

Invited Speaker



Prof. Ren-yuan Chu
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Biography

Ren-yuan Chu has been engaged in clinical, research and education work in ophthalmology since his graduation from Shanghai First Medical College in 1962. He is Director of Ophthalmology at Shanghai Medical College, Director of the Eye Institute of Fudan University, and Director of the Key Laboratory of Myopia at the Ministry of Health. He is also Honorary Professor at the Chinese University of Hong Kong, and Vice Director of Chinese Journal of Ophthalmology, Chinese Journal of Optometry and Ophthalmology, and Chinese Journal of Ophthalmology and Otorhinolaryngology. Prof. Chu's main research field is optometry, especially myopia. A pioneer of modern optometry in China, he first introduced the application of posterior scleral reinforcement, PRK, LASIK, LASEK, etc. in the mainland, and successfully developed domestic corneal contact lenses and devices for LASIK surgery. Prof. Chu has published more than 100 papers, including on his genetic study of cataract in Nature Genetics. He has written or compiled 13 books. Prof. Chu has received more than 10 technology awards, including the second prize in the National Technology Invention Awards for his key technology and application of the myopic micro-corneal cutting system and the first prize in the Technology Progress Awards of the National Education Department in 2006.

Empirical study on the effects of long wavelength light induced myopia

Abstract

Purpose: During eye development, early visual experience plays a critical role in controlling eye growth. This study investigated effects of color vision on eye refractive development.

Methods: Infant animals were raised in long wavelength or short wavelength monochromatic lights. The wavelengths of monochromatic lights were chosen based on the cone spectral sensitivity function of guinea pig or rhesus monkey. Guinea pigs have dichromatic vision and were raised in 430nm (blue) and 530nm (green) lights, respectively; rhesus monkeys possess a trichromatic vision system and were raised in 455nm (blue) and 610nm (red) lights, respectively. Animals raised in white light (color temperature 5000K) formed a control group. All subjects underwent biometric measurements, including refraction, corneal power, and axial components before and after treatment. To determine whether there is a difference in the L/M-cone sensitivity between myopes and emmetropes, Rayleigh match testing was conducted in 59 emmetropes and 166 myopes to obtain the red/green match values and the brightness match points by using an HMC anomaloscope. An epidemiological survey was conducted to compare the incidence of myopia in students with congenital color vision deficiencies (CVD) with that of students with normal color vision (CN).

Results: Compared with the control group, the eyes in the green light group developed toward myopia (about -1.5D) accompanied with the accelerate speed of vitreous length extension, while the eyes in the blue light group developed toward hyperopia (about 4D) accompanied with the slow down speed of vitreous length extension after 12 weeks' illumination. The mean difference in refraction between the 530nm and 430nm groups reached a maximum with 5.69D, which is much greater than the longitudinal chromatic aberration between 430nm and 530nm lights (approximately 1.5D). In the experiments with monkeys, those raised in red light showed significant myopic shift in refraction (approximately 3D) associates with a longer vitreous chamber after 50 weeks' illumination, which was also well beyond the estimated chromatic defocus between 455nm and 610nm (approximately 1D). In contrast, no significant hyperopic shift was found in monkeys from the blue light during the observation period ($P > 0.05$). There was no significant difference in the radius of corneal curvature, depth of

anterior chamber, and lens thickness between the eyes of each group for all subjects ($P > 0.05$). In the human experiments, statistical analysis demonstrated a significantly lower level of red/green match value in the myopic group than in the emmetropic group (38.51 ± 1.73 vs. 40.77 ± 1.41 , $P < 0.001$), which showed that myopes have increased L-cone sensitivity. An epidemiological survey indicated that students with abnormal color vision presented with a significantly lower prevalence (45.6%) than those with normal color vision (65.8%).

Conclusions: Long wavelength light can produce effects on eye growth and induce the development of myopia. The alterations of the signals from different chromatic channels should play a role in regulating eye emmetropization. However, effects of color vision on emmetropization process were less than those of form deprivation or optical defocus on emmetropization process.