MEDICONCEPT

Improved Functional Vision with a Modified Prolate IOL

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INTRODUCTION

Dr. Kershner discussed the potential for improved functional vision with the newest technology intraocular lenses (IOLs), exemplified by the Tecnis modified prolate IOL. Dr. Kershner believes in the Tecnis lens, based on solid technology that has been proven in study after study. He has no financial or proprietary interest in the product and states that his studies were performed strictly independently. He urges his colleagues to rely upon evidence-based medicine in determining what IOL is best for their patients, and not what is most loudly promoted or the least costly to use.

ASK THE RIGHT QUESTIONS

The concept behind designing this new IOL optic was based on the solid science of wavefront technology. This technology showed that over 93% of the optical aberrations within the ocular system are due primarily to spherical aberration. Conventional spherical IOLs worsen spherical aberration because they add additional aberration to the system. Edge characteristics of an IOL optic can further induce undesirable optical effects of glare and halos. Dr. Kershner dismissed claims that such issues aren't important just because surgeons don't hear about them from their patients. "If you don't ask, you won't know" he states. By specifically addressing such issues as night vision, vision under different lighting conditions, halos, and glare, surgeons may better appreciate the results of their treatment. They can then select IOLs that will give the best visual outcome and the most satisfaction for patient and physician.

NEW DESIGN PLATFORM

Optical engineers developed their newest IOL design using a knowledge base that has been evolving for years. The work of reknowned Dr. David Apple long ago demonstrated the need for the IOL to be in the capsular bag, with an edge design that would minimize ICO and haptics that would center the lens and not permit tilting. The product of this work was created with the former Pharmacia CeeOn 911-913 series which became the platform for the Tecnis IOL.

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IOLS AND SPHERICAL ABERRATION

Conventional spherical IOLs have a poor track record when it comes to spherical aberration, they in fact worsen it. For those who say that their patients do well following IOL implantation, Dr. Kershner had this to say: "They don't *all* do well. The spherical aberration and contrast are worse following implantation of a conventional, spherical IOL optic. You may not recognize it, because you don't measured for it." Most surgeons talk about visual acuity, but few talk about visual quality. He cited a study in which one group of patients implanted with the Tecnis modified prolate IOL, and another group was implanted with a conventional spherical IOL. Using wavefront analysis researchers found that the standard spherical lens added to the prexisting spherical aberration, while the Tecnis lens completely neutralized it. A good analogy is that of a poor quality camera lens, images taken with it are blurry, have edge flare, and poor contrast. Cameras featuring an aspherical lens (which are most produced today) create high-quality, sharp to the edges images. Using an indirect ophthalmoscope, ophthalmologists always use a nonspherical lens to neutralize corneal asphericity for sharper imaging all the way to the periphery. If we use an aspheric lens to get a clear image looking into a patient's eyes, why not implant a lens that allows the patient to see "out" equally clearly? Dr. Kershner's own research on the subject was published in the *Journal of Cataract and Refractive Surgery* in 2003. Conventional spherical lenses all added to the spherical aberration inherent in the patient's own cornea and reduced image quality both for looking into the eye (retinal imaging) and for the patient looking out (functional visual acuity).

PRESBYOPIA AND POOR VISION QUALITY

Presbyopia is an inevitable sign of aging and occurs because the lens thickens, hardens, and enlarges. The accompanying lack of ability to focus and the image quality degradation that comes with age is not necessarily due to opacity in the lens. In the office, patients are encountered whose lenses are clear and acuity good, yet they complain bitterly about poor vision quality, especially at night. They are experiencing the increase in spherical aberration that comes with increasing age. The positive spherical aberration of the cornea remains fairly constant throughout life, yet the lens increases in spherical aberration as it gets larger and rounder. The net effect is to increase the overall spherical aberration of the eye. Those who subsequently undergo cataract surgery, may experience an acuity of 6/6 (20/20) post-surgery, yet they've actually been made worse with the implantion of a spherical IOL. Why? Dr. Kershner explains that the IOL which replaced their cataract is clear and restores focus, but adds to the spherical aberration. The result, good acuity but decreased contrast. Can the patient read a menu in a dark restaurant or drive at night? Probably not, but patients think that this loss of visual quality simply comes with aging. It doesn't have to be. Implanting a modified prolate anterior surface optic— not just an aspheric optic — but one with a specific curvature that neutralizes the average spherical aberration of the human cornea can actually make the spherical

aberration go away. The effect for the patient is improved functional visual acuity, the renewed ability to function with clear vision in all lighting situations, dusk, nighttime and with glare.

CONTRAST TESTING

The Snellen chart, in use since 1865, is the highest contrast testing environment possible, 100% contrast, black letters on a white background. This test does not begin to evaluate the patient under the conditions that the individual is most likely to experience. Patients don't function in their daily lives as they do sitting in an exam room in dim light looking at a vision chart. Subtle perception deficiencies in contrast can significantly impact vision quality. Real life demands of the cataract patient outside of the examining office, require them to drive home at night, walk upstairs before they flip the light switch on, and see in low contrast environments. Contrast is critical to everything we do, and Dr. Kershner warns that companies not to play down its importance. It is so important for survival that this primitive function occurs at the level of the retinal ganglion cells; even blind people can perceive contrast. Contrast sensitivity can easily be measured by using a series of sine-wave grating charts or a variety of available testing apparatus. Dr. Kershner performed a study in which he carried out a wide range of tests, including the testing of functional acuity and digital retinal analysis. He found it was easy to measure contrast. There are several pieces of equipment to measure contrast, which may help justify surgery in a patient with seemingly good acuity but subjective complaints of glare and visual quality. Dr. Kershner compared 3 lenses: the AMO Tecnis Z9000-9001 IOL (with modified prolate optic), the Staar one-piece plate silicone, and the AcrySof , acrylic IOLs. All the patients did well without glasses after surgery, but the Tecnis patients were seeing better compared to the other groups in the first postoperative month. The Tecnis patients performed superiorly to the other intraocular lenses in contrast testing. Dr. Kershner photographed all of the patients with a digital fundus camera pre-operatively and at three months post-surgery. The modified prolate Tecnis lens revealed a much wider range in image quality and smoother distribution if color (Fig. 1). The luminosity profiles of the three lenses were not different from preoperative cataract except for the Tecnis which had a threshold luminosity profile of 91, or a 38.5% improvement over the others (Fig. 2).

CONTRAST AND DRIVING

How does improved contrast translate into driving safety? Night driving simulation tests under rural and city conditions, demonstrated conclusively that patients with the Tecnis IOL identified a pedestrian target on average 47 feet sooner (at 50 miles per hour this translates into 0.5 seconds increased reaction time) than patients implanted with a conventional spherical monofocal IOL, the Acrysof. Putting this into perspective the United States National Transportation Safety Administration mandated the addition of the

rear third brake light as it improved stopping distances by 0.3 second. “I’m worried about my daughter crossing the street at dusk when there is an 80-year-old driving down that street at 50 miles an hour with a spherical IOL, if they had been implanted with the modified prolate lens they would be able to see her in the crosswalk in enough time to stop. It could make the difference between life and death”

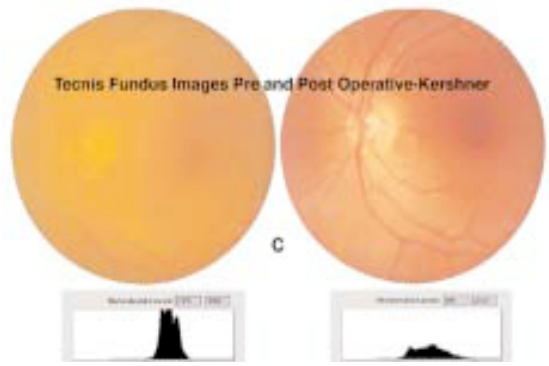

Fig. 1 Fundus of Cataract Patient pre-operatively on left (histogram below image shows steep peek, poor contrast) and post-operatively on right with AMO’s Tecnis modified prolate IOL (histogram below image shows increased contrast and even color distribution)

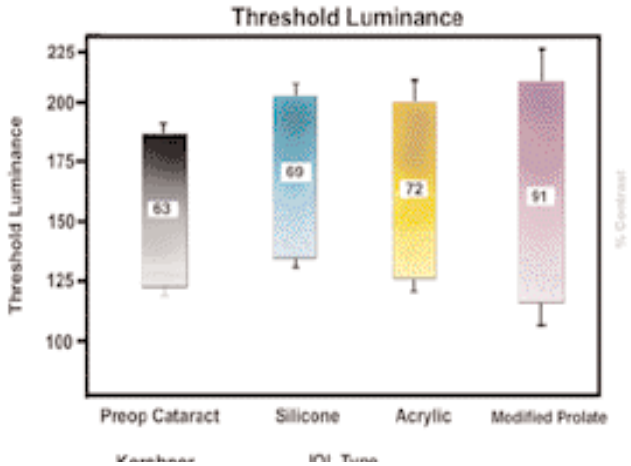

Fig. 2 Luminosity profiles of preoperative cataract and postoperative IOLs. Note the Tecnis IOL has the widest range from dark (bottom) to light (top). Spherical IOLs are not statistically different from preoperative cataract.