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The Effect of Correcting Small Astigmatisms on Visual Acuity

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Abstract

Purpose: Astigmatism has a significant degrading impact on visual performance when larger than around 0.5 D. However the effect of smaller values of astigmatism, and its correction, on visual acuity is still controversial. In this context, we performed new experiments using wave-front sensing technology to study the influence on visual acuity (VA) of correcting astigmatism smaller than 0.5 D.

Methods: We selected a group of 40 young subjects with astigmatism ranging from 0.15 to 0.50 D (defocus between -1 and +1D) with VA uniformly distributed from 20/20 to 20/10. A Hartmann-Shack wave-front sensor was used to measure both astigmatism and high order aberrations. We designed and built a simple device to correct astigmatism consisting of two rotating 0.25 D-astigmatic lenses that change cylindrical power from 0 D to 0.5 D with a precision of 0.03 D. The procedure of correcting astigmatism was controlled with the Hartmann-Shack wave-front sensor. Astigmatism was compensated for natural pupil diameters (ranging from 5 to 7.5 mm) and the residual (uncorrected) values were in every case lower than 0.07 D. VA was measured using a force choice method for high (100%) and low (20%) contrast, in the best subjective focus, for two conditions: natural and corrected astigmatism.

Results: High-contrast VA after correction of astigmatism was lower or similar as before correction in most eyes with astigmatism below around 0.3 D. For astigmatism from 0.3 to 0.5 D, high-contrast VA was similar or better. Most subjects in the complete range (up to 0.5 D) had a low-contrast VA with correction of astigmatism lower or similar than without correction. In general, VA was very similar or even worse with corrected astigmatism. There was not correlation between the difference in VA before and after astigmatism correction and the amount of higher order aberrations for each eye.

Conclusions: In most subjects, the correction of small amounts of astigmatism did not improve visual

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acuity when measured at best focus. Moreover, many subjects even showed a small decrease of VA after correction of astigmatism, especially for low-contrast acuity. This result could be interpreted in relation with a possible adaptation to the normal astigmatism present in the each eye. This research could have practical implications when determining the optimal correction with both optical and surgical approaches.

Keywords: astigmatism • visual acuity



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