

# Aberration-free IOL could provide improved quality of vision regardless of decentration



Louis D Nichamin

## Roibeard O hÉineacháin in San Diego

A NEW aberration-neutral IOL (LI61AO, Bausch & Lomb) may provide cataract patients with better quality of vision than they would achieve with a conventional lens and the effect would not be lost or diminished through decentration, Louis D Nichamin MD told the annual meeting of the American Society of Cataract and Refractive Surgeons.

"The criteria used to design this IOL were developed with the recognition that optical performance of conventional IOL optics and current aspheric IOL optics can be adversely affected by

numerous factors including decentration and tilt as well as variations in corneal aberrations or pupil diameters that exist within a typical pseudophakic population," Dr Nichamin explained.

The investigational IOL has prolate posterior and anterior surfaces and no inherent spherical aberration. The lens therefore neither adds to nor subtracts from the natural spherical aberration of the cornea. Conventional spherical IOLs impart positive spherical aberration, adding to that already present in the cornea and degrading image quality.

One currently available aspheric IOL, the Tecnis (AMO), is designed to compensate for the positive spherical aberration of the cornea by mimicking the negative spherical aberration of the natural lens in the young eye. However, the design of that lens is based on an average amount of corneal aberration found in a sample population of 71 eyes, whereas in fact the degree of corneal aberration varies considerably throughout the population. Moreover, successful visual results with the Tecnis depend on good centration and pupil size.

On the other hand, as the new aspheric LI61AO IOL is aberration-neutral it should optimise the image quality regardless of a

patient's degree of corneal aberration and the quality of vision will be unaffected by decentration, tilt, or variation in pupil size.

"Pseudophakic eyes with the LI61AO will have less spherical aberration than they would with conventional spherical IOLs. Furthermore, a lens without spherical aberration does not induce higher-order asymmetrical aberrations, like coma and astigmatism, when it is decentred. When you consider that the average lens decentration following cataract surgery is 0.4 mm and decentrations greater than 1.0 mm do occur occasionally, this is an important advantage of the design."

The new lens has a three-piece design with a 6.0 mm silicone optic body and blue PMMA, modified C loop haptics with an overall length of 13.0 mm blue PMMA haptics. The anterior and posterior edges are square for the entire 360-degrees of the optic. The blue PMMA haptics have an angulation of six degrees to bring it into close contact with the posterior capsule and enhance capsular bending in order to help mitigate PCO.

The IOL will be available in powers from 0 D through 30 D in 1.0 D steps for powers less than 5.0 D and in 0.5 D steps for powers greater than or equal to 5.0 D. The lens will be implantable with the MportSI planar delivery injector that allows insertion of a lens through an unenlarged phaco incision of 2.8 mm or less.

As a demonstration of the visual outcomes that might be expected from the new lens, Jay Pepose MD presented an initial analysis of the optical performance of the lens performed with sophisticated ray-tracing software and a theoretical model eye.

The study compared the new lens with a conventional IOL (LI61U, Bausch & Lomb), the Tecnis IOL and the LI61AO IOL in simulated range of intraocular conditions, said Dr Pepose,

Chesterfield, Missouri, US.

The analysis showed that the new lens performed better than the conventional IOL under all conditions regardless of centration or pupil size. Furthermore, while the optical performance of the Tecnis IOL was diffraction-limited when perfectly centred, with only modest decentration, it performed less well than the new lens at all spatial frequencies. This difference became more pronounced as pupil size increased.

At 0.5 mm to 1.0 mm decentration, the aberration-free IOL had a much higher modulation transfer function at all spatial frequencies in comparison to both of the other lenses. In fact, even when decentred by 1.0 mm it outperformed a perfectly centred conventional IOL.

With perfect centration but as pupil size increased from 3.0 mm to 4.0 mm, the Tecnis lens remained diffraction limited while the performance of the aberration-free IOL degraded somewhat and that of the conventional IOL degraded considerably more. However, when the lens was decentred by 0.5 mm to 1.0 mm the modulation transfer function of the new lens remained unchanged as pupil size increased while that of the conventional lens and the Tecnis both performed poorly in comparison to the new lens and showed features suggesting increasing amounts of coma.

"There is some splaying of the curve between a tangential and sagittal view and that's because we're inducing non-symmetric aberrations like coma when we have a lens decentred that has either positive or negative inherent spherical aberrations. You don't see the splaying of the MTF curve with an aberration-free IOL because it is basically immune to the optical effects of decentration."

Dr Pepose told *EuroTimes* that the new lens has several features that may further enhance visual outcomes. For example, because

the anterior surface is steeper than the posterior surface, it should have less potential for unwanted surface reflections. Furthermore, since the refractive index of B&L's second-generation silicone is only 1.43 and is substantially lower than other lens materials, the potential for dys-



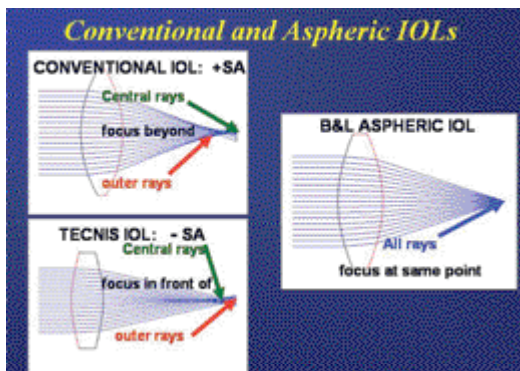
Jay Pepose

photopia is further reduced. Further studies carried out with lens involving bench testing of the lens with physical measurements have supported the findings of his initial analysis, Dr Pepose noted. The results of these studies will be presented at this year's meeting of the ESCRS in Paris. The first implantation of the lens will most likely take place later this year, Dr Pepose noted, adding:

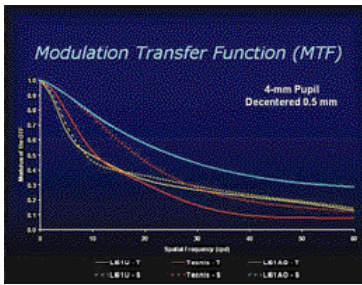
"Given the extensive and rigorous laboratory testing of the technology and what we know about the clinical performance of other aspheric technologies, we are confident that the LI61AO will perform as anticipated."

ldnichamin@aol.com

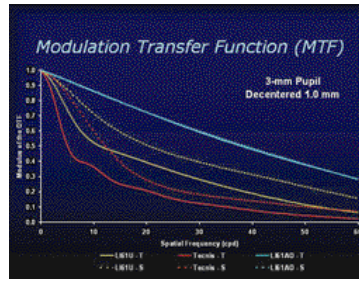
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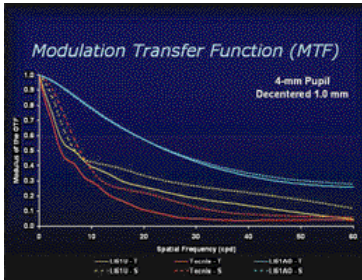
When the pupil is small spherical aberration caused by the cornea and the IOL are not significant, so the centered performance of each lens is quite good.



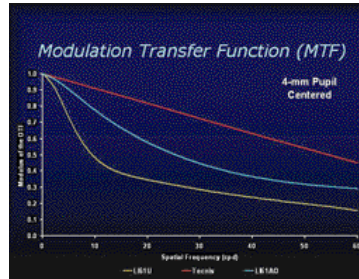
Decentration of 0.5 mm is typical post-operatively. In such conditions the aberration-free lens outperforms Tecnis and LI61U for all spatial frequencies.



Decentration does not degrade the optical performance of the aberration-free lens, because it does not have inherent spherical aberration.



Even with 1.0 mm decentration, tangential (T) and sagittal (S) MTF curves for aberration-free lens do not sink or separate, indicating decentration does not affect optical performance



Spherical aberration from the cornea and IOL is more detrimental when the pupil is enlarged. Tecnis clearly outperforms the other IOLs when the lenses are well centered.