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Abstract Title: **Corneal/Internal Compensation of Aberrations: Evidence for a Passive Mechanism**
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Purpose: It is well-known that in young eyes positive spherical aberration (SA) of the cornea is partially compensated by internal SA. Aspheric intraocular lenses have been introduced to mimic this effect in pseudophakic eyes. Compensation of horizontal coma (H-coma) has also been shown to occur in young eyes, and the active/passive nature of this effect has been debated. We studied if compensation of coma also occurs in pseudophakic eyes with SA correcting IOLs and if so, to understand the geometrical factors that produce it.

Methods: We studied 38 eyes from 21 patients implanted with 2 types of aspheric IOLs with negative SA. Total aberrations were measured using a laser ray tracing laboratory system. Corneal aberrations were obtained from videokeratometry by ray tracing, and referred to the pupil center, after compensation of the videokeratosce-line of sight misalignment (related to angle λ). Data are for 5-mm pupils. IOL tilt and decentration were obtained using a Purkinje-image custom-built instrument, assuming linear relationships between the Purkinje image locations and eye rotation, lens tilt and decentration. Tilt was referred to the pupillary axis and decentration to the pupil center.

Results: 1) SA was reduced in all eyes with respect to corneal values. 2) Corneal H-coma was mirror symmetric across left and right eyes (average= $-0.22 \pm 0.15 \mu\text{m}$, OD and $+0.15 \pm 0.20 \mu\text{m}$, OS), and highly correlated ($r = -0.71$, $p < 0.0001$) with angle λ (average= $+2.47 \pm 1.32 \text{ deg}$, OD and $-2.48 \pm 2.15 \text{ deg}$, OS). 3) Total H-coma was significantly reduced in all eyes with respect to corneal values (by $0.18 \mu\text{m}$ on average), and was $-0.03 \pm 0.06 \mu\text{m}$ (OD) and $+0.01 \pm 0.09 \mu\text{m}$ (OS). Although there was a slight correlation of total H-coma with angle λ , it was not statistically significant ($r = -0.36$, $p = 0.06$). 4) A comparison of total H-coma in eyes with spherical IOLs (with positive SA) previous studied reveals that this aberration is $0.21 \mu\text{m}$ higher in eyes with spherical than with aspheric IOLs. 5) Horizontal (around x-axis) tilt and horizontal decentration are mirror symmetric ($+1.45 \pm 0.09$ and $-1.82 \pm 1.26 \text{ deg}$, and $+0.28 \pm 0.24$ and $-0.29 \pm 0.22 \text{ mm}$, for OD and OS respectively), and favor a reduction of H-coma in 70% of the eyes.

Conclusions: Compensation of off-axis corneal H-coma by the internal optics occurs in eyes with IOLs of negative SA, confirming that this phenomenon is the result of the geometrical configuration of the eye. IOL tilt and decentration do not seem to result from surgical misalignments, and tend to further reduce, rather than induce, off-axis H-coma, perhaps as a result of maintaining the original orientation of the crystalline lens.

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