Press Release

Keio University

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Keio University School of Medicine

Violet Light May Also Suppress Progression of Adult High Myopia
A possible step toward preventing sight-threatening myopia?

Professor Kazuo Tsubota, Professor Kazuno Negishi, Project Associate Professor Toshihide Kurihara, and Assistant Professor Hidemasa Torii of Keio University School of Medicine's Department of Ophthalmology have discovered that violet light (VL) may suppress myopia progression (axial length elongation[1]) in adult high myopia.

High myopia is the fourth most common cause of blindness (first-grade visual impairment) in Japan, according to a 2005 research report by the Ministry of Health, Labour and Welfare, and is known for a very high risk of causing blindness. However, there is currently no effective way to suppress axial length elongation in adults with high myopia, which is effective in reducing myopia progression.

This research group has previously reported on the possibility that VL can be effective for suppressing ocular axial length elongation in young people aged 13 to 18 years old. Further research has found that VL may also suppress ocular axial length elongation in adults with high myopia.
This time, The research group performed phakic intraocular lens (pIOL) implantation, a refractive surgery, on patients with adult high myopia and compared myopia progression between two groups implanted with different lenses for a 5-year period following surgery. The results show a significant difference between the axial length elongation between the two groups in the 5 years following surgery. This research group compared the differences between the two lenses against a variety of criteria including higher-order aberration, residual astigmatism, spectral transmittance of the pIOL, and off-axis aberration simulation using eye models. This research group found that there were no significant differences other than the spectral transmittance of the pIOL, suggesting the possibility that the difference in VL transmittance may have produced the differences seen in the current results.

Based on the results of this research, it is expected that VL can be used to suppress axial length elongation and myopia progression not only in young people, but also adults with high myopia, and will play a role in preventing blindness.

Findings were published in the November 2017 issue of open access journal *Scientific Reports*.

1. Research Background

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, and it is reported that 1 billion will be cases of high myopia. (Holden BA. et al., *Ophthalmology*, 2016) However, for adults with sight-threatening high myopia, there has been no effective method for suppressing axial length elongation, which is considered effective for suppressing myopia progression.

2. Research Significance and Future Development

This research group examined the progression of myopia over a long period of time following refractive surgery using pIOLs intended to correct high myopia and compared the difference between two types of corrective lenses implanted during surgery.

The two types of lenses used were the ARTISAN® (Ophtec BV, Groningen, The Netherlands) (Fig. 1-A) and the ARTIFLEX® (Ophtec BV) (Fig. 1-B), both iris-fixated pIOLs.
In the February 2017 issue of EBioMedicine, we report the possibility that violet light (visible light

with a wavelength of 360–400 nm) is effective for preventing myopia progression in young people. (Torii H, Kurihara T, Seko Y, et al., "Violet Light Exposure Can Be a Preventive Strategy Against Myopia Progression," *Ebiomedicine*, 15: 210-219, 2017)

After investigating the spectral transmission of each lens, this study looked at two groups: the AS Group, the pIOL group with 11 eyes of 11 patients (mean age, 39.9 ± 8.9 years) implanted with ARTISAN® pIOLs; and the AF Group, the pIOL group with 15 eyes of 15 patients (mean age, 36.3 ± 7.2 years) implanted with ARTIFLEX® pIOLs.

Fig 1 (A, B, & C)

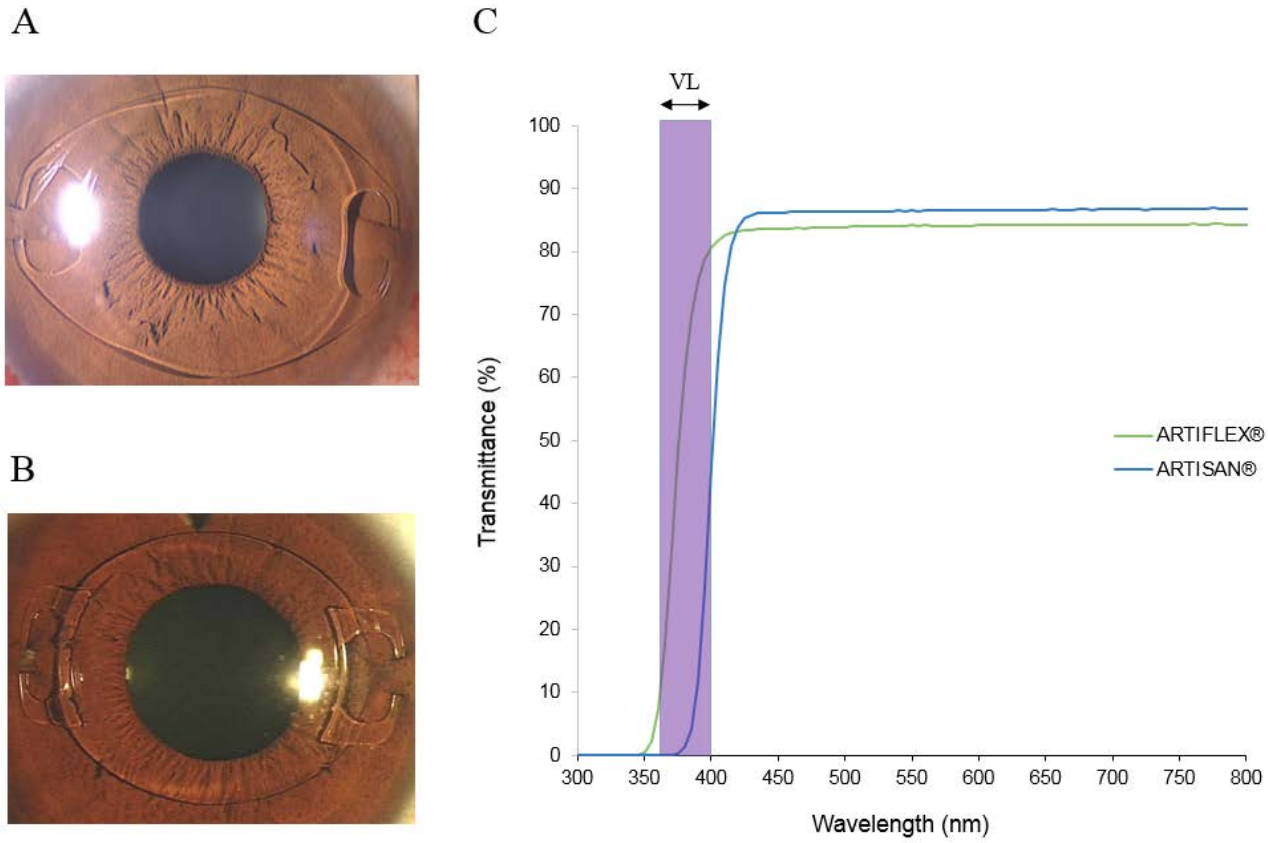

Fig. 1: Comparison of Two Phakic Intraocular Lenses
Fig. 1-A indicates ARTISAN® (Ophtec BV) and Fig. 1-B indicates ARTIFLEX® (Ophtec BV). Fig. 1C represents the difference in the spectral transmission curves of the two lenses. ARTISAN® pIOL transmits minimal VL. ARTIFLEX® is a VL transmitting pIOL.

VL: Violet Light (Torii H. et al., *Scientific Reports*, 2017 [partially modified])

As Table 1 shows, the backgrounds of target patients prior to surgery are comparable, with no significant difference between the two groups in regard to age, refraction (under cycloplegia), axial length, uncorrected visual acuity, or corrected visual acuity.

Table 1: Patient Background Prior to Surgery

	AS Group (Mean ± Standard Deviation)	AF Group (Mean ± Standard Deviation)	P-Value
Number of Cases	11 Cases 11 Eyes	15 Cases 15 Eyes	-
Age (years)	39.9 ± 8.9	36.3 ± 7.2	0.260
Refraction (Dipoter, under cycloplegia. Spherical equivalent value)	-12.96 ± 4.19	-11.14 ± 1.65	0.243
Axial Length (mm)	28.54 ± 1.85	28.13 ± 1.41	0.529
Uncorrected Visual Acuity (logMAR)	1.48 ± 0.26	1.49 ± 0.14	0.868
Corrected Visual Acuity (logMAR)	-0.11 ± 0.16	-0.15 ± 0.12	0.514

Refractive change over five years following surgery was -1.09D in the AS group and -0.49D in the AF group, showing a tendency for the progression of myopia to be more suppressed in the AF group than in the AS group (Fig. 2A). The change in axial length over five years after operation was 0.38mm in the AS group and 0.09mm in the AF group, confirming that axial length elongation was significantly smaller (P = 0.030) in the AF group than in the AS group (Fig. 2B).

Fig. 2 (A & B)

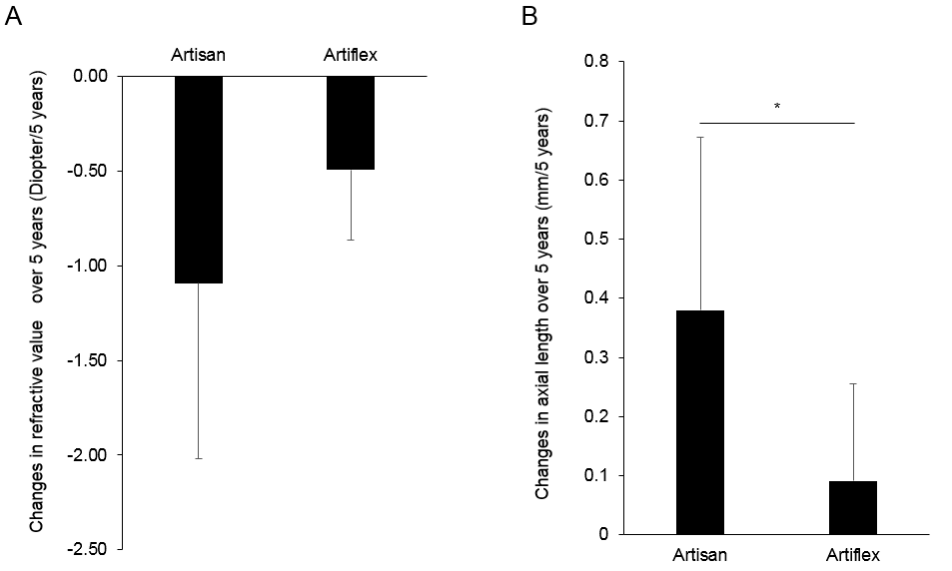

Fig.2: Comparison of myopia progression in two groups over five years following surgery **A** shows the changes in refractive value over 5 years following surgery and **B** shows the changes in axial length over 5 years following surgery. Axial length elongation is significantly smaller in the AF group than in the AS group. (Torii H. et al., *Scientific Reports*, 2017)

The cause of the difference between these two groups were compared against a variety of criteria including higher-order aberration, residual astigmatism, spectral transmittance of the pIOL (Fig. 1C), and off-axis aberration simulation using eye models (Fig. 3). However, there were no significant differences other than the spectral transmittance of the pIOL.

This shows the possibility that the difference in the transmittance of VL may be effective in suppressing the elongation of axial length in adult high myopia.

Fig. 3 (A & B)

A B

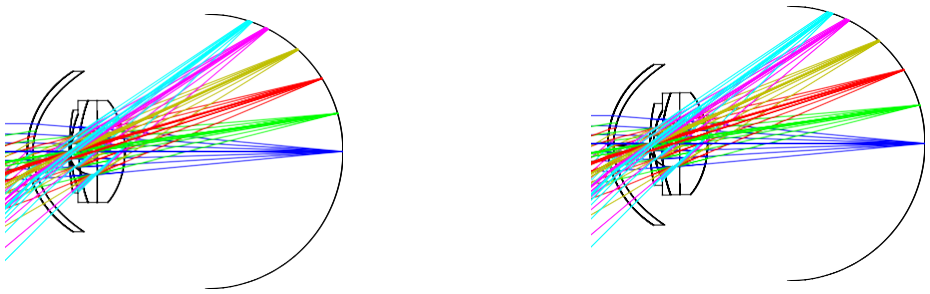

Fig. 3: Results of an Off-Axis Aberration Simulation Using Eye Models
A shows the ARTISAN® model results, and **B** shows the ARTIFLEX® model results.
There are reports from previous studies that off-axis aberrations are related to myopia progression, but our results suggest that there is little difference in off-axis aberrations between the two lenses.
(Torii H. et al., *Scientific Reports*, 2017)

The results of this research shed light on the suppression of ocular axial length elongation in adult high myopic patients and it is expected that VL can be used to inhibit ocular axial length elongation in both children and adults.

We plan to further investigate the effect of inhibiting myopia progression with VL, while also developing products through industry-academia collaboration that we hope will lead to the development of a treatment method that can stop abnormal axial length elongation.

3. Research Paper

Title：Violet Light Transmission is Related to Myopia Progression in Adult High Myopia
Japanese Title：バイオレットライトの透過率は成人強度近視患者の近視進行にも関与する
Authors: Hidemasa Torii, Kazuhiko Ohnuma, Toshihide Kurihara, Kazuo Tsubota, Kazuno Negishi
Publication: Scientific Reports

[Glossary]
[1] Myopic progression (ocular axial length elongation): The depth of the eye is called the ocular axial length, and it is thought that myopia progresses as axial length increases.

*Please direct any requests or inquiries to the contact information provided below.

Inquiries about the research	Inquiries about the press release
Professor Kazuno Negishi Department of Ophthalmology Keio University School of Medicine TEL: +81-3-5363-3821 FAX: +81-3-3359-8302 E-mail: kazunonegishi@keio.jp http://ophthal.med.keio.ac.jp/ (Japanese language only)	Office of General Affairs Shinanomachi Campus Keio University 35 Shinanomachi, Shinjuku-ku Tokyo 160-8582 TEL: +81-3-5363-3611 FAX: +81-3-5363-3612 E-mail: med-koho@adst.keio.ac.jp http://www.med.keio.ac.jp/en/index.html *A color version of this press release is available. Please contact the above address