I love the flexibility the femtosecond laser gives me, and incisions created with this technology will only get better in time.

**FLEXIBILITY**

What I enjoy about laser cataract surgery is that I have the flexibility to construct different sizes and shapes of incision. For example, I use a three-plane primary cataract incision. I make a vertical cut-down that is about 60% depth of the total corneal thickness, followed by a horizontal cut that travels just short of the anterior chamber, and then another vertical cut-down. The advantage of that geometry is that the incision self-seals regularly, consistently, and reproducibly. It also allows me to shorten the length of the tunnel. In other words, instead of a square incision, I create a reverse trapezoid: the external portion is 2.3 mm, and the internal portion is 2.5 mm. I find that this geometry reduces “oar locking” and improves visibility compared with a manually created incision. The length of the tunnel, however, is only 1.5 mm, so visibility is excellent.

I think clear corneal incisions created with a laser are more prone to edema than those made with a blade, although I do not know the reason for this difference. I have found, however, that using a reverse trapezoid configuration, moving the incision farther up to the

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INTRAOPERATIVE ABERROMETRY

Intraoperative aberrometry (IA) has decreased the need for a predictable cataract incision. The technology allows surgeons to measure the direct effect of the incision on the axis and power of astigmatism. In addition, they can measure the incision’s effect on posterior corneal astigmatism, which is very difficult to predict with current preoperative diagnostics.

The challenge of IA is that it requires careful management of intraoperative surgical variables to obtain accurate and reliable readings. One of the most important variables is IOP. When the pressure is too low, the eye becomes soft and prone to distortion. An improperly made cataract incision can compromise IOP, resulting in poor IA readings, or it can leak, requiring additional stromal hydration that may alter IA readings through an induction of astigmatism or a change in its axis. Moreover, an incision created too centrally may interfere with and alter the IA readings. Ideally, the cataract incision should be made as peripherally as possible to avoid interfering with IA readings (Figure 1).

A hope was that femtosecond lasers would increase the reproducibility of the cataract incision and thereby increase the utility of IA. Instead, I have seen laser incisions interfere with IA. Because the currently available lasers have difficulty cutting through arcus senilis, cataract incisions must be placed more centrally, which can compromise IA measurements. I also find...
that cataract incisions created with lens-based femtosecond lasers can require greater stromal hydration, which can stretch or traumatize tissue, preventing it from immediately self-sealing.

**ENERGY LEVELS**

My first experience with a femtosecond laser for cataract surgery involved the use of the iFS Laser (Abbott Medical Optics) in 2010. Because this system was designed to cut corneal tissue, I was not surprised to achieve high-quality, self-sealing, well-created clear corneal cataract incisions. The problem with using the iFS Laser for cataract incisions lay in the system’s usable diameter of 9.5 mm: for the incision to be placed at the limbus required offset docking of the patient interface. Although I found this maneuver relatively straightforward, I noticed that offset docking occasionally disrupted the central corneal epithelium, which could interfere with IA readings. Another problem, of course, was that the iFS Laser cannot be used on lens structures, thus limiting the device’s usefulness in cataract surgery.

Since then, I have used the Catalys Precision Laser System (Abbott Medical Optics), the LenSx Laser System (Alcon), and the Lensar Laser System (Lensar). All three are superb at cutting lens structures but, in my opinion, have fallen short in terms of corneal incisions. A laser needs a lower numerical aperture angle to focus and deliver energy relatively deep into the eye to reach lens structures. A cornea-cutting laser uses a larger numerical aperture to deliver energy to superficial tissues, allowing for a precise cut with relatively minimal energy. If the laser system has a small numerical aperture, it becomes difficult to optimize energy levels for cutting corneal tissue. If the laser settings generate too much energy, gas bubbles are created that block subsequent laser shots, thus decreasing their efficacy and making it impossible to open or pass through the incision. Energy levels that are too low do not allow the proper cutting of tissue.

Further complicating matters, corneal density often varies inferiorly to superiorly and anteriorly to posteriorly. This variability seems to affect laser systems with a low numerical aperture, which interferes with the creation of a cataract incision (Figure 2).

Stated another way, at least with current technology, a laser system that is good at softening the nucleus will not also be efficient at cutting corneal tissue.

**CONCLUSION**

The goal of refractive cataract surgery is to remove the cataract safely and to provide a refractive result that is stable over time. The current femtosecond lasers soften the cataract, allowing for its safe removal, and they allow surgeons to create a stable, predictable capsulorhexis, which promotes the IOL’s stability and fixation over time. As far as the cataract incision, however, today’s laser technology does not help surgeons to achieve refractive outcomes, and the devices may actually threaten the usefulness of IA, one of the most powerful refractive tools available.

I expect that technological advances will one day allow femtosecond lasers to address both lens structures and the cornea. The ability to use a laser to safely create reproducible, reliable, watertight incisions will be a significant clinical improvement. It will also improve the accuracy of complementary technologies.

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