Peripheral Refraction and Aberrations for Different Wavelengths: Off-axis Chromatic Aberration

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PURPOSE

The interest in the peripheral optical quality of the eye is increasing, mainly because animal studies have shown that off-axis refractive errors may influence the progression of myopia. Off-axis image quality has been often assessed monochromatically using infrared light. To validate previous data obtained with this procedure, it is important to compare off-axis refraction and aberrations for different wavelengths. This may reveal possible systematic measurement errors and potential wavelength dependence of retinal reflections in the periphery. The off-axis chromatic aberrations measured in both emmetropes and myopes could also offer some insights on the issue of the relationship between aberrations and myopia progression.

METHODS

Data analysis details

- For each measurement the spot pattern was unwrapped using a b-spline unwrapping algorithm
- 4th order Zernike least squares fit over the whole elliptic pupil
- Zernike coefficients were re-scaled to ± 4 mm circular pupill within the original pupil
- Refraction was calculated from low order (defocus & astigmatism)
- Zernike coefficients
- Astigmatism was decomposed for analysis, further horizontal and vertical coma was examined and spherical aberration
- Higher order RMS was calculated from the 3rd and 4th order terms
- Statistical significance was examined using a multi-variable ANOVA test

CONCLUSIONS

• We designed and built an instrument to successfully measure refraction and aberrations in the periphery for wavelengths over the range of the visible spectrum in two refractive groups.
• Longitudinal chromatic aberration (LCA) was nearly constant with retinal eccentricity. The chromatic difference of astigmatism and higher order RMS was also found not to vary significantly with eccentricity.
• There was no statistical variation found in chromatic aberrations between emmetropes and (mild) myopes.
• The use monochromatic light for measurements of peripheral optics may provide an accurate representation of the visible image quality as long as the chromatic shift is taken into account.

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