Effect of UV-light filtering lenses on mesopic pupil size

Sánchez-Ramos C¹, Viñas-Peña M¹, Bonnin-Arias C¹, Flores P², Molina-Gómez C¹
¹Neuro-Computation and Neuro-Robotics Group, Universidad Complutense de Madrid.
²Pontificia Universidad Católica de Valparaíso. Instituto de Física. Chile.
Winter School Optometry (WSO) Valencia, 2009
celiasr@opt.ucm.es

Introduction

With the advent of corneal refractive surgery, the role of pupillary diameter as a diaphragm aperture of the optical system that controls the aberration of the human visual system, has gained clinical relevance in the present.

Changes in pupil size (Øp) produced in response to changes in light intensity optimise the amount of light that reaches the retina, maximising visual perception. This could be applied in several ways. First, Myopia obtained can be implemented to improve night driving or visual perception of post-refractive surgery patients, among others. Also, Mydriasis to help gain access to the eye fundus in a non-invasive manner, thereby achieving a reduction in medication required in these tests. Pupil diameter can be manipulated using optical filters to improve pupil performance according to the light intensity and the portion of the light spectrum modified by these filters

Knowledge of the specific band of the spectrum that needs to be absorbed or transmitted will have obvious benefits for non-invasively achieving a quantifiable amount of artificial mydriasis or myopia.

Methods

The electromagnetic spectrum comprises several wavelength bands, being the visible portion of the spectrum the band from 380 to 780nm. The shorter the wavelength, the greater the energy of the radiation.

Optical filters are an effective way of eliminating short wavelength radiation from the light spectrum.

SAMPLE:
Pupil size measurements (n=220) were made in 20 eyes of 10 subjects (20-55 years old) at high Mesopic condition (4.0lux).

PUPILLOMETER:
The instrument used—a portable, binocular, digital Procyon P2000SA Dynamic Pupillometer—has an infrared light source and is able to capture 10 images per eye every 2 seconds. The images are then analyzed by PupilFIT™ software.

The lighting level selected was high Mesopic (HM, 4.0lux).

In this pupillometer a diffuse screen with two fixation tests (white discs with a central black spot placed at 10°m using convex lenses) subtending an 8° angle in the central visual field is used as visual stimulus.

220 pupil measurements were taken using the Procyon P2000SA at high Mesopic level with and without the use of 10 different filters of varying transmittance (4%-65%), in a randomized way. The measurements were done with naked eye, also subjects didn’t wear their prescription. Environmental lighting was 0.04lux (Ecotrophic), in which subjects remained for 15 minutes before the test started.

Filters were then incorporated in the ocular lens of the pupillometer. The images are then analyzed by PupilFIT™ software, later these data were compared using a post hoc Tukey statistical test, with Statgraphics software.

Results

In high Mesopic condition (4.0lux), significant differences (p<0.01) were rejected in Øp, measurements for 6 of the 10 filters respect to measurements without filter, the 6 with lower transmittance characteristics.

No significant differences were detected when using the high transmittance filters (neither UV absorbent, neither UV transmitting).

According to these results, differences between these 6 filters were analyzed.

10 filters were used in the study: 5 coloured filters (material:PET,E-colour: Rosco Iberica and 5 coloured optical filters (material:Optphamic lens;Essilor), both with similar visible light transmittance characteristics, but with different UV light absorption. Measurements in the absence of a filter served as controls.

Conclusions

Some optical filters significantly produce variations in Øp at intermediate Mesopic lighting levels.

In conclusion, some filters, regardless of how much visible light they transmit, significantly produce variations in pupil size.

References

5. Ramírez J, Lluchás-Arce, Francisco Cáceres (CEAC) de electricidad, ED. CEAC. 1994
8. Hedges JT, Optical effects, Barcelona: Ed. OptoTec, 2005