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ORIGINAL ARTICLE

Influence of macular pigment optical density spatial distribution on intraocular scatter

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KEYWORDS
Macular pigment optical density;
Spatial distribution;
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Abstract
Purpose: This study evaluated the summed measures of macular pigment optical density (MPOD) spatial distribution and their effects on intraocular scatter using a commercially available device (C-Quant, Oculus, USA).
Methods: A customized heterochromatic flicker photometer (cHFP) device was used to measure MPOD spatial distribution across the central 16° using a 1° stimulus. MPOD was calculated as a discrete measure and summed measures across the central 1°, 3.3°, 10° and 16° diameters. Intraocular scatter was determined as a mean of 5 trials in which reliability and repeatability measures were met using the C-Quant. MPOD spatial distribution maps were constructed and the effects of both discrete and summed values on intraocular scatter were examined.
Results: Spatial mapping identified mean values for discrete MPOD [0.32 (s.d. = 0.08)], MPOD summed across central 1° [0.37 (s.d. = 0.11)], MPOD summed across central 3.3° [0.85 (s.d. = 0.20)], MPOD summed across central 10° [1.60 (s.d. = 0.35)] and MPOD summed across central 16° [1.78 (s.d. = 0.39)]. Mean intraocular scatter was 0.83 (s.d. = 0.16) log units. While there were consistent trends for an inverse relationship between MPOD and scatter, these relationships were not statistically significant. Correlations between the highest and lowest quartiles of MPOD within the central 1° were near significance.
Conclusions: While there was an overall trend of decreased intraocular forward scatter with increased MPOD consistent with selective short wavelength visible light attenuation, neither discrete nor summed values of MPOD significantly influence intraocular scatter as measured by the C-Quant device.
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PALABRAS CLAVE
Densidad óptica del pigmento macular;
Distribución espacial;
Dispersión intraocular

Influencia de la distribución espacial de la densidad óptica del pigmento macular sobre la dispersión intraocular

Resumen
Objetivo: Este estudio evaluó la suma de las mediciones de la distribución espacial de la densidad óptica del pigmento macular (MPOD) y sus efectos sobre la dispersión intraocular, utilizando un dispositivo comercialmente disponible (C-Quant, Oculus, EEUU).
Métodos: Se utilizó un fotómetro intermitente heterocromático personalizado (cHFP) para medir la distribución espacial de la MPOD a lo largo de los 16° centrales, utilizando un estímulo de 1°. La MPOD se calculó como medición discreta y como las sumas de las mediciones a lo largo de los diámetros centrales de 1°, 3,3°, 10° y 16°. Se calculó la dispersión intraocular como media de los cinco ensayos en los que se lograron mediciones de fiabilidad y repetibilidad utilizando el dispositivo C-Quant. Se construyeron mapas de distribución espacial de la MPOD, examinándose los efectos sobre la dispersión intraocular, tanto de los valores discretos como de la suma de valores.
Resultados: El mapeado espacial identificó valores medios para la MPOD discreta [0,32 (DE = 0,08)], la suma de MPOD a lo largo de 1° central [0,37 (DE = 0,11)], la suma de MPOD a lo largo de 3,3° centrales [0,85 (DE = 0.20)], la suma de MPOD a lo largo de 10° centrales [1,60 (DE = 0,35)] y la suma de MPOD a lo largo de 16° centrales [1,78 (DE = 0,39)]. La dispersión intraocular media fue de 0,83 (DE = 0,16) unidades log. A pesar de producirse una tendencia consistente hacia una relación inversa entre MPOD y dispersión, dichas relaciones no fueron estadísticamente significativas. Las correlaciones entre los cuartiles superior e inferior de la MPOD dentro de 1° central fueron próximas a la significación estadística.
Conclusiones: A pesar de producirse una tendencia general hacia la disminución de la dispersión intraocular con el incremento de la MPOD, consistente con una atenuación selectiva de la luz visible con longitud de onda corta, ni los valores discretos ni la suma de valores de la MPOD reflejaron una influencia significativa sobre la dispersión intraocular, según las mediciones realizadas con el dispositivo C-Quant.
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Introduction

van den Berg proposed a psychophysical method, termed direct compensation, to measure retinal light scatter in human observers.[1] Using this method, retinal light scatter was found to increase with age,[2] decrease with eye pigmentation,[3] and be related to a number of diseases.[4,5] While this technique was mainly used in the laboratory, a version that was simpler to understand, fast and criterion-independent was developed called the compensation comparison technique.[6] This device was subsequently developed for clinical use (C-Quant, Oculus Optikgeräte, Wetzler, Germany). The C-Quant gives reliable measures[6,7] and has been evaluated in subjects with cataracts,[8] contact lens wearers[9] and those undergoing refractive surgery patients.[10]

Retinal straylight has been shown to result in disability glare.[1,11,12] A number of studies have found that greater levels of macular pigment optical density (MPOD) are associated to a decrease in disability glare.[13–15] It seems reasonable to hypothesize that intraocular light scatter and MPOD may also be related.

However, two recent studies incorporating the C-Quant device demonstrated non-significant relationships between MPOD and intraocular scatter.[16,17] Several reasons have been proposed for this lack of association. Jongenelen et al.[16] included older subjects that may have influenced intraocular scatter values secondary to ocular transmission changes that occur with age. Jongenelen et al. further suggested the lack of correlation may result because macular pigment has peak absorption of short wavelengths and the C-quant uses an ''achromatic light source''. Beirne et al. also described the stimulus as being ''non-blue light dominant''.[17] Finally, another possible explanation is that both the Jongenelen et al. and Beirne study designs used only discrete MPOD measurements in their analyses while the C-Quant glare annulus has a 10° size. Thus, differences in the density of macular pigment outside the fovea may have an impact as well.

This study utilizes MPOD spatial mapping across the entire macula in a young cohort allowing summed measures of MPOD across central 1°, MPOD across 3.3° to match the C-Quant fixation target,[18] MPOD across 10° to match the C-Quant glare source outer diameter and MPOD across 16° to match the area of highest MP deposition within the retina. We also used a spectrophotometer for spectral analysis of the C-Quant glare source to determine the peak wavelength and spectral composition.

Methods

The current study included a total of 33 subjects derived from an *a priori* power analysis using an 80% power estimate and a Cohen's effect size of 0.5 expressed by the equation:

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