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Aberration Correction using Customized Soft Contact Lenses with Aspheric and Asymmetric Surfaces

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Abstract

Purpose: To evaluate the level of correction of ocular monochromatic aberrations and the impact in visual performance of a new generation of customized soft contact lenses with aspheric and asymmetric surfaces (SCLAAS).

Methods: Ocular wave-front aberration was determined using a near-infrared Hartmann-Shack sensor, capable of measuring highly aberrated eyes. Six eyes were measured: two normal, two with keratoconus, and two after corneal transplantation by penetrating keratoplasty (PK). Aberration data obtained on each subject were used to manufacture the personalized contact lens using a sub-micron precision lathe technology. First, the SCLAAS were tested with a Fizeau interferometer to compare the actual lens aberration pattern with the design target. Then, we measured the wave-front aberration of the eyes wearing the lenses. Finally, we estimated visual acuity with the best refraction achieved with spectacles and with the customized SCLAAS.

Results: The lenses were easily fitted in every eye. The two normal eyes had similar and slightly larger high-order aberrations with the contact lenses. Their VA was also slightly lower with the lenses than with conventional spectacle correction. In the keratoconic eyes, we obtained a reduction of 43% in the high-order aberrations for a 5 mm pupil with the SCLAAS, nearly reaching normal aberration levels. The aberration reduction on this group produced a 37% improvement on visual acuity on average. In the PK patients the high-order aberrations with the contact lenses were not reduced. This could be explained in base of stabilization problems which allow small misalignments or rotations of the SCLAAS.

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Conclusion: We designed and manufactured customized soft contact lenses to correct the high-order aberration in normal and highly aberrated eyes. A significant reduction of aberrations, and a large improvement in visual acuity, was achieved in keratoconic eyes. In normal and PK eyes, we did not obtain yet significant levels of correction. These are promising results, specially for patients with large high-order aberrations and difficulties tolerating rigid contact lenses.

Keywords: 367 contact lens • 519 physiological optics • 450 keratoconus



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