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Case Report of Axial Length Shortening in a High Myopic Child After Wearing Violet Light-Transmitting Eyeglasses

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Tsubota Laboratory, Inc. has developed a novel medical device, which suppresses the progression of myopia using violet light technology and related patents. This is a joint research project with the Department of Ophthalmology, Keio University School of Medicine.

Prof. Kazuo Tsubota (CEO of Tsubota Laboratory, Inc.), with Assistant Professor Hidemasa Torii and Instructor Yoshiko Ofuji of the Department of Ophthalmology and Laboratory of Photobiology (led by Assistant Professor Toshihide Kurihara), Keio University School of Medicine, is pleased to announce case study results of a four-year-old boy whose choroid (* 1) thickened, his axial length (* 2) shortened, and high myopia gradually improved over two years.

The myopia population is increasing in various countries around the world, including Japan, and it is reported that the world myopia population will be nearly 5 billion by 2050, and the population with high myopia will be about 1 billion. Several methods have been reported to suppress the progression of myopia, but improving myopia requires conservative treatment with contact lenses such as orthokeratology or surgical refractive surgery such as LASIK. Moreover, these options improve the refractive error but are not curative. In addition, it has been considered difficult to improve myopia by wearing eyeglasses.

This case report suggests that high myopia may be improved by experiencing more outdoor activities while wearing violet light-transmitting eyeglasses.

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Tsubota, CEO of the Company, said, "Isn't this a big step to expand the fundamental role of eyeglasses in ‘vision correction’ to a solution that suppresses the progression of myopia itself? We would like to expand the possibility of developing innovative medical devices based on science."

This case report was published in the *American Journal of Ophthalmology Case Reports* on December 19, 2020 (US time).

1. Research background and outline

The myopia population is increasing in countries around the world including Japan (Holden, B.A. *Ophthalmology*. 2016; Yotsukura E, et al. *JAMA Ophthalmol*. 2019), and taking countermeasures is an urgent issue. Among the factors that encompass outdoor activities that suppress myopia progression, we focus on violet light with a wavelength of 360-400 nm, which is abundant in the outdoor environment, and we have reported that it may contribute to the suppression of axial length elongation and myopia progression (Torii H, et al. *EBioMedicine*. 2017; Torii H, et al. *Sci Rep*. 2017). Since ordinary eyeglasses often block violet light through the UV blocking function, we have developed a violet light-transmitting lens (Fig. 1), which is already on the market in Japan.

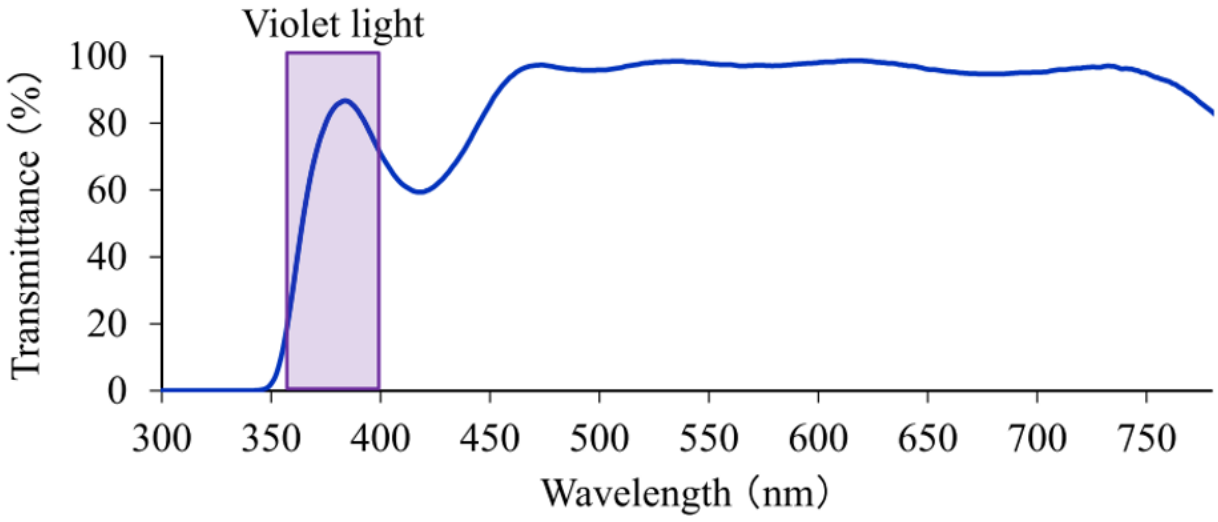

Fig. 1 Spectral transmission curve of violet light-transmitting eyeglasses
The solid blue line represents the wavelength and transmittance of light transmitted through violet light-transmitting eyeglasses. Ordinary eyeglasses do not transmit violet light but violet light which has a wavelength of 360-400 nm is transmitted through violet light-transmitting eyeglasses.

2. Research results and significance ・ Future development
In this case, a four-year-old boy was diagnosed with high myopia exceeding -5 diopters (D) in both eyes from the first visit (Fig. 2), as well as anisometropic amblyopia (* 3).

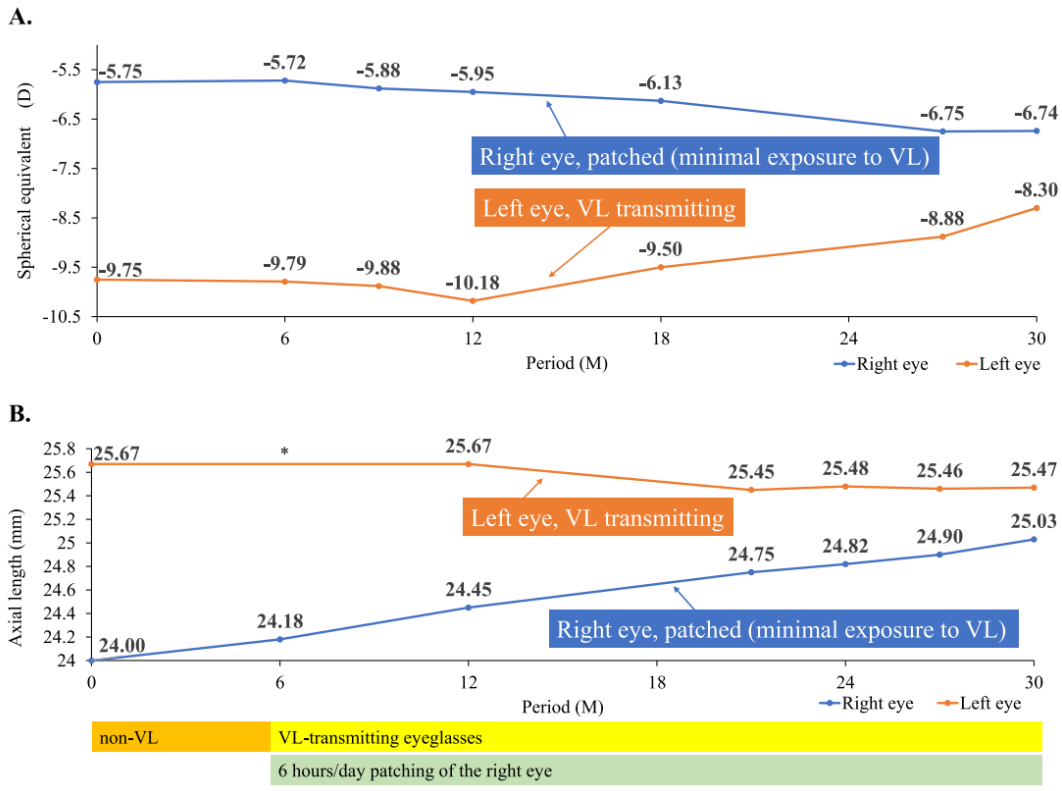

Fig. 2 Two-year course of refraction value (A) and axial length (B) of both left and right eyes
After wearing violet light-transmitting eyeglasses, myopia improved (A) and axial length shortened (B) in the left eye that received violet light. In the right eye, which was patched for 6 hours a day, violet light did not penetrate much. As a result, myopia progressed, and the axial length increased.

It has already been reported that myopia progresses in both eyes in cases of anisometropia (Deng L, et al. *Invest Ophthalmol Vis Sci*. 2014; Lum E, et al. *Clin Exp Optom*. 2018). In this case, for treatment of myopic anisometropic amblyopia, the patient wore violet light-transmitting eyeglasses and was recommended to spend at least two hours per day outdoors while patching his right eye for six hours per day (* 3). It is relevant to note that the left and right eyes were exposed to different light environments during the treatment period.

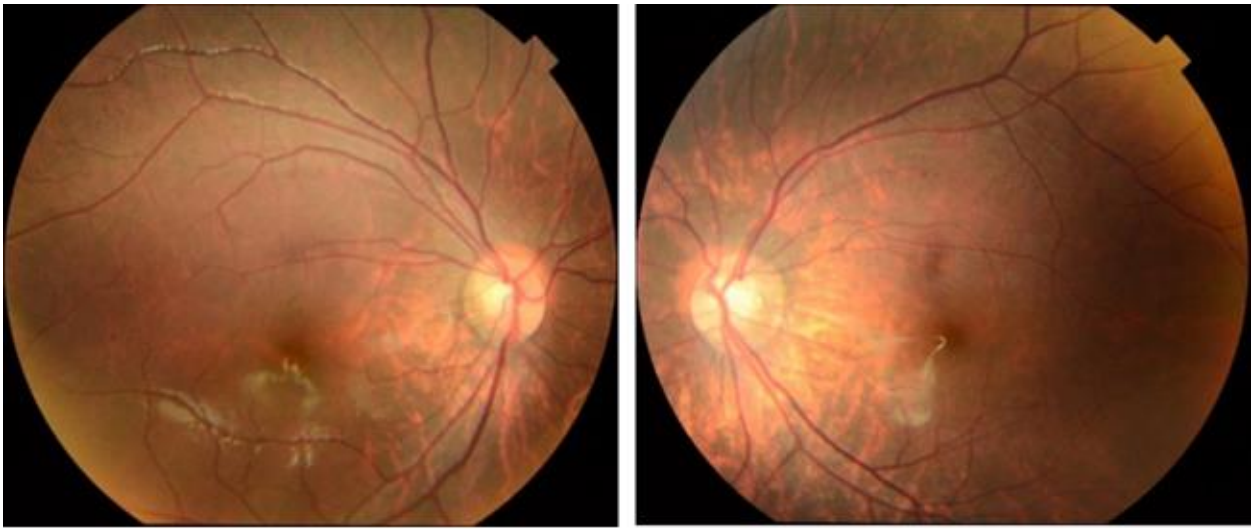

Figure 3 Photographs of the fundus of a four-year-old boy
No obvious abnormal findings were found in the anterior segment, lens, and vitreous body, but the fundus had a tigroid fundus already at the age of 4 years.

Two years after wearing violet light-transmitting spectacles, the right eye, which had minimal violet light transmission due to patching, had a 4.9 μm choroidal thickening (Fig. 4), a 0.85 mm axial length elongation, and -1.02 D myopia progression (cycloplegic spherical equivalent value, Fig. 2) were observed, whereas in the left eye, which was more permeable to violet light, the choroidal thickness was thickened by 115.7 μm (Fig. 4), the axial length shortened by 0.20 mm, and myopia improved by +1.88 D (cycloplegic spherical equivalent value, Fig. 2) is shown. We reported the world's first case of thickening of the choroid, shortening of the axial length, and gradual improvement of high myopia over two years by wearing violet light-transmitting eyeglasses and engaging in outdoor activities for two hours or more per day. We plan to increase the number of cases in the future.

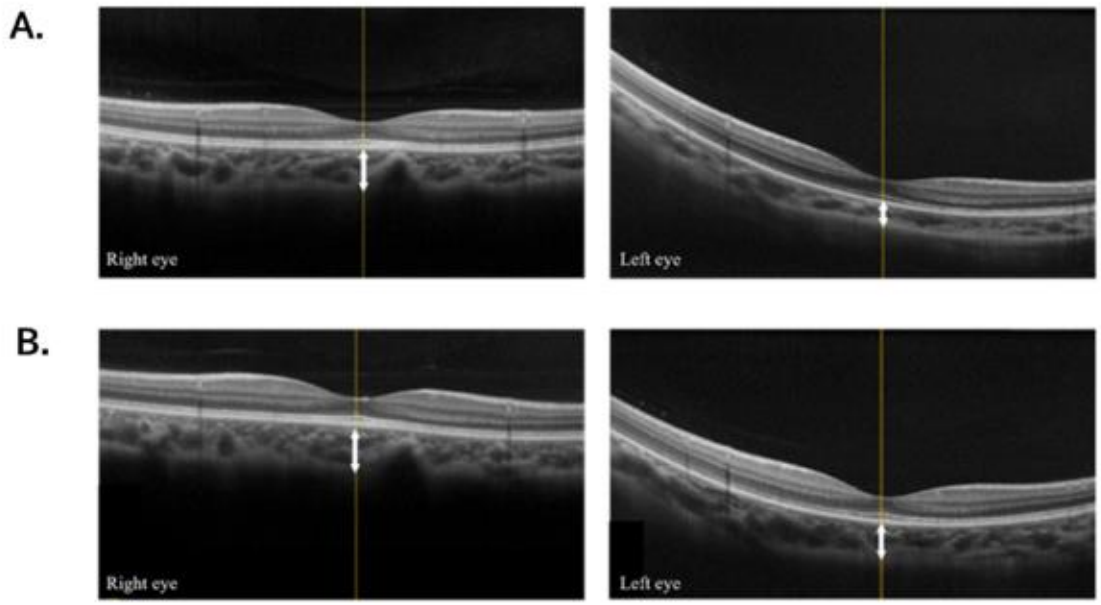

Fig. 4 Choroidal thicknesses of the right and left eyes measured with optical coherence tomography (white arrows)
The choroids of the left and right eyes were measured at A; 4 months and B; 24 months after wearing violet light-transmitting eyeglasses, the right eye thickened by 4.9 μm, while the left eye thickened by 115.7 μm, the latter being a significant change.

3. Notice

This research was carried out with the support of the Takeda Science Foundation "2018 Medical Research Grant (Clinical)".

4. Published paper

Title: Axial length shortening in a myopic child with anisometropic amblyopia after wearing violet light-transmitting eyeglasses for 2 years
Authors: Yoshiko Ofuji, Hidemasa Torii, Erisa Yotsukura, Kiwako Mori, Toshihide Kurihara, Kazuno Negishi, Kazuo Tsubota
Journal: American Journal of Ophthalmology Case Reports
DOI: 10.1016/j.ajoc.2020.101002

* 1 The membrane on the outside of the retina is called the choroid, and it is known that it is thin in severe myopes and thick such as in non-myopia emmetropes. A thick choroid is thought to protect against the progression of myopia.

* 2 The length of the eye is called the axial length, and it is believed that myopia progresses as the axial length increases.

* 3 Anisometropia differs in the degree of refractive error between both eyes, and a difference of approximately 1.5 to 2.0 D or more is treated as anisometropia. Anisometropic amblyopia occurs when one eye has a strong refractive error, and the visual acuity of the eye with a strong refractive error is reduced. If nothing is done, the eye with strong refractive error will not be used, so the eye with mild refractive error will be patched (patched healthy eye) for treatment.

Conflicts of Interest: Yes
Tsubota, who is the CEO of Tsubota Laboratory, Inc., is one of the authors of this paper.
Regarding the suppression of myopia progression with violet light, a patent invented by Torii, Kurihara, Negishi, and Tsubota has been filed internationally (WO2015 / 186723), and it is already registered in Japan (No. 6085722, No. 6677382), in the United States (10133092, 10823982), in China (106413643) and in Taiwan (I704908). In addition, Torii, Kurihara, and Tsubota have applied for a patent internationally with JINS Inc. as inventors for violet light-transmitting lenses (WO2017 / 090128). It is already registered in Japan (No. 6629343), Singapore (11201804325X), and the United States (10866433).

Company Profile

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Founded: February 19, 2015

Paid-in Capital: 201,553,000 yen

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