Assessment of Three Accommodative IOLs

A European perspective on the promise and drawbacks of these lenses.

BY H. BURKHARD DICK, MD

Unlike most surgeons, I have had the opportunity to work with three accommodative lenses that are currently available or in development. I have implanted approximately 20 Crystalens IOLs (Eyeonics, Inc., Aliso Viejo, CA), about 50 Akkommodative 1CU lenses (HumanOptics AG, Erlangen, Germany), and approximately 22 Synchrony lenses (Visiogen, Inc., Irvine, CA). The Crystalens is FDA-approved and has received CE Marking, the 1CU has attained CE Marking, and the Synchrony is in the experimental phase. These lenses hold a great deal of promise, but they are not without drawbacks.

THE OPTIC-SHIFT PRINCIPLE

All three lenses to some degree work on the optic-shift principle. The multipiece Crystalens has a movable haptic-optic junction that functions like a hinge. Vitreous body pressure should produce a forward shifting of the lens optic (Figure 1A). The one-piece, hydrophilic acrylic 1CU lens features four haptics, and its movement depends on a relaxation of the capsular bag (Figure 1B). The dual-optic Synchrony lens has an approximately +30.00-D anterior lens and a negatively powered posterior lens. Theoretically, with ciliary muscle contraction's alternately causing relaxation and then tensing of the capsular bag, slight axial movement of the front optic will produce a greater refractive shift compared with other lenses because of the Synchrony's high dioptric power.

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MEASURING ACCOMMODATION

Because no device currently exists that objectively measures pseudophakic accommodation, most investigators and surgeons rely on what is called the defocus curve. This subjective measurement reveals the amplitude of accommodation. Thus far, the results with both the Crystalens and 1CU have differed greatly. A study by Küchle et al[1] demonstrated a mean accommodative effect of 1.80 D with the 1CU, but my colleagues and I were unable to verify this result with dynamic aberrometry. It is possible that pseudoaccommodation (as can result from 0.75 D of against-the-rule astigmatism, for example) influenced the subjective determination of visual acuity.

In their study of the Crystalens, Menapace et al[2] discovered that, in some eyes, the optic moved 100 µm in the wrong direction, and the investigators found no accommodative effect. By contrast, my colleagues and I objectively verified a median effect of 0.48 D with both lenses.[3] For this study in Mainz, Germany, we used

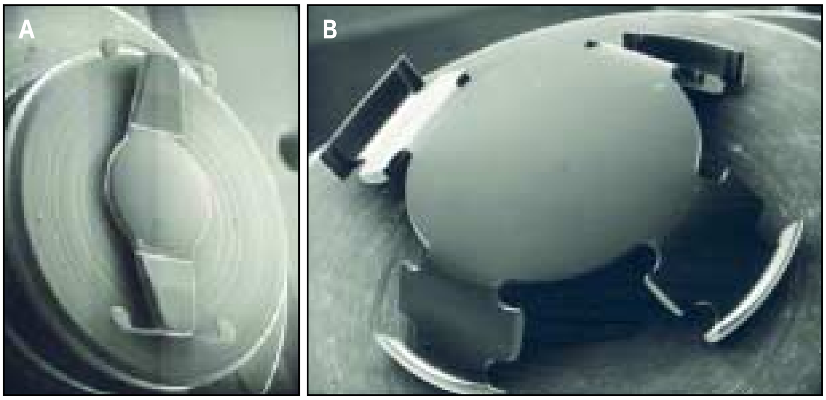

Figure 1. Scanning electron microscopy of the Crystalens (A) and Akkommodative 1CU lens (B) was performed.

dynamic aberrometry to measure accommodation with both the 1CU and the Crystalens. We found a mean accommodative effect of 0.50 D (range, 0.25 to 0.85 D).

Findl[2] employed partial coherence laser interferometry—a highly precise and objective method—to measure the movement of various IOLs within the anterior chamber. He found that the 1CU shifts only slightly and that this anterior movement is equivalent to a mean refractive change of 0.50 D. He reported that the Crystalens actually moved backward slightly.

One of my patients who received the Synchrony lens has an accommodative amplitude of 2.50 D, as demonstrated by the defocus curve. My colleagues and I did not verify this measurement objectively. Dynamic aberrometry is more difficult and time consuming with this lens versus a standard monofocal IOL. Wavefront Sciences Inc. (Albuquerque, NM) is currently working on a device to allow more reliable measurements of this lens.

SIZE OF THE CAPSULAR BAG

The Crystalens and the 1CU lens have diameters of 11.5 and 9.8 mm, respectively. With both lenses, the haptics are expected to touch the rim of the capsular bag in order to function properly. This positioning will not occur with all patients, however, because the size of the capsular bag varies among individuals, with measurements ranging from 9 to 12 mm.[4]

Additionally, the capsular bag may begin to shrink 1 month after lens implantation, and this shrinkage can continue for up to 3 months postoperatively. It is currently unclear how much the discrepancy between the bag's diameter and the IOL's length affects this shrinkage. Neither is it known to what extent polishing of the capsular bag affects this process.

Whereas surgeons calculate IOL power for each patient, the size of accommodative implants is fixed. The ability to customize the size of the implant to each patient's capsular bag would be advantageous.

FIBROTIC RESPONSE

Findl[2] assumed a high incidence of fibrotic and regenerative after-cataract with the Crystalens. Küchle et al[1] reported a 20% rate of Nd:YAG capsulotomy with the 1CU at 2 years. It is unclear how much a posterior capsulotomy affects the function of these accommodative lenses. An Nd:YAG capsulotomy involves risk to the patient, however, such as an increased incidence of retinal detachment.

CONCLUSION

Accommodative lenses hold promise for the treatment of presbyopia. Surgeons must be cautious in how they present the technology to patients, however. It may not be fair, for instance, to tell them that, if an accommodative lens does not restore accommodation, then they will have the equivalent of a standard monofocal lens. Some accommodative IOLs have required explantation.

I believe that a lot could be learned from a prospective, randomized, masked clinical trial that compared each accommodative lens with a standard monofocal IOL. Of interest would be the difference in the level of accommodation achieved with each lens—particularly in light of the fact that some patients achieve accommodation with standard lenses. Also informative would be a trial comparing accommodative lenses with a well-known, three-piece lens designed to prevent PCO.

I will be interested to see what further research on these lenses shows and how other technologies in development perform. Of interest, for example, is the Preussner magnetic implant (Acri.Tec GmbH, Berlin, Germany), which is currently undergoing animal studies.[5] The surgeon implants small, flat magnets under the conjunctiva and places the lens, which has magnetic parts, inside the capsular bag. During reading, the lens optic and capsular bag shift along the optical axis and thus produce accommodation. Because the optic need not move within the capsular bag, this lens system is nearly independent of capsular fibrosis. Also intriguing is the closed-capsule irrigation system developed by Anthony Maloof, MD, of Sydney, Australia. After aspiration of the lens material, the capsulorhexis is sealed, and distilled water or pharmaceuticals are instilled into the capsular bag. The endothelium remains untouched. The aim is to inhibit capsular fibrosis after surgery. Injectable lenses and an injectable lens polymer are also in the works.

Although the development of accommodative IOLs is a step toward achieving presbyopic correction, I do not believe that they are the final solution. ■

H. Burkhard Dick, MD, is Clinical Professor and Head Physician for the Department of Ophthalmology at Johannes Gutenberg University in Mainz, Germany. He holds no financial interest in the products, technologies, and companies mentioned herein. Dr. Dick may be reached at +49 61 31 17 54 45; bdick@mail.uni-mainz.de.

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