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Designing And Testing Contact Lenses For Presbyopia With Adaptive Optics

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Abstract

Purpose: Contact lenses with advanced phase profiles may provide improved correction for presbyopia. Traditionally, the process to obtain new lenses involved long and tedious steps, from design to manufacturing and clinical testing. We propose here the use of adaptive optics to test both optically and visually presbyopic phase profiles before and after the actual lenses were manufactured.

Methods: We used an adaptive optics instrument based on a liquid crystal programmable phase modulator as a high resolution active element. The system was designed to operate the modulator as generator of aberrations for visual testing (Prieto, Fernandez, Manzanera & Artal, *Optics Express*; 12, 4059, 2004). Controlled progressive phase profiles were produced on a plane conjugate to the eye's pupil. Adequate control of pupil position with respect to the modulator was achieved. An additional visual channel was used by presbyopic subjects to perform visual tasks (visual acuity, contrast sensitivity, letter recognition, etc.) through the modified optics. A motorized Badal-type optometer integrated in the instrument was used to change the vergence of the visual stimulus.

Results: Merit functions were obtained for each progressive profile combining visual performance data obtained for stimulus placed at vergences from distance to around 3.5 D near. The procedure allowed a kind of closed-loop design process by using subjective feedback. Some of the progressive phase profiles were manufactured as contact lenses. The performance of these actual lenses compared well with that predicted by the adaptive optics system. The agreement of these results validates the complete procedure.

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Conclusions: We have demonstrated the potential of using adaptive optics to evaluate the visual performance of different phase profiles to correct presbyopia. This approach could save several steps in current procedures of contact lens design and eventually lead to improved solutions.

Keywords: contact lens • presbyopia



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