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Revolutionary technology for revolutionary cataract surgery

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Surgeon experiences good results with LenSx Laser over the past year



Stephen Slade, M.D.

⁴⁴The laser treatment of the lens prior to phacoemulsification reduces phaco time and power significantly⁵⁵

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Copyright 2011 ASCRS Ophthalmic Corporation. All rights reserved. The views expressed here do not necessarily reflect those of the editor, editorial board, or the publisher, and in no way imply endorsement by EyeWorld or ASCRS. Dr. Slade reports better safety, precision, and reproducibility with femtosecond laser technology in cataract surgery

> tephen Slade, M.D., Slade & Baker Vision Center, Houston, has been using a femtosecond laser to perform laser refractive

cataract surgery routinely for more than a year now in his practice, and in that time, he has learned a lot about the technology.

"We use it on almost all of our cases," said Dr. Slade. He uses the LenSx Laser (Alcon, Fort Worth, Texas) for all of his advanced technology IOL cases. During such cases, the femtosecond laser is utilized to make incisions, create the capsulorhexis, perform lens chopping, and create arcuate cuts, he said.

"The precision is tighter, and I believe it is safer," Dr. Slade said.

For instance, in terms of creating the capsulorhexis, "It allows me to make the capsule perfectly circular and centered wherever I want," said Dr. Slade. "It allows me to make the same rhexis every time."

Hence, the LenSx Laser makes that surgical buzzword "reproducibility" real. "Once you get reproducibility, you can tighten your calculations," Dr. Slade said.

The LenSx Laser has a significant impact on effective lens position. "Right now, we can measure the length of the eye, the curvature ... but [before the LenSx Laser] we couldn't control capsular contraction," Dr. Slade said. Researchers have identified some factors that impact capsular contraction, such as the size of the lens, but until recently, the contraction itself evaded control.

The LenSx Laser helps in that it leaves a more precise capsular bag in place, Dr. Slade said. "A small capsulotomy will contract more, while a big one contracts less," Dr. Slade said. "If surgeons do it by hand, the size will vary. If they do it by laser, it won't vary."

No longer having to worry about capsular contraction, ophthalmologists can be more confident in their positioning of lenses. "Surgeons can center the capsulotomy or place it where they want it," Dr. Slade said. "Because of this more precise placement, the standard deviation of the spherical component of the lens is much tighter."

Dividing the nuclear segment via quick laser treatment, the LenSx Laser reduces surgical manipulation inside the eye. "The laser treatment of the lens prior to phacoemulsification reduces phaco time and power significantly," Dr. Slade said.

When Dr. Slade explored endothelial cell counts post-op, he found that there was less endothelial cell loss compared to published norms when the LenSx Laser was utilized. That said, the LenSx Laser doesn't replace ultrasound. While the LenSx Laser could be responsible for dividing a lens into quadrants, a surgeon still uses his or her preferred method of ultrasound delivery to emulsify the nucleus.

"The LenSx Laser provides a higher level of precision and safety for the cataract procedure," Dr. Slade said.

In December 2009, **Zoltan Nagy**, **M.D.**, Budapest, Hungary, and colleagues, published a report in the *Journal of Refractive Surgery* evaluating the LenSx Laser for cataract surgery.

His reason for doing so was compelling. "Manual capsulorhexis results in capsular tears in approximately 1% of cases and has limited diameter predictability, which can affect IOL centration, postoperative anterior chamber depth, and posterior capsular opacification rates," Dr. Nagy wrote.

continued on page 3



The LenSx Laser, FDA cleared in October 2010

New technologies in a practice



Robert J. Cionni, M.D.

⁶⁶Educate yourself and educate your staff to make sure the same message is being presented at each step ³³ Ensuring everyone in a practice is educated about new technologies will ease their introduction, surgeon says

dvances in technology have helped expand cataract surgery beyond the older, Medicare-based patient base to younger people who want spectacle independence and are willing to pay outof-pocket for the added benefit. With cuts in Medicare reimbursement to ophthalmic surgeons continuing yearly and the sustainable growth rate cuts looming each year, surgeons need to abandon the mindset that if 10% cuts are enacted, all they need to do is increase their patient base by 10% to cover the cuts, said Robert J. Cionni, M.D., medical director, The Eye Institute of Utah, Salt Lake City.

Educate yourself on newer technologies

Before making the decision to incorporate the latest technology into a practice—whether it's the newest generation of multifocal or accommodating intraocular lenses (IOLs), the femtosecond laser for cataract surgery, or wavefront analyzers and topographers for refractive surgery candidates-"you need to educate yourself about it," Dr. Cionni said. In his opinion, limiting your education to peer-reviewed journals is insufficient because of the time delay from submission to publication. Instead, he highly recommends attending user meetings and large conferences, and reading some of the non-peer-reviewed magazines.

"The reason I could bring some of the technology to my practice before others even knew about it was because I've gone to meetings like ASCRS," he said. Introducing new technology into a practice should be a two-pronged approach, he said. First and foremost, educate yourself and "educate your staff—anyone who has any phone or personal contact with your patients—to make sure the same message is being presented at each step," he said.

"If patients have been receiving a consistent message from the getgo, it's very likely that when I sit down with them, they already want the newest technology lenses, leaving it up to me to tell them if they're good candidates." Even those who are not candidates may end up being the best publicity for your practice, he said, as they often recommend friends and family to physicians they deem more knowledgeable about what is available.

In his practice, staff will send potential advanced technology lens patients information about what the lens implants are, how each differs, what patients can expect from the pre-op exams through the post-op follow-up period, etc. For his refractive patients, he includes information not just about LASIK but also about refractive lens options, toric IOLs, and implantable corrective lenses (ICLs).

"I've used every advanced technology lens that's come on the market, and I've gone to corporatesponsored courses for each. Bias notwithstanding, these courses offer some of the best pearls and tips for successful use of the lenses," Dr. Cionni said.

Because patients are now arriving in the office "already informed by friends and family who have newer technology lenses or procedures, any surgeon who doesn't at least discuss the technology is going to watch those patients jump ship." That said, a good 70% of the patients in Dr. Cionni's practice do not qualify for the newer technology lenses (mostly due to co-morbidities).

He recommended keeping all the testing equipment in one central location in an office so when new machines are purchased, the overall office footprint does not drastically change.

Sharing knowledge

In the past 5 years, there has been a "paradigm shift" in how cataract surgeons treat their patients. "When we start presenting results from the femtosecond cataract laser on a larger scale, I think we'll see this new technology utilized more com-



The LenSx Laser in Dr. Cionni's practice



monly for cataract surgery," he said. "I'm confident we'll start hearing how much more consistent results are. This latest advance in cataract surgery eliminates inter- and intrasurgeon variability," he said.

Practices that are considering adding new technologies—whether it's a new type of laser or a new diagnostic tool—have to manage the costs. "It takes some careful planning by the practitioner to ensure the monies are there for a large investment such as a laser," Dr. Cionni said.

Dr. Cionni plans to incorporate the femtosecond cataract laser into his practice by "opening up the laser center to other surgeons in the area. This way, we're all using a common facility and fixed assets. We'll let other surgeons use it for a nominal fee, but it will still take careful planning to determine what we pass along to the patient in terms of cost."

As surgeons purchase new technologies in the clinic or the OR, they have to find a way to pay for them. "Sometimes these costs must be passed on to patients if they are related to non-covered services such as refractive surgery," Dr. Cionni said.

All told, educating yourself, your staff, and your patient base is the only way to successfully incorporate the latest technology into any practice, he said.

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continued from page 1



The LenSx Laser uses a real-time OCT imaging system to map the eye and place the incisions, capsulotomy, and nuclear cuts. A video image of the surgeon's view is overlaid with "drag and drop" incisions and the capsulotomy's parameters (left). An OCT section of the cornea in which a multiplaned incision is planned and positioned (top right). A section through the anterior segment shows the lens for planning and placement of the nuclear cuts (bottom right)

Additionally, he reported, "The surgical challenges posed by nuclear chopping techniques have hindered widespread adoption, despite evidence that they reduce ultrasound requirements relative to traditional phacoemulsification."

Meanwhile, he noted that femtosecond laser precision "exceeds that of highly sophisticated mechanical devices, with fewer likely collateral tissue effects." But would that necessarily be the case in cataract surgery? Dr. Nagy put the LenSx Laser to the test, and the answer was affirmative. "Initial results with an intraocular femtosecond laser demonstrate higher precision of capsulorhexis and reduced phacoemulsification power in porcine and human eyes," Dr. Nagy wrote.

Dr. Nagy began research by looking at the LenSx Laser anterior

capsulotomy and phacofragmentation procedures in ex vivo porcine eyes, proceeding to an initial series of nine patients undergoing cataract surgery.

"For an intended 5 mm capsulorhexis in porcine eyes, average achieved diameters were 5.88+/-0.73 mm using a standard manual technique and 5.02 ± -0.04 mm using the femtosecond laser," Dr. Nagy reported. "Scanning electron microscopy revealed equally smooth cut edges of the capsulotomy with the femtosecond laser and manual technique. Compared to control porcine eyes, femtosecond laser phacofragmentation resulted in a 43% reduction in phacoemulsification power and a 51% decrease in phacoemulsification time. In a small series of human clinical procedures, femtosecond laser capsulotomies and phacofragmentation demonstrated similarly high levels of accuracy and effectiveness, with no operative complications."

In December 2010, **William Culbertson**, **M.D.**, Bascom Palmer Eye Institute, University of Miami, and colleagues, published a report on femtosecond laser-assisted cataract surgery in *Current Opinion in Ophthalmology*, which supported Dr. Nagy's results.

"Although they only had a limited number of patients, they demonstrated that femtosecond laser systems for cataract surgery appeared to be well tolerated for use," the researchers wrote.

They also suggested that the femtosecond laser will do for cataract surgery what it has already done for LASIK.

"With the advent of multifocal and accommodating intraocular lenses and patients pursuing surgery earlier with less tolerance for visual impairment, cataract surgeons are facing increasingly high patient expectations for refractive outcomes," they noted. "Today, the goal of cataract surgery is to achieve near emmetropia. Just as for LASIK, femtosecond laser technology can deliver remarkable gains in reproducibility, centration, and safety in cataract surgery, delivering the necessary accuracy and precision to improve beyond current clinical outcomes."

So far, Dr. Slade has experienced these femtosecond laser refractive cataract surgery innovations firsthand with the LenSx Laser. Ophthalmologists eager to embrace innovation may soon follow his lead.

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Surgeon says ReSTOR +3 offers advantage over other presbyopia-correcting IOLs



Kerry Solomon, M.D.

⁴⁴Post-operative uncorrected VA was excellent in both groups. Our results mirrored the defocus curve data from the FDA studies, with intermediate vision testing better on the ReSTOR lens³⁵

Preliminary analysis suggests a better patient satisfaction level with the ReSTOR IOL and better near and intermediate vision

ow well a presbyopia-correcting lens will perform depends on numerous factors, including corneal astigmatism (both pre-op and surgically induced), biometry, pupil size, lens position predictability, residual refractive error, and patient selection/expectations. The first prospective, randomized, headto-head comparison of two multifocal IOLs found several notable differences, said Kerry Solomon, M.D., in private practice, Carolina Eyecare Physicians LLC. In this prospective study, 62 patients were bilaterally implanted with either the AcrySof IQ ReSTOR +3.0 IOL (Alcon, Fort Worth, Texas) or the Tecnis ZMB00 (Abbott Medical Optics, Santa Ana, Calif.). The study took place at four sites in the U.S. with a 3-month post-op follow-up, and while surgeons were not masked for

obvious reasons, the patients were. Each patient was implanted bilaterally with the same lens model.

"We wanted to find out if there was a difference in terms of what we measure—defocus curves, visual acuity, sphere, and cylinder—and what patients notice," Dr. Solomon said.

At their simplest, defocus curves measure the lens function without accounting for variables such as biometric accuracy or surgical variability, he explained. In the Food and Drug Administration studies, the drop-off in intermediate range was less for the ReSTOR +3 IOL than for the ReSTOR +4 (an earlier iteration). Dr. Solomon said he expected similar outcomes between the Tecnis ZMB00 and ReSTOR +3 IOL. In theory, the defocus curve is the primary means of ensuring each lens starts off equivalent to every other lens and provides an objective measure of expected vision across a wide variety of distances.

For this study, Dr. Solomon noted the inherent differences in the two lenses would suggest the Tecnis would allow patients to see finer print more clearly, while the ReSTOR would offer more comfortable reading distances and intermediate vision. The ReSTOR lens is a 3 add, while the Tecnis is a 4 add; the ReSTOR is a diffractive lens with rings out "to about the middle of the lens," while the Tecnis has concentric rings out to the edge of the optic, he said. (The ReSTOR +3 lens reduced the overall number of rings from 12 to 9, according to company information, and has slightly wider ring spacing to achieve the add power.)

In theory, he said, "The Tecnis should have better near vision and allow patients to see finer print. The downside to the +4 is that patients have to hold objects closer than is typically comfortable in order to read. The ReSTOR +3 lens should be more functional and offer a more comfortable reading distance, something like 18-20 inches instead of the 12 or 14 inches the Tecnis is expected to provide."

Similarly, the advantage of having the concentric rings out to the edge of the optic means the lens is less pupil-dependent and may offer the ability to read in lower lighting situations, but the trade off is worse halo and glare. The periphery of the ReSTOR IOL is a standard aspheric optic, Dr. Solomon said, which should provide better night vision, but because the rings do not encompass the whole lens, patients may

continued on page 5

Results: Patient reported outcomes

- VISTAS questionnaire (1-mo data)
 - Rate difficulty with tasks at various distances without spectacles
 - 1 (no difficulty) to 5 (extremely difficult)



4



Study finds multifocal IOLs preferred over accommodating IOLs

In a patient satisfaction study, patients preferred the ReSTOR +3.0 IOL over an accommodative option

resbyopia-correcting IOLs can help provide patients with more spectacle independence, according to **Robert R. Rivera**, M.D., in private practice, Barnet Dulaney Perkins Eye Center, Phoenix, Ariz. As

surgical experience with these spe-

cialty lenses—or advanced technology IOLs, as some call them— improves, surgeons have also determined which candidates make better patients, Dr. Rivera said. For instance, those candidates with severe dry eye, blepharitis, macular problems, or unusual topographies might not have the same visual outcomes as candidates without those morbidities, and some symptomatic side effects (night vision complaints) may be exaggerated, he said.

Trouble with nighttime vision



The question of which lens type—accommodative or multifocal—is capable of offering the best vision at all distances has remained elusive. Results of a new study comparing patient outcomes in near and intermediate visual acuity between the AcrySof IQ ReSTOR +3.0 IOL (Alcon, Fort Worth, Texas) and the Crystalens HD or AO (Bausch & Lomb Surgical, Aliso Viejo, Calif.) indicated that patients preferred the multifocal technology to the accommodative platform, Dr. Rivera said.

Patient preferences, study details

"What we want to do with our prospective study is be able to say to our patients, 'Based on our clinical results, this is what you should expect," Dr. Rivera said. The comparative study occurred across four sites in the U.S. General inclusion factors were visually significant cataract with less than 1.00 D of astigmatism. Refractive error was not calculated, as the patients' primary visual complaint was cataract, Dr. Rivera said. At baseline, the mean age of the patients was 64.19 years, and the female to male ratio was about 60:40. Patients enrolled were masked about which of the three lenses they would receive (the Crystalens HD500 or AO or the IQ ReSTOR +3.0 continued on page 7



Robert R. Rivera, M.D.

⁶⁶When patients with the same numbers and acuity outcomes with multifocal lenses were asked, they were happier overall with their vision ⁵⁵

continued from page 4

need to rely on better lighting to read comfortably.

Study results

Baseline patient demographics were about the same, with the exception of intermediate visual acuity. For the purposes of this study, best corrected visual acuity (BCVA) was measured at typical distance, 70 cm for intermediate vision and 40 cm for near vision. At baseline, patients in the ReSTOR IOL group (n=33) had a mean BCVA of 0.31±0.14 logMAR at intermediate, while those in the Tecnis group (n=31) had a mean BCVA of 0.19±0.14 logMAR (P<.001). This difference was statistically significant at the 1-month post-op visit. Dr. Solomon discussed the preliminary 1-month results.

"Post-operative uncorrected VA was excellent in both groups," Dr. Solomon said. "We would expect that from the defocus curve data. Our results mirrored the defocus curve data from the FDA studies, with intermediate vision testing better on the ReSTOR lens."

Both lenses performed equally at distance vision, Dr. Solomon said. For near vision, however, the ReSTOR IOL's 0.08 ± 0.11 (*P*<.001) was slightly better compared to the Tecnis 1-month UCVA of 0.17 ± 0.09 (*P*<.001).

"Multifocal lenses provide very predictable outcomes," he said. "Patients will be less spectacle dependent with a multifocal lens than others, and for now, this is the best way we have to treat presbyopia."

It is imperative, however, that patients understand the compromises of the lenses. The best candidates, in Dr. Solomon's opinion, are those with less than 1.00 D of astigmatism at baseline and those with a healthy macula and retina.

Patients were also asked to assess the difficulty of performing various tasks at various distances with each lens without wearing spectacles and rate the outcomes on a scale of 1 (no difficulty) to 5 (extremely difficult). The 1-month interim results showed the ReSTOR +3 IOL outperforming the Tecnis in three key measures: effectively and safely performing near tasks, effectively and safely performing intermediate tasks, and driving confidently and safely at night (see Figure 1). In all cases, the standard deviation was tighter with the ReSTOR IOL as well, "which means we had greater predictability with the lens," Dr. Solomon said.

Knowing how the defocus curve translates into functional vision and leaving patients with minimal residual astigmatism will help surgeons maximize patient satisfaction in the post-op period.

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Surgeon finds spectacle independence,



Trevor Woodhams, M.D.

⁴⁴We're such a computer-intensive society now that intermediate vision is just as important as distance and reading vision ³³

Delivering on the promise of reduced spectacle dependence will keep patients happy

study was recently performed to evaluate and compare the visual performance outcomes of three presbyopia-correcting IOLs: the AcrySof IQ ReSTOR +3 IOL (Alcon, Fort Worth, Texas), the Tecnis Multifocal (Abbott Medical Optics, Santa Ana, Calif.), and the Crystalens AO and HD (Bausch & Lomb Surgical, Aliso Viejo, Calif.). The goal was to evaluate satisfaction in patients with early cataract undergoing refractive IOL surgery, said Trevor Woodhams, M.D., in private practice, Woodhams Eye Clinic, Atlanta.

The Tecnis Multifocal lens has a full-optic, posterior diffractive design with an aspheric surface. The AcrySof IQ ReSTOR +3 IOL (also a multifocal design) has an apodized, diffractive center with a refractive periphery. These allow for selective near, intermediate, and far distribution of light passing through the pupil and being focused on the macula. The Crystalens 5.0 (both the HD and AO version) is an accommodating IOL, which works by a combination of anterior/posterior displacement and vaulting of the central portion of the IOL optic with ciliary body contraction.

Study details

The study was designed to target emmetropia for each patient. Patients were disqualified from the study if they had more than 1 D of corneal astigmatism, Dr. Woodhams said. The study protocol did not allow for any post-op keratorefractive procedures for residual ametropic correction with the exception of YAG laser for capsular opacification.

"Eliminating significant corneal pre-op astigmatism allowed us greater accuracy in achieving close to emmetropia at distance," he said. "About 95% of the patients in the ReSTOR and Tecnis groups achieved a binocular 20/20, which was spectacular. The Crystalens group was somewhat different—we targeted post-op vision based on the recommendations of Bausch & Lomb, which were plano in the dominant eye and -0.75 D of myopic undercorrection in the non-dominant eye to enhance near magnification." This particular study did not address the issues of reduced contrast sensitivity, glare, halos, starbursts, or other optical side effects.

In the first phase of the study, 39 patients were randomized to receive either the ReSTOR +3 (16 patients) or the Crystalens. Because of the change in design during the study from the AO to the HD (with an aspheric surface), 13 received the HD and 10 the AO Crystalens. In the second phase, 15 patients were randomized to receive either the same ReSTOR +3 IOL (n=9) or the Tecnis Multifocal (n=6). Dr. Woodhams noted he was speaking only about the 54 patients enrolled at his site (there were three other sites included in the study).

"One thing about the study we found interesting was that patient satisfaction seemed inversely proportional to the degree of pre-operative refractive error," Dr. Woodhams said. "Those with a higher pre-op refraction, whether hyperopic or myopic, tended to be more satisfied overall than those in whom we were correcting very little distance refractive error. This was true for all the IOL models." High myopes and hyperopes seem to be more tolerant than lower myopes or emmetropes of undesirable optical side effects inherent in any IOL, he said.

"With emmetropes, it's much more likely they will complain of something no matter what degree of reading and distance vision they get with the surgery," Dr. Woodhams said. "We can measure how small a line of letters can be identified at 12 or 14 inches, but that's not how well they can read. A reading speed test is much more reflective of satisfaction levels."

A reading speed test is much more reflective of visual performance at near than a near card of Jaeger letters; "this involves reading aloud grammatical sentences of equal length at progressively smaller font sizes. The time it takes to complete each short block of text is recorded with adjustments made for missed words," he said. "The distance at which reading speed was recorded varied for each IOL type: 33 cm for the Tecnis Multifocal and 40 cm for the ReSTOR IOL and Crystalens, based on their somewhat different near points."

Dr. Woodhams said in his group, the best magnification for reading was with the Tecnis, followed closely by the ReSTOR IOL, "although the Tecnis reading distance was felt to be too close by many patients. Remarkably, none of the patients in the multifocal groups needed reading glasses at their optimal near reading distances. The Crystalens was the least reliable for satisfactory, unaided reading at near. Many of the patients in that group needed supplemental, low-powered reading glasses, although this same

Limitations with near vision activities at 3-months



patient satisfaction linked with presbyopia-correcting IOLs

lens performed the best at intermediate distances, e.g., computer monitor reading."

Diffractive technology advantages

In today's refractive lens environment, providing a patient with good

continued from page 5

IOL), and they were followed for 6 months post-op to gauge overall satisfaction with the lenses and to determine if that correlated with the expected outcomes. The IQ ReSTOR +3.0 IOL is an apodized, diffractive lens, the HD500 is a spherical accommodating lens, and the AO is an aspheric accommodating lens.

"We've thought for a while that the accommodative lenses move around the visual axis, and that might lead to more refractive surprises than we would get with multifocal lenses," Dr. Rivera said. In this study, surgeons were able to hit the target refraction more consistently with the IQ ReSTOR +3.0 IOL than with either version of the Crystalens.

"That might have to do with effective lens position (ELP), or where the lens resides in the eye. When we pick lenses pre-operatively, we want them to reside on a predetermined spot inside the eye," Dr. Rivera explained. "If the lens ends up a littler farther posterior or anterior to our predetermined spot, that will affect visual outcomes. There's more flexibility in movement with accommodating IOLs, so the working hypothesis is that flexibility will make a lens less likely to stabilize where the surgeon wants it to be." Multifocal lenses center well in the capsular bag and are more likely to stay put, Dr. Rivera said.

This study evaluated all patients at 3 months to assess range of vision and overall patient satisfaction with the lenses. Patients also underwent binocular defocus testing and were evaluated for overall spectacle wear, Dr. Rivera said.

At 40 cm, visual acuity was significantly better with the IQ ReSTOR +3.0 IOL (-0.02 logMAR or slightly better than 20/20; n=41) than the Crystalens HD (0.37 logMAR; n=37) or Crystalens AO (0.43 logMAR, n=40). At 50 cm, VA with the ReSTOR +3.0 IOL was significantly better than with either the HD or AO lens (0.05 vs. 0.22 and 0.29, respectively). distance vision is important, but "it's equally important to provide good reading and intermediate vision," Dr. Woodhams said. "The ability to have satisfied patients depends on great distance vision—it has to be at least as good as what they had with spectacles. "We're such a computer-intensive society now that intermediate vision is just as important as distance and reading vision," he said.

In his opinion, lens centration with a multifocal lens is "far more important" than surgeons might otherwise think. "My advice is to constrict the pupil and visualize the coaxial light; move the lens around until you know it's centered correctly," he said.

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Earlier analyses before this study showed "there were more surprises in visual outcomes with the accommodating IOL. We often had times when patients looked good on paper, but they would complain about the quality of their vision. When patients with the same numbers and acuity outcomes with multifocal lenses were asked, they were happier overall with their vision," Dr. Rivera said. In this study, while all patients had good overall vision, the IQ ReSTOR +3.0 IOL patients were happier overall than either group of Crystalens patients.

On a scale of 1-10. where "10" was considered the best vision, patients rated the ReSTOR +3.0 IOL at 8.43, the Crystalens HD at 7.08, and the Crystalens AO at 7.94 (there was a statistically significant difference between the ReSTOR IOL and the Crystalens HD). Under good lighting (daytime), those in the IQ ReSTOR +3.0 IOL group had the least amount of difficulty with vision (0.5 on a scale of 0-4), while those in the AO group had slightly more difficulty (0.78), and those in the HD group reported the most difficulty (1.05). Likewise, the least trouble with nighttime vision was reported with the IQ ReSTOR +3.0 IOL group (0.68), followed by the AO group (0.9) and the HD group (1.32).

Additionally, overall spectacle independence was greater with the IQ ReSTOR +3.0 IOL as well, Dr. Rivera said. At 3 months, 77.3% of the patients in the ReSTOR +3.0 IOL group (n=44) reported overall spectacle independence, compared with 37.8% in the HD group (n=37) and 37.5% in the AO group (n=40).

Surgical pearls

As someone who has implanted "hundreds" of these advanced technology IOLs, Dr. Rivera had some suggestions for those who are just beginning to gain experience with the lenses. Best distance corrected VA at 40 cm







"First, don't be afraid of these IOLs," he said. "We can and do end up with extremely happy patients." Second, "make sure you have a

good capsulorhexis that will hold the edge of the optic in place," he said. "You need to ensure the lens is being held in a good position in the capsular bag. That is the last area of wide variability among surgeons and may have to do with effective lens positioning."

Do what you can to correct any

residual refractive error as well, he said. For this group of patients with increased expectations, it is unacceptable to leave them with a half diopter of cylinder or sphere, Dr. Rivera said.

"You can recommend these IOLs, and if you're not comfortable with refractive surgery, partner with someone who is," he said.

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Surgeon says AcrySof IQ Toric IOL corrects lower levels of astigmatism



Paul Ernest, M.D.

⁴⁶My wound placement lets the lens correct astigmatism the way it has been designed to do, and l'm not adding a significant amount of astigmatism with my technique ⁵⁵

Using a low power toric lens allows more consistent astigmatic correction

reating astigmatism has presented challenges in the past, as limbal relaxing incisions are not always predictable or stable, and the

U.S. has only had toric IOLs available since the latter half of the last decade. Now that toric IOLs are widely available, surgeons have a much safer, more predictable, and more stable option, according to Paul Ernest, M.D., founder of TLC Michigan. Surgeons are now able to improve visual outcomes for numerous patients by treating their corneal astigmatism at the time of cataract surgery; toric IOLs are able to correct a wide range of astigmatism—in some cases up to 2.00 D of astigmatism and as low as 0.75 D. Dr. Ernest said the key to keeping residual astigmatism to a minimum is to create a square wound, place it more posteriorly than typical, and keep a small incision size (he prefers 2.2-2.4 mm).

The AcrySof IQ Toric T3 lens (Alcon, Fort Worth, Texas) is designed to treat between 0.75 D and 1.25 D of astigmatism at the corneal plane, Dr. Ernest said. "Conventional wisdom" tells surgeons that 0.5 D of astigmatism equates to about 0.25 D of spherical error and can affect high contrast visual acuity as well, Dr. Ernest said. In addition, the lens is aspheric, "which gives a better level of contrast sensitivity after implantation," he said.

"I've used the lens to treat between 0.87 D and 1.25 D," he said. In a recent study¹ of 323 eyes with astigmatism ranging from 0.75 D to 1.38 D, 185 eyes were implanted with the AcrySof Toric T3 IOL, and the rest received the AcrySof IQ spherical power lens. (The T3 has the lowest cylinder power of 1.5 D at the IOL plane and just over 1.00 D at the corneal plane, Dr. Ernest said.)

Overall, no complications related to the implantation or the lens were reported, and none of the surgeries involved sutures for wound closure, showing the importance of proper wound construction.

Technique







Dr. Ernest shows his temporal, 2.2-mm square posterior limbal incision technique Source: Paul Ernest, M.D.

Know your SIA levels

"We wanted to calculate the surgically induced astigmatism (SIA) for a subset of eyes (n=38) with post- operative keratometry results as well," Dr. Ernest said. Simulations of the lens after 0.5 D of surgically induced astigmatism suggested the lens would have a low likelihood for overcorrection. With an estimated 65% of the population having some amount of corneal astigmatism up to 1.25 D, reducing the amount of induced astigmatism is paramount, he said.

"When we look at some of the other lenses—the T4 or T5—we see they have lower residual astigmatism than the T3 (0.6 D on the T3 compared to about 0.5 D with the others)," he said. "We wanted to find out why a lens would create a lower amount of astigmatism than any other."

The simple answer is "surgically induced astigmatism. In my experience, square wounds induce less astigmatism. When you induce a significant amount of astigmatism, it greatly alters the effect of the lens on visual outcomes in those patients with lower levels of corneal astigmatism," Dr. Ernest said. For example, if a surgeon's typical induced astigmatism rate is 1.00 D, that will have a much more clinically relevant outcome if the patient had 1.00 D of pre-op astigmatism than if the patient had 2.50 D of pre-op astigmatism, he said.

Dr. Ernest's typical surgically induced astigmatism rates with the T3 are about 0.25 D with a standard deviation of 0.14 D. Because his levels of induced astigmatism are consistent between lens types and model numbers, Dr. Ernest said he did not adjust for lens power in the T3 study.

"I'm able to achieve those low rates not only because the lens is good, but because using a posterior limbal incision did not induce the amount of astigmatism that would offset letting the lens do its job," Dr. Ernest said. In fact, he said opting to use a posterior limbal incision will induce about half the astigmatism as a clear corneal incision, even with a temporal, 2.2-mm square incision. His technique involves making an incision in the posterior limbus "without getting into sub-Tenon's space," he said.

Overall, 92% of those implanted with the T3 had no more than 0.50 D of residual refractive astigmatism, compared with 13% of the patients in the spherical IOL group. Where the astigmatism is located may affect outcomes as well, Dr. Ernest said, noting that with-the-rule astigmatics had more than 1.00 D of refractive astigmatism post-op, compared to

First U.S. study comparing LRI to aspheric toric IOL implants

Preliminary results indicate better outcomes with the aspheric toric IOL implant

reating astigmatism has been a challenge for surgeons—limbal relaxing incisions (LRIs) are not necessarily the most consistent option for patients with more than 1.00 D of astigmatism, and longer-term results have not always been reliable. Some estimates predict half the people over 60 years old have at least 1.00 D of astigmatism, and almost one-quarter of those undergoing cataract surgery have more than 1.50 D of astigmatism. In general, astigmatism of as little as half a diopter can be visually disturbing.

There are two surgical approaches to changing refractive astigmatism, said **Anna F. Fakadej, M.D.**, in private practice at Carolina Eye Associates. Surgeons can either change the corneal anatomy by LRI or by laser, or they can implant a toric IOL.

Visual acuity

"In either case, the pre-operative evaluation is paramount for a quality outcome," she said. "Once the evaluation has determined regular corneal astigmatism without ectasia, the decision becomes one of which technique would better address the astigmatism."

Studies outside the United States have found toric implants can provide better consistency and offer patients better visual outcomes than LRIs, she said.¹ Dr. Fakadej believes the inconsistencies between the two procedures are due to the "inherent

continued on page 11



Anna F. Fakadej, M.D.

⁶⁶With a toric implant, we take that unknown out of the equation. We are not counting on the cornea to react in the way we predict but rather using an optic, which is intraocular, to correct the astigmatism ⁵⁵





continued from page 8

against-the-rule astigmatics who had about 0.70 D.

"It's not enough to pick up this lens and use it—even though this is an easy lens to insert and place due to its platform," he said. "If surgeons are creating clear corneal incisions, they may be inducing enough astigmatism that nailing the refractive results might be more difficult."

He attributes his low levels of surgically induced astigmatism to "incisions that are small, square, and more posterior. It's not because I'm a better surgeon than others, it's because my wound placement lets the lens correct astigmatism the way it has been designed to do, and I'm not adding a significant amount of astigmatism with my technique," he said.

The addition of the T3 to his armamentarium allows Dr. Ernest "to provide a real visual benefit to the candidates with lower levels of astigmatism—when surgeons start talking about patients in the 0.75 D to 1.25 D range, that's a large number. If surgeons want to offer treatment to these patients, they'll have to also provide a clinical difference for them. There is a huge difference in perceived vision with a residual error of 0.75 D and one that's 0.5 D or less."

Reference

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Surgeon describes



Bonnie An Henderson, M.D.

⁴⁴The IQ IOL reduces both spherical and total higher-order aberrations, so the functional vision delivered by this lens is noticeable for patients ³³ or patients who are not candidates or not interested in toric or multifocal technology, aspheric IOLs can offer improved visual outcomes. The AcrySof IQ IOL (Alcon, Fort Worth, Texas) incorporates an aspheric, thinner central posterior optic (9% thinner than the standard AcrySof lens) on the singlepiece hydrophobic acrylic lens, which results in a slightly net positive spherical aberration, enhancing image quality.

Aberrations normally lead to degradation of vision even when refractive error is corrected with glasses or contact lenses. In a younger eye, the crystalline lens has negative spherical aberration while the cornea has positive spherical aberration. As one ages, the compensating negative spherical aberration of the lens decreases. When the crystalline lens is removed in cataract surgery, surgeons need to offset some of the positive corneal aberration with a negative spherical aberration lens, said **Bonnie An Henderson, M.D.**, partner at Ophthalmic Consultants of Boston, and assistant clinical professor of ophthalmology, Harvard Medical School, Boston. "We can't correct for these types of corneal aberrations with traditional glasses," Dr. Henderson said. "That's the idea behind the aspheric intraocular lens."

The AcrySof platform was altered to thin the center of the lens and flatten the posterior side, and "those two changes cause a net negative asphericity of the lens itself, enough to counteract the majority of the positive spherical aberration of the cornea," Dr. Henderson said. The average cornea has +0.275 microns spherical aberration, and the AcrySof IQ IOL has -0.20 microns spherical aberration, leaving the eye with about +.08 microns spherical aberration. Leaving the eye slightly positive benefits patients by increasing contrast sensitivity. The IQ IOL

also reduces both spherical and total higher-order aberrations, so the functional vision delivered by this lens is noticeable for patients, according to Dr. Henderson.

Since the lens is a monofocal optic, indications for implantation are the same as for non-aspheric monofocal IOLs. Dr. Henderson said that when choosing a lens, however, surgeons should consider pupil size.

"The larger the pupil, the more aberration the patient will experience," she said. "Light rays are overrefracted at the periphery of the lens and cornea so the larger the pupil, the greater the aberration. Therefore, eyes with larger pupils in particular benefit more from an aspheric IOL."

Predictability, stability

Although all of the newer generation IOLs offer patients better outcomes, "the AcrySof stands out because the soft, gummy material opens slowly and predictably in the eye," Dr. Henderson said. "Implantation is so controlled, the risk of



Implantation of AcrySof IQ IOL

breaking a capsule during implantation is significantly minimized. If the haptic is rotated or curled, it doesn't matter since you can manipulate the lens as it unrolls in the bag." She notes the time—about 3 seconds for haptic-to-haptic unrolling—helps the lens maintain its stability, but also allows surgeons to manipulate the lens as it's unfurling without causing subsequent damage to the eye.

Other IOLs incorporate stiffer haptics that can open abruptly, she said.

An additional benefit of the AcrySof IOL material is "the 'stickiness' of the lens, which allows the lens to stay where you need it to," Dr. Henderson said. "Proper lens placement is very important for centration, and the stability of this lens decreases the risk of IOL tilt."

Dr. Henderson prefers DuoVisc (Alcon) as her viscoelastic because of the versatility of two different agents. "Being able to use a disper-

continued from page 9

unknown with LRIs about how an individual patient's cornea will heal." Even with nomograms that can offset the surgeon's induced astigmatism, "the patient may fibrose the cornea quickly and the LRI may be ineffectual." Conversely, a patient may have more relaxing and be overcorrected.

"With a toric implant, we take that unknown out of the equation. We are not counting on the cornea to react in the way we predict but rather using an optic, which is intraocular, to correct the astigmatism. Additionally, having the correction closer to the nodal point of the eye typically improves the visual quality. Another inherent problem with the LRI is the risk of perforation and with that increased risk of infection," she said.

Preliminary results: LRI vs. toric IOL

Dr. Fakadej was part of a team that conducted the first prospective, randomized, contralateral eye study comparing the AcrySof IQ Toric IOL (Alcon, Fort Worth, Texas) with an LRI incision with an AcrySof IQ IOL on 69 patients scheduled to undergo phacoemulsification. Mean age was sive [VISCOAT OVD, sodium chondroitin sulfate, sodium hyaluronate] at the beginning of the case to protect the endothelium but then switching to a cohesive [ProVisc OVD, sodium hyaluronate] to inflate the capsular bag and maintain space for IOL implantation is ideal. ProVisc is easy to remove after IOL implantation because it adheres to itself and is aspirated quickly."

Enhanced satisfaction

Patients are satisfied with the excellent visual performance of the AcrySof IQ IOL, from performing various everyday activities to the most challenging tasks such as driving under mesopic conditions. The IOL delivers improved contrast sensitivity in low light situations and improved image quality due to the amount of spherical aberration corrected. There have been 55 million AcrySof IOLs implanted since its introduction, and the consistency,



Filtering both UV and high energy blue light, the proprietary AcrySof IOL chromophore more closely approximates the light transmission of a human lens

ease of implantation for the surgeon, and proven benefits for the patient in terms of increased visual performance have led to enhanced satisfaction. **Contact information Henderson:** 617-957-9279, bahenderson@eyeboston.com

67 years old; 68% were female. Preop corneal cylinder was limited to no more than 2.5 D, and patients in the toric arm received one of three lenses: the AcrySof IQ Toric T3, T4, or T5 IOL, depending upon pre-op cylinder. (Those in the LRI arm received a monofocal AcrySof IQ IOL and LRI). The study will follow patients for 6 months; Dr. Fakadej discussed the preliminary 1-month results.

"Most of the patients had very symmetric corneal astigmatism between both eyes," she said. "The approach to correct astigmatism was randomly chosen for the first eye and the other procedure was performed on the second eve. We found a reduction in the post-operative refractive astigmatism in most patients. However, we found that the post-op refractive astigmatism was reduced more consistently with the toric IOL. We found that post-operative uncorrected and corrected visual acuity was better with the toric IOL than the LRI by at least one but more often greater than two lines." (See Figure 1.)

She added the preliminary results in this study are mimicking those found outside the U.S. and expects that trend to continue once the 3- and 6-month evaluations are completed.

Precision counts

In general, Dr. Fakadej said LRIs are reliable "if performed by the same surgeons with the same nomograms, but for increasing amounts of corneal astigmatism, the LRI becomes less reliable." A general rule of thumb, she suggested, is to use LRIs on patients who have less than 1.00 D of astigmatism.

"You can get good outcomes with LRIs in cases of residual astigmatism." Additionally, patients who have previously undergone refractive surgery may be problematic with either LRIs or toric implants, Dr. Fakadej said. "Another comorbidity that might look like regular corneal astigmatism is anterior basement membrane dystrophy. Those patients can be tricky, but they can be treated with other methods."

She also advised ensuring "anything that's cornea-based" such as dry eye or Fuchs' dystrophy be addressed clinically before implanting a toric lens or opting for LRIs.

Dr. Fakadej has implanted "about 800 eyes" with the toric lens and offered some additional pearls.

"If you have the luxury of marking the cornea at the slit lamp in an upright position, that's my personal preference," she said. "There are corneal marking instruments that can help orient the toric lens to the 3 and 9 o'clock position." Intraoperatively, she recommends leaving the toric lens "a little counterclockwise of the marking." During viscoelastic removal, keep the I/A tip on the lens to prevent its "quivering" and use the hook to settle it into place after all the visco is removed. Her viscoelastic of choice is ProVisc (sodium hyaluronate, Alcon) for the entire operation except in cases of floppy iris or corneal endothelial disease where she'll opt for DuoVisc OVD (Alcon) instead.

Reference

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