CATARACT / IOL

No adjustment needed

by Matt Young EyeWorld Contributing Editor

Spherical aberration and horizontal coma often compensated for in these IOLs

What you should know about aspheric IOLs

• The aspheric IOL tries to mimic the effects of the crystalline lens, and "several studies have shown that the spherical aberration of the cornea is generally positive, while that of the crystalline lens is negative, reducing the total spherical aberration of the eye," Dr. Marcos noted.
• In one aspheric IOL study, spherical aberration was compensated for by 66%.
• Horizontal coma was compensated for by 87%. So, generic IOLs with negative spherical aberration can almost completely compensate for horizontal coma.

• The Tecnis lens compensated for more coma than the AcrySof IQ.

Source: Susana Marcos, M.D.

Aspheric IOLs don't need to be fine-tuned to adjust for horizontal coma, a new study suggests. "The lens shape, gradient index or foveal location do not need to be fine-tuned to achieve a compensation of horizontal coma," wrote lead study author Susana Marcos, M.D., Instituto de Óptica "Daza de Valdés," Consejo Superior de Investigaciones Científicas, Madrid, Spain.

The Tecnis multifocal IOL after implantation in a presbyopic eye
Source: Matteo Piovella, M.D.

The study, published online in Vision Research in December, found that spherical aberration was compensated for by 66% and horizontal coma by 87% on average in aspheric IOLs. While the lenses are intended to correct spherical aberration, the fact that they also correct for horizontal coma is the notable study finding.
"The spherical aberration is not compensated at an individual level, but horizontal coma is compensated individually," Dr. Marcos noted. The amount and direction of tilts and misalignments of the lens are comparable to those found in young eyes, and on average tend to compensate (rather than increase) horizontal coma."

Testing the compensation

Dr. Marcos analyzed 38 eyes from 21 participants. All underwent cataract surgery. They were implanted with IOLs of aspheric design, including the Tecnis (Advanced Medical Optics, AMO, Santa Ana, Calif.) and AcrySof IQ (Alcon, Fort Worth, Texas). Tecnis eyes, with an aspheric anterior surface, were considered to be Group 1 while AcrySof eyes, with an aspheric posterior surface, were Group 2.
Spherical aberration was compensated for by 73.6% in Group 1 and 57.0% in Group 2, for an average of 66.2%
Horizontal coma was compensated for by 94.8% in Group 1, 84.3% in Group 2, and 87.3% in all eyes.
"These results are indicative of a high compensation of the corneal spherical aberration of the average population, in keeping with the intended performance of the aspheric IOL designs," Dr. Marcos noted. "The compensation of the corneal horizontal coma is also highly statistically significant, with an average reduction close to 90%."
Further, 16 of 18 eyes in Group 1 and 18 of 20 eyes in Group 2 experienced a reduction of corneal spherical aberration. "In two eyes, with almost zero or negative corneal spherical aberration, there was a shift of the spherical aberration toward negative values," Dr. Marcos found.
Previous research had found a large compensation of horizontal coma in eyes with aspheric IOLs, but not as large as this time around (51% previously compared with 87% in this report).
"Our study supports the hypothesis of a passive, geometry-driven mechanism for compensation of horizontal coma," Dr. Marcos noted. "Our study also supports the robustness of the optical layout of the eye, in the sense that generic intraocular lenses with negative spherical aberration

(but very different optical and geometrical structure than that of the crystalline lens) still are capable to produce an almost complete compensation of horizontal coma. This confirms the idea that the oblique incidence of rays that produces corneal horizontal coma, also generates coma in the lens."

Further, while not all IOL designs compensate for horizontal coma, "a wide range of aspheric biconvex designs may produce comparable compensation to that found in young eyes with crystalline lenses, over a relatively large field of view."

In young people, aberrations of the cornea are partially compensated by the aberrations of the internal eye optics.

"Several studies have shown that the spherical aberration of the cornea is generally positive, while that of the crystalline lens is negative, reducing the total spherical aberration of the eye," Dr. Marcos noted.

It is therefore good news that the new aspheric lenses can mimic these young eye features.

It's conceivable that some implants could correct for coma, said Mark Packer, M.D., clinical associate professor, ophthalmology, Casey Eye Institute, Oregon Health & Science University, Portland. "The biggest issue would be knowing the surgically induced coma and then getting the thing in the right position," Dr. Packer said.

There still are many lenses, however, that can't compensate for coma, Dr. Packer said. "An implant that is rotationally symmetric really cannot compensate for coma," he said. "That's where ultimately Calhoun Vision's [Pasadena, Calif.] Light Adjustable Lens, which would be fine-tuned post-implantation after the lens is seated and no longer moving, might be an advantage," Dr. Packer said.

***Editors' note**: Dr. Marcos has no financial interests related to her comments. Dr. Packer has financial interests with Advanced Medical Optics (Santa Ana, Calif.), Alcon (Fort Worth, Texas), and Bausch & Lomb (Rochester, N.Y.), among other companies.*

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