Ophthalmology Times®

CUTTING-EDGE ADVANCEMENTS

July 15, 2018 VOL. 43, NO.12

CLINICAL DIAGNOSIS | SURGERY | DRUG THERAPY

Special Report

UNDERSTANDING VISUAL QUALITY

Why timing is

storing vision in patients with glaucoma. "All available medical and surgical treatments for glaucoma target IOP, but while IOP is a risk factor for glaucoma, the underlying disease is an optic neuropathy characterized by loss of RGCs," according to Jeffrey L. Goldberg, MD, PhD.

*(See story on page 12 : **RGC therapy**)*

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growth factor (VEGF) treatment has undoubtedly revolutionized how ophthalmologists manage patients with wet age-related macular degeneration (AMD). Unfortunately, after more than a decade of the current anti-VEGF monotherapy treatment paradigm, we have plateaued.

Why have we leveled out? More importantly, how do we break through the plateau? It's simple: Detect wet AMD earlier, before patients lose several lines of vision. As physicians, we intuitively know that patients have better outcomes if we detect disease

trials, have demonstrated that lesion size and visual acuity at the time of wet AMD diagnosis are two of the best predictors of visual outcomes following anti-VEGF treatments.[1,2]

Given what we know and what has been studied, early detection of wet AMD is an urgent matter that requires our focus. Our goal should not be the number of letters gained. Our goal should be maintaining functional vision in a higher proportion of our patients. Gaining 2 or 3 lines is irrelevant

*(Continues on page 14 : **Timing**)*

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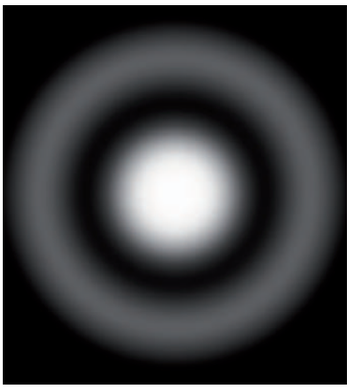
Special Report

UNDERSTANDING VISUAL QUALITY COMPLAINTS



With modern presbyopia-correcting IOLs, patients are generally happy with their quality of vision after surgery. Nevertheless, some patients are unhappy even with Snellen visual acuity of 20/20 or better. Understanding what makes these patients dissatisfied even with good Snellen visual is important for their proper management, explains Daniel H. Chang, MD.

*(See story on page 29 : **20/20 complaints**)*

Surgery

RGC THERAPY ONE STEP CLOSER TO GLAUCOMA GOAL

Progress occurring on several fronts is creating optimism that retinal ganglion cell (RGC) replacement may become a reality for preserving or restoring vision in patients with glaucoma. "All available medical and surgical treatments for glaucoma target IOP, but while IOP is a risk factor for glaucoma, the underlying disease is an optic neuropathy characterized by loss of RGCs," according to Jeffrey L. Goldberg, MD, PhD.

*(See story on page 12 : **RGC therapy**)*

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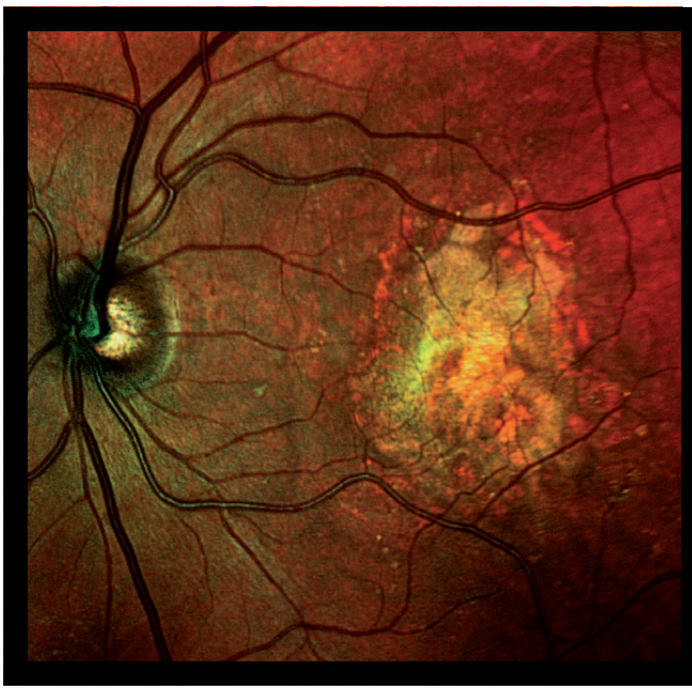
Why timing is everything in AMD

Surgeons' goal should be maintaining functional vision in a higher proportion of patients



IN VIEW: Detect wet AMD earlier, before patients lose several lines of vision. The longer the disease goes undetected and undiagnosed, the larger the lesion will be and that more letters will be lost. *(Image courtesy of Heidelberg Engineering)*

By Allen C. Ho, MD
Special to Ophthalmology Times

ANTI-VASCULAR ENDOTHELIAL growth factor (VEGF) treatment has undoubtedly revolutionized how ophthalmologists manage patients with wet age-related macular degeneration (AMD). Unfortunately, after more than a decade of the current anti-VEGF monotherapy treatment paradigm, we have plateaued.

Why have we leveled out? More importantly, how do we break through the plateau? It's simple: Detect wet AMD earlier, before patients lose several lines of vision. As physicians, we intuitively know that patients have better outcomes if we detect disease in its earliest stages. We know that the longer the disease goes undetected and undiagnosed, the larger the lesion will be and that more letters will be lost.

Multiple studies, including randomized clinical trials, have demonstrated that lesion size and visual acuity at the time of wet AMD diagnosis are two of the best predictors of visual outcomes following anti-VEGF treatments.[1,2]

Given what we know and what has been studied, early detection of wet AMD is an urgent matter that requires our focus. Our goal should not be the number of letters gained. Our goal should be maintaining functional vision in a higher proportion of our patients. Gaining 2 or 3 lines is irrelevant

*(Continues on page 14 : **Timing**)*

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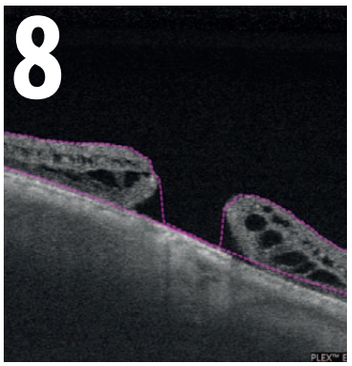

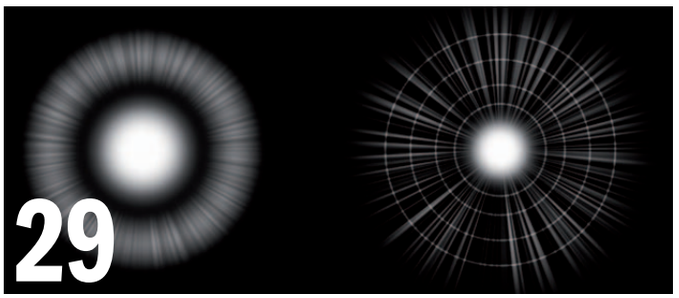

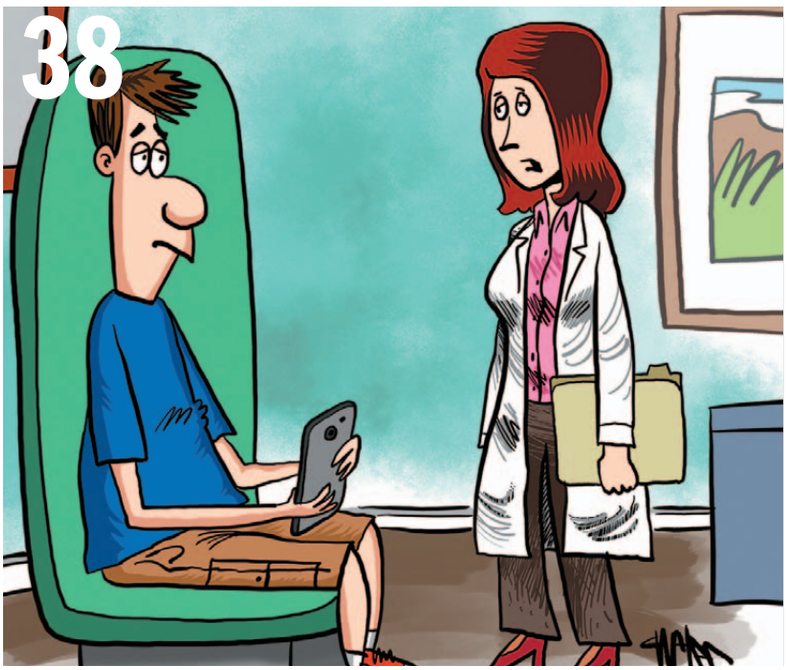

Surgery

Clinical Diagnosis

Special Report

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A fresh set of eyes

An outsider's view of the ophthalmology certification examination

By James Lifton, MBA

THIS PAST JUNE I was invited to observe the oral certification examination being administered by the American Board of Ophthalmology to more than 300 ophthalmologists. The experience gave me a deeper appreciation for what physicians have to do in order to become board certified. And, as a public (non-physician) member of the American Board of Medical Specialties, I feel better equipped to discuss issues related to physician certification.

I learned that the path to certification in ophthalmology is similar to the process used by several other specialty boards: a computer-based qualification examination followed by the oral certification exam.

The oral certification examination lasted three hours. Examinees were assigned to panels of six, along with six examiners and a panel leader. Over three hours examinees rotated through six stations, each covering a different area of ophthalmology (glaucoma, neuro-ophthalmology, pediatrics, and so forth), and each with a different examiner. Following the session, examiners and the panel leader met to discuss the physicians that they had just examined. The certification decision is based on input from these panels.

Administering the oral examination is no small undertaking, even after the patient management problems have been written, field-tested, and formatted for the exam. It involved 150 physician examiners, some mentoring first-time examiners, as well as the panel leaders and physicians who provided orientation and training.

Dr. George Bartley, Chief Executive Officer of the American Board of Ophthalmology (ABO) as well as a practicing ophthalmologist, was my host. During one of our conversations he commented that from time to time, ABO leadership reconsiders whether or not the oral exam is worthwhile, as administering it is expensive and the costs fall to ophthalmologists who typically are not yet financially established. In light of my experience, I believe it is.

WHY ADMINISTER AN ORAL EXAM?

An obvious reason is that it tests different things than the computer-based multiple choice examination. The qualifying exam requires ophthalmologists to demonstrate that they have the knowledge at their disposal—sometimes called "walking around knowledge"—necessary to practice independently. The oral examination requires ophthalmologists to exercise judgement in applying that knowledge to a variety of patients and conditions.

A MODEL OF PROFESSIONALISM

In addition to assessing a physician's judgement and underlying knowledge, I believe the oral examination has three benefits.

First, the panel meeting following each exam session provides an opportunity to discuss physicians who didn't clearly pass or fail the oral exam. No matter how an examination is structured, there will always be candidates who fall in this category. Having a process to evaluate these physicians, using a dialog between seven practicing ophthalmologists, and especially just after interacting with the candidates, seems to me as reasonable and fair.

Second, the oral examination meeting provides physicians being examined an opportunity to meet new colleagues, and develop or nurture peer relationships.

Finally, and I believe most importantly, it offers a model of professionalism to ophthalmologists, most just beginning their careers. (In a recent Editorial, Dr. Peter McDonnell illustrated the importance of role models in acquiring knowledge.) The examiners volunteer their time and pay their own way to the exam site, where they welcome all candidates as peers. Physician examiners look and act like the professionals they are, and that their younger colleagues can aspire to become.

Physicians may feel themselves under pressure, faced with ever higher expectations, sometimes leading to "burnout" and its manifestations. Developing peer relationships and having role models can help physicians maintain their sense of professionalism and fulfillment in what they do. I believe that this benefits physicians, as well as those of us who rely on them for care. ■

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Xiidra® (lifitegrast ophthalmic solution) 5% is indicated for the treatment of signs and symptoms of dry eye disease (DED).

Important Safety Information

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In clinical trials, the most common adverse reactions reported in 5-25% of patients were instillation site irritation, dysgeusia and reduced visual acuity. Other adverse reactions reported in 1% to 5% of the patients were blurred vision, conjunctival hyperemia, eye irritation, headache, increased lacrimation, eye discharge, eye discomfort, eye pruritus and sinusitis.

To avoid the potential for eye injury or contamination of the solution, patients should not touch the tip of the single-use container to their eye or to any surface.

Contact lenses should be removed prior to the administration of Xiidra and may be reinserted 15 minutes following administration.

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DOSAGE AND ADMINISTRATION
Instill one drop of Xiidra twice daily (approximately 12 hours apart) into each eye using a single-use container. Discard the single-use container immediately after using in each eye. Contact lenses should be removed prior to the administration of Xiidra and may be reinserted 15 minutes following administration.

CONTRAINDICATIONS
Xiidra is contraindicated in patients with known hypersensitivity to lifitegrast or to any of the other ingredients in the formulation.

ADVERSE REACTIONS
Clinical Trials Experience
Because clinical studies are conducted under widely varying conditions, adverse reaction rates observed in clinical studies of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice. In five clinical studies of dry eye disease conducted with lifitegrast ophthalmic solution, 1401 patients received at least 1 dose of lifitegrast (1287 of which received lifitegrast 5%). The majority of patients (84%) had ≤3 months of treatment exposure. 170 patients were exposed to lifitegrast for approximately 12 months. The majority of the treated patients were female (77%). The most common adverse reactions reported in 5-25 % of patients were instillation site irritation, dysgeusia and reduced visual acuity. Other adverse reactions reported in 1% to 5% of the patients were blurred vision, conjunctival hyperemia, eye irritation, headache, increased lacrimation, eye discharge, eye discomfort, eye pruritus and sinusitis.

Postmarketing Experience
The following adverse reactions have been identified during postapproval use of Xiidra. Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to reliably estimate their frequency or establish a causal relationship to drug exposure.

Rare cases of hypersensitivity, including anaphylactic reaction, bronchospasm, respiratory distress, pharyngeal edema, swollen tongue, and urticaria have been reported. Eye swelling and rash have been reported.

USE IN SPECIFIC POPULATIONS
Pregnancy
There are no available data on Xiidra use in pregnant women to inform any drug associated risks. Intravenous (IV) administration of lifitegrast to pregnant rats, from pre-mating through gestation day 17, did not produce teratogenicity at clinically relevant systemic exposures. Intravenous administration of lifitegrast to pregnant rabbits during organogenesis produced an increased incidence of omphalocele at the lowest dose tested, 3 mg/kg/day (400-fold the human plasma exposure at the recommended human ophthalmic dose [RHOD], based on the area under the curve [AUC] level). Since human systemic exposure to lifitegrast following ocular administration of Xiidra at the RHOD is low, the applicability of animal findings to the risk of Xiidra use in humans during pregnancy is unclear.

Animal Data
Lifitegrast administered daily by intravenous (IV) injection to rats, from pre-mating through gestation day 17, caused an increase in mean preimplantation loss and an increased incidence of several minor skeletal anomalies at 30 mg /kg / day, representing 5,400-fold the human plasma exposure at the RHOD of Xiidra, based on AUC. No teratogenicity was observed in the rat at 10 mg /kg /day (460-fold the human plasma exposure at the RHOD, based on AUC). In the rabbit, an increased incidence of omphalocele was observed at the lowest dose tested, 3 mg /kg /day (400-fold the human plasma exposure at the RHOD, based on AUC), when administered by IV injection daily from gestation days 7 through 19. A fetal No Observed Adverse Effect Level (NOAEL) was not identified in the rabbit.

Lactation
There are no data on the presence of lifitegrast in human milk, the effects on the breastfed infant, or the effects on milk production. However, systemic exposure to lifitegrast from ocular administration is low. The developmental and health benefits of breastfeeding should be considered, along with the mother's clinical need for Xiidra and any potential adverse effects on the breastfed child from Xiidra.

Pediatric Use
Safety and efficacy in pediatric patients below the age of 17 years have not been established.

Geriatric Use
No overall differences in safety or effectiveness have been observed between elderly and younger adult patients.

NONCLINICAL TOXICOLOGY
Carcinogenesis, Mutagenesis, Impairment of Fertility
Carcinogenesis: Animal studies have not been conducted to determine the carcinogenic potential of lifitegrast.
Mutagenesis: Lifitegrast was not mutagenic in the *in vitro* Ames assay. Lifitegrast was not clastogenic in the *in vivo* mouse micronucleus assay. In an *in vitro* chromosomal aberration assay using mammalian cells (Chinese hamster ovary cells), lifitegrast was positive at the highest concentration tested, without metabolic activation.
Impairment of fertility: Lifitegrast administered at intravenous (IV) doses of up to 30 mg/kg/day (5400-fold the human plasma exposure at the recommended human ophthalmic dose (RHOD) of lifitegrast ophthalmic solution, 5%) had no effect on fertility and reproductive performance in male and female treated rats.

Shire

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When and how to treat myopic traction maculopathy

ILM peeling and flap techniques may improve MH closure rates

By Linda Charters, MD; *Reviewed by Hiroko Terasaki, MD*

MYOPIC TRACTION maculopa (MTM) and macular hole retinal detachments (MHRDs) are complex scenarios that demand accurate diagnoses and high surgical expertise. Internal limiting membrane (ILM) peeling and foveal-sparing ILM flap techniques are showing improved macular hole (MH) closure rates in difficult cases.

These pathologies fall into four categories, each of which requires a different treatment approach, according to Hiroko Terasaki, MD.

The first three categories—schisis only, schisis and retinal detachment, and full-thickness macular hole (FTMH)—are the prodromal stages of MHRDs, the fourth category, said Dr. Terasaki, who is chairman and professor, Department of Ophthalmology, Nagoya University, Graduate School of Medicine, Nagoya, Japan.

SIMPLE SCHISIS, SCHISIS, AND RETINAL DETACHMENT

In eyes with schisis without a foveal detachment—i.e., schisis only—total ILM peeling is performed. At first, the posterior vitreous membrane and residual vitreous cortex are removed. Triamcinolone is injected again and the ILM is peeled gently.

"Correct diagnosis is the important factor," said Dr. Terasaki, describing an eye that had more than just simple schisis. Those eyes should be included in the group with foveal retinal detachments, which are seen clearly on swept-source optical coherence tomography (SS-OCT).

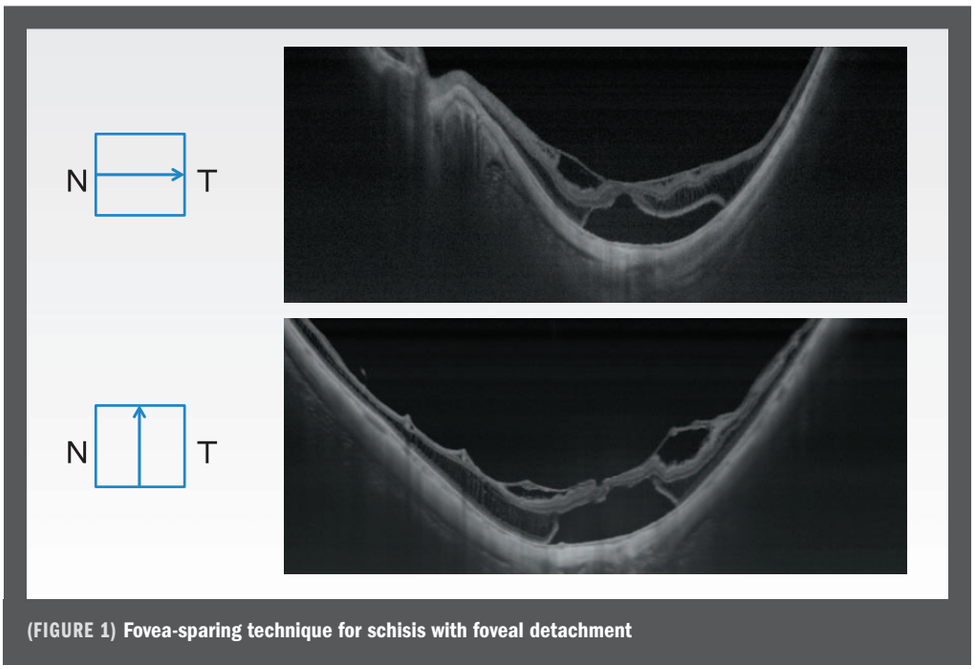
When considering these more complicated eyes, previous studies have reported that MHs develop in about 10% of eyes after total ILM peeling.

Interestingly, macular holes have been reported much less often or do not develop after ILM peeling that spared the fovea to treat myopic schisis, Dr. Terasaki noted.

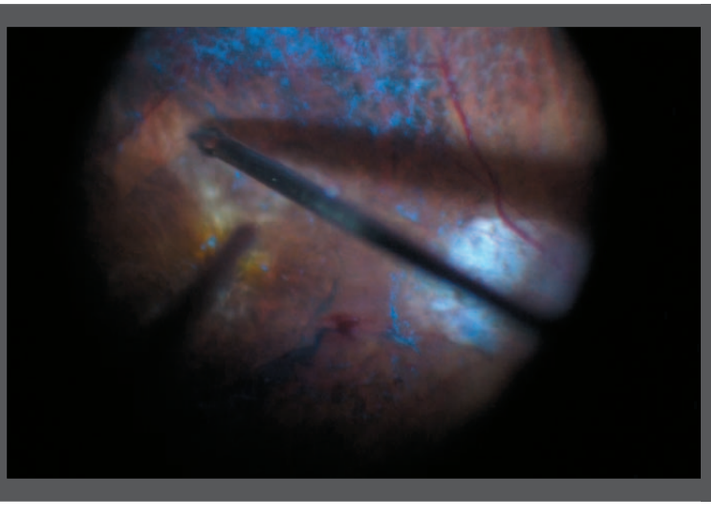
Even in eyes with schisis only, schisis with a deep pseudohole, i.e., schisis shaped like a champagne flute, would be an indication for this method.

CASE STUDY

She described the case of a 76-year-old man with myopic schisis with foveal detachments bilaterally who was treated with a foveal-sparing technique. In the right eye, the posterior hyaloid membrane, which resembles an ILM, was totally peeled. Triamcinolone was again injected and the ILM was peeled toward the edge of the fovea.



(FIGURE 1) Fovea-sparing technique for schisis with foveal detachment



(FIGURE 2) After peeling the posterior vitreous cortex, ILM was stained with BBG. Using ILM forceps, ILM was peeled toward the edge of the fovea. The flickering ILM was trimmed with a vitreous cutter. ILM was further peeled up to just before the edge of fovea and further trimmed.

During the trimming procedure of this peeled ILM, Dr. Terasaki advised that the port of the cutter should always face in the direction opposite to the fovea.

In this case, Brilliant Blue dye (BBD) was used to identify the ILM more clearly during trimming. An OCT scan performed intraop-

eratively showed the area of attachment of the trimmed ILM. In this case of one eye, the ILM was visible for at least 4 months postoperatively. She noted that an unpeeled ILM can become an epiretinal membrane (ERM).

In the second eye of this patient, after the posterior vitreous cortex was peeled, the ILM was stained with BBD. ILM forceps were used to peel the ILM toward the edge of the fovea. The flapping ILM was trimmed using the vitreous cutter, after which the ILM was peeled further up to immediately before the edge of the fovea to prevent postoperative ERM, Dr. Terasaki noted.

Use of OCT intraoperatively has an important function in cases such as these.

"Intraoperative OCT showed how close the ILM was peeled to the fovea," Dr. Terasaki said.

She demonstrated on spectral-domain OCT and SS-OCT images that the minute remnant of the ILM became invisible shortly after surgery in this eye.

FULL-THICKNESS MACULAR HOLE

The third prodromal stage under discussion is that of eyes with FTMHs with and without schisis. In a study of highly myopic macular holes conducted at Nagoya University, two (6%) of 33 eyes failed to achieve closure of the macular holes after total peeling of the ILM. These holes were larger than 500 µm in the minimal diameter, Dr. Terasaki noted.

"The ILM flap technique has been recommended for large MHs," she said. "The macular hole closure rates have been generally good even in eyes with a long axial length."

TAKE-HOME

- ***Learn how peeling of the internal limiting membrane (ILM) and foveal-sparing ILM flap techniques are showing improved macular hole closure rates in difficult cases. Hiroko Terasaki, MD, shares some surgical pearls.***

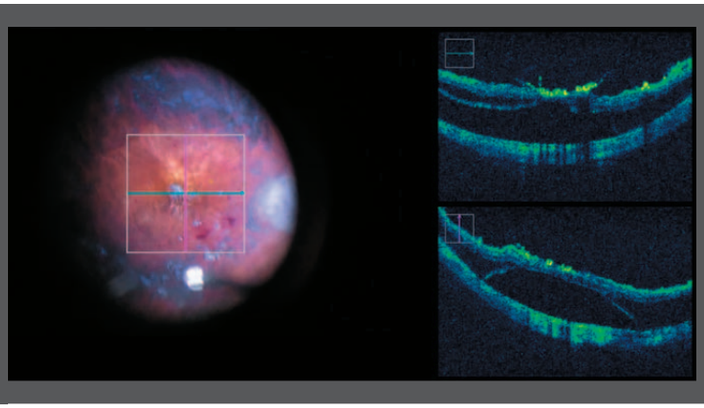
She described the case of a 69-year-old woman with a high myopic MH with a minimal diameter of 627 µm. The inverted ILM flap technique to treat the MH was performed after the patient had undergone a previous failed vitrectomy. The ILM remained in the eye.

In the surgery under discussion, the ILM was peeled toward the edge of the MH, folded over, and slid into the edge of the MH using a diamond-dusted eraser. OCT images obtained intraoperatively showed the multi-layered ILM plugging the MH.

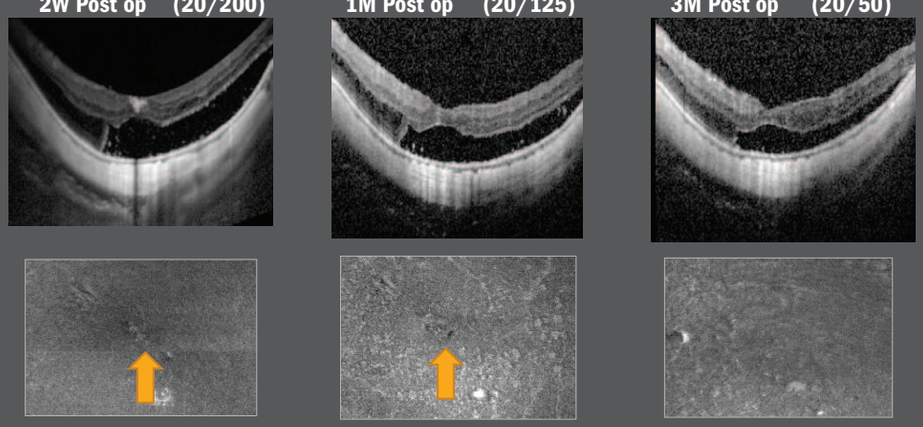
The technique used in this surgery was the classic multi-layered flap technique. However,

Continues on page 10 : ***ILM peeling***

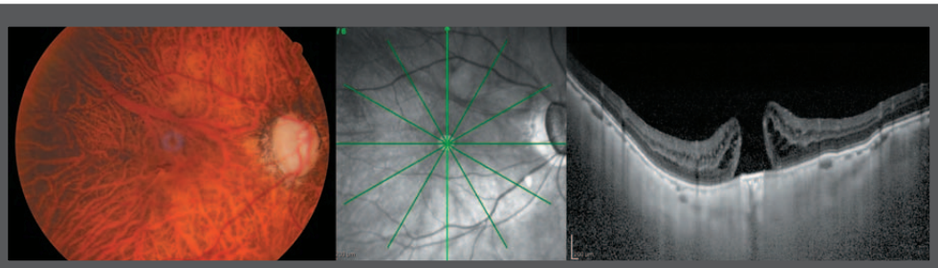
> 'The macular hole closure rates have been generally good even in eyes with a long axial length.' *– Hiroko Terasaki, MD*



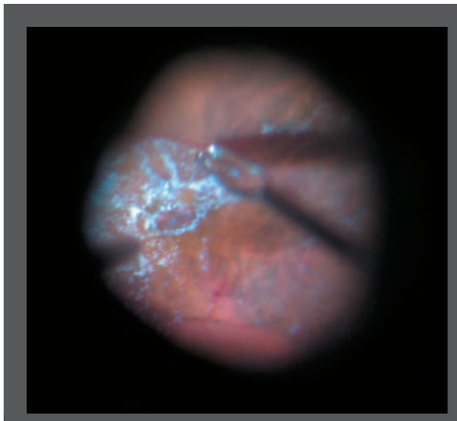
(FIGURE 3) Intraoperative OCT shows how close ILM was peeled toward the fovea.



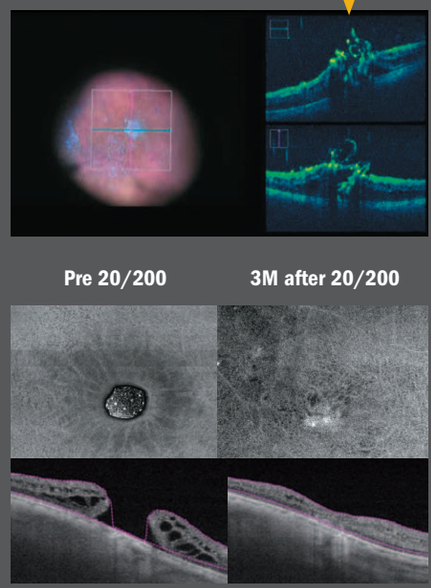
(FIGURE 4) The remaining small ILM became invisible early after surgery.



(FIGURE 5) This patient had been referred after the first vitrectomy.



(FIGURE 6) Even after the surgery, ILM remained. After peeling ILM toward the edge of MH, ILM is folded over and slid in the edge of MH using a diamond-dusted scraper without pushing toward the bottom.



(FIGURE 7) Intraoperative OCT shows the multi-layered ILM plugging MH. *(Photos courtesy of Hiroko Terasaki, MD)*

ILM PEELING

(Continued from page 9)

other techniques exist, such as the single-layer technique, which is not performed for myopia. For large myopic MHs, gentle insertion is recommended.

MACULAR HOLE RETINAL DETACHMENTS

The reported MH closure rates are low in these eyes following vitrectomy.

In light of this, Dr. Terasaki noted that the ILM flap technique has been recommended for all eyes with a MHRD. A 74-year-old woman with MHRD underwent vitrectomy and ILM peeling.

After the ILM was peeled to the edge of the MH and trimmed, the inverted ILM flap insertion technique was performed in which the ILM was inserted into the macular hole. Intraocular OCT showed that the ILM was in the macular hole. Autologous neurosensory retinal free flap method has been reported recently to close a refractory MH in a 69-year-old woman who had undergone two previous retinal detachment surgeries in failed attempts to close the MH. During surgery, a retinal free flap was translocated from the periphery of the retina. The postoperative findings indicated that the macular hole was closed using the retinal flap from the periphery.

"Although this may work to prevent recurrence of the macular hole, the effect on the visual function has yet to be determined," Dr. Terasaki said. ■

HIROKO TERASAKI, MD

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This article was adapted from Dr. Terasaki's presentation during Retina Subspecialty Day at the 2017 meeting of the American Academy of Ophthalmology. Dr. Terasaki reported a financial interest in Carl Zeiss Meditec.

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OMIDRIA® is the first and only FDA-approved drug that provides continuous intracameral delivery of NSAID and mydriatic/anti-miotic therapy during cataract surgery[1]

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INDICATIONS AND USAGE

OMIDRIA® (phenylephrine and ketorolac intraocular solution) 1% / 0.3% is added to ophthalmic irrigating solution used during cataract surgery or intraocular lens replacement and is indicated for maintaining pupil size by preventing intraoperative miosis and reducing postoperative ocular pain.

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OMIDRIA must be added to irrigating solution prior to intraocular use.

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Systemic exposure of phenylephrine may cause elevations in blood pressure.

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The most commonly reported adverse reactions at ≥2% are eye irritation, posterior capsule opacification, increased intraocular pressure, and anterior chamber inflammation.

Please see the Full Prescribing Information for OMIDRIA at www.omidria.com/prescribinginformation.

You are encouraged to report Suspected Adverse Reactions to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

Reference: 1. OMIDRIA [package insert]. Seattle, WA: Omeros Corporation; 2017.

Visit www.omidria.com

Omeros does not guarantee reimbursement by any third-party payer. To be eligible for the "Equal Access" Patient Assistance Program, patients must be enrolled in OMIDRIAssure prior to surgery. For any patient for whom your facility received a free vial through the "Equal Access" Patient Assistance Program, the patient's insurance carrier(s) should not be billed for OMIDRIA. OMIDRIAssure program services are subject to change without notice.

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1% / 0.3%

OMEROS®

Neuroregeneration being pursued as ultimate goal for glaucoma therapy

To focus on IOP, the underlying optic nerve could be treated with an innovative RGC therapy

By Cheryl Guttman Krader; *Reviewed by Jeffrey L. Goldberg, MD*

PROGRESS OCCURRING on several fronts is creating optimism that retinal ganglion cell (RGC) replacement may become a reality for preserving or restoring vision in patients with glaucoma, according to Jeffrey L. Goldberg, MD, PhD.

"All available medical and surgical treatments for glaucoma target IOP, but while IOP is a risk factor for glaucoma, the underlying disease is an optic neuropathy characterized by loss of RGCs," said Dr. Goldberg, Professor and Chair, Byers Eye Institute, Stanford University, Palo Alto, CA.


Dr. Goldberg

"The real hope for advancing glaucoma care in the future is to discover therapies that target the RGCs to stave off or even restore the vision loss that can be so profound with this disease. We have encouraging evidence supporting the potential for RGC therapies, but there are many questions yet to be answered and much work needs to be done."

Important advances are occurring both in basic research and in clinical trials. Among the developments taking place in the laboratory, there has been progress delineating molecular pathways for generating RGC-like cells from human stem cells.

Dr. Goldberg noted that results from previous research in animal models demonstrated that RGC cells delivered into the vitreous migrated to and integrated into the retina and then grew lengthy axons projecting down the optic nerve and extending to the brain. However, a low rate of RGC differentiation from progenitor or stem cells in vitro limited further development of RGC cell therapy.

TAKE-HOME

- ***Evidence supports the use of retinal ganglion cell (RGC) therapy to stave off or restore vision loss in glaucoma patients. RGC biomarker research is an important step toward future therapy.***

RGC IMPACT

"The signaling pathways that make photoreceptors out of stem cells or retinal progenitor cells have been understood for a long time, but it has been more challenging to define the pathway for specifying RGC fate," Dr. Goldberg told *Ophthalmology Times*.

To solve this problem, Dr. Goldberg and colleagues undertook a screen of developmentally expressed transcription factors. In their work, they discovered that a molecular pathway involving Sox4/Sox11 was required for RGC differentiation and optic nerve formation in mice in vivo and was sufficient for promoting differentiation of human induced pluripotent cells and human embryonic stem cells into RGC-like cells in culture [Chang KC, et al. *J Neurosci*. 2017;37(19):4967-4981].

"The induced cells are structurally and functionally similar to endogenous RGCs. Not only do they look like RGCs and express protein markers typically expressed by the RGCs, but they also mimic RGCs in terms of electrophysiologic activity," Dr. Goldberg said.

BIOMARKERS

Research developing new biomarkers as study endpoints is also progressing and is important and exciting because of its implications for facilitating the process of candidate discovery and decreasing the time needed to demonstrate efficacy.

"By using these biomarkers, we can test new candidates for neuroprotection and vision restoration in a shorter time frame, and that should help us to accelerate investigations towards finding new treatments for glaucoma," Dr. Goldberg said.

The new biomarkers include new imaging modalities being developed in the laboratory of Alfredo Dubra, PhD, Associate Professor of Ophthalmology, Stanford University School of Medicine.

"Dr. Dubra and colleagues are creating new adaptive optics-based imaging modalities that are providing very high resolution measurements of RGCs, their axons, and even the subcellular elements inside the axons that we think will give us insight on the mitochondrial health of the cells," said Dr. Goldberg.

"With this noninvasive modality, we will be able to determine with confidence whether investigational agents are having biologic effects in early phase clinical testing," Dr. Goldberg said.

CLINICAL TRIALS UNDERWAY

Promising candidates for neuroprotection in glaucoma that target RGC viability are being investigated in clinical trials. Two studies are underway at Stanford University, and Dr. Goldberg is the principal investigator for the trials.

Topical treatment with recombinant human nerve growth factor (Dompé Farmaceutici) is being evaluated in a Phase 1 single center, double-masked, placebo-controlled study is being conducted at Stanford and includes 60 patients with primary open angle glaucoma. Eligible patients had progressive disease despite maximal therapy or stable IOP but diminished vision. The trial has a 32-week duration.

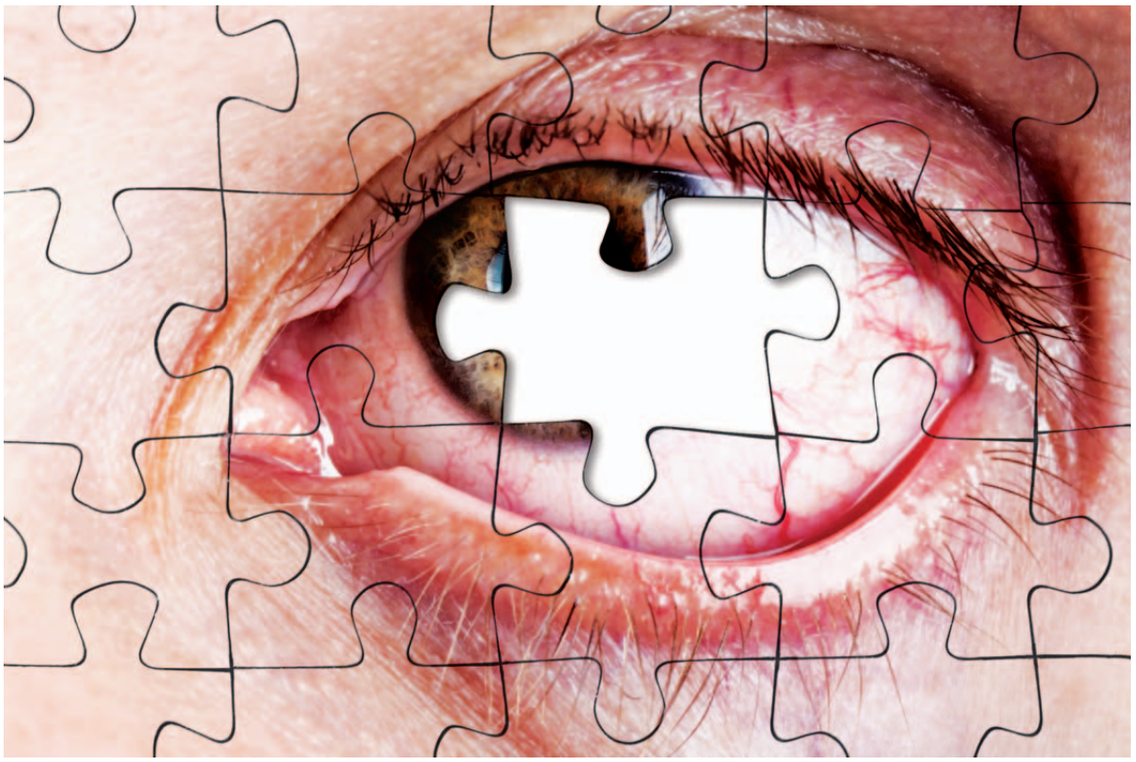
Stanford is also participating in a phase 2 multicenter, single-masked randomized trial of NT-501 Encapsulated Cell Therapy (Neurotech), an intravitreal device that secretes ciliary neurotrophic factor (CNTF). Other participating sites are Glaucoma Associates of Texas, Dallas, Columbia University, NY, and New York University, NY.

Enrolled patients received NT-501 or underwent sham surgery. The primary outcome analysis will be performed at 6 months and follow-up will continue to 2 years. ■

JEFFREY L. GOLDBERG, MD, PHD

This article is based on a presentation given by Dr. Goldberg at the 2017 Glaucoma Subspecialty Day meeting. Dr. Goldberg has no financial interests in the products discussed.

MANAGING BIOBURDEN



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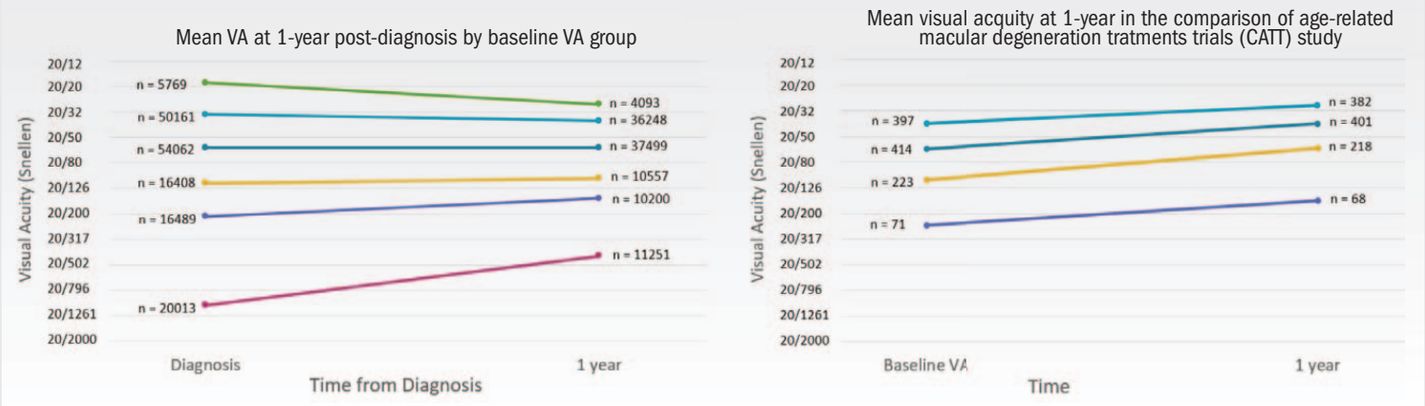


(FIGURE 1) IRIS® registry results correlate with those seen in CATT: patients with better VA at diagnosis had better VA at 1-year.

TIMING

(Continued from page 1)

if the patient is still unable to have functional independence-the ability to drive, read, watch television, see their grandkids-because this is the outcome that matters most to our patients.

WHAT THE NUMBERS TELL US

Decreasing the time between onset of disease and initiating anti-VEGF treatment is the key to improving outcomes and maintaining functional vision. However, the reality is that too many patients are diagnosed late with poor baseline vision.

One analysis suggested that patients have wet AMD for 7.7 months prior to being treated with anti-VEGF monotherapy.[3] The negative impact to visual acuity is devastating. Additionally. real-world data and clinical trials showed us that few newly diagnosed eyes were detected when visual acuity was 20/40 or better.

The AAO IRIS Registry (Intelligent Research in Sight) retrospective cohort study of more than 150,000 patients with neovascular AMD included nearly five years of data (January 2013 to June 2017). The study included eyes with a diagnosis of wet AMD (as designated by the first anti-VEGF injection) and a second anti-VEGF intravitreal injection in the study eye less than 45 days from the first. Eyes receiving anti-VEGF injections prior to the diagnosis of wet AMD were excluded.

TAKE-HOME

- ***Decreasing time between diseas onset and treatment is key to maintaining funcitonal vision.***

The IRIS study reaffirms an alarming statistic-only a small percentage (34%) have vision of 20/40 or better when initiating anti-VEGF therapy.[4] The mean visual acuity at diagnosis was 20/83, far from functional. Even under the careful management of a treating physician, the second eye fared only slightly better with a mean visual acuity of 20/79. Intermediate AMD often escapes detection until functional vision is lost.

THE PHYSICIAN'S ROLE

Our current standard of care includes the Amsler grid, a self-administered and subjective vision

Continues on page 17 : ***Timing***

US private equity-backed firm buys Blink Medical US

SOLIHULL-HEADQUARTERED Blink Medical has been acquired by US-based private equity-backed Katena Products in a deal advised on by Castle Donington-based Cooper Parry Corporate Finance. Blink Medical is a supplier of single-use medical instruments in the ophthalmic surgical sector. Blink's product range has since expanded to include dermatology, ENT, cosmetic and plastic surgery.

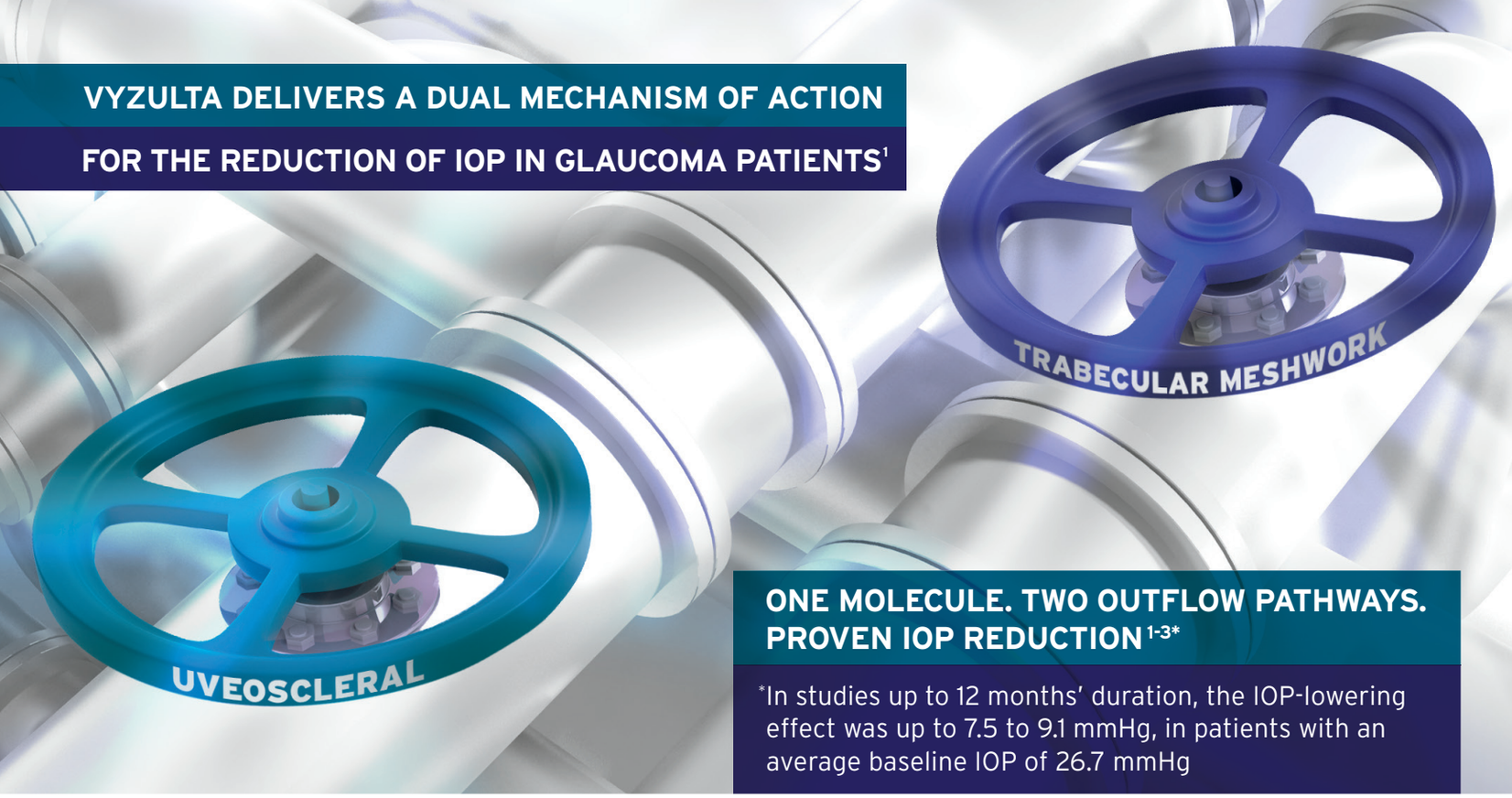
Supplying NHS hospitals and private hospital groups and independent clinics, Blink also export to more than 20 countries. The business has been snapped up by Katena, which makes ophthalmic products and operates in 110 countries, in its first UK acquisition.

Blink Medical founder and managing director Roger Tyler is to remain at the company. Sally Saunders of Cooper Parry Corporate Finance acted as the lead adviser to the shareholders of the Solihull company on the deal.

Tyler said: "The synergies created in the ophthalmic sector, by offering multiple instrument solutions to our customers will help both companies achieve their business objectives." Saunders added: "Medical Products is a sector that is generating a lot of interest.

"It was good to work with the investors in Katena, Audax Private Equity based in the US. "There remains to be a lot of money in private equity, and we're seeing more and more buy and build opportunities in the sector."

Katina chief executive Mark J Fletcher said: "The acquisition of Blink Medical strengthens and expands Katena's offering in high quality ophthalmic instrumentation. "Single-use instruments are important to our strategy and the addition of Blink also offers Katena the benefits of a physical presence in Europe." ■



VYZULTA DELIVERS A DUAL MECHANISM OF ACTION FOR THE REDUCTION OF IOP IN GLAUCOMA PATIENTS[1]

ONE MOLECULE. TWO OUTFLOW PATHWAYS. PROVEN IOP REDUCTION[1-3*]

*In studies up to 12 months' duration, the IOP-lowering effect was up to 7.5 to 9.1 mmHg, in patients with an average baseline IOP of 26.7 mmHg

INDICATION

VYZULTA™ (latanoprostene bunod ophthalmic solution), 0.024% is indicated for the reduction of intraocular pressure (IOP) in patients with open-angle glaucoma or ocular hypertension.

IMPORTANT SAFETY INFORMATION

- Increased pigmentation of the iris and periorbital tissue (eyelid) can occur. Iris pigmentation is likely to be permanent
- Gradual changes to eyelashes, including increased length, increased thickness, and number of eyelashes, may occur. These changes are usually reversible upon treatment discontinuation
- Use with caution in patients with a history of intraocular inflammation (iritis/uveitis). VYZULTA should generally not be used in patients with active intraocular inflammation
- Macular edema, including cystoid macular edema, has been reported during treatment with prostaglandin analogs. Use with caution in aphakic patients, in pseudophakic patients with a torn posterior lens capsule, or in patients with known risk factors for macular edema

IMPORTANT SAFETY INFORMATION (CONTINUED)

- There have been reports of bacterial keratitis associated with the use of multiple-dose containers of topical ophthalmic products that were inadvertently contaminated by patients
- Contact lenses should be removed prior to the administration of VYZULTA and may be reinserted 15 minutes after administration
- Most common ocular adverse reactions with incidence ≥2% are conjunctival hyperemia (6%), eye irritation (4%), eye pain (3%), and instillation site pain (2%)

For more information, please see Brief Summary of Prescribing Information on next page.

References:

1. VYZULTA Prescribing Information. Bausch & Lomb Incorporated. 2017.
2. Weinreb RN, Sforzolini BS, Vittitow J, Liebmann J. Latanoprostene bunod 0.024% versus timolol maleate 0.5% in subjects with open-angle glaucoma or ocular hypertension: the APOLLO study. *Ophthalmology*. 2016;123(5):965-973.
3. Medeiros FA, Martin KR, Peace J, Sforzolini BS, Vittitow JL, Weinreb RN. Comparison of latanoprostene bunod 0.024% and timolol maleate 0.5% in open-angle glaucoma or ocular hypertension: the LUNAR study. *Am J Ophthalmol*. 2016;168:250-259.

For more information about VYZULTA and how it works, visit vyzultanow.com

BAUSCH + LOMB

VYZULTA™
(latanoprostene bunod ophthalmic solution), 0.024%

BRIEF SUMMARY OF PRESCRIBING INFORMATION

This Brief Summary does not include all the information needed to use VYZULTA safely and effectively. See full Prescribing Information for VYZULTA.

VYZULTA™ (latanoprostene bunod ophthalmic solution), 0.024%, for topical ophthalmic use.

Initial U.S. Approval: 2017

1 INDICATIONS AND USAGE

VYZULTA™ (latanoprostene bunod ophthalmic solution) 0.024% is indicated for the reduction of intraocular pressure (IOP) in patients with open-angle glaucoma or ocular hypertension.

4 CONTRAINDICATIONS

None

5 WARNINGS AND PRECAUTIONS

5.1 Pigmentation

VYZULTA™ (latanoprostene bunod ophthalmic solution), 0.024% may cause changes to pigmented tissues. The most frequently reported changes with prostaglandin analogs have been increased pigmentation of the iris and periorbital tissue (eyelid).

Pigmentation is expected to increase as long as latanoprostene bunod ophthalmic solution is administered. The pigmentation change is due to increased melanin content in the melanocytes rather than to an increase in the number of melanocytes. After discontinuation of VYZULTA, pigmentation of the iris is likely to be permanent, while pigmentation of the periorbital tissue and eyelash changes are likely to be reversible in most patients. Patients who receive prostaglandin analogs, including VYZULTA, should be informed of the possibility of increased pigmentation, including permanent changes. The long-term effects of increased pigmentation are not known.

Iris color change may not be noticeable for several months to years. Typically, the brown pigmentation around the pupil spreads concentrically towards the periphery of the iris and the entire iris or parts of the iris become more brownish. Neither nevi nor freckles of the iris appear to be affected by treatment. While treatment with VYZULTA™ (latanoprostene bunod ophthalmic solution), 0.024% can be continued in patients who develop noticeably increased iris pigmentation, these patients should be examined regularly *[see Patient Counseling Information (17) in full Prescribing Information]*.

5.2 Eyelash Changes

VYZULTA may gradually change eyelashes and vellus hair in the treated eye. These changes include increased length, thickness, and the number of lashes or hairs. Eyelash changes are usually reversible upon discontinuation of treatment.

5.3 Intraocular Inflammation

VYZULTA should be used with caution in patients with a history of intraocular inflammation (iritis/uveitis) and should generally not be used in patients with active intraocular inflammation as it may exacerbate this condition.

5.4 Macular Edema

Macular edema, including cystoid macular edema, has been reported during treatment with prostaglandin analogs. VYZULTA should be used with caution in aphakic patients, in pseudophakic patients with a torn posterior lens capsule, or in patients with known risk factors for macular edema.

5.5 Bacterial Keratitis

There have been reports of bacterial keratitis associated with the use of multiple-dose containers of topical ophthalmic products. These containers had been inadvertently contaminated by patients who, in most cases, had a concurrent corneal disease or a disruption of the ocular epithelial surface.

5.6 Use with Contact Lens

Contact lenses should be removed prior to the administration of VYZULTA because this product contains benzalkonium chloride. Lenses may be reinserted 15 minutes after administration.

6 ADVERSE REACTIONS

The following adverse reactions are described in the Warnings and Precautions section: pigmentation (5.1), eyelash changes (5.2), intraocular inflammation (5.3), macular edema (5.4), bacterial keratitis (5.5), use with contact lens (5.6).

6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice.

VYZULTA was evaluated in 811 patients in 2 controlled clinical trials of up to 12 months duration. The most common ocular adverse reactions observed in patients treated with latanoprostene bunod were: conjunctival hyperemia (6%), eye irritation (4%), eye pain (3%), and instillation site pain (2%). Approximately 0.6% of patients discontinued therapy due to ocular adverse reactions including ocular hyperemia, conjunctival irritation, eye irritation, eye pain, conjunctival edema, vision blurred, punctate keratitis and foreign body sensation.

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Risk Summary

There are no available human data for the use of VYZULTA during pregnancy to inform any drug associated risks.

Latanoprostene bunod has caused miscarriages, abortion, and fetal harm in rabbits. Latanoprostene bunod was shown to be abortifacient and teratogenic when administered intravenously (IV) to pregnant rabbits at exposures ≥ 0.28 times the clinical dose. Doses ≥ 20 µg/kg/day (23 times the clinical dose) produced 100% embryofetal lethality. Structural abnormalities observed in rabbit fetuses included anomalies of the great vessels and aortic arch vessels, domed head, sternebral and vertebral skeletal anomalies, limb hyperextension and malrotation, abdominal distension and edema. Latanoprostene bunod was not teratogenic in the rat when administered IV at 150 mcg/kg/day (87 times the clinical dose) *[see Data]*.

The background risk of major birth defects and miscarriage for the indicated population is unknown. However, the background risk in the U.S. general population of major birth defects is 2 to 4%, and of miscarriage is 15 to 20%, of clinically recognized pregnancies.

Data

Animal Data

Embryofetal studies were conducted in pregnant rabbits administered latanoprostene bunod daily by intravenous injection on gestation days 7 through 19, to target the period of organogenesis. The doses administered ranged from 0.24 to 80 mcg/kg/day. Abortion occurred at doses ≥ 0.24 mcg/kg/day latanoprostene bunod (0.28 times the clinical dose, on a body surface area basis, assuming 100% absorption). Embryofetal lethality (resorption) was increased in latanoprostene bunod treatment groups, as evidenced by increases in early resorptions at doses ≥ 0.24 mcg/kg/day and late resorptions at doses ≥ 6 mcg/kg/day (approximately 7 times the clinical dose). No fetuses survived in any rabbit pregnancy at doses of 20 mcg/kg/day (23 times the clinical dose) or greater. Latanoprostene bunod produced structural abnormalities at doses ≥ 0.24 mcg/kg/day (0.28 times the clinical dose). Malformations included anomalies of sternum, coarctation of the aorta with pulmonary trunk dilation, retroesophageal subclavian artery with absent brachiocephalic artery, domed head, forepaw hyperextension and hindlimb malrotation, abdominal distention/edema, and missing/fused caudal vertebrae.

An embryofetal study was conducted in pregnant rats administered latanoprostene bunod daily by intravenous injection on gestation days 7 through 17, to target the period of organogenesis. The doses administered ranged from 150 to 1500 mcg/kg/day. Maternal toxicity was produced at 1500 mcg/kg/day (870 times the clinical dose, on a body surface area basis, assuming 100% absorption), as evidenced by reduced maternal weight gain. Embryofetal lethality (resorption and fetal death) and structural anomalies were produced at doses ≥ 300 mcg/kg/day (174 times the clinical dose). Malformations included anomalies of the sternum, domed head, forepaw hyperextension and hindlimb malrotation, vertebral anomalies and delayed ossification of distal limb bones. A no observed adverse effect level (NOAEL) was established at 150 mcg/kg/day (87 times the clinical dose) in this study.

8.2 Lactation

Risk Summary

There are no data on the presence of VYZULTA in human milk, the effects on the breastfed infant, or the effects on milk production. The developmental and health benefits of breastfeeding should be considered, along with the mother's clinical need for VYZULTA, and any potential adverse effects on the breastfed infant from VYZULTA.

8.4 Pediatric Use

Use in pediatric patients aged 16 years and younger is not recommended because of potential safety concerns related to increased pigmentation following long-term chronic use.

8.5 Geriatric Use

No overall clinical differences in safety or effectiveness have been observed between elderly and other adult patients.

13 NONCLINICAL TOXICOLOGY

13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

Latanoprostene bunod was not mutagenic in bacteria and did not induce micronuclei formation in the *in vivo* rat bone marrow micronucleus assay. Chromosomal aberrations were observed *in vitro* with human lymphocytes in the absence of metabolic activation.

Latanoprostene bunod has not been tested for carcinogenic activity in long-term animal studies. Latanoprost acid is a main metabolite of latanoprostene bunod. Exposure of rats and mice to latanoprost acid, resulting from oral dosing with latanoprost in lifetime rodent bioassays, was not carcinogenic.

Fertility studies have not been conducted with latanoprostene bunod. The potential to impact fertility can be partially characterized by exposure to latanoprost acid, a common metabolite of both latanoprostene bunod and latanoprost. Latanoprost acid has not been found to have any effect on male or female fertility in animal studies.

13.2 Animal Toxicology and/or Pharmacology

A 9-month toxicology study administered topical ocular doses of latanoprostene bunod to one eye of cynomolgus monkeys: control (vehicle only), one drop of 0.024% bid, one drop of 0.04% bid and two drops of 0.04% per dose, bid. The systemic exposures are equivalent to 4.2-fold, 7.9-fold, and 13.5-fold the clinical dose, respectively, on a body surface area basis (assuming 100% absorption). Microscopic evaluation of the lungs after 9 months observed pleural/subpleural chronic fibrosis/inflammation in the 0.04% dose male groups, with increasing incidence and severity compared to controls. Lung toxicity was not observed at the 0.024% dose.

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Bridgewater, NJ 08807 USA

U.S. Patent Numbers: 6,211,233; 7,273,946; 7,629,345; 7,910,767; 8,058,467.

Based on 9464800 11/2017 VYZ.0055.USA.16 Issued: 11/2017

TIMING

(Continued from page 14)

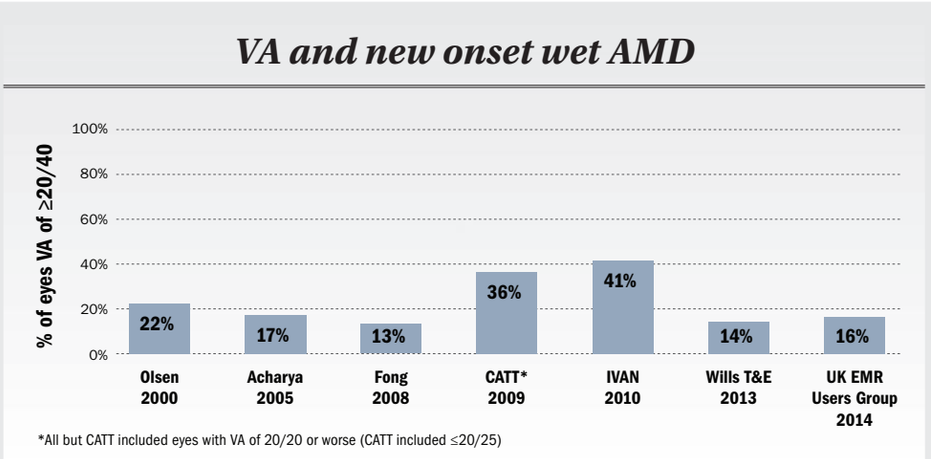
test. This is an outdated and antiquated method yielding unreliable results.

We are capable of better and equipped with telemonitoring technologies to provide us with highly effective way to detect wet AMD earlier. Conducting a highly sensitive, objective test in the convenience of a patient's home is a reasonable and necessary option to preserve vision. Simply put, telemonitoring offers at-risk patients a viable alternative to daily office visits.

> 'Simply put, telemonitoring offers at-risk patients a viable alternative to daily office visits.'

Several technologies currently exist. Mobile visual technology such as the FDA-cleared Paxos (DigiSight Technologies) and mVT App (Vital Art and Science LLC) offer a visual monitoring solution, and the ForeseeHome (Notal Vision) testing device has definitively proven efficacy in early disease detection.

The AREDS2 HOME Study compared outcomes between patients using the Amsler grid and the ForeseeHome device and Amsler grid. Ninety-four percent who converted to wet AMD maintained ≥20/40 compared with 64% of patients using other methods.[5] The disparity in outcomes between ForeseeHome and the current standard of care was so significant that the Data Safety and Monitoring Committee terminated the study early so that all patients could have access to this sight-preserving technology. The ForeseeHome device is covered by Medicare for patients with 20/60 or better visual acuity and intermediate dry AMD.

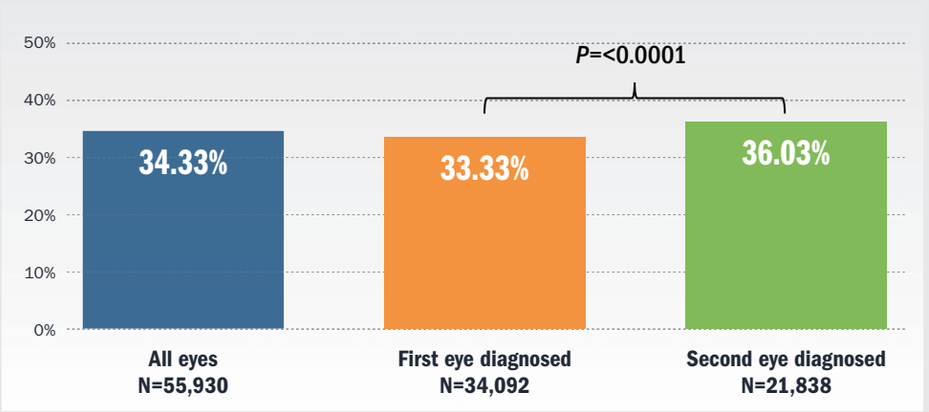


(FIGURE 2) **Real-world data demonstrates few newly diagnosed CNV eyes are detected when VA is relatively good.**

Figure 3: IRIS registry analysis baseline VA at wet AMD diagnosis

	COHORT COUNT	WITH BASELINE VA	PRIMARY: BASELINE VA >20/40	MEAN VA AT DIAGNOSIS
PATIENTS	220,434	153,141		
EYES	236,843	162,902	55,930	20/83
FIRST EYES	150,208	102,284	34,092	20/85
SECOND EYES	86,635	60,618	21,838	20/79

***Primary and secondary analyses were run on the subset of patients that had both a pre-conversion VA and a conversion VA. This relatively poor mean VA at diagnosis corresponds with previously reported baseline VA from the IRIS® registry.**



(FIGURE 4) **IRIS Registry Analysis: Less than 35% of All Eyes had a VA of 20/40 or better at treatment initiation, with the Second Eye faring slightly better than the First. The % of patients with ≥20/40 is LOW, even when in the care of the treating MD.** *(Figures courtesy of Allen C. Ho, MD)*

WHAT PATIENTS DO WE NEED TO MONITOR MORE CLOSELY?

A simplified risk scoring system was developed by the AREDS Research Group that assigns one risk factor for the presence of one or more large drusen and one risk factor for the presence of any pigment abnormality. The risk factors are then summed across both eyes.[6] Three risk factors represent a 25% risk of develop-

Continues on page 18 : ***Timing***

TIMING

(Continued from page 17)

ing advanced AMD over five years, and four risk factors jumps to a 50% risk. Given, that these patients are at high risk for progressing to wet AMD, our immediate objective should be to monitor these patients more closely, with objective monitoring technologies.

For the sake of simplicity, the patients to whom you recommend an AREDS2-formulated vitamin are most likely candidates for intensive home monitoring. Many of these patients are Medicare patients and fortunately for them, ForeseeHome is covered as long as the patient has intermediate AMD and best-corrected visual acuity of 20/60 or better.

> Patients who start with better vision have the best outcomes, and conversely, patients who start with poor vision end up with poor outcomes.

BREAKING THROUGH THE PLATEAU

Early detection and decreasing the time between detection, diagnosis, and treatment is critical to preserving independence and quality of life for our patients at risk for wet AMD. We know that patients who start with better vision have the best outcomes, and conversely, patients who start with poor vision end up with poor outcomes. As doctors, we can dramatically improve visual outcomes by identifying high-risk intermediate AMD patients and ensuring that they use an effective telemonitoring system. The difference can be life changing. ■

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ALLEN C. HO, MD
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Dr. Ho is director of Retina Research at Wills Eye Hospital and professor of ophthalmology at Thomas Jefferson University, both in Philadelphia.

Novartis to spin off Alcon

NOVARTIS HAS ANNOUNCED plans to spin off Alcon into a separately traded, standalone company.

If shareholders approve the move, Novartis will continue to operate the ophthalmic drug business while Alcon will focus on surgical and vision care. The move, expected to close in early 2019, will leave Novartis entirely as a prescription-medicine company.

The split will enable both companies to "focus fully on their respective growth strategies," according to a Novartis press release.

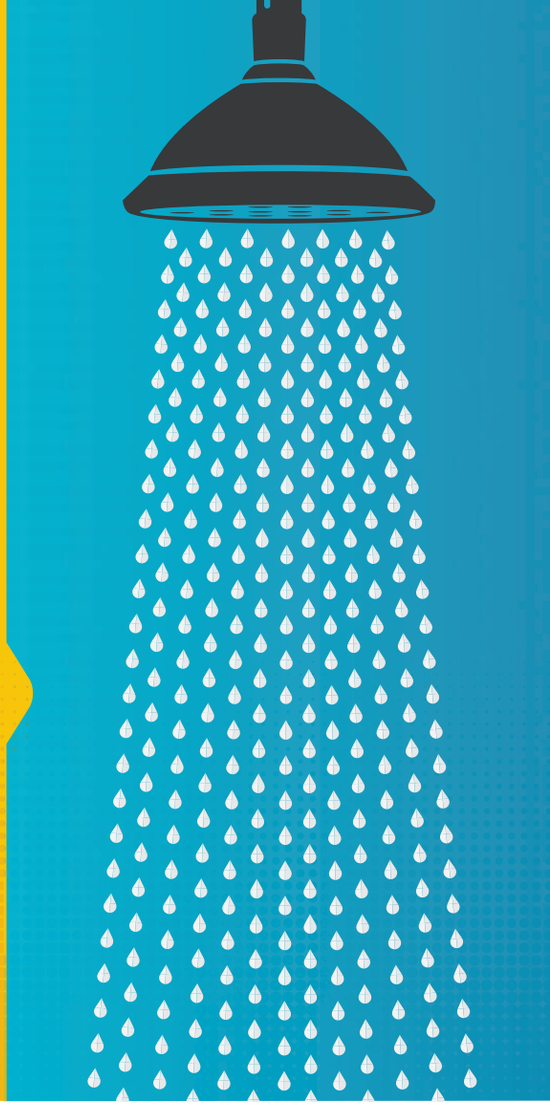
In a call with reporters, Novartis' CEO Vas Narasimhan, MD, explained his decision to spinoff Alcon. In a rapidly-evolving technological landscape, Narasimhan said, Novartis needs to concentrate its capital on the use of digital technology.

After struggling with flat sales for several years, Alcon was reorganized in January 2016 and put under strategic review a year later. The division has recently shown signs of a turnaround, however.

"Alcon has returned to a position of strength and it is time to give the business more flexibility to pursue its own growth strategy," said Narasimhan, a Harvard-trained doctor who assumed the role of Novartis' CEO earlier this year.

Mike Ball will become chairman-designate of Alcon, tasked with prepping the company for the split. Alcon COO David Endicott will be promoted to Alcon CEO. Both appointments were effective July 1. ■

ILUVIEN®
(fluocinolone acetonide intravitreal implant) 0.19mg



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ILUVIEN® is a CONTINUOUS MICRODOSING™ Delivery System specifically engineered for the treatment of DME in patients who have been previously treated with a course of corticosteroids and did not have a clinically significant rise in intraocular pressure.

In pivotal studies, ILUVIEN demonstrated efficacy in visual acuity through 24 months (primary endpoint), which was sustained for up to 36 months.[1,2,3]

Adverse reactions in the ILUVIEN Phase 3 clinical trials were consistent with other corticosteroid treatments.[1]

INDICATION

ILUVIEN® (fluocinolone acetonide intravitreal implant) 0.19 mg is indicated for the treatment of diabetic macular edema (DME) in patients who have been previously treated with a course of corticosteroids and did not have a clinically significant rise in intraocular pressure.

IMPORTANT SAFETY INFORMATION

Contraindications

- ILUVIEN is contraindicated in patients with active or suspected ocular or periocular infections including most viral diseases of the cornea and conjunctiva including active epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, varicella, mycobacterial infections and fungal diseases.
- ILUVIEN is contraindicated in patients with glaucoma who have cup to disc ratios of greater than 0.8.
- ILUVIEN is contraindicated in patients with known hypersensitivity to any components of this product.

Warnings and Precautions

- Intravitreal injections, including those with ILUVIEN, have been associated with endophthalmitis, eye inflammation, increased intraocular pressure, and retinal detachments. Patients should be monitored following the intravitreal injection.
- Use of corticosteroids including ILUVIEN may produce posterior subcapsular cataracts, increased intraocular pressure and glaucoma. Use of corticosteroids may enhance the establishment of secondary ocular infections due to bacteria, fungi, or viruses. Corticosteroids are not recommended to be used in patients with a history of ocular herpes simplex because of the potential for reactivation of the viral infection.
- Patients in whom the posterior capsule of the lens is absent or has a tear are at risk of implant migration into the anterior chamber.

Adverse Reactions

- In controlled studies, the most common adverse reactions reported were cataract development (ILUVIEN 82%; sham 50%) and intraocular pressure elevation of ≥10 mm Hg (ILUVIEN 34%; sham 10%).

Please see Brief Summary of Full Prescribing Information on the following page.

1. Iluvien [package insert]. Alpharetta, GA: Alimera Sciences, Inc; 2014. **2.** Campochiaro PA, Brown DM, Pearson A, et al. Long-term benefit of sustained delivery fluocinolone acetonide vitreous inserts for diabetic macular edema. *Ophthalmology*. 2011;118(4):626-635.e2. **3.** Campochiaro PA, Brown DM, Pearson A, et al. Sustained delivery fluocinolone acetonide vitreous inserts provide benefit for at least 3 years in patients with diabetic macular edema. *Ophthalmology*. 2012;119(10):2125-2132.

ALIMERA SCIENCES

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BRIEF SUMMARY OF FULL PRESCRIBING INFORMATION

ILUVIEN® (fluocinolone acetonide intravitreal implant) 0.19 mg
For Intravitreal Injection

INDICATIONS AND USAGE

ILUVIEN® (fluocinolone acetonide intravitreal implant) 0.19 mg is indicated for the treatment of diabetic macular edema in patients who have been previously treated with a course of corticosteroids and did not have a clinically significant rise in intraocular pressure.

CONTRAINDICATIONS

Ocular or Periocular Infections: ILUVIEN is contraindicated in patients with active or suspected ocular or periocular infections including most viral disease of the cornea and conjunctiva including active epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, varicella, mycobacterial infections and fungal diseases.

Glaucoma: ILUVIEN is contraindicated in patients with glaucoma, who have cup to disc ratios of greater than 0.8.

Hypersensitivity: ILUVIEN is contraindicated in patients with known hypersensitivity to any components of this product.

WARNINGS AND PRECAUTIONS

Intravitreal Injection-related Effects: Intravitreal injections, including those with **ILUVIEN**, have been associated with endophthalmitis, eye inflammation, increased intraocular pressure, and retinal detachments. Patients should be monitored following the intravitreal injection.

Steroid-related Effects: Use of corticosteroids including **ILUVIEN** may produce posterior subcapsular cataracts, increased intraocular pressure and glaucoma. Use of corticosteroids may enhance the establishment of secondary ocular infections due to bacteria, fungi, or viruses.

Corticosteroids are not recommended to be used in patients with a history of ocular herpes simplex because of the potential for reactivation of the viral infection.

Risk of Implant Migration: Patients in whom the posterior capsule of the lens is absent or has a tear are at risk of implant migration into the anterior chamber.

ADVERSE REACTIONS

Clinical Studies Experience: Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice.

Adverse reactions associated with ophthalmic steroids including **ILUVIEN** include cataract formation and subsequent cataract surgery, elevated intraocular pressure, which may be associated with optic nerve damage, visual acuity and field defects, secondary ocular infection from pathogens including herpes simplex, and perforation of the globe where there is thinning of the cornea or sclera.

ILUVIEN was studied in two multicenter, randomized, sham-controlled, masked trials in which patients with diabetic macular edema were treated with either **ILUVIEN** (n=375) or sham (n=185). Table 1 summarizes safety data available when the last subject completed the last 36-month follow up visit for the two primary **ILUVIEN** trials. In these trials, subjects were eligible for retreatment no earlier than 12 months after study entry. Over the three-year follow up period, approximately 75% of the **ILUVIEN** treated subjects received only one **ILUVIEN** implant.

Table 1: Ocular Adverse Reactions Reported by ≥1% of Patients and Non-ocular Adverse Reactions Reported by ≥5% of Patients

Adverse Reactions	ILUVIEN (N=375) n (%)	Sham (N=185) n (%)
Ocular		
Cataract[1]	192/235[2] (82%)	61/121[2] (50%)
Myodesopsia	80 (21%)	17 (9%)
Eye pain	57 (15%)	25 (14%)
Conjunctival haemorrhage	50 (13%)	21 (11%)
Posterior capsule opacification	35 (9%)	6 (3%)
Eye irritation	30 (8%)	11 (6%)
Vitreous detachment	26 (7%)	12 (7%)
Conjunctivitis	14 (4%)	5 (3%)
Corneal oedema	13 (4%)	3 (2%)
Foreign body sensation in eyes	12 (3%)	4 (2%)
Eye pruritus	10 (3%)	3 (2%)
Ocular hyperaemia	10 (3%)	3 (2%)
Optic atrophy	9 (2%)	2 (1%)
Ocular discomfort	8 (2%)	1 (1%)
Photophobia	7 (2%)	2 (1%)
Retinal exudates	7 (2%)	0 (0%)
Anterior chamber cell	6 (2%)	1 (1%)
Eye discharge	6 (2%)	1 (1%)

Table 1 (continued)

Adverse Reactions	ILUVIEN (N=375) n (%)	Sham (N=185) n (%)
Non-ocular		
Anemia	40 (11%)	10 (5%)
Headache	33 (9%)	11 (6%)
Renal failure	32 (9%)	10 (5%)
Pneumonia	28 (7%)	8 (4%)

[1] Includes cataract, cataract nuclear, cataract subcapsular, cataract cortical and cataract diabetic in patients who were phakic at baseline. Among these patients, 80% of **ILUVIEN** subjects vs. 27% of sham-controlled subjects underwent cataract surgery.

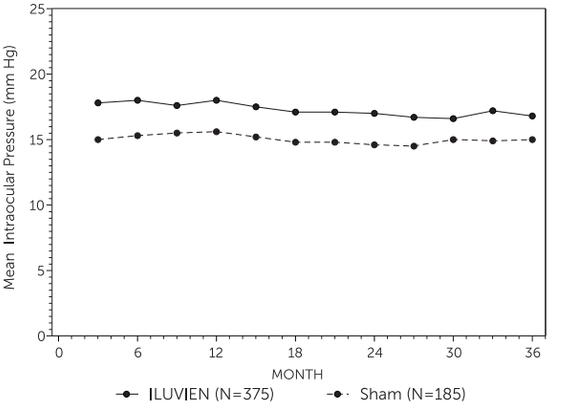
[2] 235 of the 375 **ILUVIEN** subjects were phakic at baseline; 121 of 185 sham-controlled subjects were phakic at baseline.

Increased Intraocular Pressure

Table 2: Summary of Elevated IOP-Related Adverse Reactions

Event	ILUVIEN (N=375) n (%)	Sham (N=185) n (%)
Non-ocular		
IOP elevation ≥ 10 mm Hg from baseline	127 (34%)	18 (10%)
IOP elevation ≥ 30 mm Hg	75 (20%)	8 (4%)
Any IOP-lowering medication	144 (38%)	26 (14%)
Any surgical intervention for elevated intraocular pressure	18 (5%)	1 (1%)

Figure 1: Mean IOP during the study



Cataracts and Cataract Surgery

At baseline, 235 of the 375 **ILUVIEN** subjects were phakic; 121 of 185 sham-controlled subjects were phakic. The incidence of cataract development in patients who had a phakic study eye was higher in the **ILUVIEN** group (82%) compared with sham (50%). The median time of cataract being reported as an adverse event was approximately 12 months in the **ILUVIEN** group and 19 months in the sham group. Among these patients, 80% of **ILUVIEN** subjects vs. 27% of sham-controlled subjects underwent cataract surgery, generally within the first 18 months (Median Month 15 for both **ILUVIEN** group and for sham) of the studies.

Postmarketing Experience: The following reactions have been identified during post-marketing use of **ILUVIEN** in clinical practice. Because they are reported voluntarily, estimates of frequency cannot be made. The reactions, which have been chosen for inclusion due to either their seriousness, frequency of reporting, possible causal connection to **ILUVIEN**, or a combination of these factors, include reports of drug administration error and reports of the drug being ineffective.

USE IN SPECIFIC POPULATIONS

Pregnancy: Pregnancy Category C.
There are no adequate and well-controlled studies of **ILUVIEN** in pregnant women. Animal reproduction studies have not been conducted with fluocinolone acetonide. Corticosteroids have been shown to be teratogenic in laboratory animals when administered systemically at relatively low dosage levels. **ILUVIEN** should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Nursing Mothers: Systemically administered corticosteroids are present in human milk and could suppress growth and interfere with endogenous corticosteroid production. The systemic concentration of fluocinolone acetonide following intravitreal treatment with **ILUVIEN** is low. It is not known whether intravitreal treatment with **ILUVIEN** could result in sufficient systemic absorption to produce detectable quantities in human milk. Exercise caution when **ILUVIEN** is administered to a nursing woman.

Pediatric Use: Safety and effectiveness of **ILUVIEN** in pediatric patients have not been established.

Geriatric Use: No overall differences in safety or effectiveness have been observed between elderly and younger patients.

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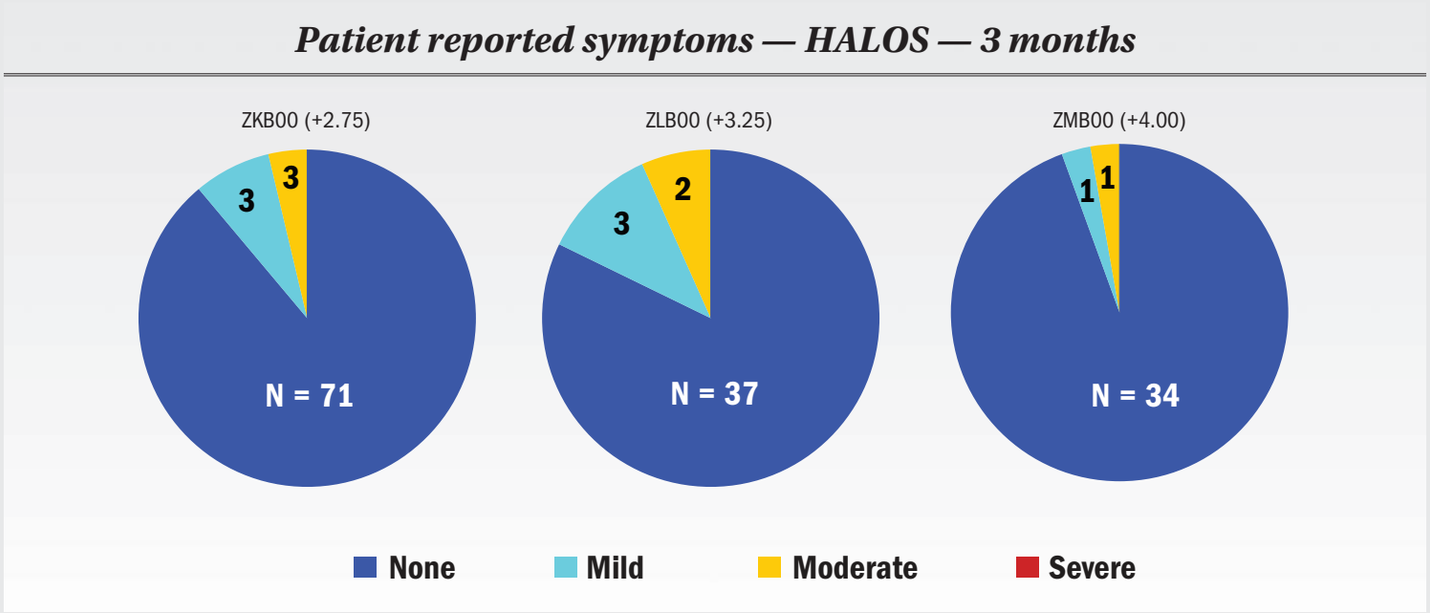

While halos were commonly noted at 1 month, surprisingly, by 3 months, few patients were bothered by them across all three IOL add powers. *(Image courtesy of Steven J. Dell, MD)*

MAXIMIZING MULTIFOCAL IOL OUTCOMES

Prospective study results favor combining low and intermediate add versions

By Cheryl Guttman Krader; *Reviewed by Steven J. Dell, MD*

take-home

- **Results of a prospective study find better visual acuity outcomes and higher patient satisfaction implanting a +2.75 D add multifocal IOL in the dominant eye and a +3.25 D add model contralaterally than when combining the +2.75 D model with a +4.0 D add multifocal IOL.**

Combining two different power aspheric diffractive multifocal IOLs in fellow eyes provides better visual performance than implanting the same power lens bilaterally, and outcomes with the mixed approach are better using a lower add IOL in the non-dominant eye, said Steven J. Dell, MD.

Dr. Dell's conclusions on maximizing functional outcomes with implantation of multifocal IOLs are based on findings from a physician-initiated multicenter study that included data from 82 patients who received the ZKB00 single-piece, diffractive aspheric +2.75 D add multifocal IOL (ZKB00; TECNIS Multifocal IOL +2.75 D, J&J Vision) in the dominant eye and either the +3.25 D add (ZLB00) or +4.0 D add (ZMB00) model of the same IOL in the non-dominant eye.

The results showed the +2.75 D/+3.25 D combination provided better near, intermediate, and distance uncorrected visual acuity (UCVA) and was associated with better overall satisfaction compared with the +2.75 D/+4.0 D approach. In addition, near UCVA in the +2.75 D/+3.25 D group surpassed that achieved in FDA registration trials evaluating bilateral implantation of the +2.75 D and +3.25 D add models, reported Dr. Dell, medical director, Dell Laser Consultants, Austin, TX.

"This prospective study was undertaken based on data showing an increase in patient satisfaction with multifocal IOLs as add powers have decreased. This may be due to lower incidences of photic phenomena, better intermediate vision, or both," he said.

Dr. Dell's co-investigators in the multicenter study were Farrell "Toby" Tyson, MD, Kevin L. Waltz, MD, and Jeffrey C. Whitsett, MD. Patients were eligible for participation if they had visual potential of 20/32 or better and were expected to have ≤0.5 D astigmatism postoperatively in each eye. Patients with ocular pathology known to affect VA, significant irregular astigmatism, or uncontrollable illness or disease were excluded.

Visual acuity was measured binocularly by

Continues on page 25 : ***Mixed powers***

EDOF IOL overcomes limitations of bifocal optic design

IOL is a biconvex multifocal aspherical IOL with a progressive optic featuring three zones

By Cheryl Guttman Krader; *Reviewed by Ramin Khoramnia, MD*

A NOVEL EXTENDED DEPTH of focus (EDOF) IOL (Mini WELL IOL, SIFI Medtech) is providing very favorable functional and safety outcomes that correspond with a high degree of patient satisfaction, according to data collected by ophthalmologists at the University Eye Clinic Heidelberg.

"We are finding that patients implanted with the Mini WELL IOL have excellent uncorrected visual acuity at far and intermediate distances along with very good uncorrected near visual acuity and a very low incidence of photic phenomenon," reported Ramin Khoramnia, MD, Assistant Professor of Ophthalmology, University of Heidelberg, and Head, Refractive Surgery Department, University Eye Clinic, Heidelberg, Germany.

Dr. Khoramnia

The Mini WELL IOL is a biconvex multifocal aspherical IOL with a progressive optic featuring three zones. The central zone and a surrounding annular zone have spherical aberrations of opposite signs that create a continuous number of foci, and the external zone is a basic monofocal zone.

"The Mini WELL IOL provides quite sharp images at far and intermediate distances and near image quality is also quite good. In contrast, standard bifocal IOLs provide sharp images at far and near distances, but variable quality images at intermediate distance," said Dr. Khoramnia.

REAL-WORLD EXPERIENCE

Dr. Auffarth

Dr. Khoramnia reviewed outcomes achieved at 3 months postsurgery by patients enrolled in a prospective non-randomized study conducted at the University Eye Clinic Heidelberg. Gerd U. Auffarth, MD, PhD, Professor and Chairman, Department of Ophthalmology, University of Heidelberg, is the Principal Investigator of the Study.

The analysis included data from 40 eyes of 24 patients. Their preoperative median SE was 0.50 D (range –7.75 to 4.88 D).

At 3 months, mean corrected distance visual acuity (CDVA) was 0.00 logMAR, mean distance-corrected intermediate VA measured at 80 cm was 0.04 logMAR, and mean distance corrected near VA was 0.22 logMAR.

"Defocus curves for the Mini WELL IOL also show that it provides good visual acuity over quite a large range," Dr. Khoramnia said.

(FIGURE 1) The image shows the screen from the driving scene simulation for a patient implanted with the Mini WELL IOL. *(Image courtesy of Ramin Khoramnia, MD)*

Take-home

- **The Mini WELL IOL provides quite sharp images at far and intermediate distances and near image quality is also quite good. In contrast, standard bifocal IOLs provide sharp images at far and near distances, but variable quality images at intermediate distance.**

Functional near vision was also assessed through evaluation of reading performance using the Salzburg reading desk.

"We think it is very important to objectively evaluate the reading performance with presbyopia-correcting IOLs because many patients do not read at the distance that is used in clinical studies to test near visual acuity," Dr. Khoramnia explained.

"The Salzburg reading desk calculates reading acuity while continuously measuring reading distance and speed as patients do the reading task at their preferred distance."

The results showed the Mini WELL IOL provided excellent intermediate vision and also performed well at near. Median binocular uncorrected intermediate VA was 0.11 logMAR and median binocular uncorrected near VA was 0.13 logMAR.

Reading performance in patients implanted with the Mini WELL IOL was also investigated in the FOCUS multicenter trial in which the Heidelberg center participated. Radner reading charts were used in the FOCUS trial, and the data collected showed that about 92% of patients were able to read 0.5 logRAD print (book letter size) at a rate of at least 80 words per minute.

MINIMIZING PHOTIC PHENOMENA

Photic phenomena in patients implanted with the Mini WELL IOL were assessed using a proprietary halo and glare simulator. With this device, patients view a night driving scene and indicate whether they see any halo or glare around lights, the type of these phenomena as well as their size and intensity. The data can then be converted to numerical values for statistical analysis.

Preliminary results showed that about 50% of patients implanted with the Mini WELL IOL experienced no glare or halos at all while affected patients had only minimal problems with the photic phenomena.

"Looking at the data for the patients who reported the maximum values indicates that they did not experience much bother from glare and halos," Dr. Khoramnia said. ■

RAMIN KHORAMNIA, MD

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The International Vision Correction Research Centre at the University Eye Clinic Heidelberg *receives funding support from SIFI.*

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* Alcon data on file.

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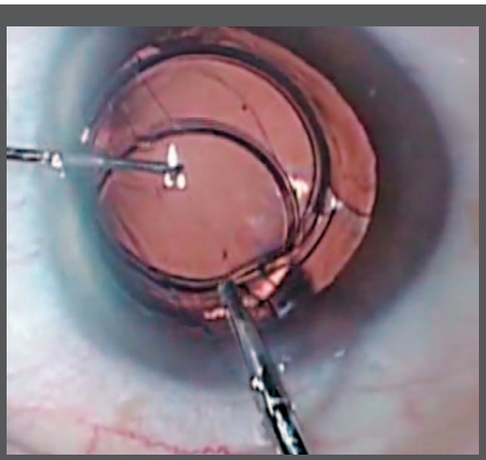
Special Report) UPDATE IN **IOL INNOVATION**

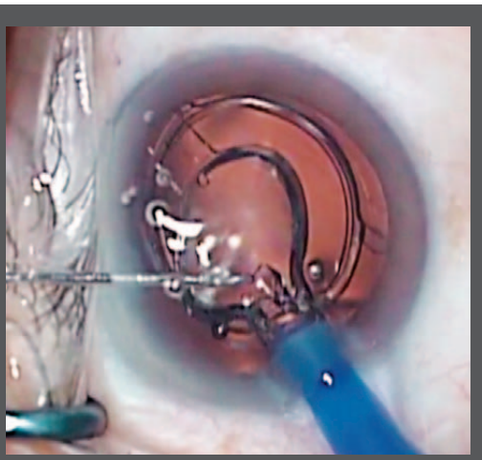
Multicomponent IOL improves vision outcomes after cataract surgery

Lens safely and effectively resulted in significant reduction of residual refractive error

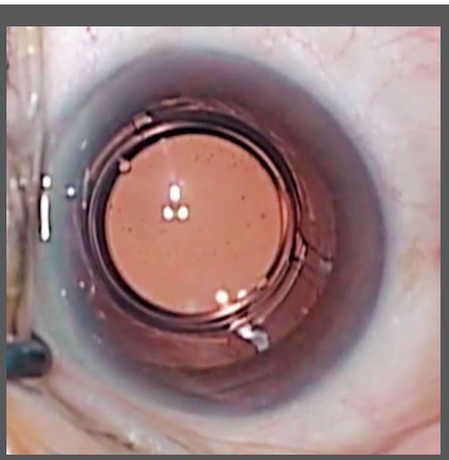
By Cheryl Guttman Krader; *Reviewed by Harvey S. Uy, MD*



(FIGURE 1) **Surgical microscope view of PreciSight front optic exchange. IOL forceps are used to pull out the front optic through the original clear corneal incision.**



(FIGURE 2) **An injector system is used to insert a new front optic into the capsular bag. Sinskey-type forceps are then used to lock the two tabs into slots onto the base optic.**



(FIGURE 3) **Surgical microscope view demonstrating the fully assembled PreciSight multicomponent IOL within the capsular bag.**
(Figures courtesy of Harvey S. Uy, MD)

A MULTICOMPONENT IOL system featuring an exchangeable front optic (PreciSight Lens, InfiniteVision Optics, Strasbourg, France) is showing promise for providing a reliable, reproducible, safe, simple, and time-independent solution for achieving desired refractive outcomes after cataract surgery, said Harvey S. Uy, MD.

Outcomes in a series of 30 eyes that underwent exchange of the front optic to correct dioptric power showed the procedure was safe and effective. Prior to enhancement, all patients had MRSE >1 D (mean 1.06 D) and <–1.0 D cylinder (mean -0.30 D). Mean logMAR distance uncorrected visual acuity (UDVA) prior to the enhancement was 0.19 (approximately 20/30 Snellen equivalent).

> ‘It gives surgeons a safety net to provide unhappy patients with a second chance.’ *– Harvey S. Uy, MD*

Analyses of data available from 30 eyes seen at 3 months post-enhancement showed statistically significant improvements in both mean MRSE (0.31 D) and mean logMAR UDVA of 0.02 (approximately 20/20 Snellen equivalent). There was no statistically significant change in mean cylinder. Furthermore, at 3 months, 100% of eyes had UDVA of 20/25 or better.

Additional measurements showed that the system exhibited excellent rotational stability; anterior chamber depth was unchanged after the exchange, indicating implant stability; and endothelial cell count was also unchanged. No other safety issues were observed, reported Dr. Uy, clinical associate professor of ophthalmology, University of the Philippines, and medical director, Peregrine Eye and Laser Institute in Makati, Philippines.

“The fact that a significant number of patients are dissatisfied after multifocal IOL surgery is limiting uptake of these premium lenses by cataract surgeons. The reasons for dissatisfaction among these patients include significant residual refractive error and inability to adjust to the visual disturbances caused by multifocal optics,” Dr. Uy said.

“IOL exchange can address these concerns, but surgeons face a dilemma in deciding on the timing of the surgery. If the exchange is done too early, patients may be deprived of the chance to adapt to the primarily implanted lens, but if the exchange is delayed, the procedure becomes more difficult because of capsular fibrosis. This investigational multicomponent IOL system allows IOL exchange without any time limits. It gives surgeons a safety net to provide unhappy patients with a second chance. For that reason, it can build surgeon confidence in using presbyopia-correcting IOLs and their ability to build a premium IOL practice.”

The multicomponent IOL consists of two optics that are implanted simultaneously into

Continues on page 25 : ***Front optic exchange***

take-home

- **Exchange of the front optic in an investigational multicomponent IOL system (PreciSight Lens, InfiniteVision Optics, Strasbourg, France) safely and effectively resulted in significant reduction of residual refractive error and significant improvement in uncorrected distance visual acuity.**

FRONT OPTIC EXCHANGE

(Continued from page 24)

the capsular bag at the time of cataract surgery. The posterior base lens, which is larger than the anterior exchangeable lens, is made of hydrophobic acrylic, contains spherical power and remains fixed in the capsular bag. The exchangeable front portion is a hydrophilic acrylic lens and can feature any type of optic—multifocal, multifocal toric, aspheric, toric, telescopic—thereby allowing surgeons to address a full spectrum of refractive needs and goals through an enhancement procedure.

"A space is maintained between the two optics after they are implanted. As capsular fibrosis occurs and the base lens becomes more fixed, exchange of the front lens becomes even easier," Dr. Uy said.

"If the problem is significant residual refractive error, then the front lens is exchanged for another that will correct the total power. If the front lens was a multifocal optic and the patient is intolerant of the visual symptoms or develops retina or nerve disease, the multifocal portion can be exchanged for a monofocal lens. Or, if a patient initially chose a monofocal lens and later became interested in presbyopia correction, the front optic can be exchanged for a multifocal optic."

The system is easy to implant. The two refractive components are assembled outside the eye by affixing tabs on the front lens into bridges on the base lens. Then, the implant is injected into the eye through a 2.2 to 2.4 mm incision.

"Eventually, a preloaded injector will be available. Thus, the primary surgery is no more complex or time-consuming than conventional cataract surgery," Dr. Uy said.

He noted that the exchange procedure is also easy. Ophthalmic viscoelastic is injected through a hole in the front optic, causing it to lift up and helping to detach it from the base. Without any need for cutting, the front optic is removed from the eye through the original clear corneal incision using commercially available IOL forceps.

The replacement optic is injected into the eye, and its tabs are guided into the bridges on the base using modified Sinskey hooks.

"The exchange generally takes less than 5 minutes to complete," Dr. Uy said.

"The base lens protects the posterior capsule during the procedure and remains stable, without any change in axis, which establishes the feasibility of a toric IOL platform." ■

HARVEY S. UY, MD

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Dr. Uy receives research funding from InfiniteVision Optics and from ClarVista Medical, which is developing another multicomponent IOL (Harmoni Modular IOL).

MIXED POWERS

(Continued from page 21)

a masked observer and under photopic conditions at far and intermediate distances and mesopic conditions for near. At 3 months, distance UCVA of 20/25 or better was achieved by 95% of patients in the +2.75/+3.25 D group and 83% of patients in the +2.75/+4.0 D group, while 20% of patients in the +2.75/+3.25 D group achieved 20/16 UCVA compared with only 8% of the +2.75/+4.0 D patients. The proportion of patients achieving distance UCVA of 20/20 or better in the +2.75/+3.25 D group was also comparable to that recorded in the FDA studies of the +2.75 D and +3.25 D add models and higher than that achieved in the FDA study of the +4.0 D add version.

Intermediate UCVA of 20/40 or better, 20/20 or better, and 20/16 or better was achieved by 93%, 22%, and 7% of patients, respectively, in the +2.75/+3.25 D group, and by 81%, 16%, and 0%, of patients, respectively, in the +2.75/+4.0 D group.

Near UCVA was 20/20 or better in 49% of patients in the +2.75/+3.25 D group, but in only 22% of patients implanted with the +2.75/+4.0 D combination. In the FDA trials where data were recorded at 6 months, only 25% of patients with bilateral implantation of the +2.75 D add multifocal IOL and only 35% of those receiving the +3.25 D add multifocal IOL bilaterally achieved 20/20 or better near UCVA.

PATIENT-REPORTED OUTCOMES

In the multicenter study of the mixed approach to multifocal IOL implantation, patients were asked about their ability to function without corrective eyewear. At 3 months in the +2.75/+3.25 D group, 78% of patients reported they had no difficulty and the rest noted having some difficulty, but none identified it as being extreme. In the +2.75/+4.0 D group, nearly three-fourths of patients said they had no difficulty functioning without corrective eyewear, but one patient reported having extreme difficulty and another indicated being unable to function without corrective eyewear.

Results were also slightly better for the +2.75/+3.25 D group in the analysis of ratings of satisfaction with overall vision without corrective eyewear. Whereas nearly all patients in the +2.75/+3.25 D and +2.75/+4.0 D groups were either extremely satisfied or satisfied (95% and 91%, respectively), no patients in the +2.75/+3.25 D group were extremely dissatisfied, compared with 3% of those implanted with the +2.75/+4.0 D combination.

Analyses of data on patient reported symptoms for each eye showed minimal problems with glare or starburst with any of the IOLs.

"We were also surprised to see very few reports of halos at 3 months with any of the IOLs. The rates were higher at 1 month, but halos were often resolved by 3 months and in no case did a patient describe the halos as severe," Dr. Dell said.

Responses to a question asking whether the patient would recommend implantation of the IOLs received also favored the +2.75/+3.25 D combination—100% of patients in that group said they would make the recommendation compared with just 91% of patients implanted with the +2.75/+4.0 D add IOLs. ■

> 'We were also surprised to see very few reports of halos at 3 months with any of the IOLs.'
>
> — Steven J. Dell, MD

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This article is based on a presentation given by Dr. Dell at the 2018 ASCRS Symposium. He is a consultant to J&J Vision.

Presbyopia-correcting IOLs vary in performance profiles

In one study, small aperture IOLs stand out for intermediate vergence and patient satisfaction

By Cheryl Guttman Krader

FINDINGS from a retrospective comparison of data from prospective studies of presbyopia-correcting IOLs highlight the performance similarities and differences of different technologies.

Undertaken by Jay S. Pepose, MD, PhD, the review included evaluations of defocus curves, visual acuity (VA) outcomes, contrast sensitivity tests, and patient-reported symptoms for an accommodating IOL (Crystalens AO, Bausch + Lomb), a diffractive bifocal IOL with a +3.0 D near add (AcrySof ReSTOR +3.0 D, Alcon), a +4.0 D near add diffractive bifocal IOL (Tecnis +4.0 D Multifocal IOL; J&J Vision), and a small aperture extended depth of focus IOL (IC-8, AcuFocus). A total of 105 patients received the small aperture IOL implanted in the non-dominant eye with a colorless aspheric monofocal IOL in the fellow eye. The other three IOLs had been studied in a trial that included 22 to 26 patients who underwent binocular implantation with the same IOL in both eyes.

PURPOSE

A retrospective comparison of two prospective studies with four lens groups:

- **Binocular Crystalens AO (N=26, Bausch + Lomb)**
- **Binocular AcrySof ReSTOR +3.0 D (N=25, Alcon)**
- **Binocular Tecnis +4.0 D Multifocal (MF) IOL (N=22, J&J Vision)**
- **Contralateral IC-8 IOL (N=105, AcuFocus) and a colorless aspheric monofocal IOL**

ACCOMMODATING LIGHT SPLITTING SMALL APERTURE

"The results show that all four IOLs perform well for providing good uncorrected distance vision, and they have comparable binocular mesopic contrast sensitivity results," said Dr. Pepose, Director, Pepose Vision Institute, and Professor of Clinical Ophthalmology, Washington University School of Medicine, St. Louis, MO.

"The bifocal IOLs perform best at near, while the small aperture IOL stands out for having a wide range of continuous functional vision and the best performance at intermediate."

The defocus curves showed that the small aperture IOL had a continuous range of functional vision (20/40 or better) of approximately 4.5 D in binocular testing and approximately 4.0 D in monocular testing of the implanted eye. The functional range of vision was approximately 2.5 D for the accommodating IOL and was non-continuous for the bifocal IOLs: 4.5 D for the +3.0 D add IOL, and 4.0 D for the +4.0 D add IOL.

"The accommodating and small aperture IOLs do best at the intermediate vergence whereas the bifocals provide better near vision," Dr. Pepose said.

Uncorrected distance VA was measured at 4 m for the small aperture IOL and at 6 m for the other implants using ETDRS charts. Across the four IOLs, mean uncorrected distance VA (Snellen equivalent) was between 20/21 and 20/26.

Uncorrected intermediate VA was measured at 67 cm for the small aperture IOL and at 80 cm for the other implants. In monocular testing, mean uncorrected intermediate VA for the small aperture and accommodating IOLs was 20/24 and 20/23, respectively, and about 2 lines better than that of the bifocal IOLs; the differences between groups were statistically significant.

Uncorrected near VA was measured at 40 cm for all IOLs. The mean value was best for the +3.0 D add bifocal IOL (20/20), similar for the small aperture and +4.0 D add bifocal IOLs (20/30 and 20/31, respectively), and worst for the accommodating IOL (20/36). The differences comparing the small aperture and +4.0 D bifocal IOL with the +3.0 D bifocal IOL and the accommodating IOL were statistically significant.

In binocular mesopic contrast sensitivity testing with and without glare, the four IOL groups had similar results with a few exceptions noted in a few comparisons at lower spatial frequencies.

take-home

- **Data from prospective studies evaluating presbyopia-correcting IOLs show all provide excellent uncorrected distance visual acuity, but the technologies vary in their performance at near and intermediate distances and in their association with photic phenomena.**

VISUAL SYMPTOM SCORES

Severity scores for blurry vision, fluctuating vision, and ghosting were low in all IOL groups. When comparing the various groups, the most remarkable differences were a very low score for ghosting in the small aperture IOL group, higher scores for halo in the bifocal IOL groups compared with the other two IOLs, and a higher score for glare with the +4.0 D add bifocal IOL. Patients in the small aperture IOL study were also asked if they would have the same procedure again. The data showed a very high satisfaction rate with 95% of patients responding"yes". "Pairing the small aperture inlay with a low myopic refractive target (–0.75D) further enhances uncorrected near vision with minimal impact on distance, given the nature of small aperture optics," said Dr. Pepose.

Dr. Pepose stated that the review was done to establish baseline metrics and that comparisons between IOLs must be done carefully recognizing that the data came from different studies.

"This is not a true prospective head-to-head comparison of the four lenses. The studies varied in their methods, including distances for VA testing and choice of patient-reported outcome tools and rating scales. In addition, the monocular and binocular defocus curve data for the small aperture IOL are from different study cohorts," he said. ■

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This article is based on a paper presented by Dr. Pepose at the 2018 ASCRS Symposium. Dr. Pepose is an advisor to AcuFocus, Bausch + Lomb, and J&J Vision.

Comprehending pseudophakic visual quality complaints

Understand what patients mean when they are 20/20 but also unhappy with their vision

By Daniel H. Chang, MD

(FIGURE 1) **Contrast and brightness at 100%**

(FIGURE 2) **Contrast and lighting affect ability to distinguish the edge of the optotype.**

WITH MODERN presbyopia-correcting IOLs, patients are generally quite happy with their quality of vision after surgery. Nevertheless, some patients are unhappy even with Snellen visual acuity of 20/20 or better. While it may sometimes be tempting to dismiss these patients as unreasonable or "crazy," understanding what makes these patients dissatisfied even with good Snellen visual is important for their proper management.

When using presbyopia-correcting IOLs, I always evaluate patients after the first eye is done before proceeding to the second eye. This way, I can address any potential visual quality and function issues prior to committing to the second eye. If a patient says things are "blurry," I first make sure that they are describing their best-corrected visual acuity in the pseudophakic eye. If they are still wearing old glasses or if they are being distracted by their cataractous eye, then proceeding with the second eye surgery makes sense. However, if they are indeed unhappy about the vision in the operative eye, I have them describe their symptoms in more detail.

Dissatisfaction with vision in spite of good Snellen acuity can be grouped into two primary causes: issues of edge-contrast (visual quality) and night vision symptoms (dysphotopsias). I distinguish these two categories by having patients describe the situation(s) in which they are unhappy with their vision. If their complaints are related to the sharpness of letters when looking at an eye chart, the issue is visual quality. If their complaints are primarily related to what they see around lights at night, the issue is dysphotopsia. In both cases, I try to correlate their descriptions with what I know is going on optically with the lens implant and eye.

VISUAL QUALITY: WHAT HAPPENS AT THE EDGE

Visual acuity is dependent on the ability to distinguish the edges of an optotype (such as an E on the eye chart). Both contrast (the difference in intensity between the background and the foreground) and brightness (light) help us to discern the edges. In an ideal situation, contrast and brightness are both at 100%, and there is no blur, providing a nice, sharp optotype and a high-quality visual experience (Fig 1).

Contrast and lighting are related. In the example above, when the light is dimmed, the optotype remains black while the background becomes darker, so the edge of the optotype becomes harder to distinguish. This is because the intensity difference between the foreground and background decreases (Fig 2a). Similarly, if contrast sensitivity is decreased, the optotype becomes lighter while the background remains white, so there is a corresponding reduction of intensity difference between foreground and background (Fig 2b). If lighting is dimmed in a low contrast state, the effect is compounded, and the optotype becomes even more difficult to see (Fig 2c). In general, if a patient is having trouble with contrast, the simplest thing to do is to turn up the light.

Blur can be thought of as a spreading of the transition between foreground and background (Fig 3). Instead of a sharp transition from black to white, the edge transition of the optotype becomes more gradual. As the amount of blur increases, the relative contrast at the edge decreases, making it increasingly difficult to distinguish a crisp separation between black-and-white (Fig 3 a, b, and c). Increasing illumination can help to some degree, but magnifying the object (e.g. by moving it closer) makes it easier to see (Fig 4a, b, and c).

Other times a patient might say the letter it-

Continues on page 30 : ***20/20 complaints***

take-home

- **Dissatisfaction with vision in spite of good Snellen acuity can be grouped into two primary causes: issues of edge-contrast (visual quality) and night vision symptoms (dysphotopsias).**

(FIGURE 3) **Blur is a spreading of the transition between foreground and background.**

(FIGURE 4) **Magnifying a blurred object makes it easier to see.**

(FIGURE 5) **Patients who describe "glows" or "shadows" may need more time for neuroadaptation.**

20/20 COMPLAINTS

(Continued from page 29)

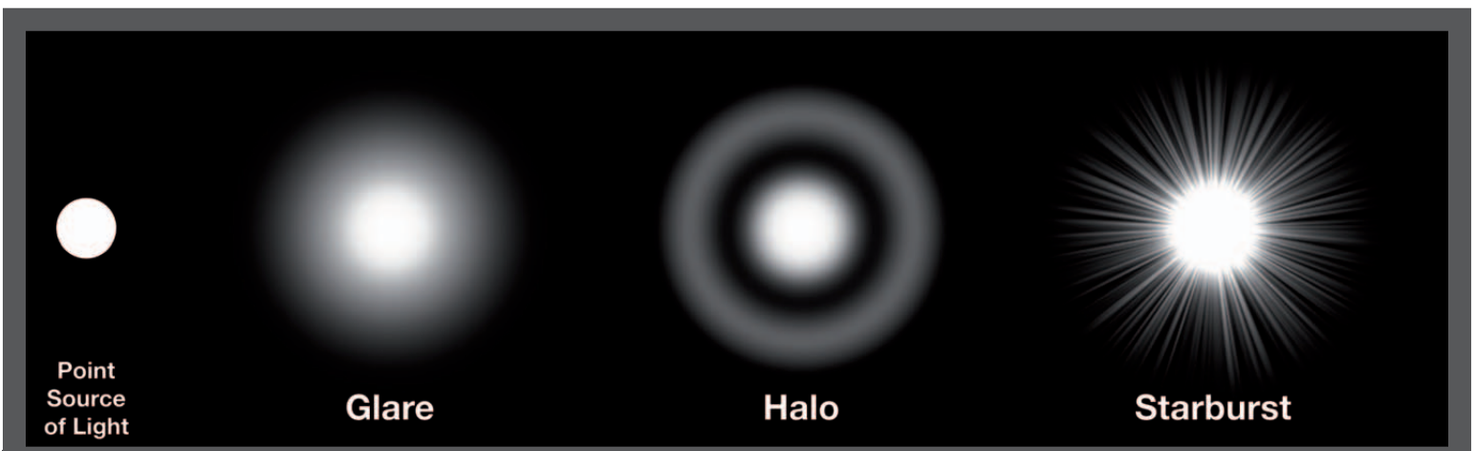
self is sharp but there's a "glow" or a "shadow" or "fuzziness" around it (Fig 5). This can occur in patients with multifocal IOLs or even extended-depth-of-focus (EDOF) IOLs. Since there is a sharp edge present, patients with these symptoms typically have good visual acuity and function and basically need reassurance and time for neuroadaptation. Even in a discerning, Type A patient, the process of neuroadaptation can take several months, rarely needing an IOL exchange for improvement.

With any of these manifestations of "blurry" vision, one should always look for possible secondary causes such as residual refractive error, dry eye, posterior capsular opacification (PCO), and cystoid macular edema.

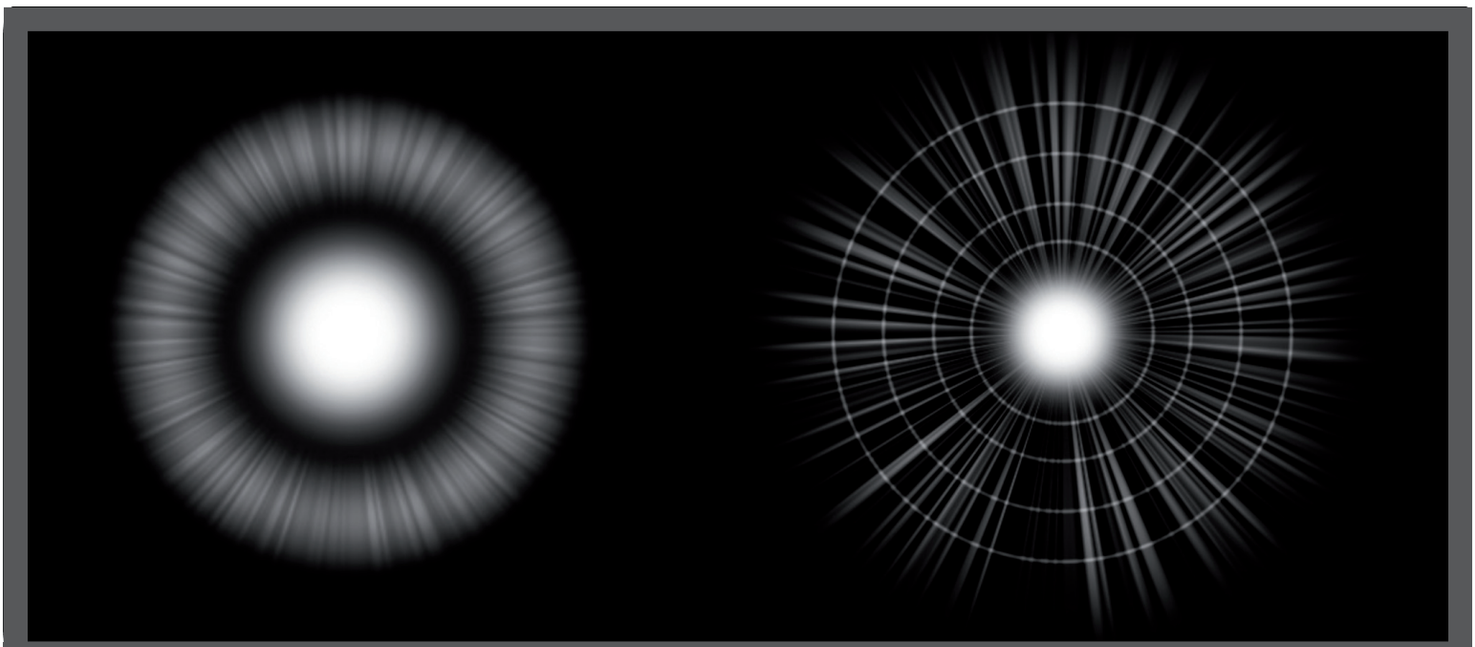
DYSPHOTOPSIAS: VISION IN THE DARK

Another reason that patients might be unhappy with objectively 20/20 vision is dissatisfaction with the quality of vision at night. Dysphotopsias are the result of out-of-focus light hitting the retina. Whether from ocular aberrations, lenticular light scatter, or pseudoaccommodating IOLs, dysphotopsias vary greater in brightness and appearance. For clinical trials, the FDA classifies dysphotopsias into three distinct categories: glare/flare; halo; and starburst. Each of these has a different appearance to the patient and occurs for different optical reasons (Fig 6).

Glare or flare, which may also be described as smearing or blur around the point source of light, can be due to refractive error, ocular surface problems, PCO, and nuclear cataracts;



(FIGURE 6) **The three categories of dysphotopsias that are especially bothersome at night occur for different optical reasons.**



(FIGURE 7) While diffractive multifocal IOLs can produce a single bright halo, diffractive EDOF IOL patients tend to describe starbursts and multiple fine concentric halos that produce a "spiderweb" effect. *(Photos courtesy of Daniel H. Chang, MD)*

and it is less likely to be directly associated with any particular IOL optics.

Halo, or a ring around the point source of light, is common with multifocal IOLs. These lenses have two focal points, which can be seen on a defocus curve as two peaks. Between the two peaks, there is a drop-off in energy distribution in the intermediate range. That dip in the defocus curve correlates with a dip in off-axis light, or the gap between the center and the ring in the halo. The size of the halo is related to add power, with larger halos associated with higher add powers.

Starbursts may be described by patients as streaks or rays of light emanating from the point source. These can occur with refractive error, ocular surface problems, posterior capsular folds/PCO, or diffractive IOLs.

Dysphotopsias can also occur in different forms and/or combinations (Fig 7). When looking at illustrations of dysphotopsias, it is important to recognize that the ability to represent dysphotopsias in a picture is limited by the contrast of the paper or display on which we view at the illustration. With only 256 levels of gray, our digital images are a far cry from the contrast ratios relevant to night vision, which can be greater than 1:1,000,000.

As new presbyopia-correcting IOLs become available, the differences in optics and design mean new trade-offs between depth of focus and dysphotopsias. For example, while diffractive multifocal IOLs can produce a single bright halo, diffractive EDOF IOL patients tend to describe starbursts and multiple fine concentric halos that produce a "spiderweb" effect. Overall, I have seen greatly reduced night vision complaints with EDOF IOLs as compared to multifocal IOLs, but I foster this with appropriate preoperative counseling.

> We have much more to learn about how our presbyopia-correcting IOL patients' visual experiences correlate to our traditional clinical testing results.

CONCLUSION

In conclusion, whether it's visual quality or dysphotopsias, we have much more to learn about how our presbyopia-correcting IOL patients' visual experiences correlate to our traditional clinical testing results. Instead of shunning patients with visual quality complaints following implantation of these lenses, we should embrace the opportunity to learn from their symptoms not only for how best to manage them, but also better to counsel future patients—and to create our next generation of IOLs to correct presbyopia. ■

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Clinical vs patient-reported outcomes in premium multifocal IOL patients

Study examined residual astigmatism, quality of life

By Steve Lenier; *Reviewed by Stephen J. Hannan, OD*

A STUDY BY Drs. Stephen Hannan and David Teenan of Optical Express compared the effect of postoperative residual astigmatism on clinical and patient reported outcomes in patients implanted with an extended depth of focus lens (Symfony, Tecnis, Johnson & Johnson Vision), and a segmental add multifocal intraocular lens (MF20, Oculentis). The preoperative and demographic characteristics of the two groups were similar, there were no statistically significant differences (Fig. 1).

The researchers found that at three months the lenses had similar postoperative clinical and patient reported performance. However, in the group of patients who had higher levels of postoperative residual astigmatism, those in the group receiving the Symfony lens reported greater satisfaction with their quality of life and willingness to undergo the procedure again than those receiving the MF20 lens.

At three months, residual astigmatism was not different between the IOL types, and there was no significant difference in the mean change in astigmatism (Fig. 2). There was also no statistically significant difference for the overall distribution of postoperative uncorrected distance visual acuities. It's possible some disparity or breakout may be present between the two lenses at the higher level of visual acuity, i.e. 20/16. (Fig. 3). Similarly, there was no statistically significant difference for the overall distribution of postoperative uncorrected near visual acuities, with some disparity or breakout possibly present between the two lenses at the higher level, i.e. N6.

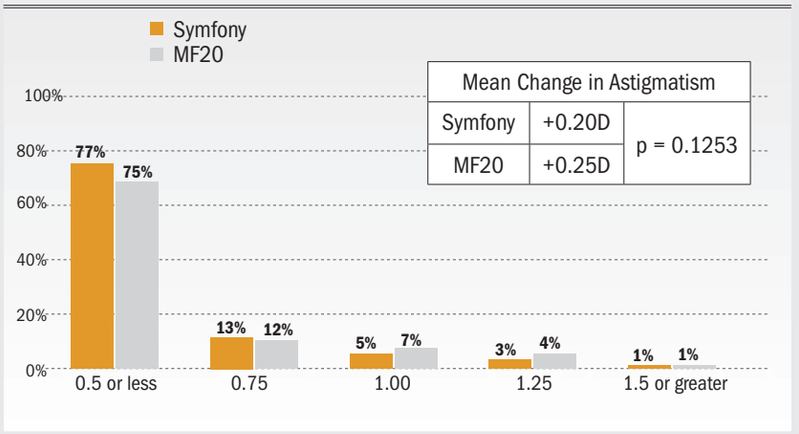
Overall, there was almost no difference when patients were asked if the surgery improved their quality of life. For the Symfony lens 90% responded yes, and for the MF20 lens 89% said yes. However, in patients who had higher levels of postoperative astigmatism, those who had a Symfony lens reported a greater rate of their life being improved (86%) than those with the MF20 lens (68%) (Fig 5).

The same results were seen when patients were asked if they would have the operation again, if they had it to do over. For both groups, 90% of patients said yes. But again, patients with higher levels of residual astigmatism reported a greater rate of willingness to have the procedure again if they had the Symfony lens (90%) over the MF20 lens (79%) (Fig. 6).

Figure 1: Demographics and preoperative clinical parameters

	SYMFONY	NF20	*P*-VALUE
Treatments (patients)	696 (408)	416 (260)	–
Age (years)	57 ± 7	56± 6	>0.05
Female/male (%)	49/51	52/48	>0.05
BVCA (logmar)	–0.05 ± 0.10	–0.04 ± 0.07	0.0298
K Difference (diopters)	0.67 ± 0.46	0.60 ± 0.47	0.0233
Myopic sphere (diopters)	–2.97 ± 2.07	–2.82 ± 2.04	>0.05
Hyperopic sphere (diopters)	+2.14 ± 1.37	+2.00 ± 1.40	>0.05
Preop cylinder (diopters)	–0.57 ± 0.44	–0.57 ± 0.43	>0.05
Myopia/hyperopia (%)	15/85	12/88	>0.05

Figure 2: Month 3 Residual Astigmatism



take-home

In a well-matched sample group, patients with higher levels of postoperative astigmatism reported a greater improvement in quality of life and a greater rate of willingness to have the procedure again if they received an extended depth of focus (Symfony, Johnson & Johnson Vision) IOL compared to patients receiving a low add multifocal (MF20, Oculentis) IOL, despite similar postoperative clinical and patient reported performance.

Figure 3: Month 3 Uncorrected Distance VA

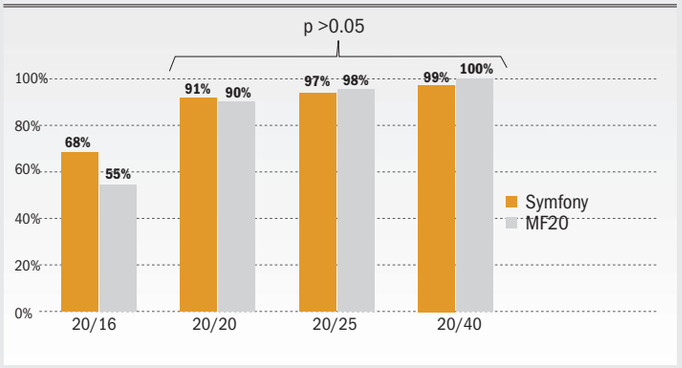


Figure 4: Month 3 uncorrected near VA

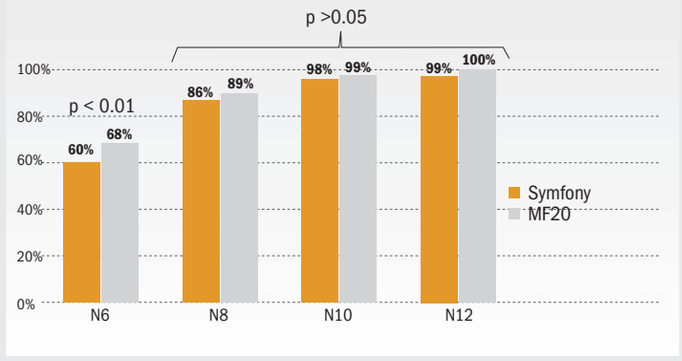


Figure 5: Has surgery improved your quality of life?

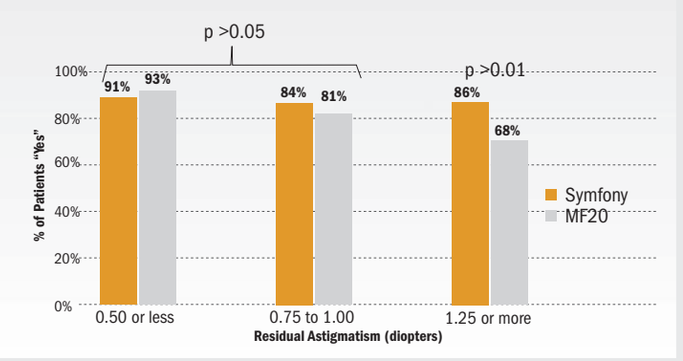
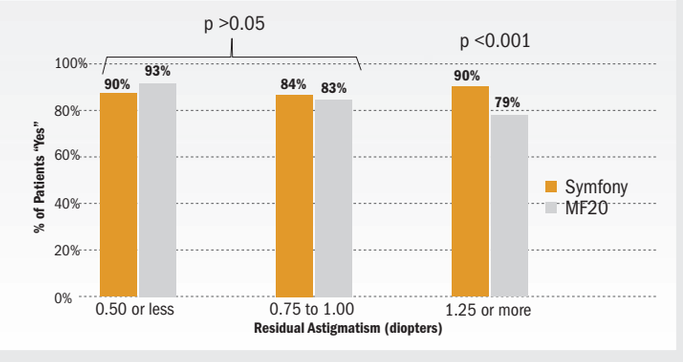


Figure 6: Thinking about your vision during the last week, if you had to do it over, would you have had vision correction surgery again?



SUMMARY

Patients in these two well-matched groups had similar clinical and patient reported results after three months, whether they received a Symfony IOL or an MF20 IOL. However in the group receiving the Symfony IOL, those with higher levels of residual astigmatism (>1D), had an increased likelihood of reporting that the procedure had improved their quality of life, and would also be more willing than others to have the procedure again.

The authors pointed out that a limitation of this study is that the proportion of patients with residual astigmatism for both groups is relatively small in this dataset, approximately 5%. They said their next step is to examine a larger sample of treatment data so the subgroup with higher levels of astigmatism can be examined further.

Stephen Hannan added that with increasing patient expectation being found today, factors such as an understanding of the tolerance to low levels of residual astigmatism will play a greater role in the lens selection decisions made by clinicians. ■

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This article was adapted from a presentation that Dr. Hannan presented at 2017 American Society of Cataract and Refractive Surgery meeting. Drs. Teenan and Hannan reported no financial disclosures regarding this study.

OCULUS incorporates OCULUS Brasil in São Paulo

OCULUS OPTIKGERÄTE GmbH, Germany, has incorporated OCULUS Brasil Comercio Importação Exportação e Serviços de Equipamentos Médicos LTDA as its 10th international subsidiary. Ideally located in São Paulo, OCULUS Brasil will support new and existing customers throughout Brazil.

OCULUS Optikgeräte GmbH took ownership of the majority of the capital of ODA Brasil, their exclusive dealer for OCULUS surgical products in Brazil. Enrico J. Nitschke, Managing Partner and CEO of OCULUS Brasil is pleased about the addition of diagnostic devices to the company's portfolio: "We are building upon the strong heritage of our parent company in Germany by providing ophthalmologists and ophthalmic surgeons with innovative, high-quality ophthalmic products 'Made in Germany´ together with the highest level in customer support." ■

New design gives premium results from non-premium IOL

Improved surgical efficacy and patient satisfaction for the MX60E

By Fred Gebhart

THE LATEST MEMBER of the Bausch+Lomb enVista intraocular lens family is getting rave reviews from early users. The MX60E opens in about 20 seconds compared to 2.5 minutes for previous versions as well as providing superior intermediate vision results.

"Of my first 45 patients, 97.7 percent were 20/30 uncorrected intermediate and 62 percent were 20/25," said Dee Stephenson, MD, the first surgeon to use the enVista MX60E. "Thirty-five percent were 20/20 and 100 percent were 20/40 or better. This was in all takers, no astigmatism correction, just a monofocal IOL. It's not a premium lens, but you could almost use it as a premium lens because it gives you such great intermediate vision. Eighty-six percent of all of my patients can read their hand-held devices without glasses."

Dr. Stephenson

Dr. Stephenson reported more detailed results on a large cohort of patients at the American Society for Cataract and Refractive Surgery annual meeting in April, 2018.

The newest enVista is glistening-free, Dr. Stephenson continued, and is highly resistant to scratches created while the lens is being loaded in the injector or during insertion into the eye.

> 'The newest enVista lens was developed with surgeons and patients in mind to address shortcomings of current monofocal IOL platforms.'

"When you see those forceps marks or scratches after the lens unfolds, you know they aren't going away," she said. "They can be visually impairing and you can't do anything short of replacing the lens. This lens just doesn't seem to scratch."

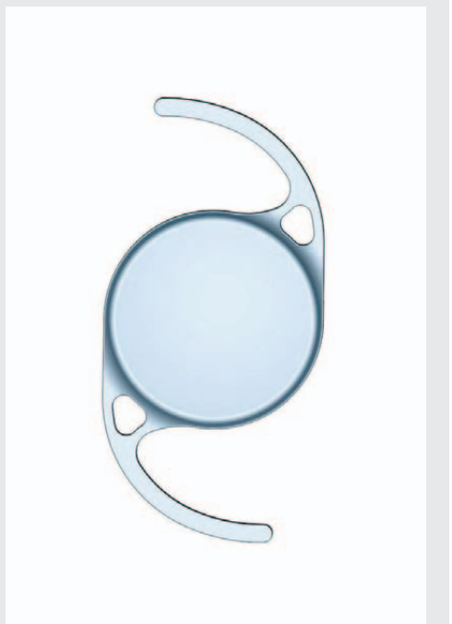
The MX60E is the latest member of the enVista IOL family to be approved for use in the United States and to reach the market. A similar toric lens has been approved for use in the European Union. B+L is looking to include a toric offering on the same platform in the United States in the near future.

Advantages like a scratch-resistant surface and faster opening time didn't happen by accident. B+L has been modifying the enVista platform based on surgeon feedback.

"Surgeons had three key things they wanted to have addressed by the next generation of monofocal IOLs," explained Chuck Hess, Vice President and General Manger, US Surgical, for Bausch+Lomb. "They wanted lens technology that provided better performance from a centration and stabilization perspective. They wanted an optic that was free of glistenings and scratches. And they wanted a lens that went into the eye and opened rapidly to allow them to improve efficiency. The next generation MX60E addresses all three of these shortfalls in current monofocal IOL technologies."

Design tweaks in the MX60E provide better centration and stabilization than other IOLs, Dr. Stephenson noted. The new haptics are angulated at 56 degrees to provide total coverage of 112 degrees. enVista provides the broadest capsular contact angle of the three IOL platforms available in the US market, Mr. Hess noted. The broader contact surface increases stability within the capsule both during and after healing.

"That 110 degrees is more than half the bag, which makes this lens amazingly stable in the eye," Dr. Stephenson said. "Even if you have a zonular weakness or a bag that isn't perfectly centered, this lens will center very nicely, almost like it has its own CTR built into the platform. The Tecnis haptics only cover 84 total degrees and the Acrysof 88 degrees. With 110 degrees, the enVista centers very nicely almost on its own."



(FIGURE 1) The new enVista IOL MX60E from Bausch+Lomb.

The enVista also has a 360 degree square edge versus the rounded edge used by other manufacturers. The square edge does a better job preventing lens epithelial cell migration compared to other designs, Dr. Stephenson explained. The lens is aspheric and does not introduce any negative or positive dysphotopsia and the power is the same from center to edge, which provides a comfortable margin of error if the lens is less than perfectly centered.

The hydrophobic acrylic material that forms the enVista platform is 16 times harder than comparable lenses, Mr. Hess said. Designers tweaked the molecular structure of the acrylic used to eliminate the tiny voids that create glistenings as the lens material absorbs moisture.

The rapid opening speed has nothing to do with visual results and everything to do with surgical efficiency. Earlier enVista lenses took about 2.5 minutes to fully open. Surgeons could reduce the opening time by warming the viscoelastic used during the insertion process, but it

Continues on page 35 : ***MX60E***

MX60E

(Continued from page 34)

was still a long wait for the newly inserted lens to unroll after it had been inserted.

"We no longer have to warm the viscoelastic to speed opening and the MX60E still opens faster than any other acrylic IOL on the market," Dr. Stephenson said. "That can be a real time savings for the surgeon."

Visual results with the new lens are outstanding, she continued. In addition to the surprisingly strong intermediate results, she is seeing very good close results, with about 66 percent of eyes at Jaeger 5.

"I have several patients who are 20/20 J1 near vision and 20/20 intermediate," she said. I have some patients doing as well as with premium lenses, if not better. The quality of vision is great, no haloes or glare, no induced dysphotopsia. This is my go-to lens for any post refractive patient who doesn't have astigmatism." ■

MPOD Measurement Approved for Category III CPT Code

THERE ARE MANY different levels and categories of medical instrumentation. As each new piece of equipment undergoes evaluation and becomes more common, the American Medical Association (AMA) assigns codes depending on where the machinery is in its research and validity journey. EyePromise® is proud to announce that macular pigment optical density (MPOD) measurement by heterochromatic flicker photometry (HFP) has earned the AMA's Category III CPT code, and it's listed under code 0506T.

WHAT IS HFP?

Heterochromatic flicker photometry is a noninvasive diagnostic test to measure MPOD. The macular pigment is made up of zeaxanthin and lutein, and these carotenoids protect the retina and shield it from harm caused by damaging light waves known as short-wavelength, high-energy, visible blue light. Damage from blue light has been linked to the development of age-related eye health concerns, and the National Eye Institute (NEI) expects a 50% increase in these concerns in the US by 2020.

WHO SHOULD BE TESTED?

Patients at risk for developing of age-related eye health concerns are candidates for HFP, but it's recommended to start testing patients over 21 to detect any eye health changes early. MPOD measurements are an objective tool for estimating this risk, and MPOD can improve with nutraceuticals and changes in the diet to include foods rich in lutein and zeaxanthin. Central measurement on one eye is typically the only measurement necessary to get an understanding of macular pigment health.

HOW CAN I MEASURE MPOD?

EyePromise offers HFP MPOD measurement technology with the QuantifEye® MPS II. Proven to have 97% repeatability, the instrument takes about 2–3 minutes per patient and includes intuitive technology with icon-driven menus and enhanced reporting for staff members and patients. Studies continue to show the accuracy and reliability of the QuantifEye MPS II, including:

- Case Report of Dietary Supplements Improving Macular Pigment and Visual Function (Herman, Kleiner-Goudey, Davis — *Advances in Ophthalmology and Visual System*: January 2017)
- The Value of Measurement of Macular Carotenoid Pigment Optical Densities and Distributions in Age-Related Macular Degeneration (Bernstein, et. al.—*Vision Research*, 2010)
- Desktop Macular Pigment Optical Density Measurement: A New Approach Based on Heterochromatic Flicker Photometry (Berendschot, et. al.—*E*, volume 25)

The QuantifEye MPS II has a small footprint, taking up little space in the office and little time with the patient. With the emerging science and continued research, MPOD measurement via HFP can be one of the most modern pieces of equipment an eye care professional can have in their practice. ■

Supported by unrestricted grants from REGENERON ZEISS

Pneumatic Retinopexy Performed by Vitreoretinal Fellows: A Multicenter Study

An examination of experience and success rates

Parisa Emami-Naeini, MD, MPH; Jordan Deanor, MD; Ferhina Ali, MD, MPH; Priyanka Chopra, MD; Richard Kaplan, MD; Kevin Chen, MD; Eric Nudelman, MD, PhD; Meenakashi Gupta, MD; Jeremy Wolfe, MD; Michael Klufas, MD; Glenn Yiu, MD, PhD; *Special to* Ophthalmology Times

BACKGROUND/PURPOSE

Pneumatic retinopexy (PR) is a minimally invasive, in-office procedure widely used for treatment of rhegmatogenous retinal detachment (RD). It is the second most common procedure performed for RD repair (after pars plana vitrectomy with or without scleral buckle). The single-procedure success rate (i.e. retinal reattachment after one PR) has been reported to be between 43.7%–93.5% with higher success rates in certain subpopulations (e.g. phakic eyes, single superior retinal break, etc.)

At academic institutions, vitreoretinal fellows commonly perform PR, which requires comparatively less supervision due to the relative simplicity of the procedure. Yet, success of the procedure depends on a myriad of factors including patient selection, examination skills, and manual dexterity that may improve with experience.

This is a multicenter study investigating the outcome of PR performed by vitreoretinal fellows from five different academic institutions.

METHODS

This is a retrospective, multicenter, consecutive case series of 457 eyes of 457 patients with primary RD who underwent PR by vitreoretinal fellows from 5 different institutions between 2002 and 2016. These institutes included: University of California Davis, Wills Eye Hospital, Associated Retinal Consultants (William Beumont Hospital), New York Eye and Ear Infirmary and University of California San Diego. We included patients with a follow-up of at least 3 months. Patients with prior history of intraocular surgery (except for uncomplicated cataract extraction) were excluded from the study.

RESULTS

Forty-nine vitreoretinal fellows from five institutions performed the procedures. Number of cases per institution ranged from 14 to 198 (median 71). Each fellow performed between 1–24 procedures (median 6.5 procedures/fellow). More than half of the procedures (65.8%) were performed by the first-year fellows. There was no statistically significant difference in the preprocedural characteristics of first- and second-year cases (i.e. age, gender, lens status, status of the macula or size of RD in clock hours).

Mean age of patients was 63.54 years (SD 10.87y) and 65.2% (298 patients) were female. Most of the patients (328, 71.8%) were phakic. RD was macula-sparing in 60.2% of patients (n=275).

Single-procedure success rate was 66.7% at 3 months. No statistically significant difference was found in outcomes of cases performed by first- or second-year fellows ($P=0.21$). Pseudophakic status and macular involvement at baseline were not associated with worse outcomes in this series ($P>0.05$).

We then categorized the cases based on the experience of the fellows performing them (i.e. number of the cases performed by each fellow). We found that single-procedure success rate is highest for the fellows with higher number of cases (70.7% for fellows who performed 15 or more procedures vs. 59.3% for fellows with 8–14 procedures and 59.3% for fellows with 7 or fewer procedures; $P=0.06$). Logistic regression analysis showed that the only factors associated with lower anatomic success at 3 months were size of the detachment ($P=0.002$) and number of cases performed by the fellows ($P=0.03$).

CONCLUSION

Anatomic outcomes of PR in the hands of vitreoretinal fellows in-training compared favorably with the previously reported literature and cases performed by skilled retina specialists. Fellows performing more procedures had higher single-procedure anatomic success rate.

These results have important implications in further development, improvement and standardization of fellowship training curriculum. ■

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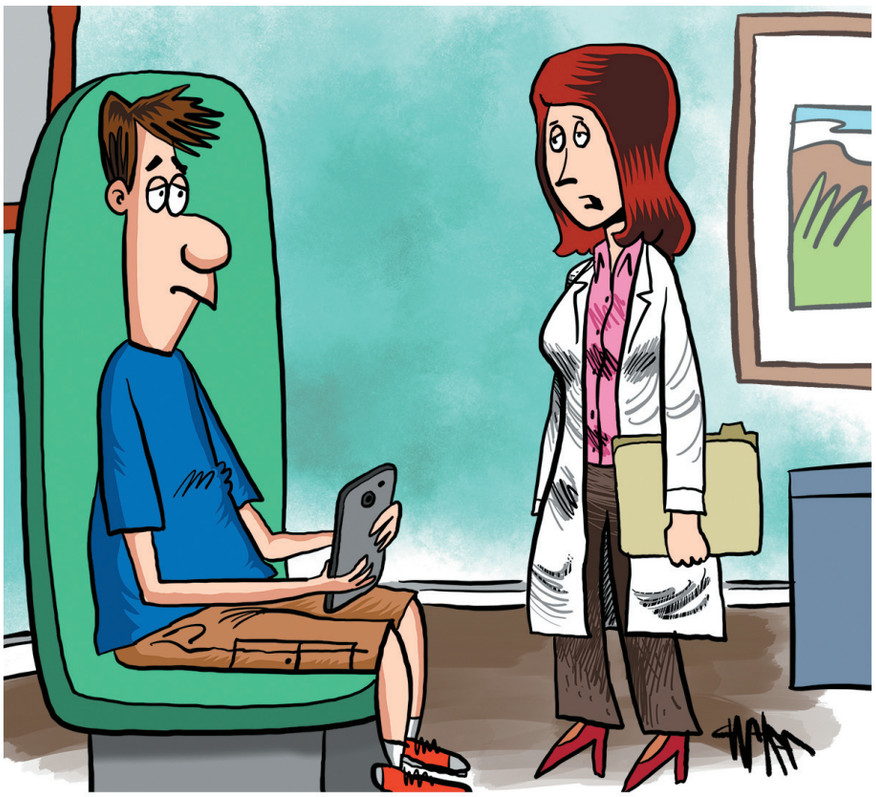

"You can't cure your eye strain by switching to a smartphone."

Artwork by Jon Carter

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in case you missed it

Neuroregeneration and stem cells: The new glaucoma frontier PAGE 12

Mixing multifocal IOLs for maximum performance PAGE 21

Picking up good vibrations: Miniwell EDOF IOL PAGE 22

Clinical versus patient-reported postop outcomes in premium IOL patients PAGE 32

Ophthalmoplegia outcomes vary
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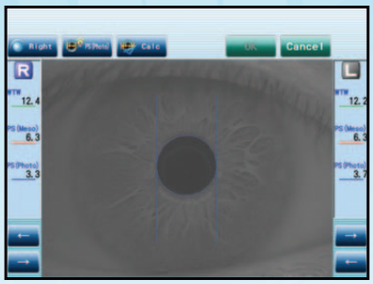

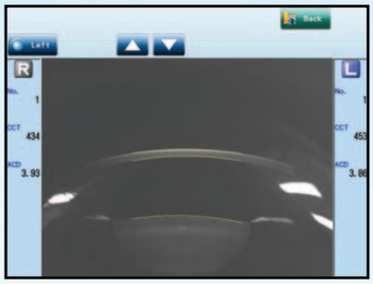

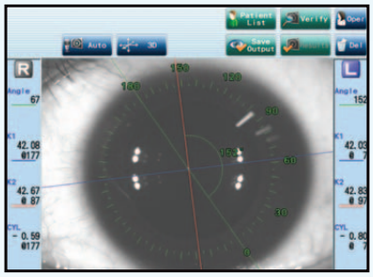

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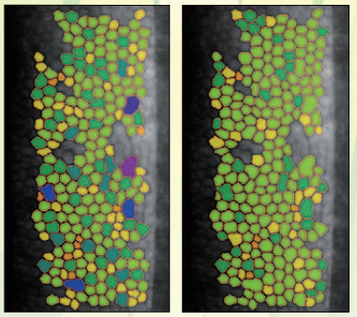

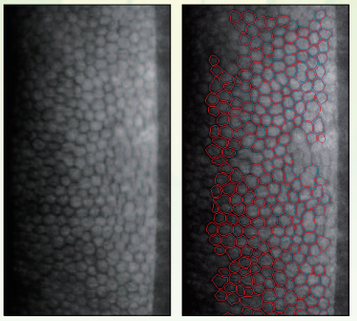

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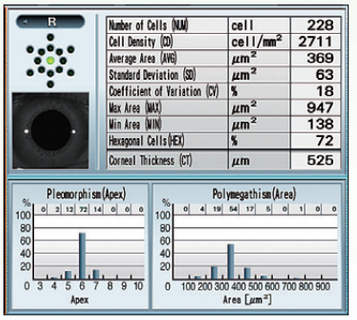

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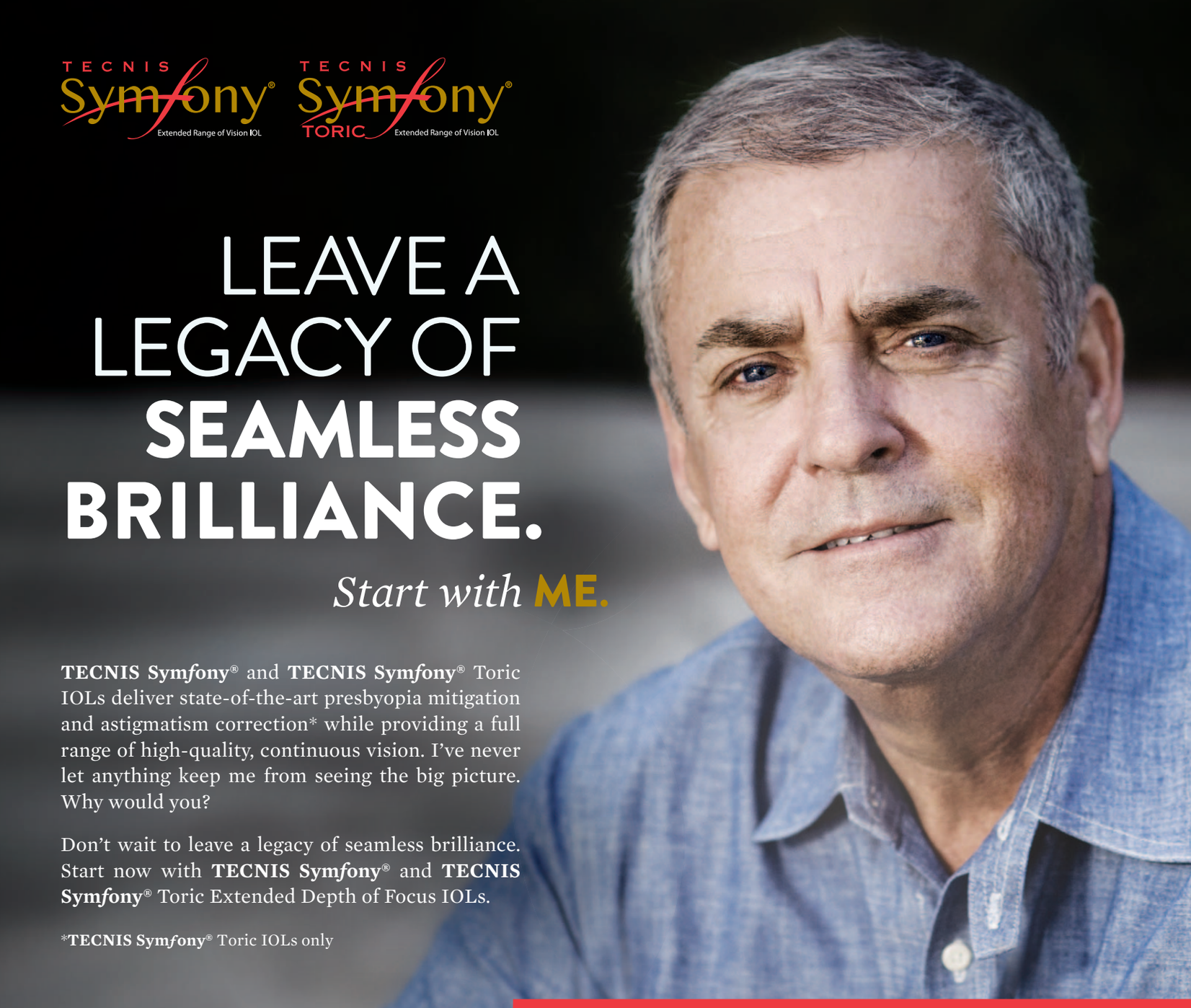

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