The Perfect Capsulorhexis: More Critical Than Ever

The growing popularity of premium IOLs places even greater demands for perfection on this surgical step.

BY TAL RAVIV, MD

Since surgeons transitioned from intracapsular to extracapsular cataract extraction, a well-constructed capsulotomy has been the key to a successful procedure. As the premium IOL era begins, the need for a perfect capsulorhexis will become even greater.

A SHRINKING MARGIN OF ERROR

Today’s demanding refractive results require a well-centered, perfectly circular capsulorhexis that slightly overlaps the IOL's optic. This construction is important for achieving the so-called capsular shrink-wrap effect during the postoperative period. A 360º overlapping capsular edge creates a capsular bend, which acts as a barrier against proliferating lens epithelial cells and thus significantly delays the onset of posterior capsular opacification (PCO).1-3 The overlap also sets the anteroposterior positioning of the IOL, which prevents capsular fibrosis from shifting the lens optic forward and creating an unwanted late refractive shift. Minimizing PCO and ensuring long-term refractive stability are critical to success with premium IOLs. Moreover, with a perfectly circular capsulorhexis, any contraction of the anterior capsule (i.e., phimosis) will be symmetrical, so late in-the-bag decentration of the optic is prevented. The aspheric optics of the AcrySof IQ Restor lenses (Alcon Laboratories, Inc., Fort Worth, TX) and Tecnis Multifocal IOL (Abbott Medical Optics Inc., Santa Ana, CA) tolerate very little decentration.4 Capsular phimosis (Figure 1) is more pronounced with overly small capsulotomies.5,6 Because most of the IOLs available in the United States have a 6-mm optic, a capsulorhexis with a 5.5-mm diameter is usually ideal (Figures 2 and 3).

Problems with the capsulorhexis’ construction can also disqualify patients from receiving certain premium IOLs. For example, an anterior capsular extension prevents the proper seating of the Crystalens (Bausch + Lomb, Rochester, NY), which has a 5-mm optic and hinged haptics. Asymmetric capsular contraction associated with a radial tear in the anterior capsulotomy may shift the IOL and cause unpredictable refractive results or, worse, an irregular IOL configuration called Z-syndrome.

TOOLS FOR LEARNING AND PERFORMING THE CAPSULORHEXIS

Simulators

A new aid for learning the capsulorhexis is The Eyesi Ophthalmic Surgical Simulator (VRmagic GmbH, Mannheim, Germany), which allows surgeons to create a virtual 3-D capsulorhexis.7 At the New York Eye and Ear Infirmary, where I teach, all residents create hundreds of virtual capsulorhexes before they ever perform one in the OR. I have...
tried the simulator and found a virtual capsulorhexis even more difficult to perform than a real one. Simulators allow the selection of different levels of difficulty (eg, managing posterior pressure or redirecting an errant tear). My teaching colleagues and I find that training with a simulator makes residents significantly more confident and skilled during their first few real capsulorhexes.

**Visualization**

Capsular dyes represented a breakthrough in cataract surgery. For white cataracts or eyes with a poor red reflex due to vitreous hemorrhage, the improved visualization provided by trypan blue is of enormous benefit. For inexperienced surgeons, the increased visualization afforded by trypan blue is useful even in routine cases.

The newest generation of microscopes has redefined the red reflex. The OPMI Lumera (Carl Zeiss Meditec, Inc., Dublin, CA) delivers a high-contrast red reflex, which greatly enhances capsular visibility and thus increases the safety of the capsulorhexis.

**Instrumentation**

Remarkably, surgeons still use essentially the same instrumentation for the capsulorhexis that they did 20 years ago. The advent of microphacoemulsification, however, is pushing manufacturers to design narrower capsulorhexis forceps, including retinal-type microcapsulorhexis forceps. As surgeons have begun paying more attention to the size of the capsulorhexis, manufacturers have also begun to develop different capsulotomy-sizing instruments, including fixed corneal markers, marked capsulorhexis forceps, the Seibel Rhexis Ruler (MicroSurgical Technology, Redmond, WA), and the Raviv Capsulorhexis Caliper® (Bausch + Lomb). More technological solutions to sizing under development by Carl Zeiss Meditec, Inc., and TrueVision Systems, Inc. (Santa Barbara, CA), include virtual overlapping reference rings in the surgeon’s microscope view. Finally, femtosecond laser technology may one day permit ophthalmologists to create circular capsulotomies with greater precision.

**CONCLUSION**

A well-constructed capsulorhexis is the foundation of complication-free phacoemulsification and IOL surgery. Technical and technological advances will continue to improve surgeons’ ability to meet increasingly exacting requirements for the capsulotomy.

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**Figure 2.** Five years postoperatively, the central, circular, overlapping capsulorhexis has maintained a clear posterior capsule and excellent long-term stability of the IOL.

**Figure 3.** A central overlapping capsulorhexis of 5.5 mm perfectly captures the optic of this AcrySof Toric IOL (Alcon Laboratories, Inc.) and, by doing so, will minimize postoperative rotation of the lens.