

Femtosecond Laser Cataract Surgery

A different option.

BY STEPHEN G. SLADE MD

The global cataract surgery sector is immense, with more than 15 million procedures performed annually. This number will increase significantly in the near future.

With today's technology, we can partially or completely correct astigmatism and optical aberrations as well as presbyopia. Cataract surgical techniques, however, although constantly refined, have not changed dramatically since the introduction of phacoemulsification. Current procedures do not deliver the results to which we are accustomed in refractive surgery. Approximately 85% of patients achieve 20/20 or better vision after LASIK. Only 35% of premium IOL patients achieve 20/25 and J1 vision (data on file with Alcon Laboratories, Inc., [Fort Worth, TX], and Bausch & Lomb [Rochester, NY]). Furthermore, complication rates are also higher in cataract surgery versus LASIK. About 35% of cataract patients experience posterior capsular opacification, cystoid macular edema, vitreous loss, or endothelial cell loss, and 2% of cataract patients can have more serious complications, including retinal detachment, persistent cystoid macular edema, corneal failure, or infection. Only 0.2% of LASIK patients have similar complications (Figure 1) (data on file with Alcon Laboratories, Inc.).

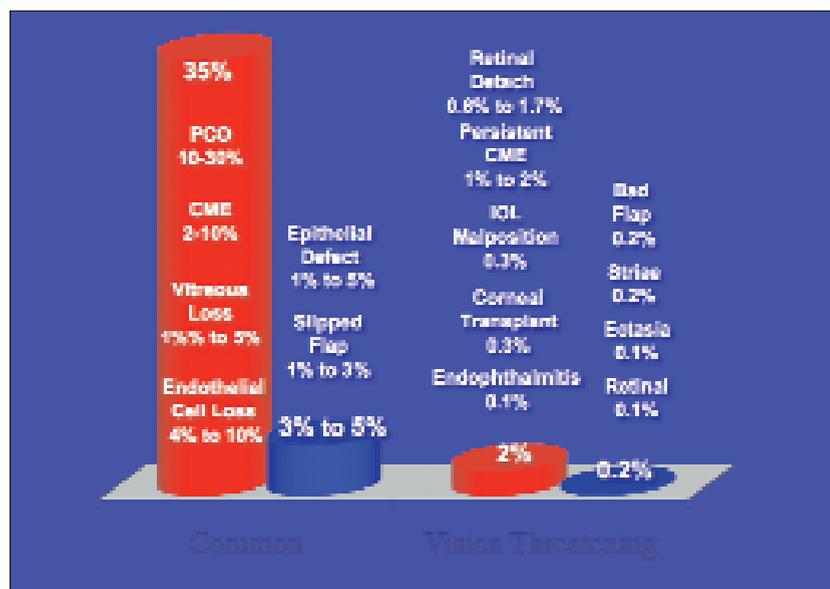


Figure 1. Is cataract surgery good enough? The procedure has a 10-fold higher rate of common and severe complications than LASIK.

In my opinion, the potential for complications is one reason why surgeons are not implanting presbyopia-correcting IOLs. As evidence, I suggest considering current vitrectomy rates. Based on my discussions with industry, surgeons' overall vitrectomy rate is approximately 3% to 6%. This is likely an underestimation, because surgeons manage many smaller, less complicated instances of vitreous loss without a vitrectomy pack. I think most of us would have a hard time counseling a



Figure 2. A scanning optical coherence tomography image of a cut anterior capsulorhexis with a femtosecond laser in a human eye. The measurement lines (green) show that the attempted diameter of 4.5 mm was close to the numbers programmed into the laser.

patient about a premium IOL and the related costs if we knew we had the aforementioned rate of vitreous loss and thus a higher chance of not implanting the lens. A technology that reduced this complication rate, increased precision, improved results, and reduced surgical time would enable more patients to receive premium IOLs and the benefits associated with them. Femtosecond laser technology for cataract surgery could answer this need.

THE CONCEPT OF FEMTOSECOND LASER TECHNOLOGY

Let's imagine a cataract procedure for which we simply sat down, inserted an I/A tip through a premade, self-sealing incision, irrigated out the lens, injected viscoelastic followed by an IOL, and then quickly irrigated out the viscoelastic. Phaco manipulations as we know them, the capsulorhexis, and the incisions (as well as all their risks and uncertainty) would probably disappear. An image-guided surgical laser could create precisely localized and sized incisions for phaco, sideport, and astigmatism; as well as create the capsulorhexis and soften the lens. Such a femtosecond laser device, due to its micron level of precision, could significantly enhance the accuracy and reproducibility of key manual steps subsequently performed during refractive cataract surgery.

The technology has the potential to

- provide a high-resolution image of the eye to drive precise guidance of the laser
- create all required corneal incisions with perfect dimensions as designed by the surgeon (for the aspiration of lenticular material and for the IOL's insertion)
- provide a refractive solution to preexisting astigmatism by creating corneal incisions of precise shape and depth as programmed by the surgeon
- create a perfectly centered capsulotomy of any

dimension or shape from which the lenticular material will be extracted

- liquefy, soften, or chop the lens

Surgeons with three companies are already executing these steps on sighted eyes with good results: LenSx Lasers Inc. (Aliso Viejo, CA), LensAR Inc. (Winter Park, FL), and Optimedica Corp. (Santa Ana, CA). In one laboratory study, average phaco times and power both decreased after treatment with the laser. In one sighted-eye study, no complications occurred during more than 150 laser capsulorhexes (data on file with LensX Inc.).

OUTLOOK

I believe many other benefits of femtosecond laser technology will become apparent. For example, the centration of the capsulotomy and IOL help reduce unwanted visual side effects, create reproducible incisions, and improve wound integrity (Figure 2).

Making cataract incisions with a femtosecond laser is analogous to using the platform to create corneal flaps for LASIK. Ex vivo and in vivo studies demonstrated the reproducibility and accuracy of the corneal flap's thickness, with the subsequent establishment of clinical benefits such as enhanced refractive predictability and reduced postoperative aberrations (data on file with LenSx Lasers Inc.). I was lucky to participate in femtosecond LASIK procedures from an early point in the procedure's development. Initially, metal blade technology was better, but I believed a computer-driven, laser "knife" would supersede it in time.

By converting a manual, multistep, multitool procedure to one with laser-created, surgeon-controlled precision, surgeons will expand the premium cataract market by improving refractive outcomes. Femtosecond laser cataract surgery could elevate the overall safety and optical results of premium cataract surgery closer to levels now attained in laser corneal refractive procedures such as LASIK. The laser technology could deliver a technique with minimal surgical touch, potentially lower risks than conventional cataract surgery, and extreme patient friendliness. I believe femtosecond cataract surgery is our future. ■

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