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TECHNICAL REPORT

Peripheral refraction and higher-order aberrations with cycloplegia and fogging lenses using the BHVI-EyeMapper

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Accommodation;
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Abstract
Purpose: To determine if a fogging lens ameliorates accommodative effects driven by the closed-view design of the BHVI-EyeMapper (EM) instrument. We compared cycloplegic refraction and higher-order aberration measurements of the EM with those obtained with a fogging lens.
Methods: Twenty-six, young, participants (15F, 25 ± 5 years, range: 18–35 years, SE: +0.25 D and −3.50 D) with good ocular health were recruited. Five independent measurements of on- and off-axis refraction and higher-order aberrations were recorded across the horizontal visual field, under two conditions: non-cycloplegic measurements with +1.00 D fogging lens and cycloplegia, always in the same sequence. The contralateral eye was occluded during the measurements. Two drops of 1% Tropicamide delivered within 5 min facilitated cycloplegic measurements. All participants were refracted 30 min after installation of the second drop.
Results: Mean spherical equivalent measures of the non-cycloplegic condition were significantly more myopic than their cycloplegic counterparts ($p < 0.05$); approximately by 0.50 D centrally, increasing to 1.00 D towards the periphery. The horizontal astigmatic component, J180, demonstrated small but statistically significant differences between the test conditions. Differences were predominant for eccentricities greater than 30°, in both nasal and temporal meridians. The oblique astigmatic component, J45, was not significantly different between the test conditions. The primary spherical aberration coefficient C(4, 0) was significantly less positive for the non-cycloplegic state than its cycloplegic counterpart. This result held true across the entire horizontal visual field. The horizontal coma and trefoil coefficients C(3, 1) and C(3, 3) were not significantly different between the two conditions.

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Conclusions: The use of +1.00 D fogging lens without cycloplegia did not provide complete relaxation of accommodation. The discrepancies between cycloplegic and non-cycloplegic EM measurements were found to be more pronounced for peripheral field angles than central measures, for both M and J180 components.

PALABRAS CLAVE
Acomodación;
Refracción periférica y aberraciones de alto orden

Refracción periférica y aberraciones de alto orden con ciclopejía y lentes de miopización utilizando el dispositivo BHVI-EyeMapper

Resumen
Objetivo: Determinar si una lente de miopización (fogging) mejora los efectos de acomodación impulsados por el diseño de campo cerrado del dispositivo BHVI-EyeMapper (EM). Comparamos las mediciones de la refracción ciclopéjica y las aberraciones de alto orden realizadas por el EM, con las obtenidas con una lente de miopización.
Métodos: Se reunió a veintiséis participantes jóvenes (15M, 25 ± 5 años, rango: 18–35 años, ES: +0,25 D y −3,50 D) con buena salud ocular. Se registraron cinco mediciones independientes de la refracción dentro y fuera de eje y de las aberraciones de alto orden a lo largo del campo visual, bajo dos situaciones diferentes: mediciones no ciclopéjicas con una lente de miopización de +1,00 D, y mediciones ciclopéjicas, siempre en la misma secuencia. El ojo contralateral fue ocluido durante la realización de las mediciones. La administración de dos gotas de Tropicamida 1%, en un plazo de cinco minutos, facilitó las mediciones ciclopéjicas. Todos los participantes fueron sometidos a refracción a los treinta minutos de la instilación de la segunda gota.
Resultados: Las mediciones del equivalente esférico de la situación no ciclopéjica reflejaron una miopía más considerable que las ciclopéjicas ($p < 0,05$); aproximadamente de 0,50 D centrales, incrementándose a 1,00 D hacia la periferia. El componente astigmático horizontal, J180, reflejó unas pequeñas diferencias, aunque estadísticamente significativas, entre las dos situaciones de la prueba. Las diferencias fueron predominantes para excentricidades superiores a 30°, tanto en los meridianos nasales como en los temporales. El componente astigmático oblicuo, J45, no reflejó una diferencia significativa entre ambas situaciones. El coeficiente de la aberración esférica primaria C(4, 0) fue considerablemente menos positivo en las situaciones no ciclopéjicas que en las ciclopéjicas. Este resultado mantuvo su validez a lo largo de todo el campo visual horizontal. Los coeficientes del coma horizontal y trefoil C(3, 1) y C(3, 3) no reflejaron una diferencia significativa entre ambas situaciones.
Conclusiones: El uso de una lente de miopización de +1,00 D, sin ciclopejía, no aporta una relajación completa de la acomodación. Las discrepancias entre las mediciones del dispositivo EM, con y sin ciclopejia, se revelaron más pronunciadas para los ángulos de campo periféricos que para los centrales, para ambos componentes M y J180.

Introduction

The actual mechanism of myopia genesis and its rate of progression are not clearly understood. Nevertheless, accumulated evidence from animal data suggests an involvement of the retinal image shell, as guided by peripheral refraction and off-axis higher-order aberrations (HOA).[1–3] There is some clinical evidence in humans supporting the role of peripheral refraction in myopia progression.[4–10] The emerging paradigm of the contribution of peripheral refraction to myopia development has triggered considerable interest in the peripheral optics of the eye.[11–25] In the majority of these studies conventional, commercial instruments or procedures, have been modified to facilitate peripheral optics measurement, requiring repeated turning of the head or eye and tedious instrument re-alignment. For this reason, techniques that facilitate expedited measurements of peripheral refraction and/or aberrations have gained much attention in the last few years.[26–28]

In response to the desire for automated peripheral refraction, the Brien Holden Vision Institute, Sydney, Australia developed the BHVI-EyeMapper (EM), a closed-view global aberrometer (Fig. 1). The EM performs fast (<0.5 s) refraction scans across 100° of the visual field in 10° steps, along horizontal, vertical and oblique visual field meridians, without the need for eye or head turn. Complete details