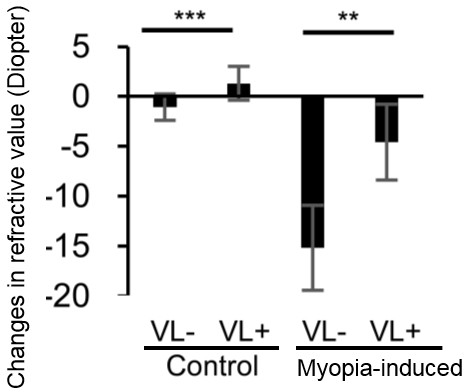

Fig. 1: Suppressive effect of violet light (VL) on myopia progression in a chick myopia model
Chicks exposed to VL suppress myopia phenotype.

As a clinical study, the research group compared the degree of myopia progression in two groups of students with different transmittance of VL in contact lenses used for refractive correction. In students aged 13 to 18 years, axial length elongation in the group wearing VL transmitting contact lenses (transmittance of 80% or more) (116 eyes of 116 patients) was 0.14 mm/year, compared to 0.19 mm/year in the group wearing partially VL-blocking contact lenses (less than 80% transmittance) (31 eyes of 31 patients), finding that axial length elongation was significantly smaller in the group wearing VL transmitting contact lenses (Fig. 2).

Furthermore, the research group investigated the extent to which VL exists indoors and in outdoor environments. The LEDs and fluorescent lamps often used today contain little VL, and it was found that VL does not pass through materials such as the UV-protected eyeglasses and window glass. (Fig. 3)

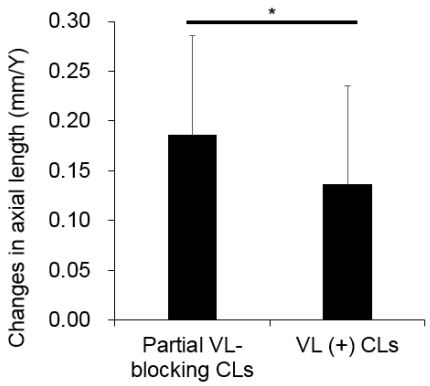

Fig. 2: Comparison of axial length elongation between children who wore partially VL-blocking contact lenses (CLs), and VL transmitting (VL [+]) CLs.

Changes in axial length in the VL (+) CLs group were significantly lower than the partially VL-blocking CLs group.

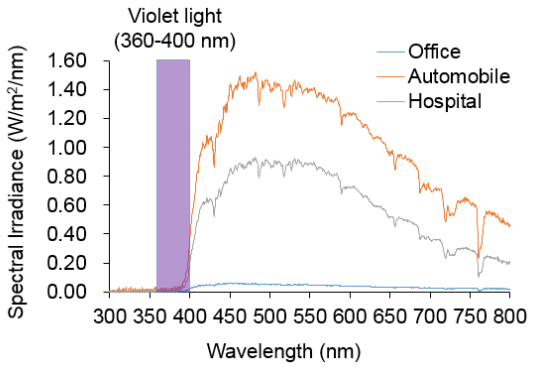

Fig. 3: Deficiency of VL in modern society

Typical spectrum patterns of sunlight transmitted through UV-protected glass windows at an office, automobile and hospital. Almost no VL penetrated the UV-protected glass.

That is, in modern society there is a lack of VL, which may be related to the global increase in myopia. Through research on myopic onset and progression as well as new therapeutic developments, it is expected that the results of this research may help to halt future myopic population growth.

3. Additional Notes

This research was carried out using JSPS Grant-in-Aid for Scientific Research JP26861467, along with data analysis support by The Sakaguchi Laboratory (System Medicine) at Keio University School of Medicine.

4. Research Paper

Title: Violet Light Exposure Can Be a Preventive Strategy Against Myopia Progression
Japanese Title: 「近視進行に対しバイオレット光は一つの予防戦略になり得る」
Authors: Hidemasa Torii, Toshihide Kurihara, Yuko Seko, Kazuno Negishi, Kazuhiko Ohnuma, Takaaki Inaba, Motoko Kawashima, Xiaoyan Jiang, Shinichiro Kondo, Maki Miyauchi, Yukihiro Miwa, Yusaku Katada, Kiwako Mori, Keiichi Kato, Kinya Tsubota, Hiroshi Goto, Mayumi Oda, Megumi Hatori, Kazuo Tsubota

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[Glossary]
(Note 1) Myopia progression (ocular axial length elongation): The depth of the eye is called the ocular axial length, and it is thought that myopia progresses by stretching this axial length.
(Note 2) "*EBioMedicine*" is a new comprehensive, online-only open access Elsevier journal jointly supported by their two leading journals, "*Cell*" and "*The Lancet*".

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