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1509

Prevalence of the Trefoil Aberration Term and Its Visual Impact

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Abstract

Purpose: To evaluate the prevalence of the trefoil aberration term in normal young eyes and to study its impact in visual acuity.

Methods: We selected 55 eyes in a group of 40 normal young subjects with a defocus error between -1 and +1 D and astigmatism equal or lower than 0.5 D. In each eye, we measured the wave-front aberrations with a Hartmann-Shack sensor. From the Zernike coefficients, we calculated the modulus and the orientation of the trefoil term. The possible combinations between coma, spherical aberration and trefoil were evaluated. Trefoil orientation can vary between 30 and 150 degrees, and the values of this aberration are repeated two times more each 120 degrees. Best corrected visual acuity (VA) was measured under carefully controlled experimental conditions with a forced-choice procedure and it was uniformly distributed from 1.0 to 2.0 in decimal scale. Both aberration and visual acuity measurements were performed with natural pupil diameters ranging from 5 to 8 mm (mean value 6.5 mm).

Results: The amount of trefoil ranges between 0 to 0.5 microns in the normal young eye. Subjects with VA higher than 1.5 have trefoil values below 0.25 μm . Vertical trefoil orientation (90-210-330 degrees) is more frequent than the opposite (30-150-270 degrees) in all subjects. This is produced by the combination of a negative C(3,-3) with a small C(3,3). In all subjects, we found a negative correlation between trefoil coefficient C(3,-3) and coma C(3,-1). This coupling produces a better image quality than each of the aberration terms independently.

Conclusions: Values of trefoil larger than 0.25 microns degrade visual acuity. Vertical orientation of trefoil is significantly more frequent than the opposite. In most subjects, this vertical component is coupled with

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vertical coma maximizing the retinal image quality and reducing the deleterious impact of trefoil in visual performance.

Keywords: optical properties • visual acuity • aging: visual performance



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