Much of the attention in cataract surgery during the past 2 decades has focused on improving the safety and efficacy of the procedure. More recently, there has been greater awareness of the need to achieve more consistent refractive outcomes. Surgeons are setting their sights on emmetropia.

Refinements in surgical techniques and technologies have improved the ability to help patients achieve quality vision after cataract surgery. Yet, according to some statistics, between 50% and 70% of patients are within 0.50 D of the intended refractive target after cataract surgery.1,2

Why are surgeons missing the refractive target? According to Robert H. Osher, MD, a professor of ophthalmology at the University of Cincinnati and medical director emeritus of the Cincinnati Eye Institute, the inability to get patients exactly where they want to be visually after removing the cataract and inserting the lens depends on multiple factors. Preexisting astigmatism is near the top of the list. It is for this reason, he said, that he introduced the idea of performing astigmatic keratometry (AK) at the time of cataract surgery in 1983, and it is why, to this day, he stresses the importance of addressing both components of the refractive error.

“Early on, it was apparent to me that we were dwelling only on the spherical component of the pseudophakic refractive error, while totally ignoring the cylindrical component,” Dr. Osher said. “By reducing preexisting astigmatism, we officially entered the era of refractive cataract surgery.”

THE ROLE OF TORIC IOLs

Various mechanisms have been proposed for surgeons to address preexisting astigmatism at the time of cataract surgery. Since Dr. Osher first suggested AK, limbal relaxing incisions—which moved the AK concept into the limbus—have become commonplace. Several nomograms have been developed and tweaked along the way, and although limbal relaxing incisions are still a popular choice, they are also acknowledged to be fairly inaccurate. In Dr. Osher’s thinking, manual incisions in the cornea, regardless of their location, are imprecise and “we cannot predict the variability in patient healing.”

“The current and the future mission are all about achieving precision and accuracy.” — Robert H. Osher, MD

In 1994, Kimiya Shimizu, MD, from Japan published the first article on the toric IOL.3 Shortly thereafter, STAAR
Surgical introduced US surgeons to toric IOLs. The AcrySof Toric IOL (Alcon Laboratories, Inc.), released in 2005, was the next major milestone in the conquest of preexisting astigmatism. Except, Dr. Osher was quick to add, the toric technology comes with an important caveat: its potential can only be fully realized if it is precisely selected and aligned.

THE ROLE OF DIAGNOSTICS
Toric IOLs would correct both spherical and cylindrical errors at the same time. The technology would appear ideal for achieving emmetropia after cataract surgery. “That’s what emmetropia is all about: accurately reducing the sphere and the native and induced cylinder so the patient can enjoy uncorrected vision,” Dr. Osher said.

Achieving that end depends on a change in the way a successful postsurgical outcome is considered. For example, it used to be standard in the industry to measure corrected vision at 6 weeks after cataract surgery. Fundamentally, though, uncorrected visual acuity gives a better indication of success. That is why Dr. Osher in 2004 published the article “Early Uncorrected Visual Acuity as a Measurement of the Visual Outcomes of Contemporary Cataract Surgery” as a challenge to his peers to reconsider how they measured surgical results.

“My entire goal was to be able to convince my colleagues that emmetropia was not beyond our reach,” he said. Because this “holy grail” is all about precision, it stands to reason that refinement of surgical techniques and development of better technology was needed.

“The bottom line is that the only way for us to achieve emmetropia is to have better diagnostics on the front end, surgical confirmation on the table, and the potential for postoperative correction after surgery. Each phase gives us the accuracy and flexibility to hit our target,” Dr. Osher said.

IMPROVING ALIGNMENT
One of the largest obstacles to toric lens’ performance is that perfect alignment is required to achieve the desired result. Every degree of misalignment from the intended axis yields a 3.3% loss of effect. According to Dr. Osher, relying on ink pens to mark the location of toric IOLs makes little sense. “How can you have the most elegant surgery in the world with microcoaxial phacoemulsification and torsional ultrasound through a 2.2-mm incision and depend upon ink pens to mark the location of toric IOLs makes little sense.”

He has worked with several companies to develop better concepts for the alignment of toric IOLs. These innovations fall into three categories:

No. 1. Iris imaging. Using the same concepts employed in iris fingerprinting for security purposes, the surgeon takes a picture of the unique crypts, nevi, vessels, pigment, stromal patterns, and Brushfield spots in patients’ eyes. With the Osher Overlay (Micron Imaging, Inc.), the software places a protractor and identifies the degree at which these landmarks are located. Similarly, the Osher Toric Alignment System (Haag-Streit AG) uses a similar slit-lamp photograph and grid overlay for intraoperative guidance.

No. 2. Limbal registration. Using laser technology, the iris and/or limbus is scanned and “memorized” prior to surgery. The resulting image is then recalled, and the target meridian is portrayed in real time in the surgical microscope or on a monitor. Three companies currently offer systems using this concept: SensoMotoric Instruments Gmbh (Surgery Guidance 3000), Carl Zeiss Meditec (Callisto and Z-Align), and TrueVision Systems, Inc. (3D guidance overlay).

No. 3. Intraoperative wavefront aberrometry. This technology is used during surgery to measure and display the actual spherical error, amount of astigmatism, and the steep axis of the cylinder. The ORA 2000 (WaveTec Vision) relies on static images, whereas the Holos Surgical Wavefront Aferrometer (Clarity Medical Systems, Inc.; still in the R&D phase) offers the potential for real-time imaging.

CONCLUSION
The concept of refractive cataract surgery has finally been embraced as patients’ expectations continue to rise. Consistently achieving excellent uncorrected vision will lead to a new standard in the use of advanced technology lenses.

“Today we have such elegant techniques, incredible technology, tiny incisions, wonderful ophthalmic viscoelastic devices, and corneas are lovely shortly after surgery,” Dr. Osher said. “We have gotten so good at what we do, it is easy to say that we have arrived. Yet, we must be receptive to and encourage change. Our sights should always to always be set on perfection. It does mean we will achieve it, but we should strive for it.”