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Original Article

Optical and imaging properties of a novel multi-segment spectacle lens designed to slow myopia progression

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Abstract

Purpose

High sampling density optical metrology combined with pupil- and image-plane numerical analyses were applied to evaluate a novel spectacle lens containing multiple small zones designed to slow myopia progression.

Methods

High-resolution aberrometry (ClearWave, www.lumetrics.com) was used to sample wavefront slopes of a novel spectacle lens, Defocus Incorporated Multiple Segments (DIMS) (www.hoya.com), incorporating many small, positive-powered lenslets in its periphery. Using wavefront slope and error maps, custom MATLAB software ('Indiana Wavefront Analyzer') was used to compute image-plane point-spread functions (PSF), modulation transfer functions (MTF), simulated images and power distributions created by the dual-focus optic for different pupil sizes and target vergences.

Results

Outside of a central 10 mm zone containing single distance optical power, a hexagonal array of small 1 mm lenslets with nearest-neighbour separations of 0.5 mm were distributed over the lens periphery. Sagittal and curvature-based measures of optical power imperfectly captured the consistent +3.50 D add produced by the lenslets. Image plane simulations revealed multiple PSFs and poor image quality at the lenslet focal plane. Blur at the distance optic focal plane was consistent with a combination of diffraction blur from the distance optic and the approximately +3.50 D of defocus from the 1 mm diameter near optic zones.

Conclusion

Converging the defocused beams generated by the multiple small (1 mm diameter) lenslets to a blurred image at the distance focal plane produced a blur magnitude determined by the small lenslet diameter and not the overall pupil diameter. The distance optic located in between the near-add lenslets determines the limits of the optical quality achievable by the lens. When compared to the optics of a traditional concentric-zone dual-focus contact lens, the optics of the DIMS lens generates higher-contrast images at low spatial frequencies (<7 cycles per degree), but lower-contrast at high spatial frequencies.

Conflict of interest

The authors report no conflicts of interest and have no proprietary interest in any of the materials mentioned in this article.