Macular Pigment Optical Density and Photophobia

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Abstract

Purpose: Two carotenoids regularly consumed in the human diet, lutein (L) and zeaxanthin (Z), accumulate in the central retina. Retinal L and Z, collectively referred to as macular pigment (MP), may protect the retina from free radical insult and photostress by acting as antioxidants and a short–wavelength filter. The light filtering properties of MP may also attenuate photophobia (PP)—visual discomfort induced by normal light exposure—for light sources containing short–wavelengths. The aim of this study was twofold: first, to investigate a possible relationship between integrated macular pigment optical density (iMPOD) and PP thresholds for a short–wavelength target relative to a mid– to long–wavelength target; and second, to measure changes in PP thresholds after increasing MPOD with L supplements.

Methods: MPOD, determined psychophysically using heterochromatic flicker photometry, was measured at four retinal loci (20', 30', 60' and 120') with a Macular Metrics® densitometer. Each subject's MPOD profile was fit with a Lorentzian function and the area under the curve was calculated to yield iMPOD. PP thresholds for two foveal and two parafoveal, 8.2–degree targets were measured using a Maxwellian–view optical system. At both loci, a psychophysical scaling technique was used to measure subjects' level of discomfort for a short–wavelength broadband (blue) light, which was strongly absorbed by MP, and a mid– to long–wavelength broadband (orange) light, which was not absorbed my MP. For both eccentricities, the relative energy necessary to induce PP for the blue target was subtracted from the energy necessary for the orange target. The foveal value was then subtracted from the parafoveal value to yield a PP ratio. PP ratios and iMPOD were calculated for ten subjects. Repeated measures were obtained for four of these subjects after six weeks and twelve weeks of consuming 60mg of lutein ester supplements per day.

Results: PP ratios were positively correlated with iMPOD (Pearson $r=0.78$, $n=10$, $p=0.008$). For subjects consuming L supplements, iMPOD increased about 16% at six weeks and 26% at twelve weeks. According to a randomized block design, iMPOD ($F=17.3$, $p<0.005$) and PP ratios ($F=10.1$, $p<0.025$) significantly increased from baseline.

Conclusions: MP appears to influence PP thresholds for lights containing short–wavelengths.