Therapeutic Review: *Finally, a Treatment for EKC?* **PAGE 90**

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December 15, 2017

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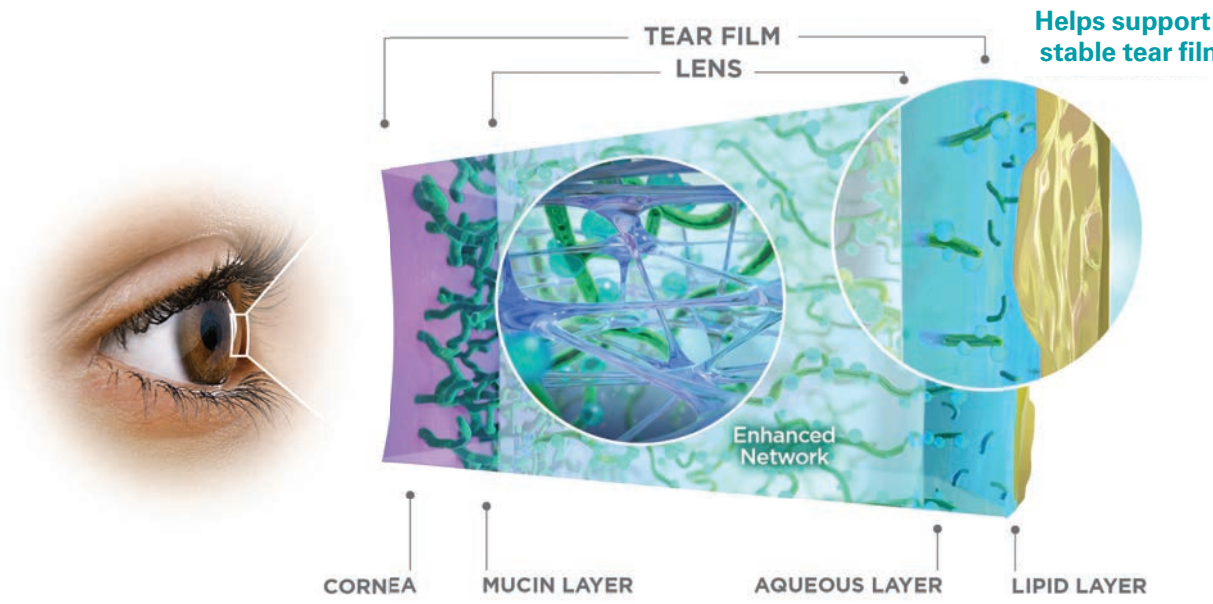

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VOL. 154 NO. 12 ■ DECEMBER 15, 2017

IN THE NEWS

The **five-year risk** of developing **age-related macular degeneration** (AMD) is **decreasing** with each generation, according to a new study. Researchers analyzed data from 4,819 Baby Boomers and their adult children from the Beaver Dam studies and found **the risk of AMD decreased by a relative 60% for each generation**. Researchers have yet to discover the factors contributing to this decline.

Cruickshanks KJ, Nondahl DM, Johnson LJ, et al. Generational differences in the 5-year incidence of age-related macular degeneration. JAMA Ophthalmol. November 16, 2017. [Epub].

Research now suggests **donor corneal tissue can be stored for 11 days** before implantation—four days longer than the current protocol of seven days. Investigators looked at 1,090 people (1,330 eyes) that underwent DSAEK at 40 different surgery centers and found a 92.1% three-year success rate for corneas preserved eight to 14 days, and 95.3% for those preserved up to seven days. Further analysis revealed much of the difference between the groups came from corneas preserved 12 to 14 days.

Lass JH, Benetz BA, Verdier DD, et al. Corneal endothelial cell loss 3 years after successful descemet stripping automated endothelial keratoplasty in the cornea preservation time study. JAMA Ophthalmol. November 10, 2017. [Epub].

Clinicians now have a better idea of population-based estimates of diplopia in the United States, thanks to a new study. Researchers found **diplopia accounts for roughly 850,000 yearly doctor office and emergency department (ED) visits.** While life-threatening diagnoses were rare in the ambulatory setting, approximately 16% of the ED visits resulted in a diagnosis of stroke or transient ischemic attack.

De Lott LB, Kerber KA, Lee PP, et al. Diplopia-related ambulatory and emergency department visits in the United States, 2003-2012. JAMA Ophthalmol. October 26, 2017. [Epub].

New Neuroprotective Target in Glaucoma

Lowering IOP may one day take a back seat to a more direct treatment strategy. **By Rebecca Hepp, Managing Editor**

A new study suggests lipid mediators found in the inner retina may be a key to halting glaucoma progression.[1] Using a rodent model, researchers at the University of California–Berkeley and the University of Toronto found that lipoxins—inflammation-regulating lipid mediators—secreted from astrocytes stopped retinal ganglion cell (RGC) degeneration. While lipoxins are known to be anti-inflammatory, the researchers were excited to uncover their neuroprotective abilities.[1]

After discovering lipoxin A_4 and B_4 secretions in the retina and optic nerve head, the researchers wanted to test their treatment potential. They administered them to rodents eight weeks after the onset of glaucoma-like damage and neurodegeneration and found injecting either lipoxin A_4 or B_4 provided sufficient neuroprotection; conversely, inhibiting key lipoxin pathway components exacerbated the damage from injury.[1] At 16 weeks, they found that lipoxin B_4, in particular, stopped RGC degeneration.

"At rest, astrocytes provide a host of neurotoxic and neuroprotective mediators to neighboring RGCs, but during acute or chronic injury the neuroprotective response is suppressed," says Brian D. Fisher, OD, who practices at the Villages VA Outpatient Clinic in the Villages, Fla. "In the study's glaucoma model, the administration of the specific lipid mediator LXB_4 showed a preservation and restoration of both RGC function and retinal nerve fiber layer structure."

The researchers have already filed a patent application and hope to one day start clinical trials. If successful, it could finally address the neurodegeneration of glaucoma directly instead of through the proxy of IOP.

"With glaucoma being a leading cause of blindness worldwide with no definitive cure, the results from this show promise for a therapeutic breakthrough," says Dr. Fisher. "If we can control intraocular pressure and provide neuroprotection to our patients, we would have less visual impairment caused by glaucoma, and keep our patients functional."

"Neuroprotection has long been the Holy Grail of glaucoma management, but thus far everything has fallen short," says Joseph W. Sowka, OD, a professor at Nova Southeastern University College of Optometry. "Now, it certainly seems possible to be able to one day use such a novel treatment, likely in conjunction with conventional IOP lowering therapies, in a holistic management of glaucoma."

1. Livne-Bar I, Wei J, Liu H, et al. Astrocyte-derived lipoxins A4 and B4 promote neuroprotection from acute and chronic injury. J Clin Invest. November 6, 2017. [Epub ahead of print].

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AMD: Supplement Regardless of Genotype

Recently, after re-analyzing data from the Age-Related Eye Disease Study (AREDS), researchers found no evidence to suggest any genotype-treatment interactions, bringing into question if clinicians should still refrain from prescribing them for patients with age-related macular degeneration (AMD) of certain genotype subgroups.[1] The results were presented at the Annual Meeting of the American Academy of Ophthalmology in New Orleans, Nov. 11-14, 2017.

The researchers looked at 879 AREDS participants for whom the same CFH and ARMS2 single nucleotide polymorphisms were available. The study took a three-pronged approach: One team focused on data concordance between conflicting studies; another focused on replicating the interaction between genotype and treatment found in previous reports; and the third group looked at baseline predictors of treatment response.[1]

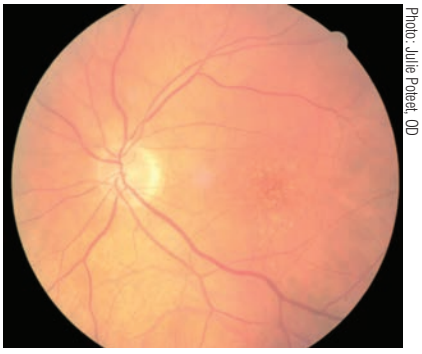

Photo: Julie Poteet, OD

Based on the AREDS classification system, this eye qualifies as intermediate AMD and would benefit from supplementation.

After crunching the numbers again, the investigators realized errors existed in the data used to support the notion of a genotype-treatment interaction. Together, the three groups were unable to replicate any genotype-treatment interaction, although they did discover treatment was more beneficial for high-risk patients.[1]

"Even if we assumed that interactions in fact did exist, we did not find evidence to support the claim that supplementation leads to a large increase in the risk of advanced AMD in some genotype subgroups," the study reads.[1]

Given this new evidence, the researchers suggest supplementation should be recommended for any patients who meet criteria for supplementation with zinc and antioxidants, regardless of genotype.[1]

"This study seems to have approached this controversy in a very rational way to come up with an unbiased conclusion," says Mohammad Rafieetary, OD, a consultative optometrist at the Charles Retina Institute. "I personally agree with their conclusion; however, I don't think the debate over this issue, as well as the appropriate zinc dosing and the correct benchmark to start the patient (i.e., at risk vs. those with AMD), will go away anytime soon."

Combo Therapy Helps with PEDs

A new study adds to the body of evidence suggesting autologous serum eye drops (ASEDs) in combination with silicone hydrogel contact lenses (CLs) can lead to successful re-epithelialization for post-infectious persistent epithelial defects (PEDs).[1]

"Each of these therapies have been used independently for treatment of this condition, and several small case series had previously reported successful use of a combination approach with persistent epithelial defects," says Aaron McNulty, OD, who practices at Louisville Eye Center in Louisville, KY. "This report is novel because it applies a combination approach specifically to post-infectious persistent defects."

Researchers reviewed 12 cases of post-infectious corneal PEDs unsuccessfully treated with conventional medical management that were then treated with combined topical 20% ASEDs and silicone hydrogel CLs. They found all 12 PEDs had complete re-epithelialization within two weeks without adverse effects. They also noticed all 12 had improved best-corrected visual acuity with the decreased intensity of corneal scarring and reduced corneal edema.[1]

"This combination therapy is within the scope of practice of optometrists and represents an effective treatment for an often frustrating condition," says Dr. McNulty. In addition, even though this study describes treatment of a very specific type of epithelial defect, Dr. McNulty suggests clinicians may consider using this therapy for other persistent epithelial defects as well.

1. Wang WY, Lee YK, Tsai SH, et al. Autologous serum eye drops combined with silicone hydrogen lenses for the treatment of postinfectious corneal persistent epithelial defects. Eye Contact Lens. 2017;43(4)225-9.

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Gene Therapy Shows Promise For Inherited Retinal Disease

Patients diagnosed with Leber congenital amaurosis (LCA) may have a new treatment option to look forward to that has significant real-world implications. Researchers found that 27 of 29 patients treated with gene therapy, or 93%, experienced meaningful improvements in their vision, including light sensitivity and peripheral vision.

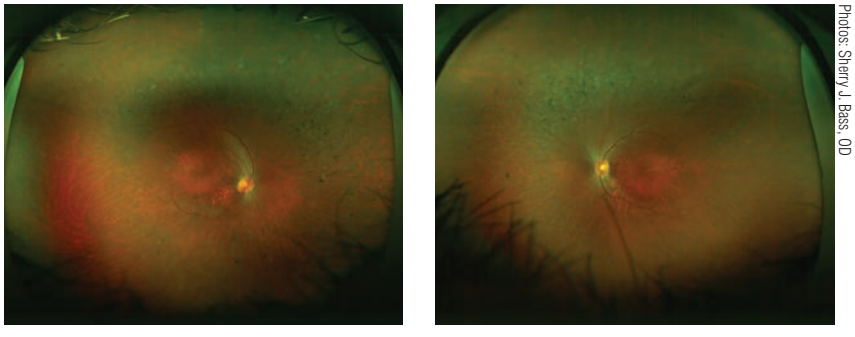
"Hard work and perseverance for the past decade by many researchers has finally resulted in the first commercial gene therapy to treat any eye disease," says Jerome Sherman, OD, a professor at SUNY College of Optometry. "LCA is considered one of the most devastating of all the retinal degenerations, since blindness is present at birth and is typically progressive."

The therapy involves the injection of billions of harmless viruses genetically modified to carry a healthy version of the gene to the retina.

Although the treatment does not restore normal vision, it does allow the patient to see shapes and light, which could give patients enough functional vision to move around without a guide dog or cane. So far patients have retained their improved vision for two years.

For the one in roughly 80,000 individuals diagnosed with LCA, the news is huge, according to researchers presenting the findings at the Annual Meeting of the American Academy of Ophthalmology in New Orleans, Nov. 11-14, 2017. No gene therapy for retinal disease—or any other eye disease, for that matter—has come this close to approval by the US Food and Drug Administration (FDA). This new treatment is currently under FDA review and could be approved soon, the researchers said.

"Clinicians need to be aware of LCA since effective treatment will shortly be available for at least LCA patients with the abnormal RPE65 gene," says Dr. Sherman. "Although RPE65 LCA is rare, the approval of an effective treatment gives hope to all patients with myriad other inherited retinal degenerations. For the first time in my five-decade career diagnosing such patients, I can now offer them hope. For those young patients, I tell them that I am (near) certain that a cure will be available in their lifetime." ■



Photos: Sherry J. Bass, OD

This 19-year-old patient, diagnosed with LCA at six months of age, has attenuated arterioles and bone-spicule pigmentation in the mid-periphery of both eyes.

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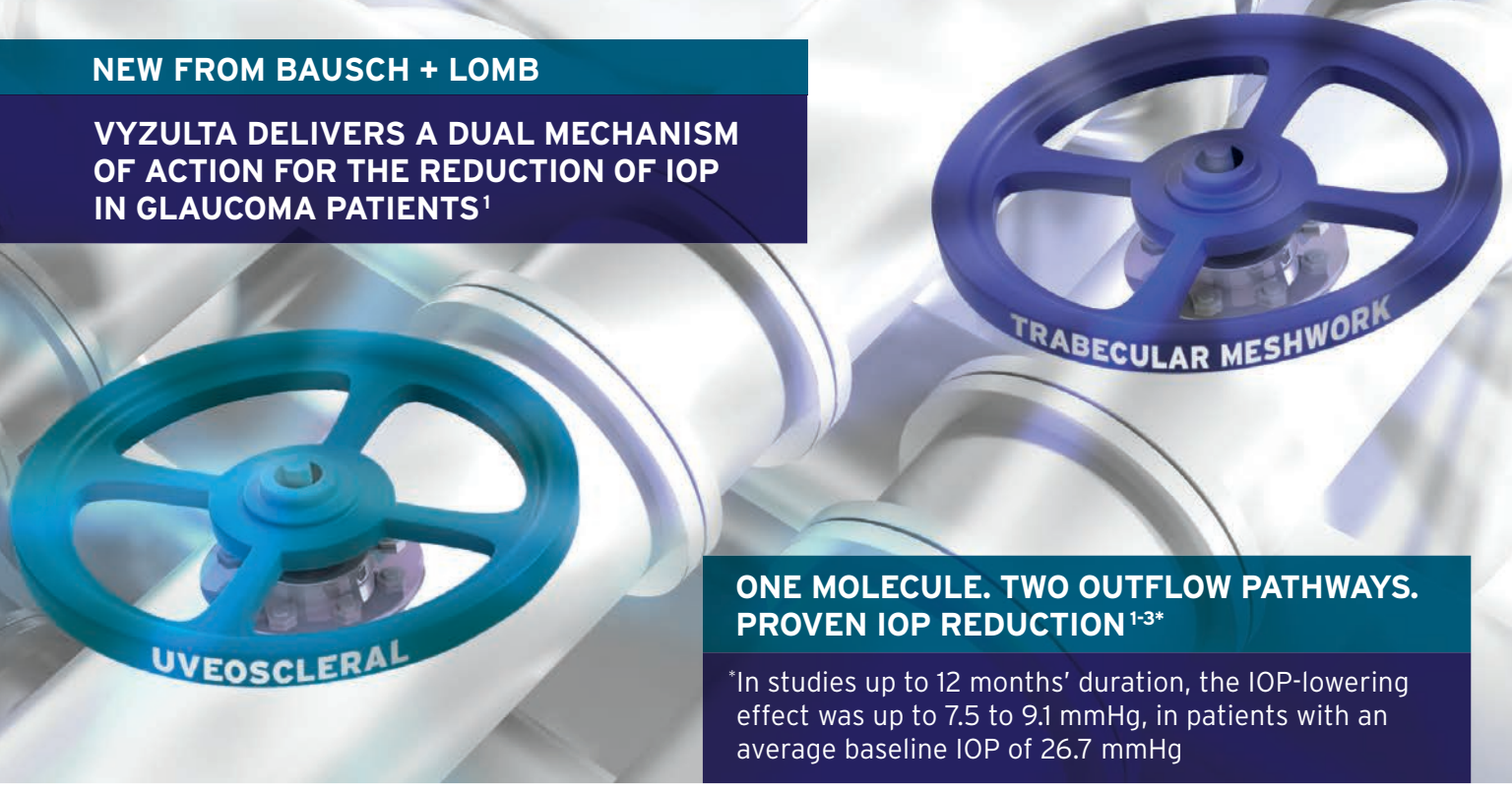
NEW FROM BAUSCH + LOMB

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

VYZULTA™
(latanoprostene bunod ophthalmic solution), 0.024%

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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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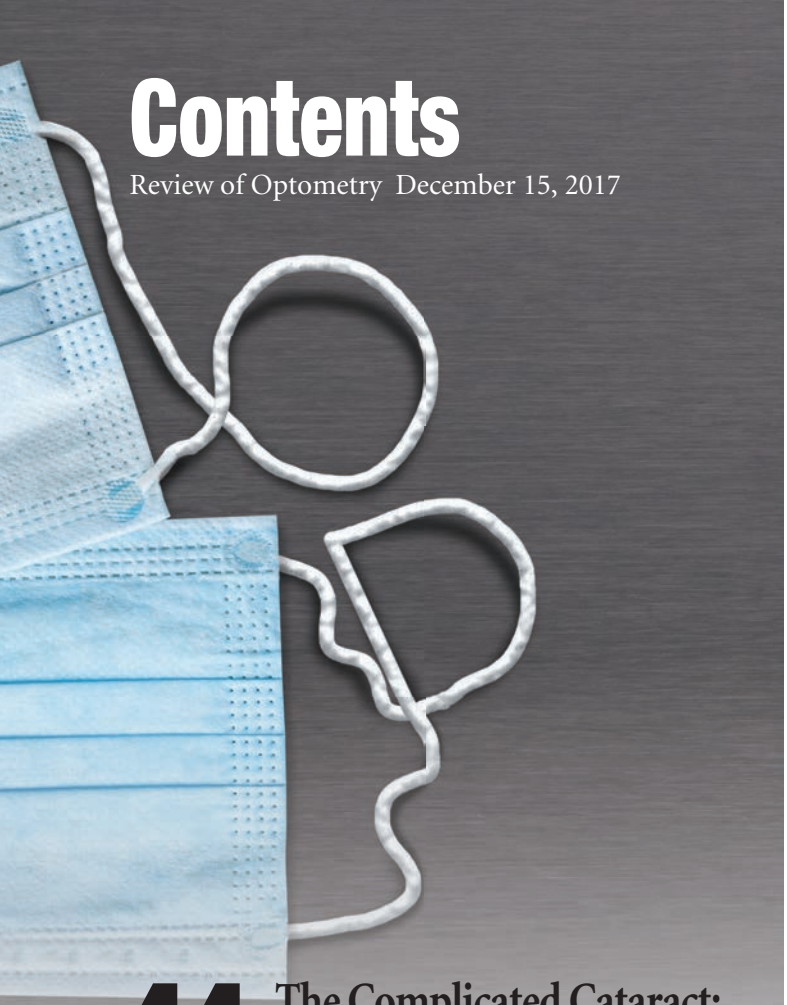

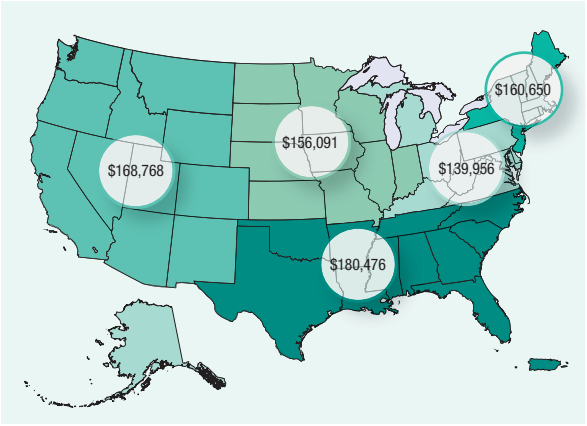

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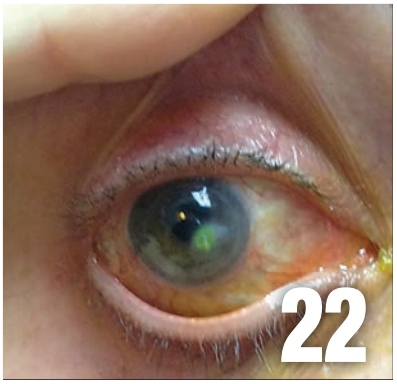

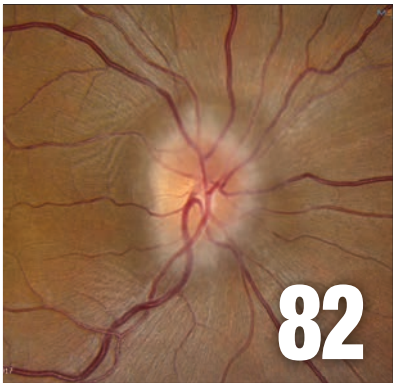

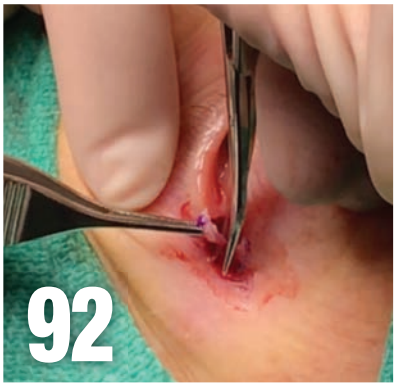

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Outlook

By Jack Persico, Editor-in-Chief

It Was a Very Good Year

No, not 2017—good riddance to it. But in 1995, laser refractive surgery became a reality, and ODs stepped up.

Few years were as momentous for refractive surgery as 1995. That year's FDA clearance of the excimer laser for photorefractive keratectomy (PRK) marks an inflection point for surgical remediation of refractive error. While 1978 brought US surgeons the Russian technique of radial keratotomy (RK) to flatten the cornea, the addition of a laser in 1995 eclipsed the rather crude incisional RK approach with a new level of predictability. It also turbo-charged interest in the very concept of refractive surgery. Suddenly, there was a high-tech gadget that was going to allow myopes to "throw away their glasses."

And *Review of Optometry* was there from the jump, debuting our annual surgery issue in January 1995 by kicking off a refractive surgery series that ran the first half of that year. While much of it was prescient and ground-breaking—we taught readers about surgical techniques, complications, the importance of understanding patient psychology and more—some of our coverage from 1995 has aged about as well as a Hootie and the Blowfish CD. Amazingly, we championed RK more than once as a viable option for low myopes. Imagine trying to offer eight-incision RK in today's era of ultra-precise, custom laser ablations. We also were excited about a flash-in-the-pan procedure for hyperopia correction called holmium laser thermokeratoplasty that didn't amount to much. A similar idea, conductive keratoplasty, didn't either. Such was life in the Wild West atmosphere of the time.

PRK hadn't even been approved yet in January 1995, but LASIK was already looming. Fred Kremer, MD, the prime mover behind LASIK in the early days, wrote about it for our first surgery issue before it even had its proper name. Terms used at the time: *laser automated lamellar keratoplasty*, *laser intrastromal keratomileusis* or its then-popular nickname *"flap and zap."*

Refractive surgery fever ran so high in 1995 that we actually billed our annual contact lens issue as "Alternatives to Refractive Surgery." Belated apologies to all the contact lens specialists who must've rolled their eyes at that one! An unrelated gem also found in the 1995 archives: a feature that used the phrase "information superhighway" without irony. Wow, just wow.

After the wild and wooly boom years of the 1990s and the inevitable backlash, a steady stream of iterative improvements honed refractive surgery to near perfection. Wavefront- and topo-guided LASIK leave few elements to chance these days. So it's harder to find good topics to dig into now, but we are honored to have two world-renowned Danish surgeons writing this month on the SMILE procedure, the first genuinely new technique since the early days. Perhaps it can build on LASIK's success and find new clinical gaps to close.

Mostly, though, our 23rd surgery issue centers on cataract surgery, which barely got a mention in 1995 but is currently where most of the action is—probably from those early RK patients reaching cataract status and needing extra attention. ■

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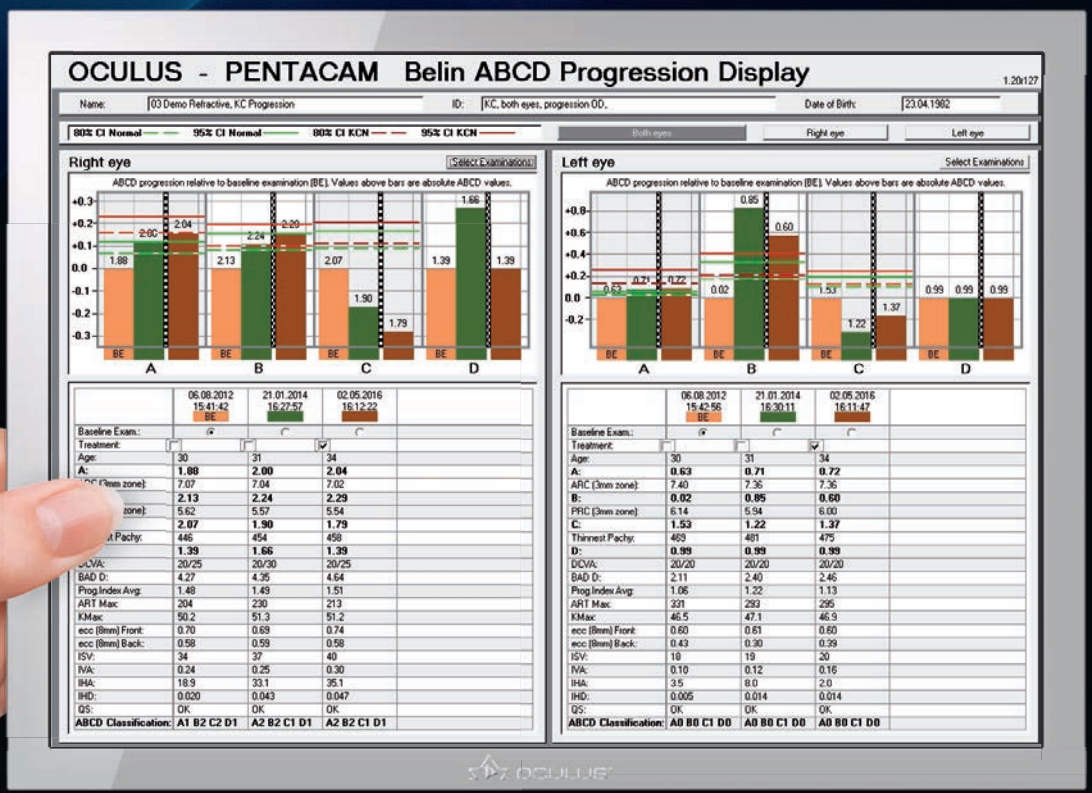

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Through **My Eyes**

By Paul M. Karpecki, OD, Chief Clinical Editor

Cataracts: Nobody Does it Better

An OD knows more about the patient's vision—and expectations—than a surgeon ever will. Let's use that strength for the good of all involved.

When a patient is referred for cataract surgery, the surgeon often only has time to see the patient for 10 to 15 minutes. No matter how astute they may be, it is unlikely they will learn as much about that patient's particular needs, idiosyncrasies and treatment successes and failures as the eye doctor who has cared for the patient for years or even decades. The relationship the long-term OD has with the patient is often the key to surgical success, especially considering the many premium intraocular lens (IOL) options available today. The choices are complex and the results are life-changing. Patients deserve the time, attention and insight that only an OD can offer.

Picking up the Mantle

America has a shortage of cataract surgeons, and that won't change any time soon. It's incumbent on us to assume the role of cataract quarterback. The trust is already there with your patients, and more will be seeking surgery as they age. The life expectancy for a patient at age 65 (a common age for cataract surgery) is in the upper 80s. That means at least 20 years of quality vision is riding on a once-in-a-lifetime decision. Consider the correction of astigmatism: glasses work but have distortions in the periphery, and while contact lenses have improved dramatically, they can still rotate and many elderly patients lack the dexterity or patience to deal with insertion and removal. For many patients, an IOL (which doesn't typically rotate) will provide the best vision when correcting astigmatism closest to the nodal point.

Although nearly 50% of the population may qualify for a toric IOL (defined as >1.00D of corneal astigmatism), only about 8% have pursued it.[1,2] Such a statistic is disheartening, given the years these patients could appreciate this vision, especially those with against-the-rule astigmatism, oblique or ≥1.25D of with-the-rule cylinder. Likewise, new presbyopic IOLs, such as extended depth of focus (EDOF) lenses, offer greater ranges of vision with fewer side effects than older designs.

Preparation is Key

Research shows the top reasons a patient is unhappy after cataract surgery include not treating underlying disease such as dry eye prior to surgery, residual refractive error (which could also be due to dry eye during the biometry measurements), not being aware of all options, not setting proper expectations or inappropriate IOL selection.

Because we are often the first to diagnose dry eye and we know more about who is an appropriate patient based on history, we are primed to nip these problems in the bud. The only remaining issue is understanding and discussing various IOL options and expectations, particularly for toric and presbyopic lenses. This is where ODs can up their game and better prepare patients with proper patient education.

Practice Building

Finally, ensure you are properly compensated for the extra testing (e.g., OCT, osmolarity, staining, topography) that goes into a premium IOL assessment and the time you spend educating patients. Remuneration should not be so high it would be construed as an inducement, but also should be more than the 20% of the basic Medicare fee alone, since it should reflect the extra preoperative work, advanced diagnostics and time involved in preparing patients who go on to pursue premium IOLs.

The recent approval of an IOL capable of being fine-tuned after surgery highlights the essential role an OD can play in cataract surgery. The Light Adjustable Lens (RxSight) reacts to UV light to alter its refractive power; applying doses of UV within a few weeks post-op can get the patient closer to emmetropia. Optometry could play the key role in determining what post-op correction is necessary and be compensated for this increased responsibility.

This month's annual surgical issue tackles the vital role we play in cataract comanagement, to help you take charge of the process from before it starts until after it's complete. The result is a more knowledgeable and better prepared patient, an ideal lens choice and visual results they can enjoy for the rest of their life. ■

1. McKendrick AM, Brennan NA. Distribution of astigmatism in the adult population. J Opt Soc Am A Opt Image Sci Vis. 1996 Feb;13(2):206-14.
2. Alcon Laboratories, Inc. www.myalcon.com/products/surgical/acrysof-iq-toric-iol.

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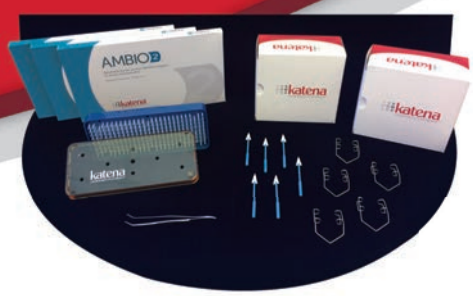
[1] Koob TJ, Lim JJ, Zabek N, Massee M. 2014. Cytokines in single layer amnion allografts compared to multilayer amnion/chorion allografts for wound healing. J Biomed Mater Res Part B 2014:00B:000-000



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Have a Seat, If You Dare

It's odd that a column called "Chairside" has never mentioned anything about the importance, in optometry, of chairs. **By Montgomery Vickers, OD**

I started thinking of my intimate relationship with chairs and how they have impacted my career and my patients, whether they have just been sat upon, bought, sold, thrown through the occasional TV set and so on. Here are my thoughts:

1. Medical stools. I must have owned and used over 30 different stools in my 39 years of practice, and I've concluded that you must spend at least $300 to get one that is even close to worth a darn. No, you misunderstand. *You* must spend that much, not me. I always bought the cheap stuff that left me on the verge of constantly tipping over. This gave me something to gripe about other than crappy vision plans.

2. Reception room chairs. All of them ultimately lead to horror as they become, sooner or later, filthy and full of whatever deadly germs every person surely carries and their snotty children spread about as they eat chili dogs beneath the sign that says "Please, no food" while the mom taps away at her phone beneath the sign that says "Please, no cell phones." Interestingly, I kept the same chairs in reception with a couple of re-upholsterings along the way. They were solid, made of real wood. They are still proudly sitting in the waiting room of my old practice. Using Kevlar for the upholstery was a good idea after all.

3. Mom's chair. This is the chair in the corner of the exam room for mom while her kid gets his eyes checked. If you saw a couple of inches off the front two legs it will at least seem like mom's leaning forward with interest when you explain little Bobby's astigmatism or, more importantly, why you don't allow smoking in the exam room.

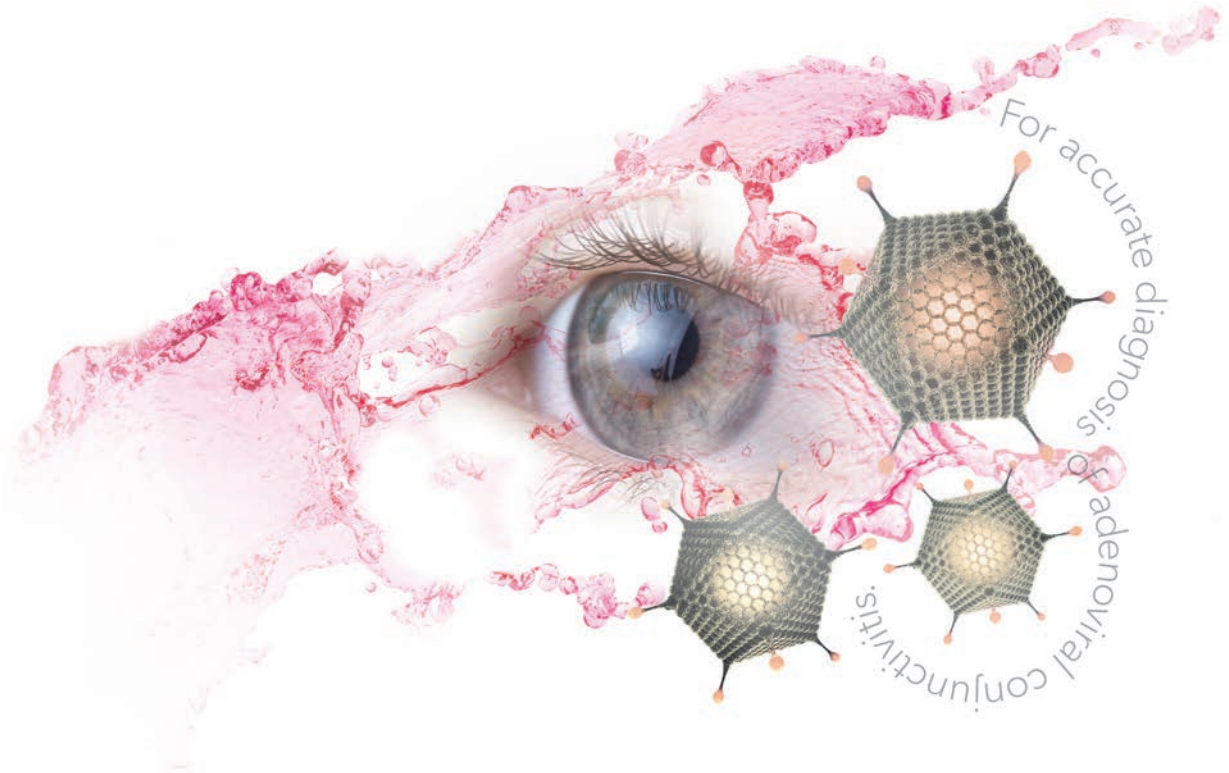
4. Office chairs. Your staff needs to feel comfortable and important. A decent chair makes a huge difference in attitude. If you don't get them a decent chair, you will be reminded all day as they groan, stretch, pop their spines and get nothing done. I really didn't care if they got anything done, but I didn't want to listen to the groaning, stretching and spine popping. After a couple months in the new, expensive chairs they will start griping again, so go ahead and order them some coccyx wedge pillows when you get a chance.

5. The exam room chair. Patients like a chair that looks clean and modern and has no rips and holes in the cushions. Too bad they don't make any like that. I guess that's why they invented duct tape.

6. CE room chairs. They should be heated. That's all I have to say about that.

7. Your patient's favorite chair. Progressive addition lenses (PALs) are one of the best advances in the history of eye care, right up there with prostaglandin analogs (PGAs). But at least the PGAs have a positive side effect when they make dad's eyelashes pretty. The side effect of PALs is that dad can't chill back in his lounger with a cold brew to watch the ball game. I am almost positive there is a spike in PAL non-adapts right after the Super Bowl. The future of favorite chairs does look bright, though, as the next generation either watches the game on some device in their lap or hangs their TV up above the fireplace, well out of the way of their near corridor and, coincidentally, in the exact spot that gives their aging optometrist father a permanent stiff neck.

Look at your office's chairs. Are they gross? As many butts have sat in them, they are a sign of true success in optometry—and an adventure in microbiology. Might be time to wipe 'em down at least, doc. ■



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The Diagnosis Was a Flop

When a patient presents with an unresponsive, irritated eye, don't head straight for the slit lamp. **Edited by Paul C. Ajamian, OD**

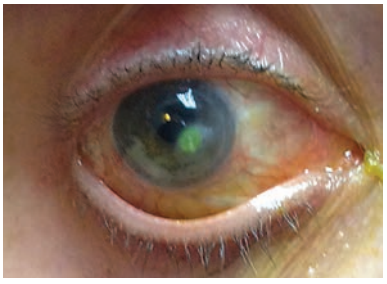
Q A middle-aged patient came to me with persistent central superficial punctate keratitis (SPK) in his left eye. After three doctors and weeks of artificial tears, steroids and antibiotics, he was still suffering. How do we solve this mystery?

A "With any patient who presents with keratitis or a red, irritated eye, always remember to evaluate the lids," says Leslie Small, OD, of the Bascom Palmer Eye Institute in Miami. "Have them look up while pulling on the lower eyelids, and down while pulling up the upper eyelids," she explains. This can help detect the less common condition of floppy eyelid syndrome.

Dr. Small follows a specific protocol to help guide her diagnosis. "I flip the eyelids, especially if it's unilateral SPK. If you see that the eyelids evert easily, this will help guide you in your diagnosis," she says, by indicating a problem with lid tonicity. In our patient, the left upper lid spontaneously everted just by pulling up on it. Dr. Small also suggests looking for sectoral injection by having the patient look in all fields of gaze.

Missed Connections

Why would doctors miss this condition? Dr. Small helps put the pieces together. Stated simply, "We tend to overlook the eyelids," she says. "We tend to go straight to the slit lamp—it's not super common for patients to have their eyelid elasticity checked by having them look up and down," says Dr. Small.



In cases of SPK that won't go away, be sure to perform a thorough exam of the eyelids, as they may reveal the problem—and uncover a serious underlying non-ocular condition.

When we see SPK, she says, "we automatically think dry eye disease (DED). Although floppy eyelid syndrome isn't a rare disorder, DED is much more prevalent and carries greater incidence rates," says Dr. Small. It may also be more symptomatic and bothersome for patients than floppy lid syndrome, although not necessarily.

Ask about history. Buddy Culbertson, MD, of Bascom Palmer Eye Institute, first described the condition; in a study of men who suffered from obesity and tarsal papillary conjunctivitis, the affected side corresponded to the way the patients slept. Practitioners should take a thorough history, as this is crucial to nailing down this diagnosis, says Dr. Small. "Asking about sleeping habits can help solidify the diagnosis of floppy eyelid syndrome, as the SPK could certainly be from trauma-induced sleep habits as in this case," Dr. Small says. Follow up questions on sleep apnea are important, such as a history of a sleep study or use of a continuous positive airway pressure machine. In this case, the patient admitted to snoring much of his life but had never been checked for sleep apnea. "When re-asked about how he sleeps, he later 'remembered' that he hugs his pillow with the left side of his face buried into it," according to Dr. Small.

A Solution to the Sag

If the patient is averse to surgical intervention in the form of lid tightening, for which Dr. Small is quick to refer—shielding the eye or eyes at night is the key to reducing the SPK and papillary conjunctivitis. "This involves keeping the eye protected from trauma so that the upper palpebral conjunctiva has time to heal," says Dr. Small. These patients will always need a referral for a sleep study.

Finally, think carefully about this condition as it applies to your cataract patients, says Dr. Small. "If you're going to be referring for cataract surgery, rule out floppy eyelid, as these patient are at increased risk for infection after surgery."

Floppy eyelid syndrome is correlated with sleep apnea, which as we know is a potentially fatal condition, says Dr. Small. While we're solving the sag, we're also facilitating intervention on a related condition that has potentially deadly consequences if left untreated. So, before going to the lamp, check the lids. It could save the life of your patient. ■

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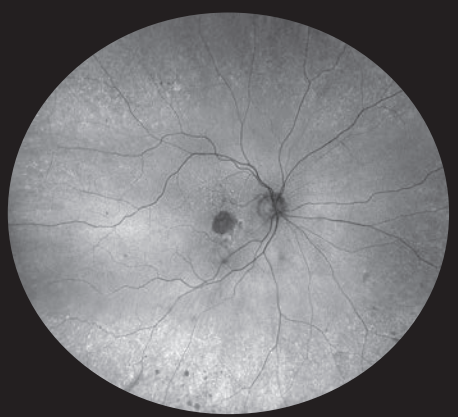

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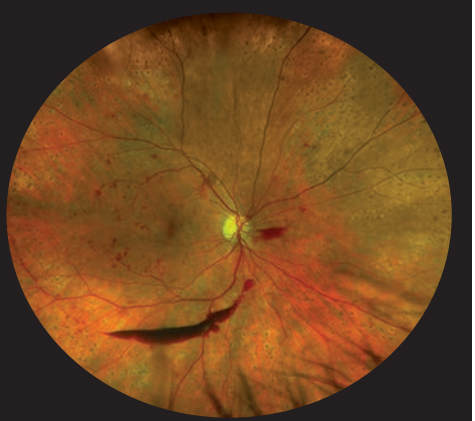

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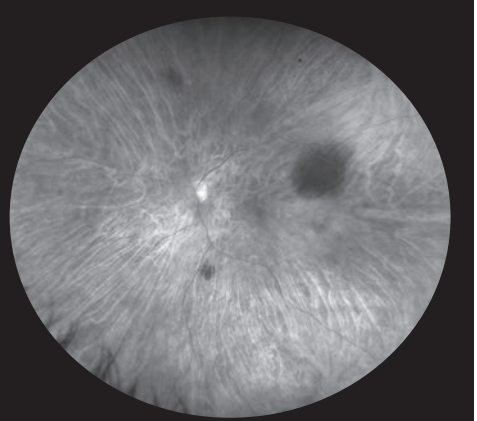

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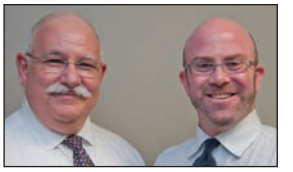

Take It to the Limit

In the pursuit of the best visual acuities for our patients, overminusing can do more harm than good—in the long run. **By Marc B. Taub, OD, MS, and Paul Harris, OD**

Early on, budding optometrists latch onto a drive to push for the highest level of visual acuities possible, and they take pride in providing their patients with ever-sharper visual acuity measures. This need for clarity, achieved with extra minus, can come at an expense. Too often, the extra few clicks of minus cause unintended nearpoint consequences. However, with careful attention, this does not have to be the case.

New Kid in Town

When Dr. Harris was a third-year student, he was playing in an orchestra next to a trombone player, Mike, who had strabismus and wore only one contact lens—he left the other eye uncorrected. Dr. Harris was given the opportunity to examine him to practice some of the clinical techniques he was learning.

Although his polymethyl methacrylate contact had not been checked in several years, his acuity through the contact was an excellent 20/20, while the other eye was much worse than 20/200. Dr. Harris performed an over-refraction of the eye with the contact and got a surprising +3.00, which also gave 20/20. Dr. Harris scratched his head and proceeded to have him remove the lens. His retinoscopy was close to +0.50, and his refraction was right around +0.25 to best-corrected 20/20+. When Dr. Harris measured the contact lens, lo and behold: It was right around

Facial expressions are a give away that a patient is over-minused.

-3.00. Dr. Harris asked Mike, "So, did you ever notice, when you first wake up in the morning, that you see fine without the contact lens?" To which Mike responded, "Oh yeah, but I really love when I put the contact on how small it makes things look."

He was supporting his musical career by being a computer programmer and, back in the day, you had to hack your system to go from 25 to 43 lines on the screen, which he had done. But, he really loved shrinking things even more with his contact lens. As Dr. Harris recalls, he had to step Mike down slowly out of the minus in a series of contacts, until his penchant for over-accommodating was quenched.

This experience, occurring as early as it did, sensitized Dr. Harris to be on the lookout for overminusing. Here, we'll highlight contemporary cases that reflect this overminusing trend.

Take it Easy

Significant visual stress that affects reading efficiency can quickly lead to asthenopic symptoms. Such was the case of a 22-year-old female who presented complaining of tired eyes and found herself holding reading material close to her, a hallmark sign of a patient suffering from significant visual stress.

The stats. In her glasses, the patient was wearing -3.50-0.50 x 090 in her right eye and -3.75 in her left; in two-week disposable contact lenses, she was wearing -3.50 in both eyes. Visual acuity was measured at 20/15 at distance and 20/20 at near in each eye. While wearing her glasses, her cover test was two prism diopters of exophoria at distance and eight prism diopters of exophoria at near. Her nearpoint of convergence, vergence ranges, accommodative amplitudes and stereopsis were all within expected ranges.

Her quality of life symptom checklist score was 25—when anything above a 20 is a red flag for an underlying visual issue. At her previous examination, her prescription had been increased by -0.50 in each eye despite her already seeing 20/15. The patient was a typical myope—she loved her minus.

Our testing showed that she could achieve 20/20 with far less minus than she was wearing. She was dispensed a trial of -3.00 in both eyes, and she was started on vision therapy (VT) because of her general binocular dysfunction. After

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Indications and Usage

BromSite® (bromfenac ophthalmic solution) 0.075% is a nonsteroidal anti-inflammatory drug (NSAID) indicated for the treatment of postoperative inflammation and prevention of ocular pain in patients undergoing cataract surgery.

Recommended Dosing

One drop of BromSite® should be applied to the affected eye twice daily (morning and evening) 1 day prior to surgery, the day of surgery, and 14 days postsurgery.

Important Safety Information

- **Slow or Delayed Healing:** All topical nonsteroidal anti-inflammatory drugs (NSAIDs), including BromSite®, may slow or delay healing. Topical corticosteroids are also known to slow or delay healing. Concomitant use of topical NSAIDs and topical steroids may increase the potential for healing problems.
- **Potential for Cross-Sensitivity:** There is the potential for cross-sensitivity to acetylsalicylic acid, phenylacetic acid derivatives, and other NSAIDs, including BromSite®. Therefore, caution should be used when treating individuals who have previously exhibited sensitivities to these drugs.
- **Increased Bleeding Time of Ocular Tissue:** With some NSAIDs, including BromSite®, there exists the potential for increased bleeding time due to interference with platelet aggregation. There have been reports that ocularly applied NSAIDs may cause increased bleeding of ocular tissues (including hyphemas) in conjunction with ocular surgery. It is recommended that BromSite® be used with caution in patients with known bleeding tendencies or who are receiving other medications which may prolong bleeding time.
- **Keratitis and Corneal Effects:** Use of topical NSAIDs may result in keratitis. In some susceptible patients, continued use of topical NSAIDs may result in epithelial breakdown, corneal thinning, corneal erosion, corneal ulceration or corneal perforation. Patients with evidence of corneal epithelial breakdown should immediately discontinue use of topical NSAIDs, including BromSite®, and should be closely monitored for corneal health. Patients with complicated ocular surgeries, corneal denervation, corneal epithelial defects, diabetes mellitus, ocular surface diseases (e.g., dry eye syndrome), rheumatoid arthritis, or repeat ocular surgeries within a short period of time may be at increased risk for corneal adverse events which may become sight threatening. Topical NSAIDs should be used with caution in these patients. Post-marketing experience with topical NSAIDs also suggests that use more than 24 hours prior to surgery or use beyond 14 days postsurgery may increase patient risk for the occurrence and severity of corneal adverse events.
- **Contact Lens Wear:** BromSite® should not be administered while wearing contact lenses. The preservative in BromSite®, benzalkonium chloride, may be absorbed by soft contact lenses.
- **Adverse Reactions:** The most commonly reported adverse reactions in 1% to 8% of patients were anterior chamber inflammation, headache, vitreous floaters, iritis, eye pain, and ocular hypertension.

Please see brief summary of Full Prescribing Information on the adjacent page.

NSAID=nonsteroidal anti-inflammatory drug.

Reference: 1. BromSite® [package insert]. Cranbury, NJ: Sun Pharmaceutical Industries, Inc.; 2016.

SUN OPHTHALMICS

BromSite® (bromfenac ophthalmic solution) 0.075%
Brief Summary

INDICATIONS AND USAGE
BromSite® (bromfenac ophthalmic solution) 0.075% is indicated for the treatment of postoperative inflammation and prevention of ocular pain in patients undergoing cataract surgery.

CONTRAINDICATIONS
None

WARNINGS AND PRECAUTIONS
Slow or Delayed Healing
All topical nonsteroidal anti-inflammatory drugs (NSAIDs), including BromSite® (bromfenac ophthalmic solution) 0.075%, may slow or delay healing. Topical corticosteroids are also known to slow or delay healing. Concomitant use of topical NSAIDs and topical steroids may increase the potential for healing problems.

Potential for Cross-Sensitivity
There is the potential for cross-sensitivity to acetylsalicylic acid, phenylacetic acid derivatives, and other NSAIDs, including BromSite® (bromfenac ophthalmic solution) 0.075%. Therefore, caution should be used when treating individuals who have previously exhibited sensitivities to these drugs.

Increased Bleeding Time of Ocular Tissue
With some NSAIDs, including BromSite® (bromfenac ophthalmic solution) 0.075%, there exists the potential for increased bleeding time due to interference with platelet aggregation. There have been reports that ocularly applied NSAIDs may cause increased bleeding of ocular tissues (including hyphemas) in conjunction with ocular surgery.

It is recommended that BromSite® be used with caution in patients with known bleeding tendencies or who are receiving other medications which may prolong bleeding time.

Keratitis and Corneal Reactions
Use of topical NSAIDs may result in keratitis. In some susceptible patients, continued use of topical NSAIDs may result in epithelial breakdown, corneal thinning, corneal erosion, corneal ulceration or corneal perforation. These events may be sight threatening. Patients with evidence of corneal epithelial breakdown should immediately discontinue use of topical NSAIDs, including BromSite® (bromfenac ophthalmic solution) 0.075%, and should be closely monitored for corneal health.

Post-marketing experience with topical NSAIDs suggests that patients with complicated ocular surgeries, corneal denervation, corneal epithelial defects, diabetes mellitus, ocular surface diseases (e.g., dry eye syndrome), rheumatoid arthritis, or repeat ocular surgeries within a short period of time may be at increased risk for corneal adverse events which may become sight threatening. Topical NSAIDs should be used with caution in these patients.

Post-marketing experience with topical NSAIDs also suggests that use more than 24 hours prior to surgery or use beyond 14 days postsurgery may increase patient risk for the occurrence and severity of corneal adverse events.

Contact Lens Wear
BromSite® should not be administered while wearing contact lenses. The preservative in BromSite®, benzalkonium chloride, may be absorbed by soft contact lenses.

ADVERSE REACTIONS
The following serious adverse reactions are described elsewhere in the Brief Summary:
- Slow or Delayed Healing
- Potential for Cross-Sensitivity
- Increased Bleeding Time of Ocular Tissue
- Keratitis and Corneal Reactions
- Contact Lens Wear

Clinical Trial 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 clinical practice.

The most commonly reported adverse reactions in 1–8% of patients were: anterior chamber inflammation, headache, vitreous floaters, iritis, eye pain and ocular hypertension.

USE IN SPECIFIC POPULATIONS
Pregnancy
Risk Summary
There are no adequate and well-controlled studies in pregnant women to inform any drug associated risks. Treatment of pregnant rats and rabbits with oral bromfenac did not produce teratogenic effects at clinically relevant doses.

Clinical Considerations
Because of the known effects of prostaglandin biosynthesis-inhibiting drugs on the fetal cardiovascular system (closure of ductus arteriosus), the use of BromSite® during late pregnancy should be avoided.

Data
Animal Data
Treatment of rats with bromfenac at oral doses up to 0.9 mg/kg/day (195 times a unilateral daily human ophthalmic dose on a mg/m^2 basis, assuming 100% absorbed) and rabbits at oral doses up to 7.5 mg/kg/day (3243 times a unilateral daily dose on a mg/m^2 basis) produced no structural teratogenicity in reproduction studies. However, embryo-fetal lethality, neonatal mortality and reduced postnatal growth were produced in rats at 0.9 mg/kg/day, and embryo-fetal lethality was produced in rabbits at 7.5 mg/kg/day. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

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

Pediatric Use
Safety and efficacy in pediatric patients below the age of 18 years have not been established.

Geriatric Use
There is no evidence that the efficacy or safety profiles for BromSite® differ in patients 65 years of age and older compared to younger adult patients.

NONCLINICAL TOXICOLOGY
Carcinogenesis, Mutagenesis and Impairment of Fertility
Long-term carcinogenicity studies in rats and mice given oral doses of bromfenac up to 0.6 mg/kg/day (129 times a unilateral daily dose assuming 100% absorbed, on a mg/m^2 basis) and 5 mg/kg/day (540 times a unilateral daily dose on a mg/m^2 basis), respectively revealed no significant increases in tumor incidence.

Bromfenac did not show mutagenic potential in various mutagenicity studies, including the bacterial reverse mutation, chromosomal aberration, and micronucleus tests.

Bromfenac did not impair fertility when administered orally to male and female rats at doses up to 0.9 mg/kg/day and 0.3 mg/kg/day, respectively (195 and 65 times a unilateral daily dose, respectively, on a mg/m^2 basis).

Rx Only
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SUN-OPH-BRO-017-1 03/2017

SUN OPHTHALMICS

her first vision therapy session, she complained of poor distance vision, though her acuity with the contacts was 20/25 and 20/20 in the right and left eyes, respectively. As is typical, she refused to let go of her minus. She wasn't very compliant with her vision therapy, coming in for a total of 11 sessions over one year and most likely doing little to none of the prescribed home practice.

Since she was demanding, the contacts were increased to 20/ happy. However, we decided to fit her in bifocal contacts, in an attempt to hold things in place. With a prescription of -3.50 with a low-add multifocal, the patient was happy and we continued trying to address the underlying binocular vision and accommodative issues. After her 11 therapy sessions, she discontinued VT. At her most recent examination, her glasses were changed to a Hoya computer lens, but the prescription remained stable. We absolutely considered that a win.

The amount of minus needed for comfort can be decreased as patients move towards balanced Rxs.

Lyin' Eyes

A 23-year-old female presented with complaints of blurry and double vision in her current correction after several hours of near work. She reported difficulty controlling her eyes when doing prolonged near work, such reading and using a microscope, and she found herself squinting at near.

The stats. At her examination with another optometrist, one year prior, she entered wearing spectacles and had stopped ortho-k one week prior. The glasses she wore were -0.50-0.25 x 140 in the right eyes (20/25-3) and -0.50-1.00 x 100 (20/20) in the left. She received a new glasses script of -1.50 (20/15) in the right eye and -1.00-0.75x070 (20/15) in the left. Traditional daily contact lenses were fit successfully in the following prescription: -1.00-0.75x170 (20/15) in the right eye -1.50 in the left (20/15). Though those lenses, the negative/positive relative accommodation (NRA/PRA) and fused cross cylinder (FCC) were +3.75/-0.25 and +1.00, respectively.**

At the vision therapy evaluation, the entering acuity was 20/15 at distance and 20/20 at near in both eyes. Her cover test was two exophoria and six exophoria at distance and near. Stereopsis was measured at 25 seconds of arc with a test of local stereopsis. Vergence ranges at near were BI 18/24/14 and BO X/26/6. Her accommodative facility was harder on the minus monocularly and binocularly, and there was tension and squinting to attempt clarity. With the plus lenses she cleared almost immediately. With both eyes there was an alternating suppression with the minus lenses.

The patient was refracted again, and the most appropriate prescription was found: -0.75 (20/20) in the right eye and -0.75-0.50 x 160 (20/20) in the left. The NRA/PRA were balanced at +2.75/-2.50. The contact lenses were refit with the same brand, but the power was reduced to -0.75 in the right eye and -1.00 in the left. This change was well-tolerated, with the patient's visual acuity remaining 20/20 in both eyes.

After one week, the patient noticed a reduction in symptoms; the prescription was finalized and VT was started. We jokingly note that we will plan on reducing the prescription further, but our intentions are sincere—as therapy proceeds, we are certain that the amount of minus needed for comfort can be decreased and that this will move this patient towards a balanced prescription.

After the Thrill is Gone

Over-minusing can have unforeseen consequences. Luckily, in these cases we determined the causes of the underlying issues and were able to address them. In the first case, we needed to give more minus at distance and provide help at near in the form of a bifocal contact lens. In the second, we were able to successfully reduce the distance correction without the need for further nearpoint assistance. In both cases, vision therapy was part of the treatment plan further exemplifies the need for the most appropriate prescription that does not exacerbate the binocular or accommodation issues.

The seeds of discontent for these patients were sown years before our first encounters. The desire to provide the sharpest acuity possible created a situation where more minus was prescribed than was appropriate. By paying closer attention to the entering acuity as well as using the many available binocular vision and accommodative tests, the issue of over-minusing can be overcome. ■

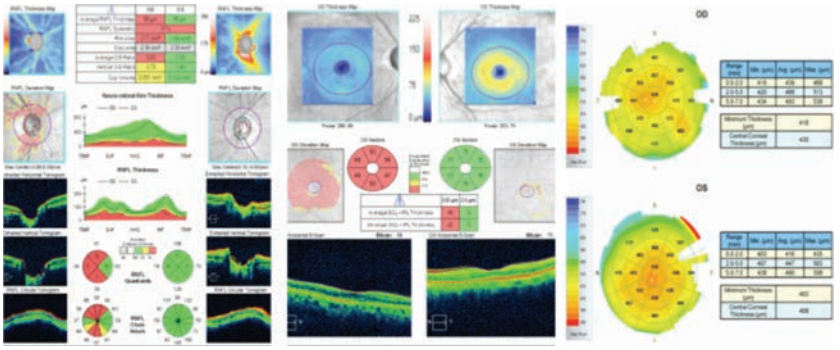
***Editor's note: the NRA, PRA and FCC numbers are all in reference to the actual refraction. The NRA and PRA are not in reference to the FCC, which is done by some.*

Coming to America

In her first visit to a medical professional, a patient gets set on the right track.

By Richard Mangan, OD

A 66-year-old Vietnamese female, recently arrived in the United States, presented complaining of debilitating blurred vision at distance and near, right eye greater than left, constant and progressive over a three-month period. She reported no pain, headache, nausea, photosensitivity or trauma. She denied both significant ocular history and any previous eye exam. She recently underwent her first medical examination, resulting in a diagnosis of hypertension and hyperlipidemia.



OCT imaging suggests the patient's elevated IOP was connected to narrowed angles.

Examination

At the initial visit, her best-corrected visual acuities (BCVAs) were 20/70 OD, 20/30- OS, and she had a 2+ afferent pupillary defect (APD) OD. Confrontations showed significant constriction in all quadrants OD, FTFC OS. Intraocular pressures (IOP) were 52mm Hg OD, 32mm Hg OS. Slit lamp exam revealed shallow anterior chambers in both the left and right eyes; mature nuclear sclerotic cataract greater in the right eye than in the left; glaucomatous cupping and superior notch approaching the rim in the patient's right eye; and possible early glaucomatous changes to her left eye.

During the glaucoma work-up, gonioscopy revealed no visible structures in primary gaze in all quadrants; open to the anterior trabecular meshwork (TM) with indentation in the right eye; plateau iris in all quadrants, most apparent along horizontal midline in the right eye; ATM in superior, nasal, inferior quadrants in the left eye, no visible structures temporal; steep iris approach in multiple angles with varied presentation in the left eye; and no PAS OU. Angle optical coherence tomography (OCT) imaging showed significant narrowed angles in both eyes, but in the right eye greater than in the left, and convex iris approach in both eyes. Pachymetry readings were 430 OD, 408 OS. OCT RNFL found average thickness 54 OD, 102 OS; severe thinning S/T/I OD, WNL OS. OCT Mac had average GCC + IPL thickness 48 OD, 76 OS; and severe thinning in all quadrants of the right eye, WNL OS.

We could not perform visual fields secondary to the language barrier.

Treatment

Because of the narrow angles and elevated IOP, she was held in clinic and started on Betimol (timolol 0.5%, Akorn), Simbrinza (brinzolamide/brimonidine tartrate ophthalmic suspension, Alcon) and, eventually, pilocarpine 2%. This regimen reduced her IOPs to 30mm Hg OD, 26mm Hg OS.

The patient was scheduled for urgent extracapsular cataract extraction with iStent (Glaukos) implant OD, OS. The procedure had no complications and an uneventful post-op period.

Follow Up

The 30-day post-op findings were remarkable. The patients IOP was 13mm Hg OD and 14mm Hg OS—an incredible reduction of 75% in the right eye and 56.2% the left. Her BCVAs were 20/30 OD (subjective complaint of bisected fixation), 20/20 OS with a 2+ APD OD. Confrontations were the same. A slit lamp exam showed a deepened anterior chamber in both her right and left eyes; well-apposed CE wound in each eye; and stable, centered PCIOL without opacity in both the right and left eyes. Her ONH c/d was 0.85v/0.75h with superior notch approaching rim in the right eye, 0.55r OS.

Repeat gonioscopy showed all quadrants open to the posterior TM with sparing view of scleral spur in

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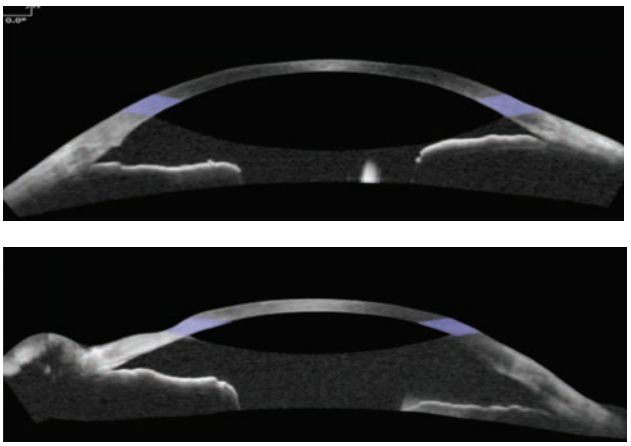

Anterior segment OCT shows the post-op state of the TM, uveal tract and Schlemm's canal OD, above, and OS, below.

the right eye; all quadrants open to scleral spur in the left; normal iris approach without pathology; and visible iStent nasal in each eye. Angle OCT showed increased angle depth with iris positioned in a more conventional location. OD remained more narrow than OS.

Discussion

In this case, a firm diagnosis was hampered by substantial pertinent negatives. Bilateral, asymmetric, severely narrowed angles suggest angle anatomy played a large factor in the elevated IOP, which also presented bilaterally but with asymmetric presentation worse in the right eye. This substantiated the final diagnosis of chronic narrow-angle glaucoma via a phacomorphic mechanism. That, in conjunction with the cataracts, indicated cataract extraction would be the appropriate first step in managing both the glaucoma and reduced acuity.

Continuous lens growth that shortens the anterior chamber length, positioning the anterior lens anterior to Schlemm's canal, offers a mechanism for elevation. This slight displacement causes forward traction on the ciliary body via the zonules, which causes displacement of the uveal tract and crowding of Schlemm's canal and TM.[1]

Anterior segment imaging was critical in this case. Potential quantitative parameters, including anterior chamber angle and depth, trabecular-iris angle and surface area and angle opening distance, give researchers an opportunity to confirm the increase in angle depth observed following cataract extraction while exploring the correlation with angle anatomy and IOP.[2,3] This is particularly significant in narrow-angle or chronic-angle closure glaucoma, as it consistently demonstrates a stronger relationship than open-angle glaucoma.[4-7] This information would provide clinicians predictive models of angle and IOP changes following cataract surgery.[8]

The medical decision-making and therapeutic results of this case are also largely impacted by the availability of the iStent. The device allows aqueous humor to drain directly from the anterior chamber to Schlemm's canal, avoiding the resistance of the TM completely. Recently published meta-analyses show iStent implantation with lens extraction decreased IOP by 9% from baseline compared with lens extraction alone with a 4% reduction; two iStents reduced IOP by 27% from baseline.[9,10] Individual studies show reduction in baseline IOPs of upwards of 30%, and elimination of ocular hypotensives at six-month follow-ups in as many as 74% of open-angle glaucoma (OAG) patients and 42% of primary OAG patients at four-year follow-ups.[11]

No studies examining closed-angle or narrow-angle glaucoma patients and the postoperative benefits of a combined phaco/iStent procedure are available. Still, with the well-documented safety of iStent implants, reduced post-op visits and less need for revision, the option was an excellent use of aggressive medical therapy in a patient with cost and compliance concerns.[9]

While the literature strongly supports iStent insertion

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in combination with cataract extraction as a viable and safe treatment for POAG, this case provides strong support for the same treatment in narrow-angle glaucoma patients. The expected decrease in pressure is related to the preoperative angle anatomy and pressure. Generally speaking, the more narrow the angle and the higher the IOP, the more dramatic the improvement—and that's precisely what we saw with this patient. ■

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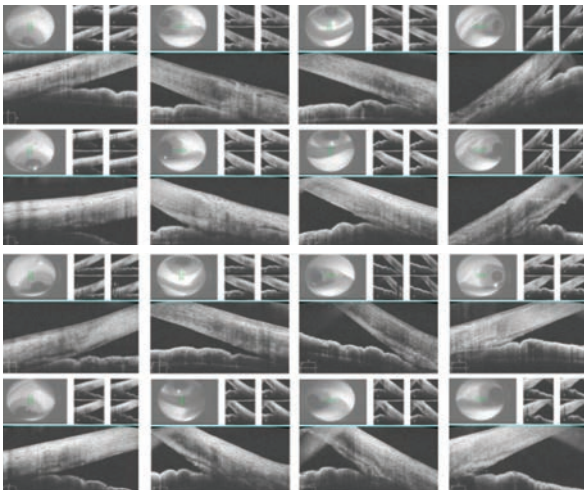

These images show each quadrant of the patient's eyes, both pre- and postoperatively. The first row shows the right eye preoperatively, the second row shows the right eye postoperatively, the third row shows the left eye preoperatively and the last row shows the left eye postoperatively.

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Coding Cataract Comanagement

What you do determines how you code it—and get paid.

By John Rumpakis, OD, MBA, Clinical Coding Editor

As the technology for refractive surgery evolves, we are seeing a whole new segment of care for which optometrists are vital: caring for cataract or clear lens extraction patients before and after surgery.

IOL technology is constantly improving, and surgical techniques and platforms are keeping pace to deliver great outcomes for patients. With all of these changes impacting patient care, don't forget the all-important question: what is our role in both the pre-op and post-op care and how does it affect how we code and bill for our professional services? Let's take a look.

Be an Expert

As first-line eye care providers, we see the vast majority of patients in the United States today for routine eye care. Because of this, we are also on the front lines providing professional advice and making appropriate referrals when an IOL implantation is the best treatment choice. It is our responsibility to be familiar with the various IOL options—and the surgeons who work with the specific platform we are recommending to our patients, whether it's a traditional monofocal IOL, or a multifocal, toric or multifocal toric lens.

Respect the Relationships

The formal transfer of care begins with the referral to a specific surgeon. After that, the patient is now formally their patient. Keep in mind that comanagement is a non-financial arrangement between a surgeon and a comanaging physician who provides care to the patient for some portion of the global follow-up period.

The comanagement portion of any surgery begins with the formal transfer of care back from the surgeon to the comanaging physician—typically to the physician who originally referred the patient for a surgical evaluation, but not always. However, the initial referral cannot be based on the requirement that the surgeon refer the patient back to the referring physician.

Most often, the patient is the one choosing the comanaging physician, so you should discuss the arrangement with your patient before the initial surgical evaluation to ensure they know to request you as their post-op care provider.

Coding Dos and Don'ts

When billing for the comanagement portion of patient care, the global period is 90 calendar days after the surgical procedure is performed. The appropriate coding for your postoperative services is described by the surgical code performed by the surgeon with the appropriate modifier appended to the code:

Traditional monofocal IOL

6698X-55-RT/LT for the first eye.
6698X-79-55-RT/LT for the second eye.

Tip: Always bill to the insurance carrier, and use the appropriate ICD-10 cataract diagnosis throughout the comanagement period.

Premium IOLs

Use the following code descriptors, in addition to the traditional monofocal codes described earlier, to bill the patient directly for the premium portion of the IOL:

Multifocal IOL. V2788: Presbyopia-correcting function of intraocular lens.

Tip: Use the ICD-10 code for presbyopia along with this code.

Toric IOL. V2787: Astigmatism-correcting function of intraocular lens.

Tip: Make sure to use the appropriate ICD-10 code for astigmatism along with this code.

Multifocal toric IOL. Follow the guidelines for a multifocal IOL as described above.

When working with premium IOLs, it is generally prudent that no money be paid from the surgeon to the comanaging physician. It is best practice to have the patient pay each entity separately for their respective portion of the care provided: one payment to the surgical center, one to the surgeon and one to the comanaging physician.

Making the right referral to the right surgeon for the best outcome is always paramount for us, and knowing the latest advances is integral to these decisions. Understanding our role in providing the very best care for our patients also helps us understand how to document the medical record and code for our services. ■

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ADVANCEMENTS IN LASIK

By Marc R. Bloomenstein, OD, FAAO; Sondra R. Black, OD; and Jim P. Owen, OD, FAAO

One of the most satisfying aspects of being an optometrist is simply the fact that we're part of our patients' journeys through their visual lives. We see many of our patients grow from small children through their teenage years and then into adulthood and old age. And throughout all this time, we oversee their visual needs by first diagnosing their ametropia and providing them with opportunities to see clearly and later getting them excited about the new levels of freedom they can enjoy away from glasses as they age. Think about the teenager who walked out of your office beaming with new self-confidence when you fit her in her first pair of contact lenses or about the 80-year-old cataract patient who hugs you because the world suddenly looks so much brighter and more distinct. This is why we love optometry.

We have so much to offer patients and can im-

Release Date: December 15, 2017

Expiration Date: December 31, 2018

Online CE will be available through February 15, 2018.

Goal Statement: On completion of this educational activity, participants should have a foundational knowledge of corneal refractive surgery—from early excimer lasers and microkeratomes to advancements made possible by today's femtosecond lasers—as well as be aware of strategies to assess surgical candidacy for LASIK and understand what to expect postoperatively.

Faculty/Editorial Board: Marc R. Bloomenstein, OD, FAAO; Sondra R. Black, OD; and Jim P. Owen, OD, FAAO

Credit Statement: This course is COPE approved for 2 hours of CE credit. COPE ID is 55753-RS. Please check your state licensing board to see if this approval counts toward your CE requirements for licensure.

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Disclosure Statement: Dr. Bloomenstein is a consultant for Allergan, Bausch + Lomb, Lunovus, TearLab, and OcuSoft; he receives research support from Allergan and Alcon; is a shareholder of TearLab; and he is on the speaker's bureaus of Allergan, Alcon, Bausch + Lomb, Johnson & Johnson Vision, and OcuSoft. **Dr. Black** is a consultant for AcuFocus, Johnson & Johnson Vision, Labtician Ophthalmics and Valeant. **Dr. Owen** is a consultant for Tear Film Innovations; and has received honorariums from Alcon, Abbott Medical Optics and ScienceBased Health.

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prove their quality of life in incredible ways. Sometimes, though, we hold back vision correction options based on old norms or simply not asking the patient if they may be interested. In particular, LASIK or other forms of corneal refractive surgery seem to be afterthoughts as of late.

This is truly unfortunate because all those years between adolescence and old age are part of the continuum of care that we should guide patients through. Each doctor may have a unique reason why they are less inclined to offer LASIK as an option for their patient. And, yet, if fear of losing a patient to refractive surgery is the main reason, the irony is it's more likely to happen to the doctor who chose not to be a part of the process.

It may not seem as new and exciting as it did in 1999, but LASIK technology has changed dramatically in the past several years. Much about the procedure today is safer and more precise, providing even better outcomes. And though ODs in this country are not performing the procedure, they guide the preoperative and postoperative care of the patient in collaboration with the patient's surgical center. The last thing we want is for our patients to select a surgical center on their own without involving us in the dialogue or surrounding care.

In the pages that follow, you'll learn about the nuances of today's LASIK platforms and procedures so you can identify and inform your patients. Educating ourselves and our patients about LASIK technology is an important responsibility. It is incumbent upon us as referring optometrists to have in-depth knowledge about the technology used by the surgeons to whom we direct our patients. Motivated patients may turn to friends, advertising and the Internet, but our informed counsel should play the more prominent role in terms of decision-making. Being an informed adviser demonstrates your desire to stay involved in the surgical process.

PATIENT SELECTION

When a patient comes into your practice and needs vision correction, that patient becomes a potential refractive surgical candidate. We may eventually find clinical reasons why we won't refer the patient, but LASIK needs to be part of the armamentarium that deserves consideration whenever it's clinically appropriate. Here, several factors are relevant, including age, corneal thickness and astigmatism.

With regard to age, refractive stability is far more important than age. Very generally speaking, low myopes (<4.00D) typically achieve refractive stability by 18 years of age, whereas high myopes may not stabilize until they're 21 or older. If a patient is new to your practice and you don't have a refractive history, consider a second evaluation after six months when patients are near these age thresholds. At the second visit, confirm that there is no more than a 0.50D shift in spherical equivalent (not diopter sphere), a 0.25D shift in astigmatism or more than a 10-degree shift in axis. Also make sure that these changes are not relative to an ocular surface change.

Next, look at corneal thickness. This becomes an import factor when considering the amount of correction needed in a given eye and the thickness of the flap incision—created by the surgeon in the anterior cornea. With the flap open, the surgeon reshapes the stroma to achieve the shape upon which light can reflect off of the retina and produce clear vision. Thin corneas alone are not a significant risk factor for refractive surgery. The prescription plays an equally important role here since a patient's refractive error dictates the amount of stroma to remove. The surgeon will use a nomogram to determine the ablation depth but you can safely

TALK TO CONTACT LENS WEARERS ABOUT LASIK

Why do people wear contact lenses? It's because they don't want to wear glasses. Period. It's only logical that these same patients might appreciate the added freedom that LASIK can provide.

In particular, contact lens wearers who have struggled with lens intolerance, dry eye, giant papillary conjunctivitis (GPC), allergies, meibomian gland dysfunction, contact lens-induced acute red eye response (CLARE), ulcers or red eyes can often benefit from LASIK. For your sake and the patient's, you may also want to present LASIK to non-compliant contact lens wearers.

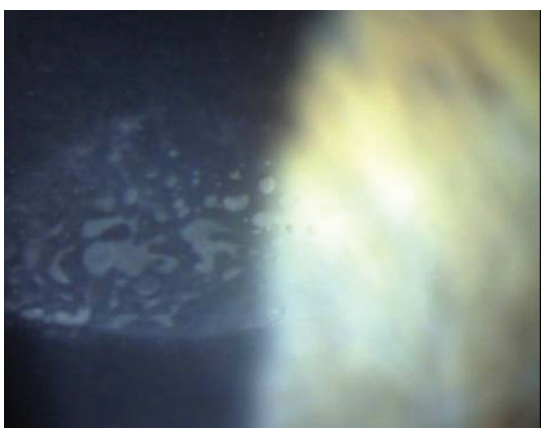
TOUCH POINTS

It's understandable that you may be stretched thin with a waiting room full of spectacle and contact lens patients. The good news is you don't have to spend a ton of time getting into specifics about refractive surgery. To start, make sure LASIK has a presence in your waiting room. You could have posters, videos and brochures describing the procedure. Next, include a question about interest on your intake form.

When you do choose to have a discussion with your patient about LASIK, you can keep it fairly brief if you properly train staff on the LASIK conversation.

assume 15 to 20 microns of ablation per diopter of prescription. The ideal residual stromal bed has been a shifting value over the years. A standard has been to leave at least 300 microns residual, but each surgeon is different. Therefore, it's also helpful to know what your surgeon's cutoff is and understand that it may vary from case to case.

If a patient presents with normal-thickness corneas (i.e., above 500 microns), they are likely to be a viable surgical candidate especially if the surgery center uses a femtosecond laser for flap creation. For corneas below 500 microns, it's still a good idea to send the patient to a surgery center for evaluation. In the majority of these cases, photorefractive keratectomy (PRK) would be performed, as less corneal tissue is removed by surface ablation vs. LASIK, but allow the center to make that decision. In cases when corneal thickness is borderline, don't get the patient too excited about LASIK in particular, but also don't rule it out. Just frame it differently. For example, you might say, "The numbers are a little tight, so let's ask the surgeon to do some measurements and further testing to determine the best procedure for you." Let the patient know you're on their side and are advocating for what is best for them. This is the same discussion that should be given in the absence of knowing your patient's pachymetry.



A patient exhibits epithelial ingrowth grade 2. Femtosecond lasers help decreased the risk of epithelial ingrowth. *Photos: Sondra R. Black, OD*

Microkeratomes—utilizing keratome instruments that incise the cornea—pulled at the corneal nerves in such a way that delayed the healing process after the surgeon put the flap back down.

Patients with astigmatism have grown accustomed to being excluded from vision correction opportunities, but that's no longer the case with modern LASIK. We still have patients assuming that their astigmatism can't be corrected, but that changed in 1998. In fact, the treatment of small amounts of astigmatism has successfully yielded sharper contrast and induced clarity in some patients.

When evaluating astigmatic patients, it's important to determine whether the astigmatism is normal or abnormal, and then investigate symmetry by looking at the top and the bottom of the topography. The level of astigmatism between the two eyes, in the absence of any disease or injury, should be relatively the same. For example, a 1D or 2D difference is not common and might be a red flag. Caution should be taken, but do not automat-

MORE MYOPIA MEANS MORE PATIENTS IN NEED

The incidence of myopia continues to rise in the United States and worldwide. According to a recent study, the prevalence of high myopia is predicted to increase seven-fold from 2000 to 2050.[1] Among Caucasians ages 40 to 49, more than 40% are myopic. However, among Caucasians, myopia may remain flat for several years, while in other races, myopia is rising sharply.[2] For example, myopia is expected to nearly double in the next 15 to 25 years among Hispanics.[2] Overall trends show an increase in myopia across the U.S. population as a whole, with long-term trends showing a much greater growth of the prevalence of myopia in Hispanic and black races compared with Caucasians.[2]

As more and more patients present in need of vision correction, it will be up to us to offer them with a menu of options that suits their needs and clinical presentations.

ically rule out refractive surgery solution for the patient; a few possibilities might exist. Consider that the asymmetry may be caused by ocular surface disease (OSD). If so, be aggressive with an ocular surface treatment regiment and determine if that is the root of the topographical disparity. If, however, the asymmetric astigmatism is physiologic, the options are fewer and wavefront-guided treatment is a must. In the absence of OSD, if there is more than 1.5D of asymmetry on vertical keratometry readings or in mean keratometry between the eyes, consult with your surgeon prior to referring.

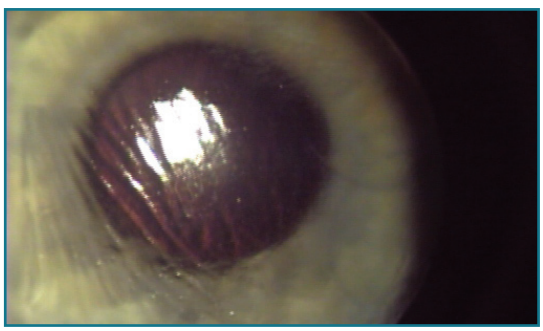
The steepness of the cornea also tells us a lot about who is a good candidate and who isn't. There is no formal limit to how much a cornea can be flattened, but anything below 35D (or above 48D for hyperopic ablation) requires a conversation with the surgeon. A myope tends to decrease curvature in a three-fourths ratio of their correction and hyperopes tend to steepen one-to-one of the hyperopic diopter. But, again, some of this may only be a sign of surface disease in need of pre-treatment.

Pupil size is much less of a concern than it used to be. With custom, wavefront-guided ablations and optical blend zones, pupil size has become an insignificant factor for assessing LASIK candidacy. However, if a patient has a very large pupil, you should counsel them about increased likelihood of some glare and halo. Essentially, the surgeon needs to take extra precautions with larger pupils, which is where wavefront-guided LASIK becomes especially important.

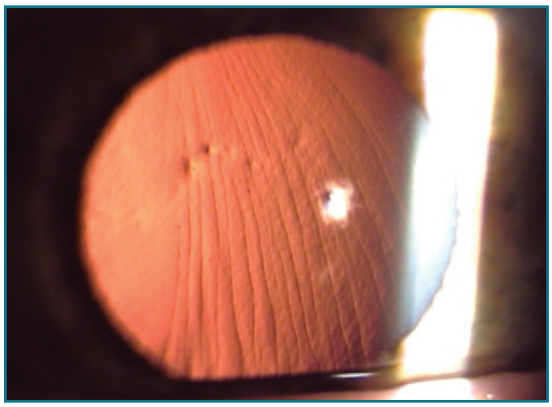
In the last 10 years, with the release of DEWS II, so much more has been discovered, and our understanding of diagnostics and new therapeutic approaches is significantly more evolved. Instead of sending patients on their way with nothing more than a boatload of artificial tears, optometrists now recognize that more can be done. We are proactively treating dry eye and are making real headway in understanding how the disease works.

FROM MICROKERATOME TO FEMTO

It seems like yesterday that microkeratomes were synonymous with LASIK surgery, and many of the complications we saw were directly related to microkeratome use. For example, surgeons struggled to control flap thickness and sometimes made the cornea too thin. Microkeratome flaps by design were thinner in the center and thicker in the periphery, which made consistency a problem and also lessened flap stability, resulting in complications such as partial flaps, button-holes and free caps.



A dislodged flap with striae post-LASIK is depicted in this photo. In the past, microkeratome design lessened flap stability, resulting in a variety of flap complications.



Prior to femtosecond lasers, flap striae were a common consequence of LASIK.

To minimize these challenges, we had to carefully consider keratometry, pachymetry and more. Although these factors need to be considered, the use of a laser to create the flap has made them less important.

Femtosecond lasers can be focused to a specific depth, creating virtually any flap thickness the surgeon requires. The many benefits to using a femtosecond laser include:

- Fewer flap creation complications
- The ability to vary the size and thickness of the flap
- Greater precision
- No moving parts
- Stronger flaps[3]
- Increased contrast sensitivity[4]
- Decreased risk of epithelial ingrowth
- Less IOP rise during procedure[5]
- Less induced dry eye[6]

Many of these benefits can be attributed to the inverted bevel-in side cut up to 150 degrees. Microkeratomes used to shear the cornea and pull at the corneal nerves such that, when you put the flap back down, they didn't heal as quickly.

On the other hand, the femtosecond angle can have a significant impact on healing, minimizing postoperative complaints such as dry eye.[6] You'll likely see increased flap adhesion postoperatively, which translates into optimal wound healing and three times more flap stability compared to a microkeratome-created flap. This also improves severed nerve apposition and results in less reduction in corneal sensitivity.

TRADITIONAL LASIK

LASIK used to be performed using a standard laser pattern that was based on a single measurement. This method relied solely on refraction results and the same type of patient preference methodology that we use to compare corrective lens options. The prescription was generated from a phoropter and was then entered into the laser for the treatment. From there, a theoretical curve, similar to that of glasses, determined the spot pattern that was applied to the eye.

Every patient with the same prescription received the same laser treatment. But, because the eye's curvature varies and the compensation for the steepness of the curvature is based on averages, some spherical and other aberrations were often induced. For example, the induction of spherical aberration often resulted in the night vision disturbances associated with traditional LASIK procedures.

THE ROAD TO A MORE EXACT PRESCRIPTION

When wavefront-optimized LASIK was introduced, surgeons could use special software to reduce LASIK-induced spherical aberration. Using wavefront modeling, surgeons can administer extra pulses in the periphery of the ablation zone to manage the induced spherical aberration.

However, as with conventional LASIK, the same number of laser pulses is used for every patient with the same prescription. In other words, the procedure is customized to be prescription-specific, but it is not specific to the individual aberrations of each eye. Furthermore, "optimized"

simply implies that adjustments have been made to treatments to minimize induction of spherical aberration; it does not mean you can correct aberration that already exists. In some patients, depending on their unique curvatures, optimized LASIK can actually make the aberrations worse and the patients symptomatic. For example, for patients who have neutral or negative spherical aberrations (approximately 10% of the population), wavefront-optimized laser treatment can be less favorable since the extra peripheral pulses induce additional negative spherical aberrations.

A PERFECT MATCH

They say no two snowflakes are the same, and the same rule applies to eyes. We want to make the surgical treatment as precise as it can be. The introduction of wavefront-guided technology allows us to achieve this. Wavefront-guided treatment platforms appear to offer significant advantages in terms of reducing residual refractive error, uncorrected distance acuity and contrast sensitivity.[7] They also provide distinct benefits in terms of night vision performance and low contrast acuity.[8]

With wavefront-guided LASIK, the goal is to reduce all higher-order aberrations. This is achieved by introducing a grid of infrared laser light into the eye. The wavefront aberrometer captures and measures each ray of light as it reflects off the retina and determines the aberrations of the entire eye based upon the deflection of the light from its ideal path. This technique can measure hundreds of individualized light rays and goes beyond the ability of the standard phoropter.

After this wavefront map is determined, the treatment software calculates the number and diameter of laser pulses to reshape the cornea so that the light from objects will focus perfectly on the fovea.

THE BENEFITS OF WAVEFRONT ABERROMETERS

Wavefront refraction measures patients' objective refractive error and is designed to be more reproducible and precise than the subjective manifest refraction. Wavefront aberrometry measures refractive aberrations of the eye, detecting the higher-order aberrations. Higher-order aberrations include distortions such as coma, trefoil and spherical aberration, as well as numerous others that cannot be adequately corrected through spectacle lenses. Spheres and cylinders, measured at the phoropter, are called lower-order aberrations.

Your preoperative measurements play a big role in your treatment plan. A variety of systems exist to measure refractive errors of the patient, including the iDesign, KR 1W and WaveLight Analyzer. We are now able to capture the shape of the cornea, its curvature/power, the ocular wavefront, the patient's refraction and pupil diameter under different lighting conditions, and to calculate keratometry and pupil size. It's incredible that we can now achieve this with a single scan of the eye from a device no bigger than an autorefractor.

By providing more high-quality measurements, advanced new systems can improve iris registration, maximizing the chances for successful eye tracking during the surgery. They can take an image of the patient's iris and note up to 24 identifying marks. This image is transferred with the treatment plan to the excimer laser. Since the patient's eye rotates when moving from prone to supine, the excimer laser rotates the treatment to ensure it is positioned correctly.

But this advanced technology doesn't merely make surgery more precise, it also often makes it available to a wider segment of patients. Now, many more patients may be eligible for LASIK—even those who previously did not qualify. That's because these kinds of systems can provide a detailed map of the eye, making it possible to treat patients with higher levels of astigmatism, a wider range of pupil sizes and even mixed astigmatism.

Although it is true that LASIK can be performed using many different technologies and techniques, not all will meet your needs. We don't want to confuse patients by overwhelming them with details, but it is our responsibility to help them recognize value vs. cost. Aligning yourself with surgeons and centers that are congruent with your practice philosophy will narrow down the details. When you and the surgery clinic are speaking as a single voice, there is little confusion left for the patient.

As technology evolves, so too must our patient conversations. Indeed, as vision correction options

expand, patients will still rely on us to educate and guide them to appropriate procedures as well as surgeons who are equipped with the tools necessary to deliver the best possible outcomes. LASIK surgery, over the last 20 years, has earned a rightful place in your refractive management plan.

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CE TEST

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1. Which factor is relevant when considering whether LASIK and refractive surgery are clinically appropriate for a patient?
a. Age
b. Corneal thickness
c. Astigmatism
d. All the above

2. For patients new to your practice who are considering LASIK and other forms of refractive surgery, at the second evaluation, confirm:
a. There is no more than a 0.50D shift in spherical equivalent (not diopter sphere)
b. There is no more than a 0.25D shift in astigmatism
c. There is no more than a 5-degree shift in axis
d. A and B

3. Which of the following is true about a patient's corneal thickness with regard to LASIK and refractive surgery?
a. Thin corneas alone are a significant risk factor for refractive surgery
b. Thin corneas alone are not a significant risk factor for refractive surgery
c. The prescription does not play an equally important role to corneal thickness
d. A patient's cornea size dictates the amount of stroma that will need to be removed

4. When evaluating astigmatic patients for LASIK and refractive surgery, the following is true:
a. It's important to determine whether the astigmatism is normal or abnormal
b. It's important to investigate symmetry on the top and the bottom of the topography and ensure the level of astigmatism between the two eyes are relatively the same
c. If you do notice a difference in symmetry, caution should be taken, but this factor alone will not automatically rule out refractive surgery
d. All the above

5. What is true about pupil size when it comes to considerations for LASIK and refractive surgery?
a. Pupil size is much less of a concern than it used to be
b. Pupil size is of great concern and is a dealbreaker for surgery
c. If a patient has a very large pupil, they have an increased likelihood of glare and halo and should be counseled
d. A and C

6. Contact lens wearers who have suffered from which issues would benefit from LASIK?
a. Lens intolerance and contact lens-induced acute red eye response
b. Dry eye, ulcers or red eye
c. Giant papillary conjunctivitis
d. All of the above

7. In which U.S. population is myopia expected to nearly double in the next 15 to 25 years?
a. Hispanic
b. Black
c. Caucasian
d. Pacific Islander

8. Historically, what aspect of microkeratome flaps led to less consistency and flap stability?
a. They were thicker in the center and thinner in the periphery
b. They were thinner in the center and thicker in the periphery
c. They were asymmetrical
d. They were oblique

9. Some benefits of femtosecond lasers, which can be focused to a specific depth, include:
a. Fewer flap creation complications
b. Stronger flaps
c. Less induced dry eye
d. All of the above

10. Many of the femtosecond lasers benefits can be attributed to the inverted bevel-in side cut up to how many degrees?
a. 75
b. 100
c. 150
d. 175

11. Increased flap adhesion postoperatively translates into optimal wound healing and three times more flap stability compared to a microkeratome-created flap. This also improves results for what?
a. Severed nerve apposition
b. Corneal sensitivity
c. Corneal abrasion
d. A and B

12. Traditionally, LASIK was performed using a standard laser pattern based on a single measurement, inducing some spherical aberration that often resulted in what?
a. Night vision disturbances
b. Bright condition vision disturbances
c. Photophobia

CE TEST

d. Strabismus

13. When wavefront-optimized LASIK was introduced, surgeons could use special software to reduce LASIK-induced _____.
a. Photophobia
b. Strabismus
c. IOP elevations
d. Spherical aberration

14. Using wavefront modeling, surgeons can administer extra pulses in the _____ of the laser ablation zone to manage the induced spherical aberration.
a. Center
b. Periphery
c. Underside
d. Top

15. Wavefront-guided treatment platforms appear to offer significant advantages in terms of what?
a. Residual refractive error, uncorrected distance acuity and contrast sensitivity
b. Night vision performance
c. Low contrast acuity
d. All of the above

16. The wavefront aberrometer captures and measures each ray of light as it reflects off the _____ and determines the aberrations of the entire eye based upon the deflection of the light from its ideal path.
a. Cornea
b. Eyelid
c. Retina
d. Sclera

17. Wavefront technology treatment software calculates the number and diameter of laser pulses to reshape the _____ so that the light from objects will focus perfectly on the fovea.
a. Cornea
b. Eyelid
c. Retina
d. Sclera

18. How many eye scans are needed with new, advanced systems to capture the shape of the cornea, its curvature/power, the ocular wavefront, the patient's refraction and pupil diameter under different lighting conditions?
a. Four
b. Three
c. Two
d. One

19. Distortions such as coma, trefoil and spherical aberration as well as others that cannot be adequately corrected through spectacle lenses are considered _____ aberrations.
a. First-order
b. Second-order
c. Higher-order
d. Lower-order

20. By providing more high-quality measurements, new, advanced systems improve _____ registration.
a. Stromal
b. Iris***
c. Corneal
d. Retinal

Examination Answer Sheet

Valid for credit through December 31, 2018

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Advancements in LASIK

Directions: Select one answer for each question in the exam and completely darken the appropriate circle. A minimum score of 70% is required to earn credit.

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Rate how well the activity supported your achievement of these learning objectives:

1=Poor, 2=Fair, 3=Neutral, 4=Good, 5=Excellent

21. Improved my knowledge about corneal refractive and LASIK surgery options in the United States. ① ② ③ ④ ⑤
22. Became familiar with corneal refractive advancements—from early excimer lasers and microkeratomes to today's femtosecond lasers. ① ② ③ ④ ⑤
23. Better understood important factors when considering whether a patient is a candidate for LASIK and refractive surgery. ① ② ③ ④ ⑤
24. Obtained a basic understanding of the benefits of femtosecond lasers to create flaps. ① ② ③ ④ ⑤
25. Gained basic knowledge about wavefront-optimized and wavefront-guided treatment platforms. ① ② ③ ④ ⑤
26. Acquired current data on myopia demographics today ① ② ③ ④ ⑤

Rate the quality of the material provided:

1=Strongly disagree, 2=Somewhat disagree, 3=Neutral, 4=Somewhat agree, 5=Strongly agree

27. The content was evidence-based. ① ② ③ ④ ⑤
28. The content was balanced & free of bias. ① ② ③ ④ ⑤
29. The information presented was clear & effective. ① ② ③ ④ ⑤
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Lesson #115828 RO-UAB-1217

The Complicated Cataract: Up Your Referral Game

A cataract referral isn't always as easy as it sounds. These cases demonstrate the importance of knowing when—and to whom—you need to refer.

By Michael S. Cooper, OD

Among the 18,000 currently practicing ophthalmologists in the United States, only 50% actively perform cataract surgery.[1,2] With approximately four million cataract surgeries per year in the United States, and with those numbers rising, this shortage of surgeons creates a strain on the system and calls for more involved care by comanaging optometrists.[1,2]

Fig. 1. True exfoliation presents with wrinkled capsular membrane peeling (arrow) of the anterior lens capsule.

This is an opportunity to hone our cataract and refractive surgery discussion to better prepare our patients. More importantly, it is a call to become more of an extension of our surgical colleagues with pre- and postoperative care. With this being said, referring for cataract surgery isn't always a simple task. Often, patients present with complicated and sometimes misleading clinical signs and symptoms. Every case is a chance to learn more about various ocular conditions that may require collaboration with colleagues to find the right diagnosis and treatment plan.

The purpose of this article is to elevate optometrists' confidence in making important and sometimes difficult decisions when determining the root cause of the need for surgery and evaluating the relationship between the lens, retina and ocular surface. These three cases exemplify the collaborative process of diagnosis and care, as well as patients' dependence on our expertise to guide their choice on whether or not to have surgery—and when.

A Closer Look: Lens

The lens is an elegant biconvex, elliptical, semi-solid avascular structure with an on-demand ability to perform accommodation based on the visual stimulus.[3] The mechanical and physiological process of the lens is driven by the near pupillary reflex whereby the ciliary muscles tense to create a "bulky" or thickened lens to facilitate near work, such as reading. When viewing distance, the lens relaxes and the pupil is typically more dilated. Disruptions to the lens can cause many ocular conditions, including cataracts.[4]

Although cataracts are typically associated with the aging process, they may be present in neonates or may develop at any time in the lifespan of an individual. Risk factors, other than increasing age, include: exposure to ultraviolet (UV) light, inadequate nutrition, smoking, high alcohol intake, diabetes, trauma and long-term use of antipsychotic medications or steroids. Cataracts will eventually lead to glare while night driving, as well as difficulty reading and focusing on distant or near objects for which corrective glasses

may or may not help.[4-6]

When a patient presents with an unusual history and signs of cataracts, collaboration is often the key.

Turn Up the Heat

A 55-year-old Puerto Rican male came to the office with a rapid onset (over the last three months) of blurred vision greater in his left eye than his right eye while driving at night. I first asked about his work environment, and he acknowledged that his profession as a glassblower exposed him to temperatures exceeding 800˚F. His best-corrected visual acuity was 20/60 in his right eye and 20/80 in his left eye, but the potential acuity meter measured 20/25 in both eyes.

His anterior segment examination revealed 2+ to 3 milky nuclear sclerosis coupled with 2+ posterior subcapsular (PSC) changes in his right eye and 3+ milky nuclear sclerosis with 2+ to 3 PSC changes in his left eye. His intraocular pressures (IOP) were 24mm Hg in the right eye and 19mm Hg in the left eye with an unremarkable posterior segment evaluation with poor dilation. However, further investigation of the lens illustrated what appeared to be a peeled back anterior capsule and rosette features reminiscent of pseudoexfoliation and trauma in both eyes. Based on his clinical presentation, I knew it was not the latter conditions, but I educated the patient on the various differential diagnoses and the associated treatment options available.

Considering the patient had no prior history of trauma and was not of Scandinavian descent, I shared the case with my glaucoma specialist regarding the findings, which doubled as a cataract consultation. As I learned from my colleague—much to his surprise as well—the patient had glassblower's cataract secondary to true exfoliation or lamellar delamination (*Figure 1*).[7] With this diagnosis, the anterior lens capsule is thickened and the superficial portion of the lens capsule splits from the deeper layer and extends into the anterior chamber.[8] The exact pathogenesis of this disorder is not clear but is theorized to be a result of intense infrared radiation from high heat exposure.[9]

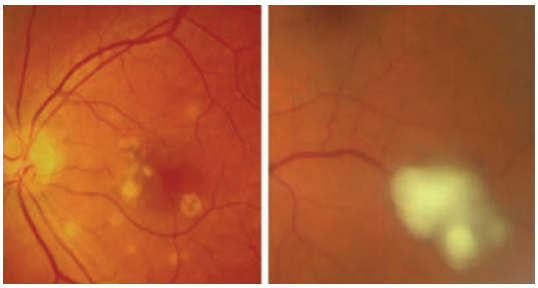

Fig. 2. These images depict fungal involvement with endophthalmitis. The left image illustrates the coagulative fungal material laid down on the retina (perifoveal), while the right shows a robust vitritis (abscess).

Consequently, the patient was given the option to treat his cataracts by traditional phacoemulsification or femtosecond laser-assisted cataract surgery to extract and replace the lens with an intraocular lens (IOL). After much discussion, the surgeon and patient made the decision to perform the femtosecond procedure due to several factors. For one, the zonules can become brittle and break easily along with a weakened capsular structure, similar to pseudoexfoliation.[10] Secondly, the phacoemulsive technique has the potential disadvantage of causing unforeseen complications (i.e., zonular rupture, posterior capsule tear) by applying more mechanical and heat stress to the intraocular space.[10] While these issues might arise with femtosecond technology, the glaucoma specialist felt the risk would be reduced, allowing better recovery and post-op visual prognosis.

A Closer Look: Retina

Some retinal conditions can mimic cataract and warrant careful examination to uncover the full clinical picture. Often, collaborating with a retina specialist is necessary before preparing a patient for cataract surgery. In addition, a cataract is a possible side effect for several treatment options, such as vitrectomy. For some patients, cataracts are the least of their problems, and cataract surgery is the last step in the referral and treatment process.

Beware the Fungus

A 52-year-old Caucasian female called to say she lost her vision and was quite concerned. The patient stated the visual symptoms were ongoing for the past 10 days analogous to a fog in headlights with mild soreness and light sensitivity.

At examination, she explained that her diabetes management was poor, and she has received at least two Avastin (bevacizumab, Genentech) injections in each eye for macular edema approximately nine months prior to presentation. Further questioning revealed she was hospitalized two months prior for five days regarding an unknown "blood" infection that caused her to have recurrent lung symptoms beyond those caused by her cigarette smoking habit. Her visual acuity was 20/30 in the right eye without pinhole improvement and 20/100 in the left eye. She said there was a central blotch in her visual field, confirmed with Amsler grid.

Entrance testing illustrated some pain superiorly in both eyes on extraocular muscle evaluation and pupils were unremarkable. Anterior

segment evaluation revealed 2+ nuclear sclerosis and arcus in both eyes. Perilimbal flush existed circumferentially in the left eye, coupled with significant infiltrative activity, multiple mutton fat keratic precipitates on the endothelium and 3+ anterior chamber cellular reaction without hypopyon. IOP was 11mm Hg in both eyes.

On dilated exam, the anterior vitreous showed a vigorous 2+ cellular reaction alongside a posterior fibrotic band hovering over the macula in the left eye. I became more concerned when I found several yellow, creamy, well-circumscribed lesions layered on top of the foveal space in the left eye, and retinal pigment perifoveal changes were noted in the right eye, likely from residual macular edema status post anti-VEGF injection (*Figure 2*). Also, the peripheral retinal examination revealed multiple dot-blot hemorrhages in the mid to far periphery in both eyes.

In addition to cataracts, my initial suspicion was an infectious panuveitis (endophthalmitis) with a potential fungal etiology based on the presentation. Endogenous endophthalmitis may mimic cataract, as well as conjunctivitis, non-infectious anterior uveitis, iritis, acute glaucoma, cellulitis and, retinoblastoma in children. Studies place misdiagnosis at initial presentation at 16% to 63% of cases.[11,12]

To ensure a timely diagnosis, I consulted with my retina specialist to discuss the case beyond just treating the surface issues with moxifloxacin 0.5% QID and cyclopentolate 1% BID in the left eye. Since we have a great working relationship, I suggested it might be necessary to perform an anterior chamber tap and order bloodwork to help determine the true nature of her condition. He agreed with my assessment and wanted to the see the patient the following day before finalizing the treatment plan.

After testing, the definitive diagnosis was fungal endogenous endophthalmitis secondary to *Candida albicans*. The condition is uncommon, but can be a potentially devastating intraocular infection in which pathogens reach the eye via the blood stream. Risk factors for endogenous endophthalmitis include: chronic diseases (i.e., diabetes mellitus (DM), renal failure, malignancies and acquired immunodeficiency syndrome); immunosupressive treatment; recent invasive surgery; intravenous drug abuse; indwelling catheter; endocarditis; hepatobiliary tract infections; organ transplantation; pregnancy or delivery; genitourinary surgeries; and dental procedures.[13] One study found a preexisting predisposing condition in 90.9% of patients, with the most common systemic condition being DM at 50%.[14]

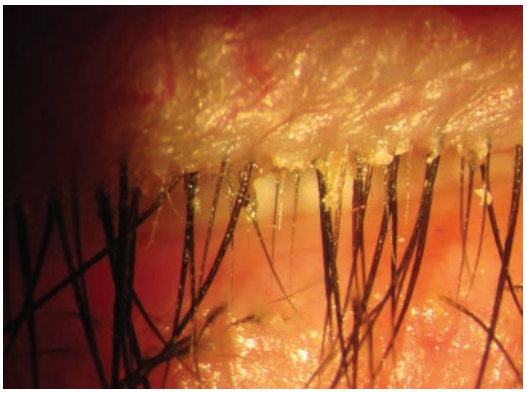

Fig. 3. Multiple cylindrical dandruff and telangiectsia of lid margin and base of lashes may lead to a diagnosis of MGD/*Demodex*/posterior blepharitis.

The retina specialist managed the condition empirically with voriconazole 200mg (one tablet BID) for the first two days while waiting on test results and then an intravitreal injection of voriconazole (100µg/0.1ml). She responded well initially, but eventually needed a vitrectomy.

During treatment, her cataract advanced rapidly to 3+ to 4 nuclear sclerosis and 2+ PSC in the left eye—not a surprising finding, considering research suggests vitrectomy increases oxygen tension and exposure within the eye, potentially leading to progressive nuclear sclerotic cataract formation.[15,16] Consequently, the retina specialist let me know that he intended to perform monofocal cataract surgery in the left eye only. He warned against a multifocal IOL because the light-splitting optics of this design would be inadequate given the level of retinal impairment in this case (as is common from diabetes, AMD, trauma, etc.). The outcome gave her best-corrected acuity of 20/40 in the left eye with residual central chorioretinal scar tissue.

The patient stopped by after the procedure to express her gratitude for our prompt response to her emergency and congenial collaboration with the retina practice.

A Closer Look: Cornea

Many ocular surface conditions, such as keratoconus, dry eye disease (DED) and meibomian gland dysfunction (MGD), affect vision and lead to patient complaints of reduced acuity. For example, an estimated 0.3 to 2,300 per 100,000 people have keratoconus, more than one-third of patients who present in eye clinics have DED, and anywhere from 3.5% to more than 70% of patients have MGD.[17-20]

While dry eye is a known side effect after cataract surgery, dry eye as part of the preoperative period is less well known. As of 2012, the American Academy of Ophthalmol-

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ogy has considered uncontrolled external disease, including dry eye, a contraindication for surgery.[21-25] The most striking and detailed landmark information came from the Prospective Health Assessment of Cataract Patients Ocular Surface (PHACO) study, which found approximately 80% of the enrolled population had a moderate to severe dry eye classification, although only 22.1% had been previously treated for the disease state.[22]

Addressing these ocular surface issues is always a priority, but it is particularly important for potential cataract patients. The next case exemplifies the complex nature of the ocular surface and the importance of addressing ocular surface disease (OSD) before referring for cataract surgery.

Restoring Balance

A 62-year-old Asian female presented more than a year ago stating she has been experiencing "mild" dryness and significant fluctuation in her vision. Her medical history was remarkable only for well-controlled hypothyroidism with Synthroid (levothyroxine, AbbVie). She mentioned her last eye doctor told her she had early signs of cataracts, but could not remember much else besides her glasses prescription (-2.25D in the right eye, -2.75D in the left eye). The technician performed testing, including osmolarity (with TearLab's osmolarity system) with readings of 325mOSm/L in the right eye and 332mOSm/L in the left eye and InflammaDry (Quidel) with a mild pink line in the right eye and subtle pink line in the left eye—suggesting moderate dry eye and mild matrix metalloproteinase 9 (MMP-9) activity in both eyes.[26,27]

Startlingly, her visual acuity was 20/50 OD and 20/80 OS. Although in-office refraction did not yield much improvement, auto and manifest refraction found a substantial myopic shift (-4.00 -0.75x110 OD, -4.25 DS OS).

Given her complaints and my initial findings, I wasn't shocked to find 2+ superficial keratopathy (SPK) in all quadrants and centrally combined with obvious meibomian gland toothpaste-like expression including 1+ cylindrical dandruff plus map/finger/dot regions superiorly in both eyes (*Figure 3*). The lens characteristics in both eyes showed 2+ to 3 nuclear sclerosis and cortical spoking extending closely into the visual axis.

A patient with both OSD and cataracts begs the age-old visual impact question, which came first? Regard-

Take Charge of Cataract Referrals

By Emily Evans, OD, and Jade Coats, OD

By 2050, the number of people in the United States with cataracts will double from 24.4 million to 50 million.[1] Optometrists must not only identify when these patients are ready for surgery, but also provide IOL education. Patients want a surgery that has evolved to keep up with technological advances, so be ready to discuss these latest options:

Laser vs. standard. Although the visual outcomes and safety are not significantly different in femtosecond laser-assisted cataract surgery vs. standard phacoemulsification, a "bladeless" option may reduce patient anxiety.[2,3]

Astigmatism. Due to astigmatism's effect on distance, intermediate and near vision, a monofocal IOL alone is inadequate to meet patients' visual needs. For patients with up to 0.75D to 1.00D of regular corneal astigmatism, laser arcuate incisions may help to minimize their dependence on distance glasses. For patients with more than 1.00D of regular corneal astigmatism, a toric IOL may be best.

Specialty IOLs. Patients must have realistic expectations when considering a multifocal, extended depth of focus or accommodating IOL. While the goal is to significantly reduce dependence on glasses, a low add power during strenuous near tasks may still be necessary. Multifocal and extended depth of focus IOLs may also cause postoperative glare and halos—a possible outcome of which ODs must make patients aware.[4] A careful review of corneal and retinal pathologies is necessary to determine if patients are candidates for specialty IOLs.

Standard multifocal IOLs are valuable for patients who require good distance and near vision. Add power differs based on the patient's near point location. This option may be beneficial for patients who prefer a closer near point rather than intermediate.

Accommodating IOLs can help improve near vision by allowing some accommodation at near while minimizing glare. For the best possible outcome with an accommodating IOL, the non-dominant eye may be set with a small amount of residual myopia to allow the widest range of near vision.[5]

Compared with a standard multifocal IOL with a specific near point, extended depth of focus IOLs—the newest entry into the marketplace—can provide more intermediate and near vision and are better suited for patients who do ample computer and deskwork.

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Dr. Coats practices at McDonald Eye Associates in Rogers, AR, focusing on perioperative surgical management, ocular disease and DED.

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less of the answer, the first step is aggressively treating the OSD prior to a cataract consultation. Although the patient was prepared for surgery, I educated her on the importance of first stabilizing the ocular surface to ensure a great outcome. Because the cataract surgery referral was inevitable, I also provided information on the surgical options to help prepare her for surgery in advance.

She was initially disappointed cataract surgery was postponed, but began treatment with Restasis (cyclosporine 0.05%, Allergan) BID, warm compresses and Cliradex wipes (Bio-Tissue) QD and scheduled a four-week follow up with refraction. Xiidra (lifitegrast 5%, Shire)—not commercially available at the time—would have been an excellent choice in this situation, considering she had both signs and symptoms of DED. Additionally, Prokera (Bio-Tissue) with or without debridement would have been an option if the anterior basement membrane yielded more significant impact on the visual axis. Of note, dehydrated amniotic membranes are FDA approved for wound coverage, whereas wet amniotic membranes are indicated for wound healing.[28] Before leaving the office, she was educated that these conditions are chronic diseases that need daily maintenance even after surgery.

At her next visit, corrected vision was 20/40 in both eyes without pinhole improvement, and her refraction was -3.25 -0.75x100 OD and -3.50DS OS. Anterior segment analysis illustrated 1+ SPK in all quadrants, trace cylindrical dandruff, cloudy meibomian gland expression and consistent epithelial basement membrane regions superiorly in both eyes. Further evaluation showed some meibomian gland dropout and glandular structure shortening. TearLab and InflammaDry tests decreased to 315mOSm/L and subtle pink lines in both eyes.

With ocular surface improvement, I initiated the cataract surgery discussion, during which she expressed a desire to be free of spectacles, which would require a multifocal lens implants. I educated her on the IOL options and overall less dependence on reading glasses, but emphasized that the ultimate decision is based on the refractive surgeon's recommendation. As comanaging ODs, we do not want to overpromise a particular refractive option, considering it may not be available based on their calculations. When making the referral to the refractive surgeon, I shared her recent DED treatment regimen and her interest in multifocal IOL options. Upon consultation, they decided she was eligible for a multifocal upgrade and went forward with the procedure. The patient was quite pleased postoperatively with her final result of 20/25 in both eyes at distance and near without glasses.

As an extra practice-building bonus moment, she referred her siblings and children to see me for their comprehensive eye examinations.

More Than Cataracts

These cases highlight the often-complex process of diagnosis and proper referral, stressing the opportunity for collaborative care with various subspecialties. Cataract patients are rarely just cataract patients, and knowing the best avenue for treatment will ensure timely care and congenial inter-professional relations. As optometry progresses, we must prepare to shoulder more of the workload with our surgical colleagues. Whether the problem lies within the lens, retina or ocular surface, we can comanage these patients to ensure exceptional care. ■

Dr. Cooper practices at Solinsky EyeCare in West Hartford, Conn., concentrating on ocular disease, perioperative cataract surgery management and DED.

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PEER-REVIEWED PRA ARTICLE

Seeing Cataract Patients Through a Different Lens

Patients present with visual needs that reflect their unique lifestyles. Let these factors lead your assessment and lens recommendation. **By Jim Owen, OD**

Cataract surgery no longer means simply removing the cataract. It now encompasses achieving a desired refractive endpoint as well. This fusion of cataract and refractive surgery has been both a blessing and a curse. Patients benefit from the ability to have their refractive status considered in the overall surgical approach, but the degree of difficulty is now higher for surgeons and comanaging optometrists alike. We must walk a fine line between enthusiasm and skepticism in our patient education and workup so that results match expectations.

Bob, a retired teacher who coaches baseball, gained 20/20 vision following toric lens implantation.

Fortunately, in contrast to just a decade ago, today's advances allow us to better match a patient's needs with the best-suited intraocular lens (IOL), as myriad options now exist to achieve a variety of visual ends for cataract patients. Modern options include toric IOLs for astigmatism and several options for presbyopia correction (accommodative, diffractive and extended depth-of-focus lenses). While all presbyopic options suffer from some degree of compromise, from inadequate near vision correction to glare and halos at night, a properly educated and well-selected patient can achieve success and satisfaction.

When evaluating and educating the preoperative cataract patient, clinicians must consider several factors when discussing a premium intraocular lens. Patients should have a clear cornea and stable ocular surface along with a stable macula when considering a diffractive lens. Toric lenses and accommodating IOLs are more forgiving and can be implanted in patients with macular changes.

Beyond the clinical findings, all cataract surgery patients come with a set of visual needs dictated by their uniqueness as a person. It is the optometrist's responsibility to help guide the patient in the IOL selection process and identify which compromises the patient can tolerate. To illustrate this, let's walk through the IOL selection process using several case examples. Bear in mind that there's no single "right answer" for these patients; the discussions below reflect my own approach and assessment, but other doctors could arrive at different solutions.

Eyeing the Ball

Bob is a 72-year-old retired teacher who coaches baseball. His chief complaint was his inability to see the player's numbers when attending baseball games at night. In addition, he reported his driving vision has gotten much worse over the past year.

The readout. His best-corrected vision was 20/40 in each eye. His intraocular pressures (IOPs) were 13mm Hg and 15mm Hg in the

right and left eyes, respectively. His osmolarity was 302mOSm/L and 304mOSm/L in the right and left eyes, respectively, with an unremarkable posterior segment and 2+ to 3+ nuclear sclerotic cataracts in both eyes. His refractive error was +2.50-1.25x005 OD and +1.75-1.50x178 OS. Simulated keratometry (sim Ks) revealed 41.50@08 and 43.50@83A OD and 41.75@173 and 43.00@98 OS. Screening OCT of the macula was unremarkable. At the visit, he had no significant health issues and was not taking any medications.

I educated Bob that some of the presbyopia-correcting lenses may increase glare and halos at night, which may be particularly problematic for coaching night games. Since he preferred to have the best night vision possible, I recommended a toric IOL for Bob, which would correct his corneal astigmatism and, when combined with intraoperative aberrometry, the lens could be inserted and rotated more precisely.

When choosing the right lens, practitioners should evaluate the corneal astigmatism, not just the refractive astigmatism. One study shows the Acrysof toric (Alcon) rotates on average 3.8 degrees.[1] In another study of more than 6,000 eyes implanted with toric IOLs, researchers found the lenses were only repositioned 0.653% of the time. In the rare instance of repositioning, it should occur one week after the initial procedure.[1]

The toric IOL was implanted using the Ora system (Alcon), which determines the refractive state of the eye using Talbot-Moire interferometry at the aphakic point during cataract surgery. This allows for precise lens selection and improved refractive outcomes. This technology is useful in post-refractive surgery patients and with toric IOLs and can improve the refractive outcome of cataract surgery patients.[2]

Tina, an avid hiker, was satisfied with the Symfony IOL, more so after both eyes received the lens.

Bob's postoperative course was uneventful and his uncorrected visual acuity (UCVA) was 20/20-OD and 20/20 OS at the three-month visit for the second eye.

Scaling the Peaks

Tina is a 68-year-old retired market researcher who now enjoys hiking. Her chief complaint was progressive decrease in vision, worse in the right eye. It affected both her indoor and outdoor activities.

The readout. Her best-corrected visual acuities were 20/50 and 20/30 in the right and left eyes, respectively, with a manifest refraction of -4.50-1.75x12 OD and -3.75-0.75x163 OS. Her IOPs were 17mm Hg in each eye and osmolarity measurements were OD 298mOSm/L OD and 301mOSm/L OS. Sim Ks revealed -2.25@13 and -1.00@165 in the right and left eyes, respectively. Slit lamp evaluation showed 2+ nuclear sclerotic cataracts in both eyes and a 2+ cortical cataract in the right. A screening OCT was normal, and the posterior segment was unremarkable. At the time of the examination, she was taking atorvastatin for high cholesterol.

When I told Tina the lenses implanted to correct distance and near will cause glare at night, she indicated that she already experiences significant glare and rarely has a need to drive at night. For Tina, having some glare at night was acceptable, and she felt the trade-off of gaining usable near vision was worth having some extra glare at night. Thus, I recommended the Tecnis Symfony toric IOL (AMO) for her. The lens is suitable to expand the depth of focus, which may help with intermediate and near vision, according to the company.[3,4]

Both of Tina's eyes had the Technis Symfony lens implanted four weeks apart. Prior to the second surgery, her UCVA was 20/25 in the OD and J4 at near with a concern for poor quality vision. This is a typical concern between surgeries, and we notice these patients have greater satisfaction after both eyes are treated. At the three-month visit her UCVA was 20/20 OU, 20/25 OD 20/25 OS at distance and J2 OU at near. She said she was very happy with the outcome.

Keeping a Poker Face

Rita is a 78-year-old female who enjoys playing card games on her computer. She has not driven at night for years and mentioned she rarely wears her glasses.

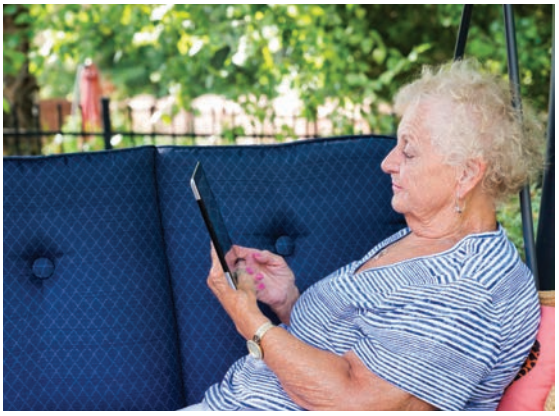
The readout. Her best-corrected vision was 20/50 and 20/70 in the right and left eyes, respectively, at distance and J1 in the right eye and J2- in the left. She had a manifest refraction of -1.50 and -1.75 in the right and left eyes, respectively, which has not changed in several years. Her IOPs were 12mm Hg and

14mm Hg in the right and left eyes, respectively, and osmolarities were 318mOSm/L and 301mOSm/L.

Anterior segment evaluation revealed a decreased tear lake and minimal secretion from her meibomian glands, along with 2+ nuclear sclerosis and 2+ brunescence in each eye. The posterior segment examination revealed rare fine drusen in the right eye and 1+ drusen without pigment change in the left. OCT of the macula confirmed a diagnosis of age-related macular degeneration in each eye, which was more significant in the left. As of the examination, she was taking an AREDS2 formula vitamin and blood pressure medication.

The frequency at which patients such as Rita wear their glasses is important to the IOL selection decision. Practitioners should ask specific questions about spectacle use, such as if they wear them for close indoor work or distant outdoor activities. In this case, the patient preferred to not wear glasses for her near work.

Rita has two factors that work against vision quality—her dry eye and her macular changes. Therefore, a diffractive lens was not the best solution for achieving sufficient levels of quality near vision because of the compromises inherent in a surgical approach that relies on light-splitting optics. Her ocular surface was treated prior to surgery with hot compress at night and cyclosporine 0.005% BID, which allowed for repeatable A-scans. Ultimately, she was treated with an aspheric monofocal IOL and a target of -1.50D in each eye. I discussed correcting both eyes for distance and stressed that, with both eyes corrected for distance, she would need glasses to see her computer. However, Rita was very happy with the current optics of her eyes, but just wanted it clearer. I did not discuss monovision because of her age and because she had never used it prior.



Rita, a dry eye patient with macular changes, received an aspheric monofocal IOL to achieve clearer vision—ideal for playing card games on a computer or tablet.

Rita had successful cataract surgery in both eyes. Her UCVA was 20/50 in each eye with a manifest refraction of -1.25 OD and -1.50 OS at her three-month visit. She continued to use cyclosporine 0.005% BID OU and her osmolarity was 301mOSm/L and 306mOSm/L at that same visit.

With is new IOLs, Pedro now only rarely needs glasses for small print and is pleased with his computer vision without glasses.

Staying in the C-Suite

Pedro is a 62-year-old retired executive who came to the clinic for a LASIK evaluation. He has worn daily disposable contact lenses in the past, with reading glasses for near work. Previously, he tried and failed at monovision; recently, his contact lenses had become increasingly uncomfortable, and he expressed an interest in refractive surgical correction.

The readout. Pedro's manifest refraction was +5.50-0.50x90 and 20/20 OD and +5.00-0.25x87 and 20/25 OS. His sim Ks were 45.00x44.75@90 OD and 45.25x45.00@85 OS, and osmolarity measurements were 302mOSm/L and 298mOSm/L in the right and left eyes, respectively. Anterior segment evaluation revealed trace nuclear sclerosis in each eye, and the left eye was slightly more brunescent.

Pedro was not a good candidate for laser vision correction. His high hyperopia and steep Ks decreased the likelihood of achieving a satisfactory result. A hyperopic LASIK surgery would result in steepening the cornea to over 50D. Our surgeon has an upper limit of 47D for hyperopic treatments secondary to his experience with poor optical outcomes above that level. The severity of his crystalline lens change was not significant enough for insurance to cover cataract surgery, but removing his lens electively

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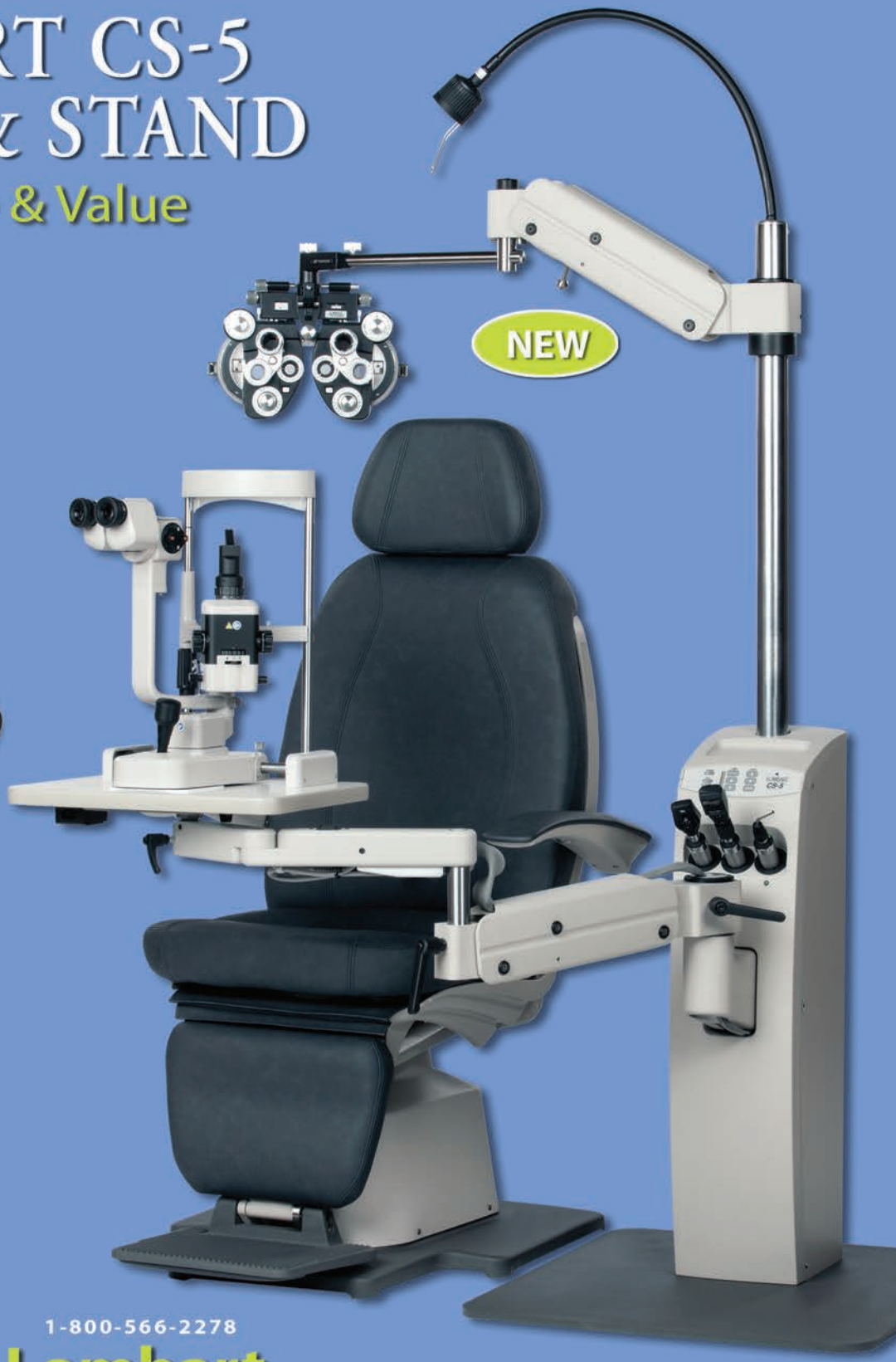

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was an option to consider. Pedro was happy to hear that having a clear lens extraction would provide stable vision and he would not develop cataracts later in life. As a working executive with the financial wherewithal to pay entirely out of pocket, clear lens extraction was a good option for him.

While he was comfortable wearing reading glasses, he loved the idea of being less dependent on them for near vision. He elected to have the Crystalens AO (Bausch + Lomb) lens implanted in each eye. This is a hinged lens designed to provide improved intermediate and some near vision by flexing forward during accommodation.[5] Because the lens is not diffractive, it does not create glare at distance.[5] Concerns exist that the effectiveness of the lens may diminish over time, but one study demonstrates stable accommodation for up to seven years after implantation.[6]

Pedro was targeted for -0.25D in each eye and his one-month manifest was -0.25D sphere OD and -0.50D sphere OS with 20/20-UCVA OU. Pedro was very pleased with his computer vision without glasses and found he only rarely needed them for small print.

Double Tech Trouble

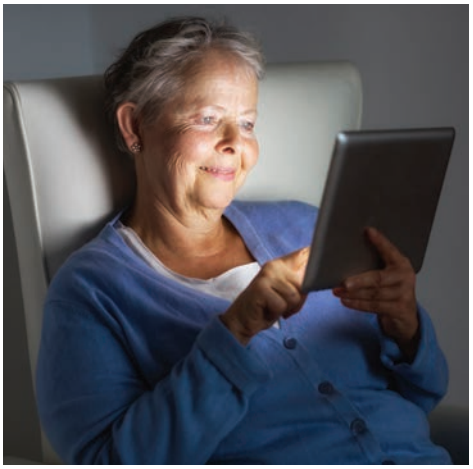
Jamile is a 78-year-old female whose chief complaint was the inability to see the television, and who was becoming increasingly frustrated because she likes to use her iPad when watching television. She reported that she rarely drives.

The readout. Her best-corrected vision was 20/40 and 20/50 in the right and left eyes, respectively. Her IOPs were 16mm Hg OS and 15mm Hg in the right and left eyes, respectively. Her glaucoma has been controlled by latanoprost OU nightly for five years. Her anterior segment exam revealed slight dermatochalasis and 3+ nuclear sclerosis in both eyes. Posterior segment evaluation revealed slight optic nerve changes with cup-to-disc ratios of 0.4x0.5 in each eye. A screening OCT was normal, and the examination of the peripheral retina was unremarkable.

I educated Jamile on the risks and complications of diffractive lenses vs. monofocal lenses. She indicated she already experiences significant glare, and that she would prefer to prioritize the ability to switch between near and far vision without having to keep taking glasses on and off. I recommended a Restor 2.5D (Alcon) lens for her dominant eye, which was treated first. This is a diffractive lens with a 2.5D add power, allowing for a reading range of approximately 21 inches.

Prior to the surgery on her second (non-dominant) eye, Jamile asked about better near vision. We discussed the risks and benefits of putting a stronger lens in her second eye. She consented to having the Restor 3.0 lens put in her non-dominant eye. At Jamile's one-month post-op visit to evaluate her second eye, her uncorrected distance vision was 20/25 and 20/20 in the right and left eyes, respectively, and her near vision was J2 in both eyes.

In our practice, we discontinue topical glaucoma drops prior to surgery, and they are not restarted until we observe an increase in IOP above the target. In Jamile's case, her IOP remained at 15mm Hg in each eye without drops one year after surgery, and there was no change in her visual fields or OCT. Removing the crystalline lens may improve outflow through the trabecular meshwork, thus reducing the IOP. Of course, we will continue to monitor as if she was taking drops.



With her new IOLs, Jamile can comfortably use her tablet while watching TV.

As important as the clinical findings are, so too are the lifestyle concerns and patient expectations. Satisfaction is largely dependent on how educated patients are about the compromises they will face, especially presbyopic patients. Usually, the optometrist has already fought the battle in discussing either progressive spectacle lenses or contact lenses. Appropriately selected patients can achieve spectacle independence with 20/happy vision with the current IOLs options. ■

Dr. Owen is the Director of Clinical Services for TLC Vision in San Diego, and a fellow of the American Academy of Optometry.

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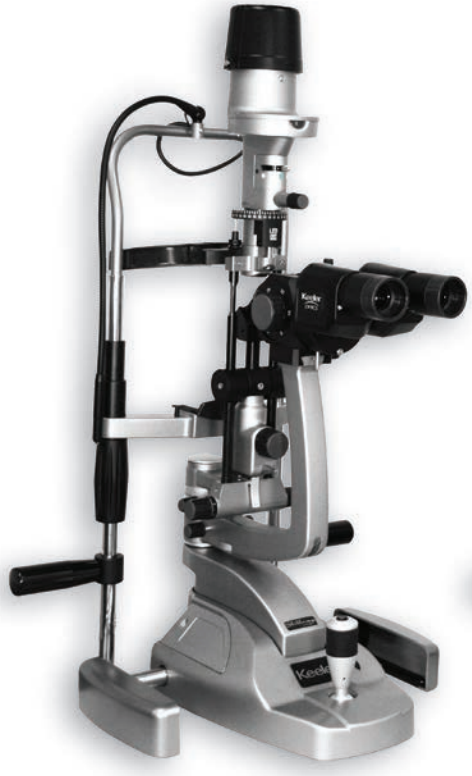

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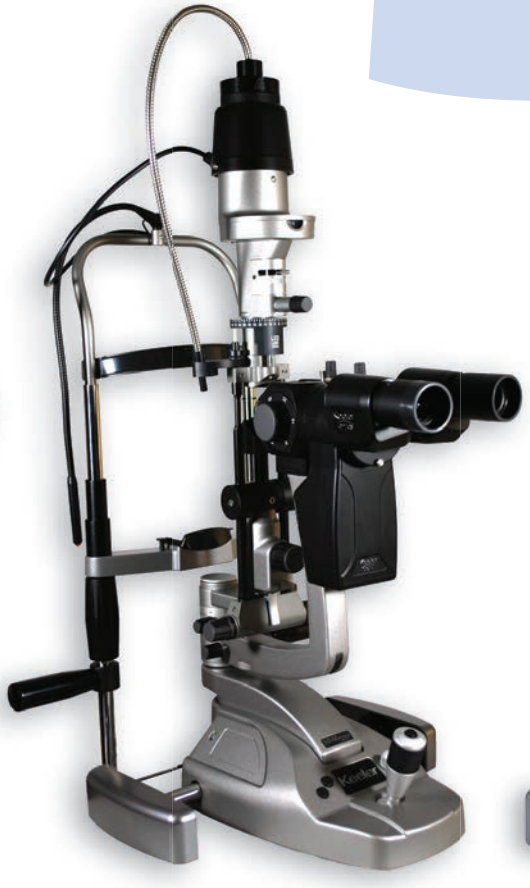

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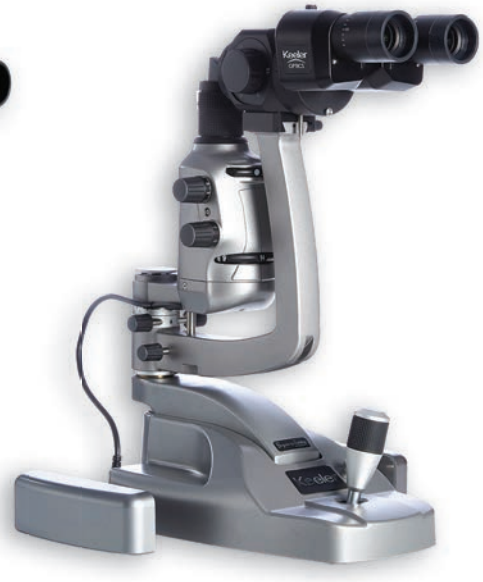

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An OD's Guide to Postoperative Cataract Care

Practical advice for both routine and complex cases. By Oliver Kuhn-Wilken, OD

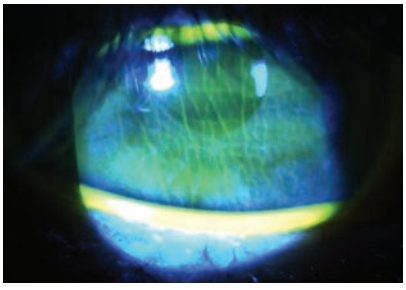
Providing care for your patients during their recovery from cataract surgery can be exciting and gratifying. Few experiences will cement patients to your practice like regaining their vision; it will also help your clinic operate at the peak of its capacity. Most patients have a straightforward recovery, and only a few require more attention. If any serious problems present, your surgeon is standing by, ready to assist.[1]

Each month, our clinic and the community optometrists we serve see hundreds of cataract patients through their healing process. This article describes the sequence and elements of an uncomplicated recovery from cataract surgery and then discusses how to handle some of the more common complications.

The Uncomplicated Course

The vast majority of cataract cases undergo an uncomplicated and predictable path; in the United States today, more than 97% of all cataract cases unfold successfully.[2] Timeline, medications and care have all been standardized for decades.

Medications. All cataract patients will require medications postoperatively to protect them from infection, inflammation and pain, but a wide variation exists in the specific medications and dosages used by individual surgeons. All formulas include an antibiotic to protect against endophthalmitis and a steroid to control inflammation. A steroid used for less than a month can be stopped abruptly when the bottle is empty, although many clinics will ask for the more traditional taper.



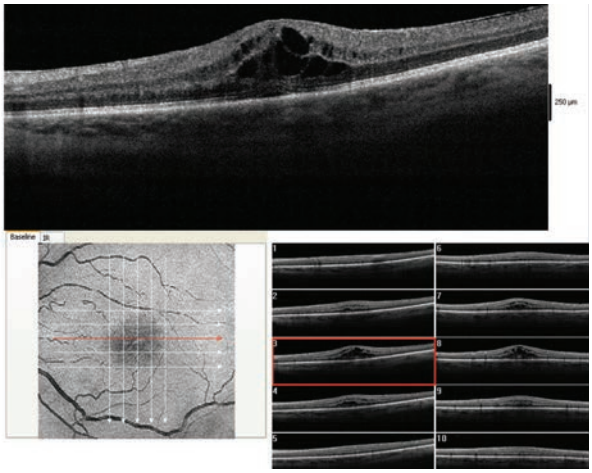
This patient—who had an IOP of 4mm Hg—displays corneal waffling. We saw no active leak, but the patient had gently rubbed the eye an hour before his one-day exam.

Some clinics use a nonsteroidal anti-inflammatory drug (NSAID) to complement the steroid in controlling inflammation and pain, while others do well without them. Regardless, NSAIDs are frequently prescribed for patients whose eyes have a high risk of developing cystoid macular edema (CME) or inflammation: this includes cases of diabetic retinopathy, epiretinal membranes, a history of retinal vein occlusion or macular degeneration.

A growing movement urges doctors to skip some, or all, post-op drops in favor of an injection usually containing a steroid and an antibiotic. In these cases you must be familiar with your surgeon's mixture and its expected performance. This approach can produce some harmless but unusual visual effects immediately after surgery and has a rare but significant risk of a dangerous reaction to the medication.[3]

The one-day exam. Use the first postoperative exam to ensure that the surgery was carried out well, to verify that the patient understands their responsibilities and to answer their immediate post-op questions and concerns. The one-day exam must include a history, measurement of visual acuity (VA), an autorefractor reading or pinhole acuity, an intraocular pressure (IOP) check and a slit-lamp exam.

For most patients, normal symptoms at the one-day exam



These images show a moderate macular edema, diagnosed four weeks after surgery. With 1% prednisolone acetate QID and flurbiprofen QID, this patient recovered to 20/25 over the course of two months.

include blur, foreign body sensation, ache and redness. Normal findings include reduced VA (typically around 20/25 to 20/60), a small ptosis (from the spring clamps used during surgery), residual dilation, mildly elevated IOP, injection and cells and flare in the anterior chamber.

There will be a primary incision, either in the temporal cornea or in the superior conjunctiva, along with one or two small corneal port incisions. Subconjunctival hemorrhages are common, especially following femtosecond-laser assisted surgery and among patients taking anticoagulants. Often, you will see some mild keratitis; grade 2+ or less should only need the diligent application of artificial tears to restore comfort. There will usually be some disruption of the endothelium ("snail tracks") and small fragments of capsular debris in the anterior chamber; these are inconsequential and self-resolving. The intraocular lenses (IOL) should be well-positioned. Often, patients will feel sore, have a mild headache or will have slept badly; it is appropriate for them to resort to their over-the-counter oral NSAID of choice for this. The retina need not be examined at the one-day exam unless you or the surgeon have specific concerns.

Any comanaging optometrist must be comfortable grading anterior chamber inflammation, as this is used to judge progress throughout the post-op period (*Table 1*).

It is important at this time to confirm that the patient understands their drop regimen. Exhorting frequent artificial tear usage and the vigorous shaking of any steroid suspensions can avoid many subsequent panicked late-night phone calls. It's also a good time to remind patients of their post-op restrictions, which usually include avoiding eye-rubbing, make-up or tap water near their eyes.

The one-week exam. Every patient should be seen between seven and 14 days after each eye's surgery; this exam is used to verify that the incisions have healed enough to discontinue the patient's antibiotics, monitor their refractive state and, often, to check for a satisfactory outcome so as to green-light their fellow eye for surgery. If so prescribed, you will ask the patient to begin tapering their steroid. The early signs of endophthalmitis can occur at this point, as well as CME, so be wary of unexplained inflammation, pain or poor vision.[4]

Although mild anterior chamber inflammation and mildly reduced

vision are standard, all findings should be stable or improved compared with the one-day exam. The one-week exam must include a history, a measurement of aided and unaided VAs, an IOP check and a slit-lamp exam of the anterior segment. A dilated fundus exam is called for only if there are concerns.

The one-month exam. Typically, the patient will have one final exam three to six weeks after surgery. This one must include a dilated fundus exam to confirm the patient is well-healed and stable, and also a final postoperative refraction and prescription. The patient should be relatively asymptomatic, with the exception of refractive error complaints.

If all has gone well, this exam transitions the patient back to their regular eye care schedule. Be sure to review their ocular health, be explicit about the recommended frequency for eye exams and discuss the importance of adequate ultraviolet light protection now that their cataracts are gone. You may ask them to stop their drops at this point.

Expectations. If a patient enters into surgery expecting an improvement in vision after a measured recovery, a significant amount of work instilling eye drops, absolute presbyopia and some amount of residual refractive error, that patient will likely be pleased at every step. If you have the misfortune of caring for a patient who is expecting a perfect outcome, you will have to spend some time working through their unrealistic expectations. Any experienced surgery center will work hard to ensure that all patients have an accurate understanding of what the cataract surgery process will and will not deliver.

Premium IOLs. These introduce a different set of expectations for the postoperative period. These patients have invested in an IOL expecting higher visual performance and will require more care.

Toric IOLs can greatly reduce the patient's astigmatism; use each postoperative exam to verify the patient's refraction and satisfaction. The toric IOLs now available in the United States can correct corneal astigmatism between 1.03D and 4.11D—they don't eliminate irregular astigmatism or astigmatism higher than 4.11D.

Multifocal IOLs are expensive and high performing, but require a significant amount of education and careful screening of candidates. Patients tend to have high expectations and some anxiety about their vision, and you will need to be well-versed in the details of the multifocal IOLs preferred by your surgeon to adequately counsel your patients. Appropriate expectations are crucial, and you must carefully counsel patients preoperatively to expect glasses wear for some specific tasks after surgery. Visual performance can increase for up to six months after implantation of multifocal IOLs as the patient's neural pathways grow increasingly facile at working with an altogether new way of seeing, and your encouragement can help tremendously along the way.

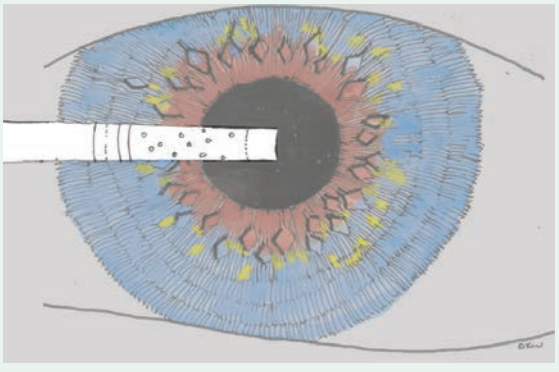
Complications

While most cataract patients recover without a hitch, a few may encounter one of these complications:

IOP rise. We often see pressure spikes, whether from retained viscoelastic, or from the impact of inflammation on the trabecular meshwork, after surgery. Fortunately, this spike is transient and usually resolves within the first few days.[5]

Table 1. Grading Anterior Chamber Cell

Cells	Grade
Rare	0-1
Trace	1-5
1+	6-15
2+	16-25
3+	26-50
4+	>50



This illustration shows grade 1+ cells in the anterior chamber, a mild and normal amount of inflammtion in the first week after cataract surgery.

The ability to accurately grade anterior cells is crucial to evaluating postoperative inflammation. In a darkened room, create a high-intensity, high-magnification field with a 1mm by 1mm slit beam at a 30º to 60º angle. Carefully differentiate between pigment granules (dark brown clumps, common after complex surgeries or small pupils), red blood cells (tiny red spots, unusual) and actual inflammatory cells: small white motes, primarily lymphocytes with some neutrophils. Count the number of inflammatory cells in your beam at a single moment. Any layer of hypopyon is unusual and should precipitate a search for endophthalmitis. Flare will cause the aqueous humor to appear smoky.

If the optic nerve is healthy, our clinic will only treat the IOP if it is greater than 30mm Hg by Goldmann tonometry. If the pressure is 30mm Hg to 35mm Hg, often a single drop of brimonidine suffices; if it is higher than 35mm Hg, we will instill brimonidine and sometimes timolol and re-measure the IOP every 30 minutes until the pressure sinks below 30mm Hg. Prostaglandins are next to useless in this case due to their slow action. If the pressure is slow to recover we prescribe a bottle of brimonidine BID for a week. In general, we avoid "burping the wound" due to the risk of infection from backflow.

If the patient has glaucoma, IOP will require more aggressive treatment, based on the glaucoma severity and the stubbornness of the pressure.[6] We keep a bottle of acetazolamide 250mg tablets in the clinic for use in dangerous situations; we give them at a QID dosage until IOP returns to its habitual level, and never for more than a month. Do not be afraid to continue the steroid at full strength in glaucoma patients, as the calming of their trabeculitis may actually help lower pressure. The first recourse should always be to add hypotensive drops and pills to control pressure, reserving an aggressive steroid taper for cases in which this doesn't work.

Corneal edema. This complication is common and often self-resolving in the first few days or weeks after cataract surgery, but will dramatically affect vision until it clears—usually causing the patient much anxiety. As blur may arise from several factors, it is crucial to rule out a retinal detachment even in cases of evident corneal edema. Immediate post-op corneal edema will come from one of three sources, each treated slightly differently. Examine all layers of the cornea carefully; edema can manifest as microcysts or even bullae at the epithelium, as thickening of the stroma or as folds in the endothelium.

If corneal edema was caused by surgical trauma, it will usually present as stromal thickening and endothelial folds; you may consider adding hypertonic sodium chloride 5% ointment at night if this is severe, but generally this will resolve with time. If the edema is caused by a transient loss of endothelial cell function due to inflammation, you will see 3+ to 4+ cells in the anterior chamber; consider doubling the steroid. If IOPs are greater than 30mm Hg, the hydraulic pressure is likely creating the edema by driving aqueous into the cornea; add timolol or brimonidine to lower IOPs. You may have to employ several tactics simultaneously.[7]

Any persistent bullae should trigger a phone call to the surgeon. If no improvement is seen after three months, this unfortunate patient will soon be talking to a surgeon about a corneal surgery.

Inflammation. Complex surgeries (e.g., dense cataracts, poor dilations and torn posterior capsules) tend to ignite a vigorous inflammatory response.[8] Known cases of uveitis, diabetes or other pre-existing inflammatory diseases are expected to struggle with inflammation. Some patients will even have a post-op uveitis without a difficult surgery.

Your first action should be to search for indicators of endophthalmitis or retained lens material. A hypopyon is a dangerous sign. Having ruled these out, you may simply proceed to dampen the inflammation using stronger or more frequent steroids. If there is a risk of CME, add an NSAID back into the mix. Consider a subconjunctival steroid injection and a surgeon consult if the reaction proves stubborn.

Cataract fragments. Occasionally, lens fragments are inadvertently left in the eye by even the most experienced surgeons. They are most commonly found in the inferior anterior chamber angle or hidden in the capsule equator behind the iris.[9] Any unusual level of cells in the anterior chamber should prompt a gonioscopic search of the angle, but a fragment behind the iris will be hard to find.

Lens cortex fragments hydrate and appear fluffy, like cotton; often the eye will melt these away within a few weeks' time, but, in the meantime, you must control the inflammation carefully. Retained nucleus will look more solid and waxy. This will arouse a greater inflammatory reaction and necessitate a return to surgery for extraction.

You should notify your surgeon of every fragment you notice, even if it is self-resolving.

Refractive surprise. Despite decades of improvements in accuracy, around 26% of patients end up missing their desired refractive target by greater than +/-0.50D.[10] If they have undergone LASIK in the past, this number doubles to more than 50%.[11] This occurrence, especially if compounded by natural astigmatism, can lead to great disappointment; once again, any seeds of unrealistic expectations will bloom inexorably into post-op discontent. If the preoperative counseling was not performed diligently and you are faced with an unhappy patient, it is best to listen carefully, take a precise refraction and adopt a compassionate attitude. Elective surgical solutions are available but unpalatable: IOL exchange or LASIK.

Toric rotation. Like any lens, toric IOLs depend on precise alignment to work, and not only is this difficult to achieve in the operating room, but the lenses have a 3% chance of rotating during the first month.[12] Your best indicators that a rotation may have happened are significant blur and an increase in oddly oriented astigmatism. If your surgeon communicates the desired axis of the implant, you can check this by dilating and looking for the marks indicating the steep axis, but you often do not have this information. A small deviation from alignment that does not greatly affect vision is not a concern.

Any suspicion of a significant rotation should precipitate a return to the surgery center, and quickly; the best time to rotate a toric IOL back into place is within the first few weeks, before the capsule has a chance to fibrose down around the lens.

Wound leak. If the IOP is less than 8mm Hg or the anterior chamber is shallow, check for a wound leak. Often the patient will complain of significant eye ache. With fluorescein, low IOPs often manifest as waffling of the corneal surface. Instill anesthetic, then gently press a wetted strip of fluorescein around every incision. A leak will show up under cobalt blue light as a stream emerging from the incision: the positive Seidel sign.

If you discover a mild leak, place a tight bandage contact lens, stop or decrease the steroid, notify the surgeon immediately and schedule a follow up the next day. You can even prescribe a topical hypotensive such as brimonidine BID to reduce the hydraulic flow. Wound leak patients must be seen daily until resolution. Mild leaks usually seal spontaneously within a day or two, at which point you can resume the steroid.

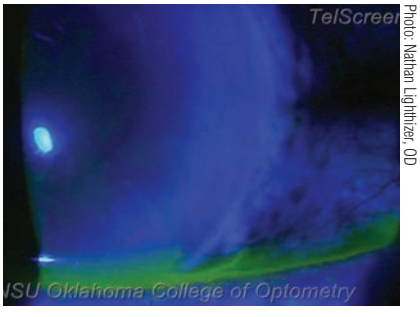


Photo: Nathan Lighthizer, OD

A vigorous wound leak, visible under cobalt blue light as a flow of dark aqueous pushing aside fluorescein. If followed superiorly this leak will reveal its origin at one of the surgical incisions.

If the leak is vigorous, the anterior chamber is so flat as to allow the iris and cornea to touch or the IOP is less than 4mm Hg, call the surgeon and send the patient back immediately; this may need a suture or anterior chamber fill.

Vitreous to the wound. If the posterior capsular tears during surgery, a strand of vitreous can stick to the surgeon's instruments and during withdrawal be pulled out into an incision. Though invisible when fresh, eventually stray pigment granules stick to the strand, making it easier to spot. The easiest tell-tale sign, however, is a peaked pupil pointing to an incision. This incites a vigorous inflammatory response and requires a quick return to the surgeon, who will likely sever the strand with a Nd:YAG laser.

Cystoid macular edema. This presents overwhelmingly in those with a history of retinal vein occlusion, pre-existing diabetic retinopathy, macular traction from the hyaloid or from an epiretinal membrane, or a posterior capsular tear during surgery. The onset can be from weeks to months after surgery; the patient will typically report initially good vision but later blur.[13] Their macula will show a petaloid or honeycomb appearance, sometimes with appreciable elevation. Look for decreased pinhole vision, or the characteristic OCT scan.

CME tends to respond quite well to a combination of a topical steroid

and NSAID at their usual dosage. These cases should be seen every two to four weeks; any case that does not improve at each visit merits consideration of a subconjunctival steroid injection or a visit to the retina specialist. If allowed to stagnate, CME can affect vision permanently.

Endophthalmitis. The most feared complication is invasion and infection of the eye by microbes. This can occur during surgery, or later if the wound is slow to heal. Any patient with some combination of significant pain, declining vision, lid edema, severe anterior chamber reaction, hypopyon and inflammatory cells in the vitreous within 72 hours after surgery should be assumed to have infectious endophthalmitis until proven otherwise. Endophthalmitis is rare—from four to 12 per 10,000 eyes in the United States.[14,15]

Unfortunately, this catastrophic infection does not follow a predictable course and can present in a mild form or even much later with certain microbes. Occasionally, a smoldering uveitis or vitritis is not correctly diagnosed until months later.

You must call the surgery center immediately with any suspicious findings. The next step is often a vitreous tap and culture. The prognosis for confirmed endophthalmitis is poor, with permanently reduced vision often from 20/40 to 20/400 or worse.

Retinal detachments. Eyes without unusual risk factors seem to have no increased risk of retinal tear or detachment after cataract surgery.[16] Myopic and lattice degeneration patients, on the other hand, do have an increased risk for up to 10 years after cataract surgery.[17] You should caution at-risk patients about the usual symptoms.[17]

After cataract surgery, patients often regain visual clarity that they have not enjoyed in many years. Watch out for the aforementioned signs, but, in the vast majority of cases, you will get to celebrate a safe and remarkable recovery and enjoy your patients' satisfaction. ■

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PEER • REVIEWED • PRA • ARTICLE

Refractive Surgery: Smiles All Around

Small incision lenticule extraction is changing a field long in need of an update. But is it all it's cracked up to be? **By Anders Ivarsen, MD, PhD, and Jesper Hjortdal, MD, PhD, DMSc**

For more than two decades, laser-assisted *in situ* keratomileusis (LASIK) has dominated the field of keratorefractive surgery with widespread acceptance as a procedure with high patient satisfaction, high precision and a good safety profile. Within the last few years, however, a new corneal refractive surgery has been making waves: small incision lenticule extraction (SMILE).

This article reviews the major SMILE studies on clinical outcomes and those comparing it with LASIK and discusses peri- and postoperative complications.

The Procedure in a Nutshell

Immediately before surgery, the patient fixates on a green blinking light to ensure centration on the optical axis. The eye is docked into a curved contact glass and a low-pressure suction is engaged at the limbus to keep the eye steady.

During the procedure, a femtosecond laser prepares a refractive lenticule within the cornea. The 500KHz laser produces ultrafast laser pulses (10^{-15} sec.) of near infrared light (1053nm) that conveys approximately 100nJ to 150nJ. Individual laser pulses are focused in the corneal stroma, where plasma expansion leads to localized photodisruption of the tissue. As cavitation bubbles from neighboring laser spots fuse, a well-defined cleavage plane is created within the tissue.

The surgeon places laser pulses in a spiral pattern at a distance of 2µm to 5µm. Initially, the posterior refractive surface of the lenticule is cut (*Figure 1a*), followed by the anterior surface, which is slightly enlarged to facilitate surgical manipulation. Finally, the surgeon creates a small peripheral incision (2mm to 4mm) from which to extract the refractive lenticule (*Figure 1b*). The surgeon breaks any remaining tissue bridges with a blunt spatula and uses forceps to grasp and remove the lenticule (*Figures 1a and 1d*).[1-3]

SMILE is a one-step laser procedure, where the critical refractive laser treatment is performed on the intact cornea, rather than on the exposed stroma, as in excimer-based procedures, avoiding the potential variability associated with excimer laser photoablation. Furthermore, the minimally invasive SMILE treatment causes very little trauma to the corneal surface and leaves the anterior stroma almost untouched, resulting in less corneal denervation than after LASIK, in theory reducing the negative biomechanical impact.

Internationally, the currently available SMILE procedure allows myopic corrections of up to -10D spherical equivalent refraction, including correction of up to 5D of astigmatism. Hyperopic treatments are not yet available, but studies are ongoing.[4,5] In September 2016, the laser was FDA-approved for myopic corrections between -1D and -8D in individuals 22 years or older.

Choosing the Right Patients

Patient selection is no different for SMILE than for LASIK, although the FDA has placed specific restrictions for patient age and refraction in the United States. Most surgeons use the same precautions for residual stromal thickness in both procedures and, as with LASIK, keratoconus suspects should not be treated with SMILE. Also similar to LASIK, the

approximate thickness of the tissue removal is dependent on the diameter of the lenticule and may be approximated using the Munnerlyn formula.[6] During pre-examination, clinicians should be aware of stromal scars, as they increase the risk of inadvertent perforation of the anterior stromal cap during surgery. However, with careful dissection of the refractive lenticule, most patients with anterior stromal scars may still be treated with SMILE.

The Results are In

The first SMILE reports were published in 2011, yet the number of clinical studies is still relatively few. Here, we primarily consider studies using the current 500kHz laser with a minimum of 100 eyes or at least a one-year follow up (*Table 1*).

Refractive outcome. Most studies have examined patients with a preoperative refraction of approximately -6D with varying degrees of astigmatism and follow up. On the whole, about 80% of patients obtain a postoperative refraction within ± 0.5D of the target refraction and roughly 95% of patients obtain a refraction within ± 1.0D.

According to one study, the refractive predictability after SMILE is unrelated to the attempted myopic correction—unlike excimer-based treatments, for which the refractive predictability typically decreases with increasing myopic correction.[7,8] Moreover, studies show other parameters, including patient age, gender and preoperative corneal power, have little impact on the refractive outcome after SMILE.[7]

Only three larger studies evaluate correction of myopic astigmatism in detail. In one study of 775 eyes three months after surgery, 95% of patients had a postoperative spherical equivalent refraction within ± 1.0D of the intended correction.[9]

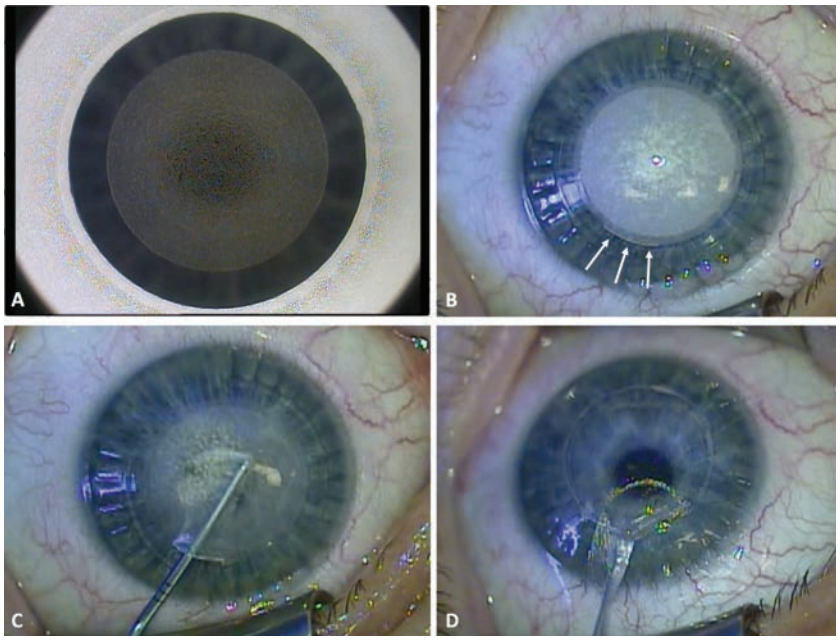

Fig. 1. These images depict the SMILE surgical procedure from start to finish. A) During the laser procedure, the posterior lenticule surface has been cut. B) After the anterior lenticule surface has been cut, a 40-degree incision is created (arrows). C) Next is careful dissection of the lenticule with a blunt Chansue dissector. The superior surface of the lenticule is dissected followed by the posterior surface. D) Finally, the lenticule is extracted through the small peripheral incision.

Table 1. Pre- and Postoperative Data

	Patient Data			Predictability					Safety		Efficacy	
	Patients	Eyes	Follow up	Pre-op SEQ (D)	Post-op error in SEQ (D)	SEQ ±0.5D	SEQ ±1.0D	Regress. (D)	CDVA loss ≥2 lines	Safety index	UDVA ≥20/20	Efficacy index
Hansen et al.[16]*	411	722	Three months	-6.8 ± 1.7	-0.4 ± 0.5	88%	98%	-	2.0%	-	58%	-
Hjortdal et al.[7]*	335	670	Three months	-7.2 ± 1.3	-0.3 ± 0.4	80%	92%	-	2.4%	1.07	60%	0.9
Ivarsen et al.[17]*	808	1,574	Three months	-7.3 ± 1.8	-0.2 ± 0.5	78%	95%	-	1.5%	1.05	-	-
Liu et al.[25]	57	113	Six months	-5.2 ± 1.7	0.0 ± 0.2	97%	100%	n/a	2.0%	-	58%	-
Reinstein et al.[12]**	69	110	One year	-2.6 ± 0.5	-0.1 ± 0.4	84%	99%	n/a	0%	-	96%	-
Sekundo et al.[15]	27	53	One year	-4.7 ± 1.3	-0.2 ± 0.2	92%	100%	0.1	0%	1.08	88%	0.99
Pedersen et al.[13]	87	87	Three years	-7.3 ± 1.4	-0.3 ± 0.6	78%	90%	n/a	0%	1.13	71%	0.91
Han et al.[14]	26	47	Four years	-6.3 ± 1.5	0.0 ± 0.1	89%	100%	n/a	0%	1.16	92%	1.07

SEQ: spherical equivalent refraction. *Includes learning curve. **Intended slight over-correction.

However, an astigmatic under-correction of 13% was reported for small cylinders and an under-correction of 16% for large cylinders greater than or equal to 2.5D. A similar astigmatic under-correction of approximately 10% to 15% per diopter was reported in two smaller studies one year after surgery.[10,11]

Refractive stability. In three studies with one, three and four years of follow up, researchers observed no significant regression.[12-14] A fourth study with a one-year follow up found a small regression of 0.08D.[15]

Following myopic astigmatism correction, investigators note the spherical equivalent refraction, as well as the cylinder, is stable from one week to 12 months post-op.[10]

Visual outcome. The postoperative uncorrected distance visual acuity (UDVA) is a common measure of the efficacy of a refractive procedure. With SMILE, researchers found an overall UDVA of 20/20 or better in 58% to 96% of individuals from three months to four years post-procedure.[12,16] The relatively large variation may be related to differences in the intended target refraction. Thus, an intentional over-correction in some studies will tend to improve the reported efficacy.

Most studies report an efficacy index between 0.9 and 1.0, indicating that patients can expect, on average, an UDVA of 90% to 100% of their preoperative corrected distance visual acuity (CDVA).[7,14]

After myopic astigmatism correction, one study reports an UDVA ≥20/20 in 55% of patients with small cylinders and 40% of patients with cylinders ≥2.5D.[9] Another investigation found an UDVA ≥20/20 in 57% after correction of cylinders from 0.75D to 4.0D, whereas other researchers found 79% to have an UDVA of at least 20/20 after correction of small cylinders.[10,11] In general, the observed UDVA after astigmatic corrections mirrored the refractive outcome with poorer outcome in larger cylinders.

Safety. The overall safety of refractive surgical procedures is usually assessed by the induced change in CDVA, where a loss of two or more lines on the Snellen acuity chart is considered significant. Unfortunately, most of the existing studies are too small to properly evaluate SMILE safety. The largest studies all report a two-line loss for between 1.5% and 2.4% of patients after the procedure.[7,17] However, these studies all include the initial learning curve of the surgeons, which may have negatively influenced the outcome. Moreover, these studies found a safety index of more than 1.0, indicating that the patients on average had an increase in CDVA—most presumably due to the induced increase in magnification after surgery.[7,17]

In a study of 1,574 eyes three months after SMILE, 1.5% of patients experienced a two-line loss in CDVA.[17] However, when re-examining these patients one to two years later, the researchers noted preoperative CDVA was restored in all eyes, suggesting late recovery of visual acuity can occur in a small subgroup of patients.[17]

Complications. A number of studies report a variety of perioperative issues with SMILE, although most studies are too small to adequately assess their prevalence (*Table 2*). In addition, another recent study found the incidence of perioperative complications drops with increasing surgeon experience.[18]

The most frequently reported complications—such as small epithelial defects, minor tears or bleeding at the incision—have little clinical implication. Occasionally, lenticule extraction may be difficult due to suboptimal cutting of the lenticule caused by either development of an opaque bubble layer or the appearance of black spots. Other rare complications that may affect the postoperative outcome include cap perforation and large tears.

The combination of low suction and a long laser treatment time may cause involuntary eye movements and a loss of suction during the surgery—a complication in 0.8% to 4.4% of surgical cases.[15,17,19-22] Excess fluid at the coupling interface and surgeon inexperience are

Table 2. Perioperative Complications

	Incidence
Epithelial defect at the incision	0.2% to 11%[3,15,17,19,20,37]
Minor tear at the incision edge	2.1% to 6.1%[17,19]
Bleeding at the incision	0.9%[37]
Suction loss	0.8% to 4.4%[15,17,19-21]
Opaque bubble layer	0.7% to 4.4%[20,37]
Black spots	0.3% to 3.8%[20,37]
Lenticule extraction difficulties	0.9% to 3.8%[15,17,37]
Central epithelial defect	0.3%[17]
Cap perforation	0.3%[17]
Large tear	0.1%[17]

Table 3. Postoperative Complications

	Incidence
Microdistortions at Bowman's membrane	4% to 60%[19,38,39]
Trace haze	4.0% to 19%[15,17,38]
Transient surface dryness	4.8%[17]
Late recovery of visual acuity	1.5%[17]
Epithelial islands at the interface	0.6% to 2.0%[15,17,19]
Fiber or debris at the interface	0.4%[17]
Monocular ghost images	0.4%[17]
Interface inflammation	0.3% to 1.6%[17,40]
Keratitis	0.3%[17]

also risk factors for suction loss, as is patient anxiety, highlighting the importance of mental preparation and perioperative reassurance.[21]

If suction loss occurs after completion of the posterior surface of the lenticule, the treatment usually may be continued immediately. However, if the posterior cut is incomplete, immediate continuation may cause an anterior-posterior shift that negatively affects the refractive outcome. In these cases, the surgeon may postpone surgery, typically for two to three months, and consider an alternative keratorefractive approach such as LASIK or surface ablation.

Most post-op complications have little clinical implication and include dry eye during the first postoperative day, microstriae and increased interface scatter (*Table 3*). Rare complications include keratitis, severe interface inflammation, epithelial ingrowth and irregular topography. In one study of 1,574 eyes three months after SMILE, researchers found irregular topography in 18 eyes, causing monocular ghost images in six eyes.[17]

Retreatment

Although SMILE has a high refractive predictability, some patients will experience a clinically significant residual refractive error. While the flap may be lifted to perform an enhancement procedure in LASIK, retreatment after SMILE is more complicated. Possible approaches include re-SMILE at another corneal plane, surface ablation with application of mitomycin C or conversion of the SMILE cap to a LASIK flap with the circle procedure.[22-24]

SMILE vs. LASIK

At present, only three small, randomized studies and a few meta-analyses compare SMILE with LASIK. In two of the randomized studies, the researchers observed no significant differences between SMILE and LASIK with respect to refractive predictability or efficacy.[25,26] SMILE showed less induction of higher-order aberrations (HOAs) in both studies and, in one of them, better postoperative contrast visual acuity and Schirmer scores.[26] The third study, however, found that topography-guided LASIK offered better refractive predictability than SMILE.[27] This study also found better UDVA and contrast vision after LASIK—both probably due to an under-correction of -0.23D in SMILE eyes.

Two meta-analyses found similar refractive predictability, efficacy and safety after SMILE and LASIK, but SMILE showed better corneal sensitivity and tear film break-up time compared with LASIK.[28,29] Another, more recent meta-analysis of 27 comparative studies also found similar clinical outcomes between the two procedures, but favored SMILE with respect to the induction of

Comanaging Refractive Surgery: An OD's Perspective

By Walter O. Whitley, OD, MBA, and Justin Schweitzer, OD

Many of our patients have thought about refractive surgery at some point, and some seek information directly from a surgery center without consulting their OD. To combat this, we must be proactive and initiate this discussion first to clarify our integral role in the pre- and post-operative care. Patients need to know the refractive surgery process begins with a refractive screening (vision, pachymetry, topography, cycloplegia, etc.) right here in our office.

FAQs

Because SMILE is a new surgical procedure, patients will have a lot of questions. Here's a look at some of the frequently asked questions and ways you can address them:

What is SMILE? It is an alternative to LASIK that some providers view as potentially safer. Essentially, it is a different road to get to the same destination of freedom from glasses.

What does the procedure entail? The SMILE procedure uses a flapless laser procedure to address your nearsightedness.

Am I a candidate for SMILE? As in any refractive procedure, this will depend on a number of factors such as your current glasses prescription, corneal shape, corneal thickness and ocular health. If you are not an ideal candidate for SMILE, our refractive surgeons can perform several other refractive surgeries such as LASIK, PRK, implantable collamer lens, extended depth of focus intraocular lens and corneal inlays. I'm happy to schedule you for a full refractive consultation to determine which procedure is best.

What are the risks? Every surgery involves risk; however, we will work closely with your surgeon to identify which procedure and medications are best for you.

How are the outcomes? SMILE has been a very successful procedure provided internationally for many years. According to the FDA clinical study, 88% of patients achieve 20/20 better.[1]

What is the next step? Let's schedule a refractive consultation to see if you are a candidate.

Partner and Grow

This exciting time for refractive surgery provides an opportunity to reinforce your partnership with your refractive surgeon. Share marketing materials in both offices, and consider hosting an open house or patient seminar to discuss the services you provide.

Refractive surgery is another opportunity to expand your practice. As you know, happy patients tell everyone. Patients remember who provided their procedure and who was with them from pre-op to post-op success. Make sure you are the doctor everyone is talking about.

Recchioni A, Hartwig A, Dermott J, et al. Early clinical outcomes after small incision lenticule extraction surgery (SMILE). Cont Lens Anterior Eye. 2017 Oct 25. pii: S1367-0484(17)30257-6. [Epub ahead of print].

corneal HOAs.[30] Finally, four meta-analyses focused on sensitivity after SMILE and LASIK and found better outcomes in SMILE treated eyes.[31-34]

Researchers speculate that the nearly intact anterior stroma after SMILE leaves the cornea biomechanically stronger than after LASIK.[35] Several studies have attempted to verify this, but with little success, although one meta-analysis suggests SMILE has less negative biomechanical impact than LASIK.[29] Still, investigators recently published one case of iatrogenic keratectasia 18 months after SMILE, in a cornea with inconspicuous preoperative topography.[36] Thus, it remains unclear whether SMILE offers any biomechanical advantages over LASIK.

What We Do and Don't Know

The minimal impact on the anterior stroma is one of the most interesting aspects of the SMILE procedure. It spares the stromal nerves, and several studies demonstrate better corneal sensitivity after SMILE than after LASIK. Still, the exact implication of this observation remains unclear. Myopic astigmatism correction is also promising, but hyperopic treatments need further evaluation. The excimer laser still remains the only option in complicated cases, as compensation for eye rotation and aspheric or custom lenticule profiles are still unavailable with SMILE.

Although only available on one laser system (VisuMax, Carl Zeiss Meditec), SMILE will be on everyone's radar moving forward, as it may eventually allow alternative new treatments, including re-implantation or transplantation of refractive lenticules for refractive or tectonic purposes. Further research will help clinicians better understand SMILE's place in the refractive surgery armamentarium and help document its evolution. ■

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Aarhus University Hospital has specified research agreements with Carl Zeiss Meditec.

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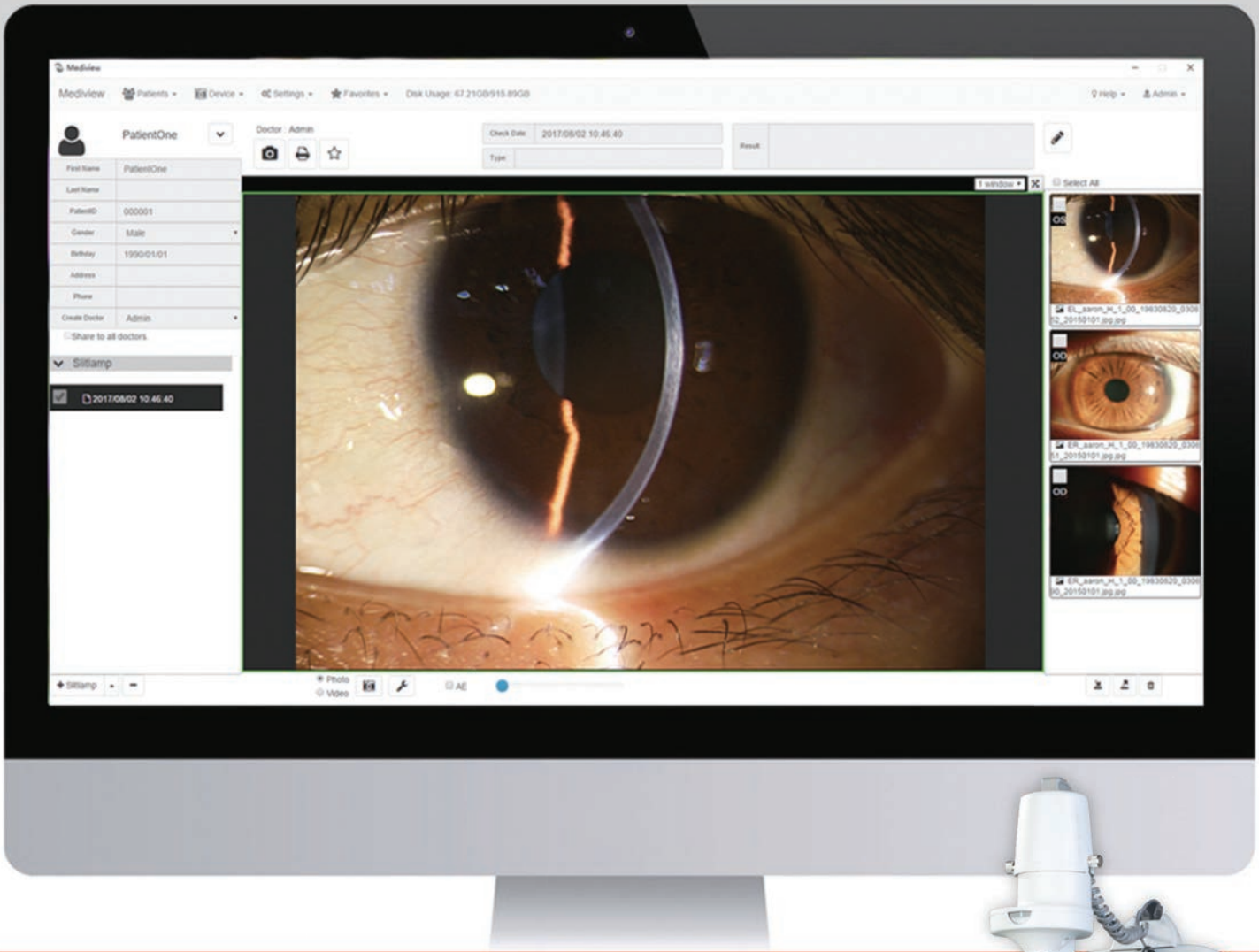

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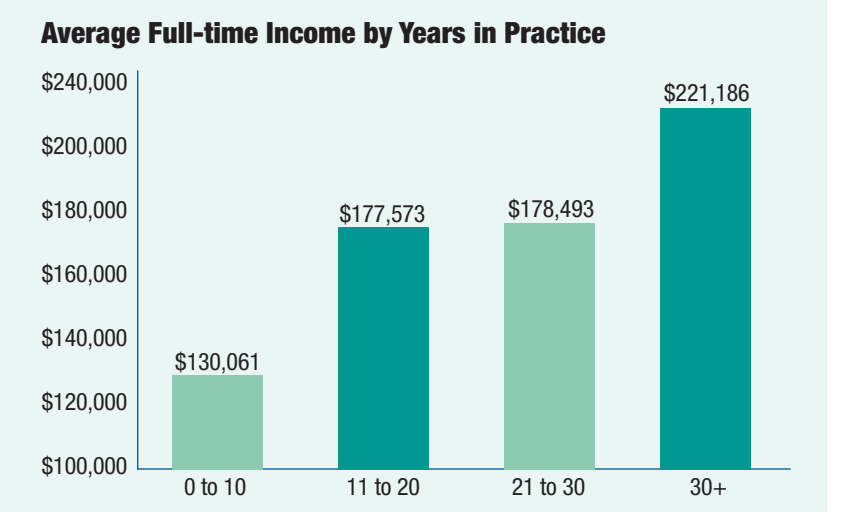
2017 Income Survey: *A MIXED BAG*

Optometry made some major strides in 2016, but how did the field fare in 2017?

By Michael Iannucci, Associate Editor

As 2017 draws to a close, it's a great time to look back and see how optometrists made out financially. According to our annual income survey, 2016 was a year of growth for optometrists, with increases across the board. This year, more than 500 ODs responded to our survey, and the overall average income was $163,761, a 4% increase from 2016. That's not as significant as the 9% increase from 2015 to 2016, but it shows things are moving in the right direction.

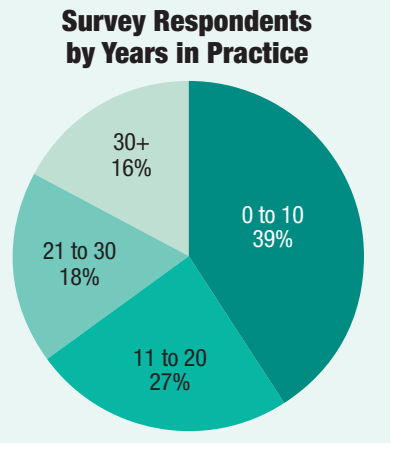
Beyond that, we broke down the results to incorporate a range of factors and see exactly what affected wages throughout the field. Here's how it played out.



Part-time Prosperity

Most of this survey's statistics focus on full-time work, but it's important to look at part-time work as well. This year, part-time optometrists only accounted for 9% of respondents (a 1% decrease from 2016), and they earned an average of $120,841, a 10% increase from the year before and a 44% increase from 2015. Full-time optometrists—91% of respondents—experienced a more modest increase in average salary, with their $167,562 representing about a 3% increase from the previous year.

The most important factor in the increased pay for part-time work was experience, as 57% of part-time respondents had more than 20 years in the profession.



Hard Work Pays Off

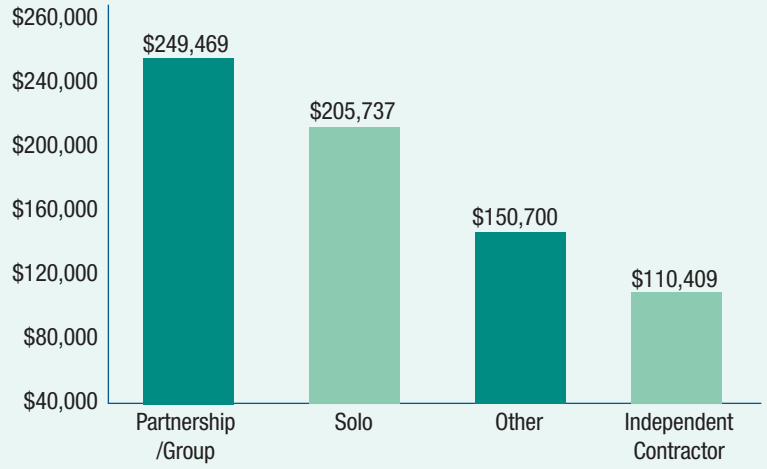
Over the years, the general rule of thumb in our income survey has been that the more experience you have,

the better, and while that remains true for 2017, your experience threshold is becoming a bigger factor. The entry-level group of optometrists—those with zero to 10 years of experience—made an average of $130,061, only a slight increase from 2016. This year's average income leap from zero to 10 years of experience to 11 to 20 years was a sizable 37% for $177,573. For optometrists with 21 to 30 years of experience, however, the average income was $178,493. That's only a 0.5% increase for 10 years more experience.

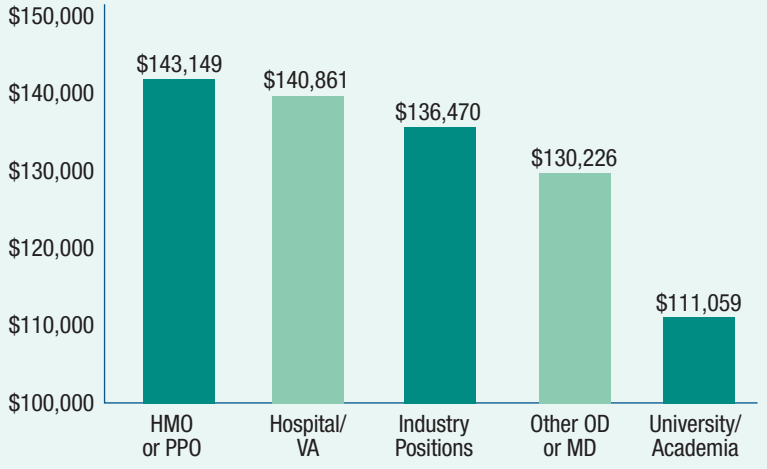
This mid-career plateau was a source of frustration for many in the 21 to 30 year group. One respondent says that her income had not changed in 10 years, and according to another: "I've been doing this for 25 years and I'm making less money than I did 15 years ago."

Still, it appears that increased experience pays off eventually. At the top of the experience pack were those with more than 30 years in the profession. The group represented only 12% of respondents but made an average salary of $219,935, a 23% rise from those who stalled out between 21 and 30 years. "Beyond my wildest dreams," was how one 30-plus-year respondent described his earnings. Others were satisfied with their comfortable lifestyles and ability to stay on track for retirement.

Average Full-time Self-employed Income by Practice Setting



Average Full-time Employed Income by Practice Setting



A Boost for Employees

In 2016, whether you were employed or self-employed was the biggest factor affecting optometrists' income. It remained vital in this year's results, but the divide is beginning to close. This year, self-employed optometrists reported an average income of $179,078 compared with $132,353 for those who are employed. The 35% difference between the two is noteworthy, but much less so than the 58% gap of 2016. Additionally, many respondents are touting the benefits of being employed.

"I have had a private practice in the past, but my current practice mode has far fewer headaches and more flexibility for vacations with other doctors available," says one employed respondent. "I now also have a 401k plan with a match and medical insurance." Another respondent reports, "My employer pays my family's entire health insurance premium, as well as stipends for continuing education and other incidentals."

It's not all positives on the employed side of the equation, however. "I am employed, so my income is a flat rate, regardless of my production," says one respondent. "There are bonuses that reflect my production, but the goal keeps rising to impossible levels. I had a great year in 2016, but that only meant goals rose to levels that were not attainable for 2017." Another respondent, who answered the survey as "satisfied"

with his current salary as opposed to "very satisfied," listed one of the pitfalls of his employment: "I would be 'very satisfied' if I got paid for 'non-revenue' visits, especially cataract post-ops, since I do hundreds a year."

Self-employment brings on a new wave of obstacles. Among those most frequently mentioned in the survey were low insurance reimbursements and competition from online sales. When it's possible to work around those factors, however, the benefits of self-employment are not to be overlooked. "I earn about three times the national average, but to get there I work six days and 56 hours per week," says one respondent. "This affords me enough money to live comfortably, vacation six weeks per year, save for retirement and donate."

Other survey takers mentioned similar perks: "I am able to work three days a week," says one respondent. "My practice has an administrative staff to handle most day-to-day decisions, while I focus on reports and 'big picture' items." According to another: "I work about 36 hours per week, my office is half a mile from my home and overall I am happy with the income I make."

Practice Setting Pluses

To maximize potential income, working in a partnership or group seems to be the way to go for ODs. The 30% of self-employed respondents who worked full-time in a partnership or group had an average income of $248,567, the highest reported figure of any group in this year's survey—and a 6% increase from last year's results, in which partnership or group ODs also reported the highest average income at the time.

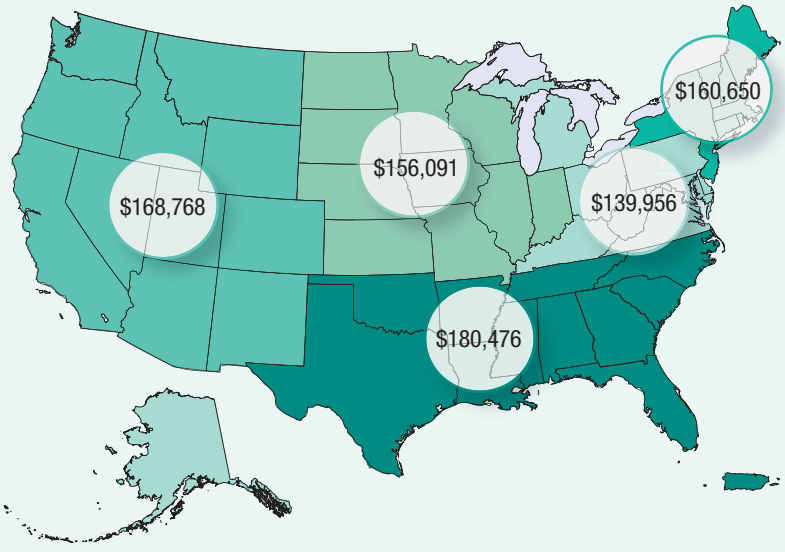
Those who chose to forego the partnership or group route and operate a solo practice experienced a healthy 7% income jump in 2017, with an average of $204,516. It wasn't a great year for independent contractors, however. The group reported the lowest full-time income average of our survey at $109,086, a 27% drop from 2016.

Overall, self-employment seems to be a rewarding direction, as 27% of those respondents were very satisfied with their income, compared with only 14% of employed respondents. That isn't to say that 2017 was a bad year to be employed. In particular, it was a good time to work in an HMO or PPO setting, as the group took over the top average employee salary spot at $143,149, thanks to an 8% boost. However, these ODs only accounted for about 4% of employed respondents.

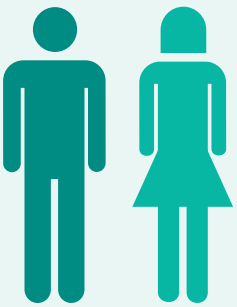
Employees who work in a hospital or Veteran Affairs setting, those who work for another OD or MD, and those who work in academia experienced notable growth as well, with 11%, 18% and 12% increases in salary, respectively. Although working in academia delivers the lowest average salary for the employed, it appears to be a fulfilling mode of work, as nearly 70% of those respondents were either satisfied or very satisfied with their salary. Some reported perks here included schedule flexibility and benefits.

One dark spot for the employed, however, was compensation from industry positions. This group lost the top spot for average employee salary as the number dropped by about 10% from 2016. Making this statistic slightly more concerning is the fact that industry position employees account for 21% of employed respondents, the second largest group behind only those who

Average Full-time Income by Region



Average Full-time Income by Gender



work for another OD or MD (50% of employed respondents). Survey comments did not establish a standout reason for the drop off, but it is cause for concern nonetheless.

Regional Riches

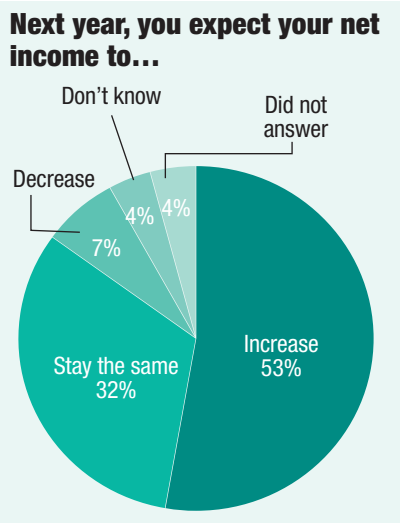
Your practice location appears to be more important than ever based on this year's results, and it could alter your pay by up to 29%. The place to be, it seems, is the South. There, ODs earn an average income of $180,476, a stark contrast to the nation's low of $139,956 in the Mid-Atlantic and Lower Great Lakes region.

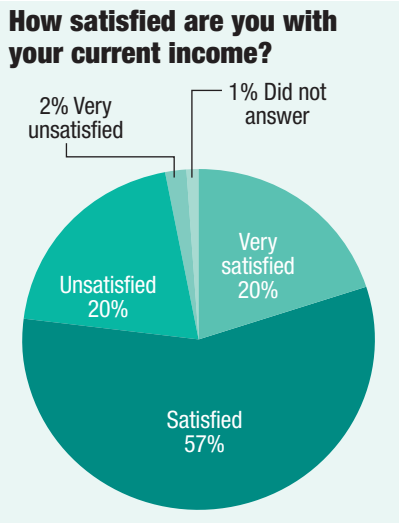
The West experienced the greatest upswing of the bunch, as ODs in these states went from the lowest paid in the nation last year to second highest paid this year. This is especially helpful for those living in California, who reported struggling with the area's high cost of living in past surveys. This year, Calidornia-based respondents moved up 18 percentage points for an average income of $181,612. "It's enough, but the cost of living in California is high, so there is still room for improvement," says one respondent.

The Gap Expands

The gender gap isn't new to optometry, or any profession for that matter. Last year, we took a big step towards equality, with the disparity between men and women shrinking from 68% to 37% in our survey. If 2016 represented a step in the right direction, 2017 will go down as a step backwards. Results show that men out-earned women by 40% in 2017, a 3% bigger gap than 2016.

One bright spot in last year's gender-based statistics was the fact that the majority of the disparity came from those with more than 30 years in the field; women with less than 10 years of experience, who accounted for a much larger percentage of





respondents, had pulled to within three percentage points of equal pay.

This year, at an average income of $204,903, men with more than 30 years under their belts earned 10% more than women with the same experience, who sat at $186,265. This actually demonstrates a closing of the gap, as this group's disparity was 33% in 2016. Still, only seven of the group's respondents were women, so those with less experience gave us a better idea of where we are headed.

Unfortunately, for the group that came so close to equality in 2016, the gap widened again. Like last year, women made up the majority of optometrists with less than 10 years of experience, accounting for 54% of respondents. Their $121,892 average income, however, was 11% less than men in the same group, who earned $135,398. When compared with last year's meager 3% gap, this represents a sizable step backwards, as the optometrists of the future reported a wider gender gap than those with the most experience.

Time to Shine?

Despite this year's mixed results, ODs were even more optimistic about the year to come. Of this year's respondents, 53% expect their net income to increase, compared with 47% in 2016. Additionally, 32% expect their income to stay the same, while only 7% expect a decrease. For those looking forward to 2018, technology investments and debt payoff are key.

"I just need to pay off some debt for equipment loans and I should be able to pay myself better," one respondent says.

For others, it's simply a matter of adjusting for business changes. "I'm in a transition phase, so my 2017 salary is significantly lower than 2016 as I work to build a new associate into the practice."

Still Advancing

The 2017 numbers were all over the place for ODs, with some steps backward, some forward and some just side-to-side. Several of the same issues that have haunted the profession for years, such as low insurance reimbursements, remain prevalent, the gender gap appears to have widened again and there's a pesky mid-career plateau to worry about. However, with an overall increase in average income and some significant growth reported in other categories, the bottom line is that the profession is moving forward, even if the pace has slowed a bit. ■

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WHEN TECH AND LUXURY COLLIDE

Review's 2017 Office Design Contest had a slew of fantastic entries. With this year's winners, "wow" starts long before the office visit. **By Rebecca Hepp, Managing Editor**

State-of-the-art equipment and high-tech exam lanes are testing the boundaries of today's optometry office. The profession, and its technology, continues to evolve, yet many office spaces do not, leading to cramped pre-testing areas and a sluggish workflow.

For those who bite the bullet and redesign a new or existing space to meet their needs, the payoff can be huge. This year's office design contest entrants did just that, and they are thrilled with the outcome.

"Our new office is night-and-day from our old space," said Will Tantum, OD, CEO of Blount County Eye Center in Maryville, Tenn., one of our winners. "The old office was 'cookie-cutter' in terms of design. It wasn't necessarily a bad design, but it also wasn't truly genuine either. We sought to create a space that made people in our community proud to come for eye care; we wanted to create a space that reflected our values."

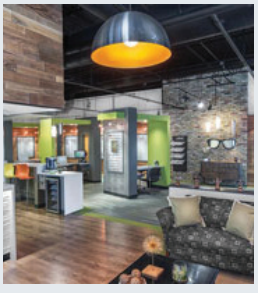
Dr. Tantum, and each of the 2017 winners, certainly delivered on their promise for a better patient experience. Open concepts, stylish designs, snack bars, music and efficient workflows are just a few of the upgrades patients can enjoy in these new spaces. The prevailing approach to renovations was two-pronged: seamless integration of technology in a luxurious atmosphere. While everyone showed off spa-like designs with cutting-edge new gadgets, three stood out with their keen eye for efficiency, equipment integration, ergonomics and aesthetics.

Take a look at this year's redesigned practices that went above and beyond to provide patients and staff the space of their dreams.

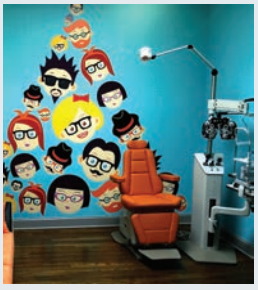
MEET THE JUDGES

These three practices won our 2015 Office Design Contest and provided expert feedback to help choose this year's winners:

Andrew Howard, OD, owner of LaFollette Eye in Jacksboro, Tenn. *Dr. Howard used colors on the floor to help patients navigate the office loop from the lobby, through testing and exams to the eyewear gallery without backtracking.*



Midwest Eye in Downers Grove, Ill. *This office now boasts a bold lime green and orange color scheme with an open loft design, giving patients a uniquely modern experience.*



Benjamin W. Kachelman, OD, from Florence Eye Center in Florence, Ala. *Florence Eye Center, once a dry goods store, tailor shop, bank and then an attorney's office, is now 7,400sq.ft. of "creative and artistic space," according to our 2015 judges.*

Winner

Swell Vision Center, Leland, NC

Craig Scibal, owner

Dr. Scibal, of Leland, NC, uses frosted barn doors to section off his office space when needed—and they wooed this year's judges. "The frosted doors are a great way to offer privacy while allowing patients to not feel secluded. And who doesn't love barn doors?" asked Pam Peters and the Midwest Eye team, one of this year's judges.

Chosen as this year's best overall office design, Swell Vision Center boasts 2,200sq.ft. of space designed to "make the office simple, elegant and to minimize clutter," Dr. Scibal said.

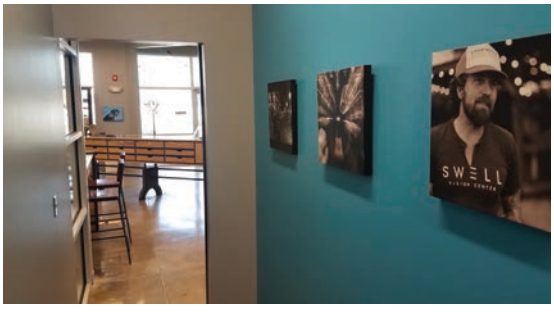
While the exposed brick, concrete floors and natural wood accents "invite the patient with comfort, blending the rustic and modern concept," the integration of a custom design and technology creates an exceptional office flow. The L-shaped reception desk makes it easy to greet and care for patients the minute they walk through the door—and those barn doors the judges were so fond of? Throughout the office they "create the unique ability to 'compartmentalize' sections of the office, which enhances lighting and privacy in several areas," Dr. Scibal said.

The optical uses a mobile laptop linked with their cloud-based electronic health record to ensure timely patient care, even if the optical bar is crowded.

Pretesting—consisting of both new and used equipment to keep up with advancements without breaking the bank—is divided so that more than one patient can flow through at the same time, and all exam rooms have new equipment and integrated computers. Even in the exam rooms, patient and practitioner comfort is achieved with style. "The modular storage desk in the exam room makes it easy to showcase various optometric lenses and equipment, and the proximity allows intimate overview of retinal photos," adds Dr. Scibal.

Patient care is priority number one in this office, but they also remembered the extras that make

a patient's visit special. The spa-like experience begins before the patient even enters the office, as receptionists take refreshment (including beer and wine) and music requests for the patient's visit. Dr. Scibal's dog, Horatio, is the office greeter, and patients are welcome to show up with their own pooch in tow. Candles are strategically placed throughout the practice to enhance the experience, according to Dr. Scibal.



"This office was designed exactly how I would want going into an establishment," Dr. Scibal says. "Every single piece of furniture, equipment, scent, wood finish, etc., has been individually selected to promote an unbelievable and memorable eye care experience."

"I would love to walk into this clinic—it doesn't look clinical at all!" says another judge, Andy Howard, OD, of LaFollette Eye in LaFollette, Tenn. "And that exam room furniture is like none other I've seen. I want it!"

1st Runner Up

Accurate Vision Clinic, Anchorage, Alaska

Benjamin Crawford, OD, CEO

Our first runner up hails all the way from Anchorage, Alaska, where they, like this year's winner, also focused on a modern, uncluttered look. This 5,000sq.ft. industrial-chic office may boast exposed beams and ductwork—but not equipment. All the data from their pretesting rooms is transferred electronically to the exam rooms for easy review with the patient. In addition, "we integrated the wiring for our TRS refraction systems into the walls of the exam room. We wanted to keep the office as 'clean' as possible without any clutter," says Dr. Crawford.

"I love the digital integration of work-up and exam room data, which makes this office not only functional, but beautiful," says Dr. Howard.

And beauty, some would argue, is just as important to patients when it comes to office aesthetics.

"The clean, inviting design makes me want

to stay a while, which is great for sales," says Dr. Howard. "I was looking for spaces that invite me to enter and explore, and this practice does just that. That front desk! Am I in an eye care practice or a spa? I can't tell the difference, and that's a good thing. The color pops, very appropriate for an eye clinic."

As much as any patient enjoys a beautiful space, they will always appreciate efficiency, and this office delivers. A huge focus for the redesign was improved patient flow, and now staff can effortlessly move patients from the reception area, through the pretesting room—which is a long, narrow room with a station for each of their instruments—into the exam rooms, and then to the optical.

"Our staff can easily guide the patient through each step," said Dr. Crawford.

At the end of the day, this colorful, tech-savvy office brings a smile to everyone's face.

"The staff loves coming to work every day in the new office, as do I," says Dr. Crawford. "It's definitely been a team morale booster, and everyone has a sense of pride when showing it off to patients. Our existing patients are always impressed with the new space, and new patients often say that they've never been to an eye clinic quite like ours!"

2nd Runner Up

Blount County Eye Center, Maryville, Tenn.
Will Tantum, OD, CEO

Space was the key for Blount County Eye Center, this year's second runner up. "This place is super-sized!" says Dr. Howard. "I can imagine being a patient entering the giant space and just saying, 'wow!'"

"Going from 2,500sq.ft. to just under 10,000sq.ft. has been a game-changer," explains Dr. Tantum. "When patients enter an open space, it makes them feel less cramped from the start of their experience. Oversized exam lanes create a more comfortable working environment and allow patients to stretch out."

With more room, the practice expanded from one full-time and one part-time OD to five full-time docs and now hosts the regions first full-service vision therapy clinic—and even a suite of exam rooms specifically designed for kids, Dr. Tantum says. With so much space, they're even able to host community events. "Because we designed the lobby/optical to be so open, we can easily clear it out and host local community groups, meetings and events," says Dr. Tantum. "Not many other optometry practices can say that!"

Far from cookie-cutter now, the office provides any number of usual—and unusual—luxuries for patients, including a larger, safer parking lot, a drive-thru window

for optical dispensing, upgraded technology in all six exam lanes and even an open-concept lab. "The lab windows have proved to be a treat for our patients, as they now like to stand and watch 'how the magic of optical happens.' People love standing there and watching their lenses run through the edger."

Amid all these patient "wows," Dr. Tantum made sure to take care of his team too. An oversized and fully functional kitchen gives everyone a space away from the hustle and bustle to relax during breaks. The massive contact lens and supply storage area, a lab quadrupled in size and "the region's largest optical" gives everyone the space they need to do their jobs efficiently and with the privacy many patients demand.

"There is something to be said for a spectacular layout," says Benjamin W. Kachelman, OD, from Florence Eye Center, one of our judges. "That leads to great flow, which leads to money in the bank." ■

Blood Omen

Patients with polycythemia vera should be given special consideration prior to considering corneal refractive surgery.

Edited by Joseph P. Shovlin, OD

Q I have a patient with polycythemia vera (PV) who wants laser-assisted in situ keratomileusis (LASIK) surgery. Are there any contraindications here?

A "PV is a rare blood disorder in which there is an increase in all blood cells, particularly red blood cells," says Justin Schweitzer, OD, who practices at Vance Thompson Vision in Sioux Falls, SD, and is an adjunct clinical professor at the Illinois College of Optometry. "Corneal laser vision correction (LASIK or photorefractive keratectomy [PRK]) in patients with PV has not been formally studied."

What Causes PV?

While an exact cause of PV has yet to be discovered, evidence points to overactive signaling by proteins known as Janus kinases (JAKs).[1] This results in the overproduction of blood cells in the bone marrow. It can also trigger overproduction of cytokine proteins, which in turn causes inflammation. An overabundance of cytokines has been linked to PV symptoms.

Researchers believe that overactive JAK signaling may be related to gene mutations, and almost everyone with PV has a mutation of the JAK 2 gene.[1]

Where's the Research?

A PubMed search using the key words "polycythemia vera," "PV," "LASIK" and "PRK" yields no results, and "there is nothing in the literature of absolute contraindications for a patient that has PV and wants to have corneal laser vision correction, but a few things need to be considered," says Dr. Schweitzer.

The first consideration revolves around making sure the patient knows that research is lacking about the effect of refractive surgery on those with this blood disorder. "The informed consent for a patient with PV that elects to undergo corneal refractive surgery needs to state that PV has not formally been studied in corneal laser vision correction," says Dr. Schweitzer. "PV can cause retinal complications, such as vitreous hemorrhages and thrombotic events, that are not linked to the corneal refractive procedure, and the patient needs to be made aware of those complications."[2]

After having the conversation and ensuring the patient fully understands the risks, practitioners should document everything in the chart, Dr. Schweitzer suggests.

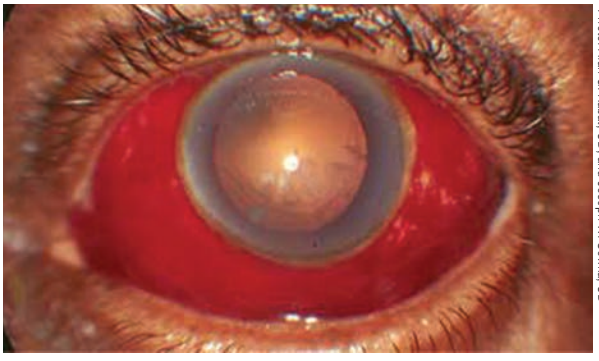


Photo: Alan G. Kabat, OD, and Joseph W. Sowka, OD

A subconjunctival hemorrhage, which can occur during LASIK, could be excessive in PV patients.

Think Through the Risks

Despite the lack of literature, clinicians must still consider the possible risks involved in the operation, and proceed accordingly. "In LASIK when the suction ring is applied for the procedure, subconjunctival hemorrhaging can occur," says Dr. Schweitzer. "In a patient with PV, the subconjunctival hemorrhage could be excessive, and possibly difficult to stop." Because of this, LASIK may not be the best refractive surgery option for these patients, Dr. Schweitzer believes. "If the patient ultimately decides they want corneal laser vision correction, PRK would be a better choice, as no suction ring is used for the procedure, limiting the risk of subconjunctival hemorrhaging." ■

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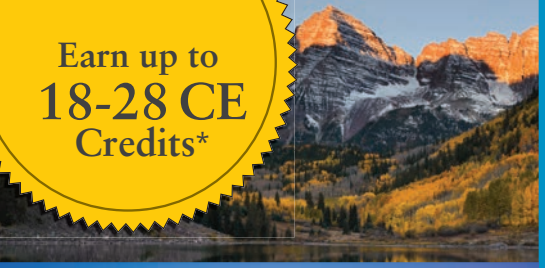

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When Things Get Tense

Imaging shows a case of computer eye strain is more than meets the eye.

By Mark T. Dunbar, OD

A 34-year-old black female presented for an annual eye exam as part of her vision plan insurance. She had not had her eyes tested in several years and said she began noticing eye fatigue after prolonged computer use. She does not wear glasses, reports being in good health and says she does not take any medications.

On examination, her entering visual acuities were 20/20 in each eye. Confrontation visual fields were full-to-careful-finger-counting in both eyes. Her pupils were equally round and reactive; there was no afferent defect. Extraocular motility testing was normal. The anterior segment examination of both eyes was unremarkable. Tensions by applanation tonometry measured 16 OU.

On dilated fundus exam, the vitreous was clear. Fundus images were taken of her optic nerves (*Figure 1*). The macula, vessels and periphery were normal. Spectral domain optical coherence tomography (SD-OCT) are available for review (*Figure 2*).

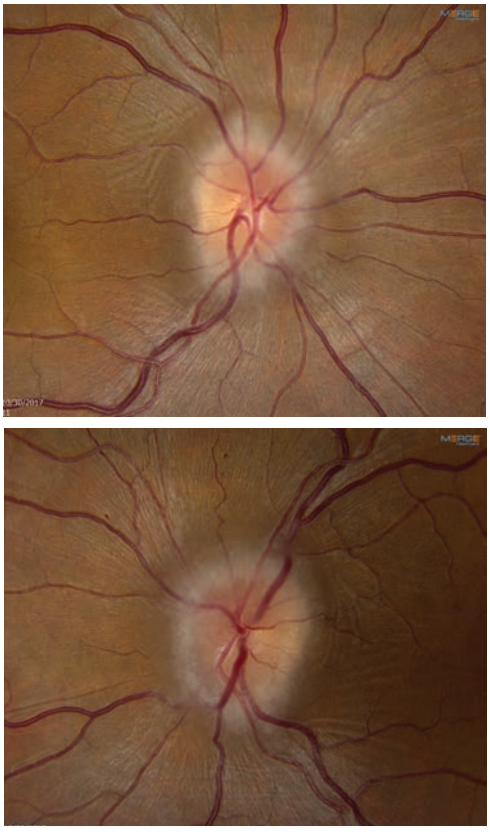

Fig. 1. These fundus images show the right (at top) and left optic nerves of our 34-year-old patient. What can they tell you about her likely diagnosis?

Take the Retina Quiz

1. How would you characterize the optic nerves?
a. Elevated but no swelling.
b. Lumpy/bumpy.
c. Grade II disc swelling.
d. Grade III disc swelling.

2. What additional testing may be necessary?
a. No additional testing.
b. MRI.
c. LP.
d. Both B and C.

3. Based on the clinical findings, what is the likely diagnosis?
a. Optic nerve head drusen.
b. Papilledema.
c. Optic nerve hypoplasia.
d. Idiopathic intracranial hypertension.

4. How should this patient be managed?
a. Only observation.
b. Weight loss.
c. Periodic visual fields.
d. Acetazolamide.

For answers, see page 98.

Diagnosis

Our patient had very obvious bilateral optic nerve swelling in both eyes. On clinical exam, the optic nerves were clearly elevated, the margins were blurred 360 degrees and there was an absence of a spontaneous venous pulse in both eyes. Based on the modified Frisén classification of disc swelling, our patient had grade III disc swelling. The SD-OCT also showed obvious RNFL thickening beyond what is seen in the normative data base.

At this point, it was too early to tell what was going on with our patient. We were most suspicious of idiopathic intracranial hypertension (IIH), but we also recognized the list of differential diagnoses can be quite extensive.

IIH predominantly affects obese women of childbearing age.[1] It has no known etiology; however, risk factors for IIH include exposure to or withdrawal from certain exogenous substances, systemic diseases,

certain endocrine or metabolic disorders and disruption of cerebral venous flow.[1] Our patient was 5 feet 2 inches and weighed 133 pounds, but she did admit that, over the past four months, she had lost more than 15 pounds due to changes in her diet and exercise. On appearance, she seemed fit and not significantly overweight.

Given the clinical findings of bilateral disc edema, a medical work up that includes magnetic resonance imaging (MRI) and a lumbar puncture (LP) is a mandatory next step.

Our patient had an MRI of her brain and orbits on the same day of our exam. It was normal without detection of any mass lesions. The following day an LP was performed and her opening pressures were 50cm H_2O. The normal range is 7cm to 18cm H_20, so our patient's cerebrospinal fluid (CSF) pressure was extremely high—consistent with a diagnosis of IIH.[2]

Discussion

IIH develops from chronically elevated intracranial pressure (ICP). Terminology for this condition has evolved over the years. Pseudotumor cerebri and benign intracranial hypertension are synonymous terms and were commonly used to describe this condition until IIH emerged as the preferred term.

The most significant neurologic complication from IIH is papilledema, which, if left untreated, may lead to progressive optic atrophy and blindness. The grading of optic nerve swelling based on the modified Frisén classification (*Table 1*).[3]

Table 1. Optic Nerve Swelling Grading Classifications

Grade I: papilledema is characterized by a C-shaped halo with a temporal gap.

Grade II: papilledema, the halo becomes circumferential.

Grade III: papilledema is characterized by loss of major vessels as they leave the disc

Grade IV: papilledema is characterized by loss of major vessels on the disc.

Grade V: papilledema has the criteria of grade IV plus partial or total obscuration of all vessels of the disc.

Other neurologic symptoms of elevated ICP include severe headaches, ringing in the ears, blurred vision and diplopia, which may result from a cranial VI palsy.[1,4] Our patient had none of these symptoms.

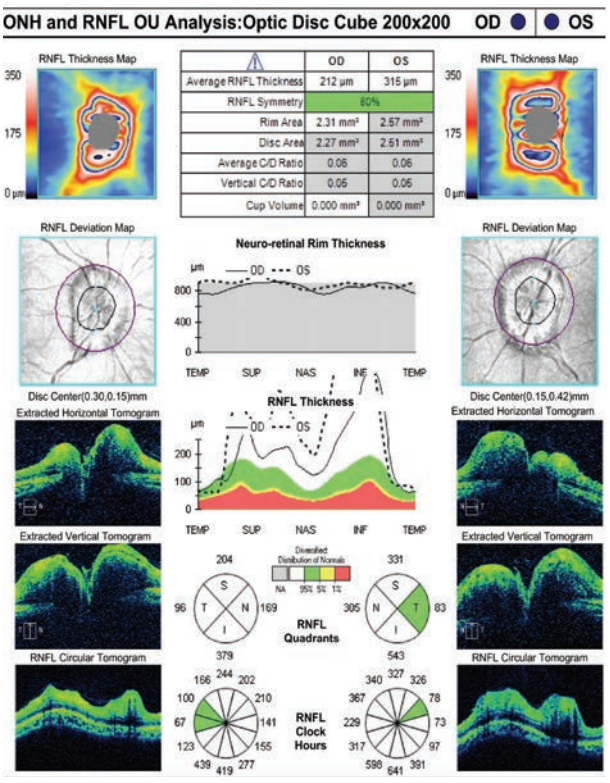

Fig. 2. How would you interpret these retinal nerve fiber layer OCT findings in our patient?

Management

Weight loss is considered the best long-term management for this condition, but can be difficult for patients to maintain.[5] A referral to a dietitian may be appropriate to help formalize this process. Our patient is off to a good start as she had already lost 14 pounds over the past three months.

The most affective pharmacologic treatment for IIH is acetazolamide. The initial dosage is 0.5g to 1g per day, usually with the 500mg Diamox Sequels bid.[1,4] Unfortunately, many patients become intolerant to the side effects of the medication, which include paresthesias in the extremities, fatigue, metallic taste from carbonated beverages and decreased libido. In patients that develop progressive vision loss despite being on Diamox, surgical management may be warranted. Options include optic nerve sheath fenestration, lumboperitoneal or ventriculoperitoneal as a means of diverting the CSF and venous sinus stenting.[1,4]

We started our patient on 1g of acetazolamide per day and counseled on the benefits of weight loss. She was asked to return in six weeks for follow up. ■

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Have As Many As You Want

Just because you identified one possible cause of vision loss doesn't mean others aren't lurking. **By James L. Fanelli, OD**

A new patient, a 69-year-old black male, presented to the office for continuation of care in 2013. He suffered a self-reported "stroke" in his right eye approximately five years earlier that had affected his vision somewhat, and his ocular history was also significant for cataracts in both eyes. At that initial visit, his best-corrected visual acuities (BCVA) were 20/50 OD and 20/25 OS through hyperopic astigmatic correction. Medications included antihypertensives, antihypercholesterolemics and NSAIDs.

His initial visit was to establish care and to see if there was anything that could be done to improve his vision in the right eye, though he said he was previously told the changes to the right eye were permanent.

His pupillary responses indicated a +1 afferent pupillary defect (APD) OD. He had symmetric early nuclear cataracts, consistent with the BCVA in his left eye.

The initial evaluation of his optic nerves demonstrated a couple of significant findings. The right optic nerve was somewhat diffusely pale, with a somewhat thinned neuroretinal rim and a cup-to-disc estimated at 0.45 x 0.6. The neuroretinal rim in the left eye was equally thinned, but was plush and well perfused on funduscopy. The retinal vasculature in his right eye was slightly attenuated, especially along the course of the superior temporal artery; overall arterial attenuation was noted in the right eye more so than in the left. Peripheral retinal evaluations were unremarkable.

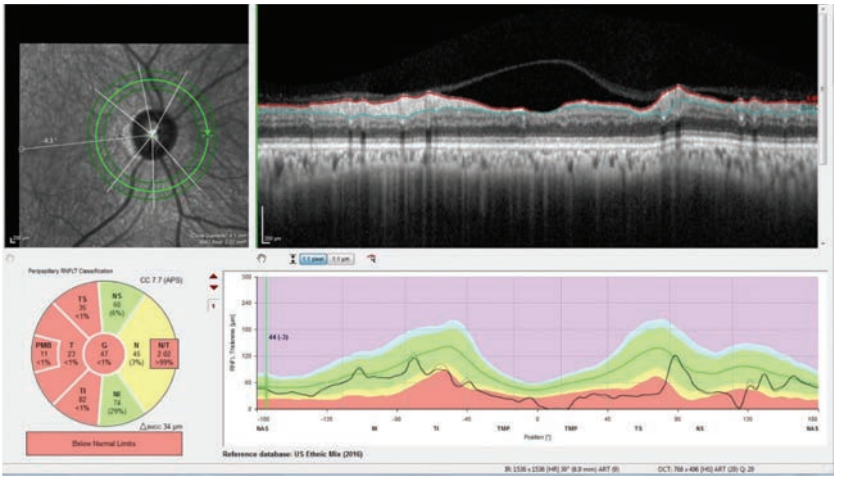

Fig. 1. The neuro protocol retinal nerve fiber layer circle scan with the papillomacular bundle (PMB) represented in the center of the double hump plotting we are used to viewing, as opposed to the standard RNFL circle scan which has the papillomacular bundle at the ends of the double hump plot. Note also the segmentation of the papillomacular bundle in the Garway-Heath sector analysis in this patient with non-glaucomatous optic neuropathy.

Given the findings, I suspected that he had had an ischemic event of either an embolic nature or local infarction of his optic nerve in the right eye in previous years, leaving him with decreased BCVA in the left eye, and I could offer no significant help in improving his vision.

However, his optic nerves, aside from the pallor in the right, were suspect for the possibility of glaucoma. Accordingly, he was scheduled for testing to obtain a baseline of optic nerve functioning, including threshold visual fields, optical coherence tomography (OCT) and Heidelberg Retina Tomograph (HRT 3) scanning, as well as multimodal imaging of the posterior segment.

A Closer Look

He complied with these requests, and not surprisingly, his right eye was found to have an altitudinal visual field defect inferiorly involving fixation, as well as a questionable field defect in the superior arcuate area, though visual field reliability indices were not the most accurate. His visual field study in the left eye was essentially normal. Structural imaging of the optic nerves with both HRT 3 and OCT demonstrated a slightly

thinned neuroretinal rim consistent with the initial clinical findings. Macular scans demonstrated superior hemispheric thinning of the total retinal thickness in the right eye, consistent with a regional infarction.

However, in the context of glaucoma, I could attribute no direct findings to uncontrolled glaucoma in either eye at the same time; so, I elected to proceed with simple monitoring of the optic nerves in the context of glaucoma and a suspected ischemic event, as well as his cataracts.

Following Through

Over the next couple of years, being seen twice a year, his cataracts progressed slightly and visual acuity decreased correspondingly. However, in mid 2016, when he presented for his scheduled follow up visit, he complained of worsening vision in his right eye. At that time, visual acuity in the right eye had dropped to 20/200 and maintained an APD. On dilated fundus evaluation, his cataracts had progressed in both eyes, lightly more in the right than in the left, but not to the level matching his BCVA in the right eye.

Medications at this visit included Cozaar (losartan potassium, Merck) Dyazide (hydrochlorothiazide/triamterene, Novartis), Zocor (simvastatin, Merck) and 81mg aspirin, with no reported allergies to medications. While the cataract had worsened in the right eye more than the left, so did the pallor of the right optic nerve as compared with previous visits. His macular and vascular evaluations were stable from baseline visits.

Given that both progression of cataracts and a suspected reoccurrence of the ischemic event in the right eye were contributing to decreased vision in the right eye, we looked at possible etiologies of progressive ischemic events that appeared concurrent with cataract progression, before heading to cataract surgery.

Differential diagnoses in this particular case included a reoccurrence of the ischemic optic neuropathy, as well as carotid and ophthalmic artery insufficiency. While no retinal emboli were noted, nor was there any history of acute ischemic neurological events, his initial vascular picture in the right eye was consistent with the possibility of retinal vascular insufficiency rather than an acute ischemic optic neuropathy.

Lab testing including erythrocyte sedimentation rate and high-sensitivity C-reactive protein were

normal, as were carotid doppler studies. Referral to the patient's primary care provider was made to facilitate tight blood pressure and cholesterol control, to ascertain other possible concurrent vasculopathies and to ultimately gain clearance for cataract surgery. Following an exhaustive work up, the patient was cleared for cataract surgery, which was performed in 2016.

Discussion

The old adage that patients are entitled to as many diseases as they choose certainly is evident here. It is our job to sift through the many possible causes of decreased vision, and to render the appropriate care. You will come across many patients, similar to the one discussed here, who have either frank glaucoma or are a glaucoma suspect and, concurrently, have some other disease process or processes that can confound your evaluation.

In this case, we sought the underlying cause of the decreased vision in the right eye beyond the obvious progression of the cataract. While no specific identifiable etiology was identified from the preoperative studies, it does appear as though the patient had a reflare of his nonglaucomatous optic neuropathy, as evidenced by both the increase in optic disc pallor as well as the postoperative BCVA in the right eye of 20/80-.

Pallor of the neuroretinal rim is not consistent with glaucoma, but is consistent with the nonglaucomatous optic neuropathies. Therefore, if you suspect that a patient has glaucoma, and you also see concurrent neuroretinal rim pallor, there most likely is another nonglaucomatous process occurring.

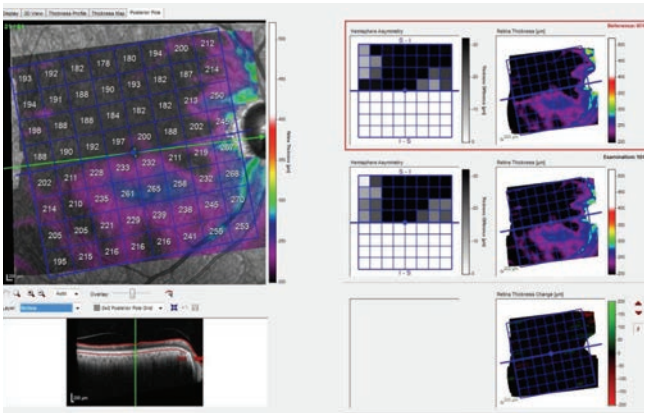

Fig. 2. These images show the patient's total macular retinal thickness over two separate visits, with essentially no discernible change over the (short) time frame between scans.

And then the question, and subsequent management, hinges upon continued monitoring. How do you manage such patients? How do you evaluate these patients? The answer is quite simple. You follow these patients just as you would any other glaucoma patient, with a specific emphasis on the hallmark of glaucoma progression: change over time.

Know Your Imaging

How you image these patients is critical. For example, the standard retinal nerve fiber layer (RNFL) circle scan may be of limited value in these patients, as the RNFL perioptic circle scans look at areas adjacent to, but not at, the optic nerve. Also, since glaucoma structurally involves the ganglion cells, approximately 50% of which come from the macula, macular scans can be helpful. Keep in mind, total macular thickness scans can be confounded by diseases such as age-related macular degeneration, macular puckering or vitreomacular traction.

Knowing the limitations of your imaging equipment of choice is critical in selecting the most appropriate techniques. For example, consider a neurological protocol RNFL circle scan (*Figure 1*). This scan is different from the normal RNFL circle scan in two important ways. The first is that the typical RNFL circle scan begins temporally and ends temporally, essentially starting and stopping in the papillomacular bundle. The neuro RNFL circle scan, on the other hand, begins nasally and ends nasally, thereby scanning through the entire papillomacular bundle in one sweep. Secondly, reference database comparison with the normal papillomacular bundle parameters are available with this scan, whereas with normal RNFL circle scans the papillomacular bundle is not segmented out.

In the case presented, the initial evaluation demonstrated thinning and loss of retinal thickness in the right eye, especially in the superior hemisphere. On the contrary, ganglion cell layer loss is consistent with glaucoma, and not consistent solely with ischemic events. While looking for change over time, note in *Figure 2* the relative stability of overall retinal thickness (as well as how dramatically thinned the entire retina is, especially in the superior hemisphere). This implies that the vascular compromise is stable, but does not reliably comment on stability of the ganglion cell layer.

Additional imaging shows the segmented macular ganglion cell

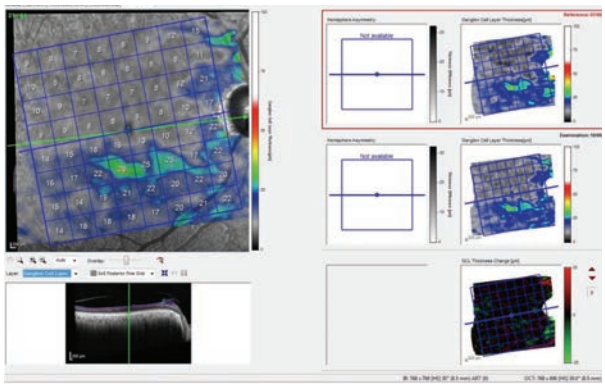

Fig. 3. Note the global thinning of the macular ganglion cell layer in the right eye and the possible subtle change occurring in the inferior temporal ganglion cell layer, suggestive of worsening glaucomatous optic neuropathy.

layer of the same patient's right eye (*Figure 3*). Since this is showing only the ganglion cell layer, it is not confounded as much by other macular diseases, making evaluation of the situation from a glaucoma perspective much easier. However, the ganglion cell layer change analysis of the left eye also seems to indicate some change, which would be attributable to conversion to glaucoma.

Focus on Structure

A portion of our patient's vision in the right eye did decrease because of the cataract, which was subsequently addressed, resulting in improved BCVA, but the BCVA was still not as good as it initially was when the patient was first seen, due to the reflare of the ischemic optic neuropathy. If you've noticed, I have not mentioned the patient's intraocular pressures (IOP). The crux of this case is the structural issue occurring in the right eye due to both glaucomatous and nonglaucomatous optic neuropathies.

Since IOP is our only modifiable risk factor, the starting point is somewhat irrelevant (assuming it is not 'too high'; therefore, a reduction in IOP may be of some benefit for his right eye). Initial IOPs have averaged 12mm Hg to 14mm Hg OU, with average central corneal thicknesses.

So should we lower IOP by a couple of points in the right eye, to mitigate any damage from glaucoma? It can certainly be argued yes. How much? Time will tell.

The key to determining whether we made the right move is answering the root question in the management of all glaucoma patients: What is changing over time? ■

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Finally, a Treatment for EKC?

After years of only palliative therapy, a new approach is taking shape.

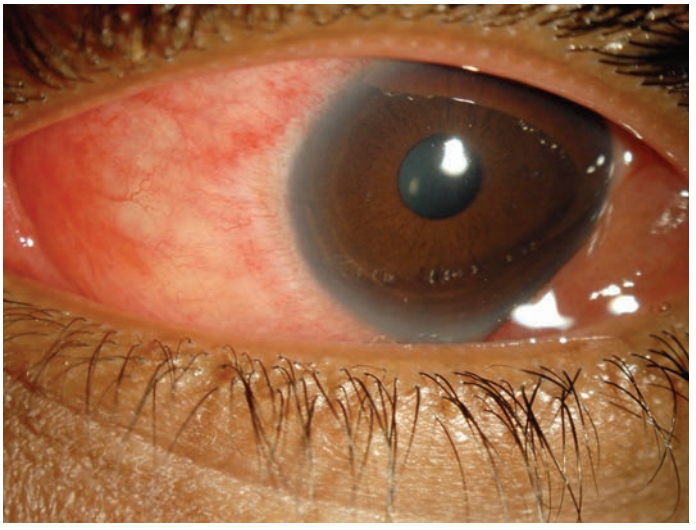
By Joseph W. Sowka, OD, and Alan G. Kabat, OD

A 30-year-old female patient presented complaining of progressively worsening red eyes over the past three days. She had no frank pain, but felt that her eyes were generally uncomfortable and "unwell." She had a fair amount of serous discharge and reported that her eyelids were matted shut with dry, crusty tears when she arose. She had no itching or photophobia. She acknowledged a mild upper respiratory infection (URI) a little more than a week ago.

Her vision was minimally reduced at 20/25 in each eye. There was no mucopurulence, but her eyes were watery with serous discharge. She had a grade 2 diffuse conjunctival injection. There were several faint subepithelial infiltrates (SEI) in both corneas and perhaps one or two white blood cells in the anterior chambers. Inspection of the palperbral conjunctiva revealed a pronounced follicular response in each eye. Palpation of her preauricular nodes showed the glands to be swollen and tender bilaterally. She was concerned that she had "pink eye."

We explained that she actually had a form of viral conjunctivitis, most likely epidemic keratoconjunctivitis (EKC). After a detailed discussion of the infectious nature of the condition, we recommended copious artificial tears and cold compresses and prescribed a mild topical steroid to give her symptomatic relief.

For many years, when encountering any form of suspected viral conjunctivitis, we could do little other than recommend palliative measures to increase comfort. There was no standard therapy, and practitioners employed cold compresses, nonsteroidal or steroidal medications and artificial tears in varying combinations dictated by personal algorithms, due to the fact that the offending viruses really weren't susceptible to any known treatment.



For EKC (not "pink eye") patients, such as this 30-year-old woman, a new option for relief may soon be available.

However, that may be changing with a new compound currently under investigation.

Monitoring

The two frequently encountered forms of viral conjunctivitis are pharyngoconjunctival fever (PCF) and EKC.[1-11] Both forms are difficult to distinguish from one another clinically. PCF is marked by fever, sore throat, history of URI and follicular conjunctivitis.[1,2,4,7,9-11] The condition may be unilateral or bilateral, but classically presents in one eye and subsequently spreads to the other.[1-8] The cornea is rarely affected, and infiltrates are uncommon.[5] Preauricular lymph nodes may be palpable and tender. The virus has a self-limiting infectious period of 14 to 30 days.[7,8] The condition is contagious through the entire clinical period. Principal ocular symptoms of PCF include diffuse conjunctival redness, watery discharge and epiphora.

EKC presents as a unilateral or bilateral inferior palpebral follicular conjunctivitis with epithelial and subepithelial keratitis.[12,13] SEI do not occur in every instance. When observed, they are typically concentrated in the central cornea.[12-15] These localized gatherings of leukocytes can persist for months or longer. It is speculated that using

topical steroids may prolong the infiltrative response. This condition is also highly contagious.[9-12] Viral conjunctival infections are thought to be spawned by viral molecules transmitted either by airborne respiratory droplets or direct transfer from fingers to the conjunctival surface.[1-4,7-16]

Differentiating the various causes of conjunctivitis can be daunting, often leading to a "shotgun approach" in an attempt to treat everything that may be present, including bacteria. The point-of-care diagnostic service AdenoPlus (Quidel) uses technology based on lateral flow immunochromatography to identify adenoviral antigens.[17,18] Once clinicians obtain the sample, a result is available within 10 minutes and can minimize misdiagnosis.

Therapies

Viral conjunctivitis is contagious but self-limiting. Management currently involves increasing patient comfort and patient education so as to limit spread of the condition. Patients should stay home from work or school until the discharge has ceased. Medical management may range from supportive cold compress and tears to topical vasoconstrictors, topical nonsteroidal anti-inflammatory agents and topical steroids BID to QID. Many practitioners will avoid steroids based on the fact that they suppress the immune system; while these medications may help to improve overall comfort, they also prolong clearance of the virus.

Recently, practitioners have employed a Betadine (povidone-iodine, Purdue) rinse of the ocular surface for viral conjunctivitis, despite the fact that this is an off-label use. The eye is topically anesthetized, and several drops of diluted povidone-iodine are placed into the palpebral fissure, bathing the conjunctivae for 10 to 30 seconds, and then rinsed away. Unfortunately, no standards exist for dilution or specific indications for use of this agent. Patients are often quite uncomfortable once the anesthesia wears off. Most importantly, success is anecdotal and few studies assess if this was even helpful.[19]

A better method may be on the way in the form of a fixed-combinaton antimicrobial/ anti-inflammatory medication. A double-masked study comparing 0.1% dexamethasone/0.6% povidone-iodine (SHP640, Shire) against povidone-iodine (PVP-I) and vehicle in 144 patients with adenoviral conjunctivitis has recently been completed. To be included in the study, patients must have had a positive AdenoPlus test, reported signs and symptoms of adenoviral conjunctivitis of at least five days, had a diagnosis of suspected acute adenoviral conjunctivitis in at least one eye, plus watery discharge and bulbar conjunctival redness.

Patients received one drop in both eyes four times a day for five days. At day six, the percentage of patients with clinical resolution (absence of watery conjunctival discharge and bulbar conjunctival redness) was 31.3% for the SHP640 group, 10.9% in the vehicle group and 18% in the PVP-I group. Adenoviral eradication was significantly higher in the SHP640 group (79.2%) compared with vehicle (56.5%) and numerically higher than the PVP-I group (62.0%). Adenoviral eradication was noted in both non-vehicle groups as early as day three, as reported at the ARVO meeting in 2017.[20] Additional Phase III studies are currently underway for the treatment of both viral and bacterial conjunctivitis.

Should ongoing clinical trials prove this combination medication to be efficacious and safe, we may soon have a therapy that actually eradicates viral particles and hastens disease resolution, allowing us to go beyond simple palliative therapy. Should antibacterial efficacy also be shown, one medication can possibly be used for cases where we are clinically uncertain whether the origin is viral or bacterial. ■

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Edited By Derek N. Cunningham, OD, and Walter O. Whitley, OD, MBA

An Eyelid Tuck

A few snips and these malpositioned eyelids are back to protecting the globe.

By Leonid Skorin, Jr., DO, OD, MS, and Rebecca Lange, OD

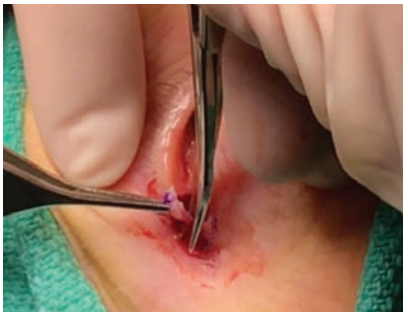
Many common patient complaints may stem not from the eye itself but the lids designed to protect it.[1] For example, the chronic exposure of the globe and palpebral conjunctiva due to ectropion—or the malposition of the eyelid turning away from the globe—may contribute to symptoms of excessive tearing (epiphora), dry eye, ocular irritation or a mucoid discharge.[1,2] It may also expose the punctum, causing it to become stenotic, which will lead to further epiphora.[1]

Clinicians can often treat mild ectropion, at least initially, with lubrication in the form of artificial tears or ointments, or temporary lid taping.[1] Once it progresses further, however, it's time to refer patients for surgical intervention.

The Procedure

If the patient has punctal stenosis, enlargement of the punctum is the most reliable method of treatment.[3] The three-snip punctoplasty is used to re-open the punctum and then provide the proper drainage channel for tears. The first two snips of the three-snip procedure are performed on the medial and lateral aspects of the vertical portion of the punctum. The third snip joins the ends of the two vertical incisions and results in the excision of the posterior aspect of the tissue.[3]

To see a video of this procedure, visit www.reviewofoptometry.com, or scan the QR code.



After incising the tendon, the surgeon measures and then excises a portion of the lower lid.

If the patient has medial ectropion, the medial portion of the eyelid must be inverted so that it is re-approximated to the globe. This is accomplished by performing a medial spindle procedure. A fusiform (elliptical) excision of the conjunctiva and lower lid retractors is performed just temporal to the punctum. The surgical site is then closed with absorbable suture, imparting an inverting vector force to the lid margin and punctum.[4]

The workhorse of ectropion lid repair is the lateral canthal strengthening procedure. It combines both horizontal shortening and a lateral tarsal strip.[3] Lateral tightening begins with a canthotomy—splitting of the lower and upper eyelids at the lateral canthus to mobilize the lateral eyelid.[3-5] The canthal tendon is then incised (cantholysis) to completely separate the lower lid.[5,6] The lower eyelid is then held taut to the globe to measure the appropriate amount of the lateral lower eyelid to be excised. Once this portion is excised, the surgeon fashions a tarsal strip on the tarsus of the lower eyelid to prevent epithelial ingrowth. The tarsal strip is then reattached with a suture to the periosteum at the level of the lateral orbital tubricle. The lower lid is then pulled taut against the globe and the lateral canthus is reconstructed with non-dissolvable suture.

Post-surgery

Comanaging physicians will note that the patient should use ice packs on the eyelids and take over-the-counter pain medication as needed following the procedure. Ophthalmic antibiotic ointment is prescribed three times a day to be used on the eyelids to keep the sutures moist, prevent infection and maximize healing.

After one week, the sutures used to reconstruct the lateral canthus are removed. The suture used to reconstruct the medial spindle is removed two weeks postoperatively. After two weeks, the antibiotic ointment can be discontinued. ■

Dr. Skorin practices ophthalmology at the Mayo Clinic Health System in Albert Lea, Minn.

Dr. Lange is a recent graduate of Pacific University College of Optometry.

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- Maintaining and expanding the high quality clinical practice environment for optometry students on rotation;
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c) **Scholarly activity**

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Product **Review**

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Bausch + Lomb has expanded the parameters of its Ultra for Astigmatism contact lenses to +6.00D to -9.00D in 0.25D steps (in 0.50D steps above -6.00D). They come in cylinder powers of -0.75D, -1.25D, -1.75D, -2.25D and axes of 10° to 180° degrees (in 10° steps), according to B+L.

Visit bausch.com.

Diagnostic Technology

Corneal Topography Software

Topcon's Aladdin biometer with corneal topography now incorporates the Olsen intraocular lens calculation formula. The addition allows for a wider selection of options to calculate IOL power with precision and confidence, according to the company. The Olsen formula uses the C-constant to predict effective lens position of both in-the-bag and anterior chamber IOLs.

Visit www.topconmedical.com.

Ophthalmic Lens Case Design

Volk Optical's new case design for its diagnostic and therapeutic lenses has been engineered to withstand 50,000 openings without hinge breakage, according to Volk. The exteriors are color-coordinated by lens family and labeled with the lens name. The cover plate can also be custom engraved, the company says.

The case is now standard on new single lens orders, or can be purchased individually as a replacement, according to Volk.

Visit www.volk.com.

Salzburg Reading Desk Now Available

The Salzburg Reading Desk (SRD), by SRD Vision, is now available to clinicians and researchers in the United States. The SRD helps optometrists assess near, computer and intermediate reading speed and reading acuity using a high-resolution monitor and software that presents progressively smaller sentences, according to the company. ■

Visit www.srdvision.com.

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Diagnostic **Quiz**

Float On

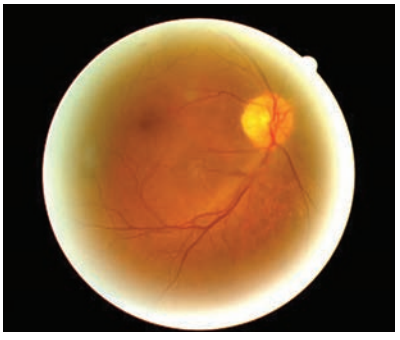
By Andrew S. Gurwood, OD

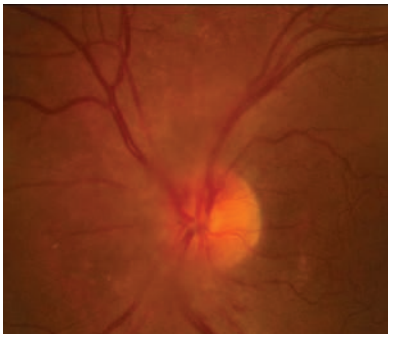
History

A 68-year-old white male presented for an initial comprehensive ocular examination with a chief complaint of intermittent burning of both eyes over the past two years.

The patient's secondary complaint was floaters in both eyes occurring daily for the last few years but stable. The patient denied any additional ocular history and reported a medical history of hypertension, gout and hypothyroidism, for which he was poorly medicated using lisinopril/hydrochlorothiazide, allopurinol, sertraline and ranitidine.

The patient was currently taking Synthroid (levothyroxine, AbbVie) and denied having any allergies to medications or environment.





A 68-year-old patient complained of a burning sensation in his eyes and floaters. Can these images help identify why?

Diagnostic Data

His best-corrected entering visual acuity was 20/20 OU. His external examination was unremarkable with no evidence of afferent pupillary defect. Biomicroscopic evaluation of the anterior segment showed mild exposure keratopathy adjacent to bilateral pterygia. Goldmann applanation tonometry measured 17mm Hg OU. The pertinent retinal findings are demonstrated in the photographs.

Your Diagnosis

Does the case presented require any additional tests, history or information? What steps would you take to manage this patient? Based on the information provided, what would be your diagnosis? What is the most likely prognosis? To find out, visit www.reviewofoptometry.com. ■

Retina Quiz Answers *(from page 82):* 1) d; 2) d; 3) d; 4) d.

Next Month in the Mag

Coming in January, *Review of Optometry* will present its Annual Cornea Report.

Topics include:

- *The Top 12 Questions About Corneal Crosslinking*
- *How to Manage a Persistent Epitheilal Defect*
- *Is it Sterile, Viral or Bacterial? Diagnosing Corneal Infiltrative Disease*
- *The Optometrist's Role in Corneal Transplant Comanagement*

Also in this issue:

- *Positive Visual Phenomena: Etiologies Beyond the Eye*

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References: 1. Alcon data on file, 2017. **2.** Alcon data on file, 2008. **3.** Alcon data on file, 2011. **4.** Angelini TE, Nixon RM, Dunn AC, et al. Viscoelasticity and mesh-size at the surface of hydrogels characterized with microrheology. *Invest Ophthalmol Vis Sci.* 2013;54:E-abstract 500.

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