High-Definition Wavefront Aberrometry to Measure Accommodation

Device can be used for pseudophakic IOL measurements of accommodation.

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Surgeons are well aware of the benefits of wavefront aberrometry in determining the eye’s overall refractive power error. Not only does this technology provide a detailed map of the eye, but it can help detect biomechanical problems such as corneal striae, scarring, and incipient and advanced keratoconus. Studies have recently been conducted to investigate the use of wavefront aberrometry in a new function: testing accommodation in young and presbyopic phakic patients.

William B. Trattler, MD, of the Center For Excellence in Eye Care in Miami, presented results of a prospective study that included 10 young phakic adults and 10 phakic patients with presbyopia at the recent Second International Society of Presbyopia, held just before the European Society of Cataract and Refractive Surgeons meeting in Barcelona, Spain. Dr. Trattler and colleagues used the Complete Ophthalmic Analysis System (COAS-HD Model 2800; AMO Wavefront Sciences LLC, Albuquerque, New Mexico) to evaluate accommodation as a measurement of refractive change recorded at 30 Hz. The measurement took 9.9 seconds and included wavefront, refraction, and pupil size using internal and external targets. A dynamically controllable near target was used to stimulate the eye, and simultaneous measurements of refraction and higher-order aberrations were recorded to identify true optical power change. This measurement was then compared with depth of focus and other changes due to pupil size or aberrations.

As expected, little to no accommodation was observed in patients with presbyopia. However, a successful quantitative measurement of optical accommodation was possible in phakic eyes, and a distinction was made between true accommodation and depth of focus and changes in spherical aberration or pupil size. These measurements of accommodation are in keeping with previously published results.

**CASE EXAMPLES**

Initially, phakic patients between the ages of 22 and 51 years were studied. Following are two case examples of patients’ accommodative measurements with the COAS-HD. Case No. 1 is a 30-year-old phakic patient, and case No. 2 is a 38-year-old patient who had been experiencing a reduction in accommodation.

**Case No. 1.** This 30-year-old patient had an accommodative range of 4.25 D. At 6 m (far target), his accommodation was 0.17 D; a -6.00 D target change occurred at 3 seconds and 0.00 D at 6 seconds. His overall stimulus was 5.75 D.

**Case No. 2.** This 38-year-old patient had an accommodative range of 1.75 D after an overall stimulus of 3.00 D.

**STUDY RESULTS**

Objective accommodation was measured repeatedly with the dynamic wavefront aberrometer and found to have a reproducibility of 0.31 D. After confirming that

**TAKE-HOME MESSAGE**

• Little to no accommodation was observed in patients with presbyopia when the COAS-HD was used to evaluate accommodation.
• A distinction was made between true accommodation and depth of focus and changes in spherical aberration or pupil size in phakic patients.
• Analysis with wavefront aberrometry showed that spherical aberration was responsible for 17% of the accommodation affect.
the COAS-HD system could accurately measure accommodation in phakic patients, it was determined that the findings followed previously published accommodation age curves. Further analysis with wavefront aberrometry also found that spherical aberration in particular was responsible for 17% of the accommodation effect.

More recently, the COAS-HD was used to compare dynamic measurements of accommodation in patients with bilateral CrystaLens HD (Bausch + Lomb, Rochester, New York), Tetraflex (Lenstec, St. Petersburg, Florida), and Tecnis 1-Piece (Abbott Medical Optics Inc., Santa Ana, California) IOLs. In this study group, eight eyes were measured using the previously described protocol.

These results determined that pseudophakic eyes had little objective accommodation. There was no significant difference in accommodative effect between the accommodating IOLs (CrystaLens HD or Tetraflex) and the standard IOL (Tecnis 1-Piece). Isolated pseudophakic individuals in each group showed some accommodative effect. However, when the contribution of spherical aberration was removed, there was no significant accommodation measurement.

**CONCLUSION**

Accommodation involves contraction of the ciliary body and notable changes in the lens shape and lenticular refractive index. We can compensate for loss of accommodation in patients with presbyopia by prescribing glasses and contact lenses or turning to surgical interventions such as monovision, implantation of multifocal or accommodating IOLs, or presbyopic laser vision correction. These strategies do not replace the natural accommodation process and, as is the case with current accommodating IOLs, may not work as well as one would hope. However, there is hope on the horizon with newer accommodating IOL models.

The COAS-HD wavefront aberrometer is a promising strategy for determining the degree of accommodation in pseudophakic patients with either an implanted monofocal or accommodating IOL.

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**INDEPENDENT ASSESSMENT**

I have now performed three PresBvis treatments by surface ablation. All patients are extremely happy, reporting excellent reading vision (NS or better) and excellent intermediate/computer vision. Distance UCVA in the PresBvis-treated eye was slightly worse following surgery; however, there was no loss in distance BCVA, and all patients reported being very happy with bilateral distance vision. Patients indicated good stereopsis and reported no problems with daily activities including playing sports or driving. Overall, patient-reported subjective quality of vision was substantially higher compared with a contact lens monovision trial.

Laser ablation is more predictable and the results more stable than conductive keratoplasty and the new femtosecond concentric circle hexagonal radial keratectomy-type procedure. It can also have the benefit of producing an additional refractive correction. Furthermore, procedures that have the near vision zone in the center—whether created by laser or corneal inlay—can introduce unacceptable levels of coma with slight decentration. PresBvis does not suffer from this potential problem.

**CONCLUSION**

As a surgeon, I am more comfortable creating a multifocal cornea in only one eye, particularly when there is no loss of BCVA, as I have seen thus far with PresBvis. The high patient satisfaction seen in my patients matched the level seen in an earlier trial, suggesting that PresBvis is an outstanding option for treating presbyopia.