The ability to measure the eye’s refractive status intraoperatively is advantageous, especially in patients who elect refractive IOLs and services, such as astigmatism reduction, as part of their cataract procedure. Population data suggest that 74% of eyes have at least 0.50 D of keratometric cylinder and 36% have at least 1.00 D. In the most recent Learning survey (2009), approximately 75% of respondents reported using either astigmatic keratotomy or toric IOLs to treat significant astigmatism.2 Being able to measure and monitor the effect of the cataract incision, the astigmatic keratotomy, and the orientation of a toric IOL intraoperatively would be extremely useful for several reasons. Aligning a toric IOL based on dynamic, objective wavefront refractive data should be more accurate than predicting the correct keratometric axis and attempting to find and mark it.

The ability to confirm the appropriate spherical IOL power immediately before or following lens implantation is also desirable. Not only would this be a useful check with unusually long or short axial length eyes, but it would also be a valuable confirmation for patients who select a presbyopia-correcting IOL. Finally, in the coming decades, increasing numbers of postrefractive-surgery patients will be presenting for cataract surgery without access to prior records from their LASIK or radial keratotomy procedure. The ability to select or confirm the spherical IOL power for an aphakic eye using intraoperative wavefront refractive data could augment or substitute for the cumbersome methods that we currently use to target emmetropia in these patients.

WAVEFRONT ABERROMETRY

Aberrometry-based wavefront technology was initially used in ophthalmology to improve the accuracy of refraction. In the operating room, an ideal aberrometry instrument would automatically provide continuous real-time optical feedback to the surgeon without requiring any extra time or steps. The data derived from real-time measures of refractive status and aberrations should be accurate and reproducible, and any ancillary intraoperative technology should not interfere with the workflow of cataract surgery. The need for surgical efficiency dictates that any refractive guidance system should not delay the procedure and should preferably save time.

Because of the limitations of established wavefront aberrometers, it has been difficult to adapt the technology to the operating room environment. Legacy aberrometer systems are able to display only static refractive data at a single point in time. Data collection, processing, and display with these systems are time consuming and require the surgeon to stop operating. Clarity Medical Systems, Inc. (Pleasanton, California), is developing a novel form of wavefront aberrometry based on fundamentally different technology. This unit, Holos IntraOp (Figure 1), is able to provide continuous, accurate, real-time refractive feedback throughout the cataract operation, including the aphakic state, without delaying or interfering with surgery.

HOLOS INTRAOP

Holos IntraOp is based on a proprietary form of aberrometry referred to as sequential scanning wavefront. Holos is capable of high-speed, high-resolution measurement and simultaneous display of real-time refractive data throughout the operation.

This technology is a fundamental departure from how other devices detect and measure wavefronts. It is the first aberrometer specifically developed for ophthalmology. Holos IntraOp enables rapid data acquisition and real-time data display with highly accurate wavefront refractive measurements (sphere, cylinder, and axis). The

TAKE-HOME MESSAGE

• Any ancillary intraoperative technology should not interfere with the workflow of cataract surgery.
• Holos IntraOp produces high-speed, high-resolution measurements and simultaneous display of real-time refractive data throughout the operation.
• The wavefront refractive data are superimposed on an integrated live image of the eye.

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device, attached to the operating microscope, provides both qualitative and quantitative measurements. The surgeon’s usual working distance is maintained, and neither the microscope nor room illumination is altered. Comparing the continuous real-time readout to existing single-measurement technologies would be analogous to comparing pulse oximetry to taking a patient’s blood gas measurement manually. In both cases, the latter is more time consuming and provides only static information.

Holos real-time measurements are displayed as continuous wavefront refractive data and simultaneously superimposed on an integrated live image of the eye. The surgeon can therefore visualize the refractive results of surgical interventions, such as rotating a toric IOL, in real time. Intraoperative guidance from existing, static wavefront-derived refractive data has been shown to improve refractive outcomes in clinical trials to date.

I had the opportunity to use the Holos IntraOp in an early clinical feasibility trial last fall. I was impressed with the compact size, the ease of aligning the instrument, and the lack of interference with surgery. The continuous refractive data display was easy to visualize and responded in real time to surgical interventions such as astigmatic keratotomy. This technology has the potential to provide intraoperative confirmation of proper IOL power selection and astigmatism reduction.

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