Effects of Narrowband Light on Choroidal Thickness and the Pupil

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Purpose: In non-human primates, long wavelength light rearing is protective against myopia, resulting in slowed eye growth and thickened choroid. Speculation exists on whether the intrinsically photosensitive retinal ganglion cells (ipRGCs), which are tuned to short wavelength light, may be involved in this process. The goal of this study was to determine the effects of short-term narrowband light exposure on choroidal thickness and the ipRGC-driven pupil response in humans.

Methods: Twenty healthy subjects, aged 21-43, underwent one hour of exposure to broadband light, narrowband “blue” or “red” light, or darkness. Spectral domain optical coherence tomography (SD-OCT) imaging and pupil responses were measured before and after exposure. Choroidal thickness was determined from SD-OCT. Pupil stimuli were six 1second (s) alternating long (651 nm, 33.3 cd/m²) and short wavelength (456 nm, 16.67 cd/m²) stimuli, presented 60s apart, with a Ganzfeld stimulator. Consensual pupil diameter was measured with an infrared camera at 60 Hz. Pupil metrics included maximum constriction and the 6s post-illumination pupil response (PIPR). Data were analyzed with two-way repeated measures ANOVA with Benjamini-Hochberg post-hoc tests.

Results: The choroid was significantly thinner at 1 hour compared to baseline after red and broadband light and dark exposure (p<0.03 for all), but not after blue light exposure (p=0.21). For pupil responses to long wavelength stimuli, maximum constriction significantly decreased after blue, red, and broadband light exposure (p<0.001 for all), but increased after dark exposure (p=0.02), while the 6s PIPR was not significantly different after any exposure. For short wavelength stimuli, maximum constriction and the 6s PIPR significantly decreased after blue, red, and broadband light exposure (p<0.005 for all), with no change after dark exposure (p>0.05).

Conclusions: Exposure to red light, broadband light, and darkness induced choroidal thinning, while blue light had no effect. Maximum constriction to long or short wavelength stimuli, a function of rod/cone activity, was attenuated after light exposures, but increased after darkness, suggesting adaptation. Similarly, the 6s PIPR to short wavelength stimuli, driven by ipRGCs, was attenuated following light exposures, but with no change after darkness. These findings demonstrate differing effects of short-term narrowband light and dark exposure on the choroid, rod/cone activity, and ipRGCs.

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