Diabetic Retinopathy: See Something? Say Something, *p. 28*

REVIEW® OF OPTOMETRY

April 15, 2019

www.reviewofoptometry.com

CORNEAL DISEASE REPORT

CORNEAL Manifestations of Systemic Diseases

Let's review the clinical presentation and management of four conditions a routine slit lamp exam might reveal.

Page 34

Only VYZULTA Expands the Trabecular Meshwork with the Power of Nitric Oxide[1-5]

Visit **VYZULTANOW.COM** to learn more.

DUAL ACTION:

› VYZULTA increases aqueous humor outflow by targeting the **uveoscleral pathway** with latanoprost acid and the **trabecular meshwork** with nitric oxide[1,6]

PROVEN EFFICACY:

› VYZULTA decreased mean IOP up to **9.1 mmHg** from baseline in clinical trials of up to 12 months[6]

DEMONSTRATED SAFETY:

› **6%** of patients in pivotal trials reported **hyperemia**[6]

› **6 out of 811** patients on VYZULTA in pivotal trials **discontinued** treatment[1]

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
- 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

IMPORTANT SAFETY INFORMATION (CONTINUED)

- 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. Cavet ME, DeCory HH. The role of nitric oxide in the intraocular pressure lowering efficacy of latanoprostene bunod: Review of nonclinical studies. *J Ocular Pharmacology and Therapeutics*. 2018;(34)1,2:52-60. DOI: 10.1089/jop.2016.0188. **2.** Wareham LK, Buys ES, Sappington RM. The nitric oxideguanylate cyclase pathway and glaucoma. *Nitric Oxide*. 2018;77:75-87. DOI/10.1016/j.niox.2018.04.010. **3.** Stamer DW, Ascott TS. Current understanding of conventional outflow dysfunction in glaucoma. *Curr Opin Ophthalmol*. 2012;23:135-143. DOI:10.1097/ICU.0b013e32834ff23e. **4.** Cavet ME, Vollmer TR, Harrington KL, VanDerMeid K, Richardson ME. Regulation of endothelin-1-induced trabecular meshwork cell contractility by latanoprostene bunod. *Invest Ophthalmol Vis Sci*. 2015;56(6):4108-4116. **5.** Kaufman PL. Enhancing trabecular outflow by disrupting the actin cytoskeleton, increasing uveoscleral outflow with prostaglandins, and understanding the pathophysiology of presbyopia: Interrogating Mother Nature: asking why, asking how, recognizing the signs, following the trail*. *Experimental Eye Research*. 2008;86:3-17. DOI:10.1016/j.exer.2007.10.007. **6.** VYZULTA Prescribing Information. Bausch & Lomb Incorporated. 2018.

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

IOP=intraocular pressure

BAUSCH + LOMB

VYZULTA®
(latanoprostene bunod ophthalmic solution), 0.024%

BRIEF SUMMARY OF PRESCRIBING INFORMATION

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

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

Initial U.S. Approval: 2017

1 INDICATIONS AND USAGE

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

4 CONTRAINDICATIONS

None

5 WARNINGS AND PRECAUTIONS

5.1 Pigmentation

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

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

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

5.2 Eyelash Changes

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

5.3 Intraocular Inflammation

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

5.4 Macular Edema

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

5.5 Bacterial Keratitis

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

5.6 Use with Contact Lens

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

6 ADVERSE REACTIONS

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

6.1 Clinical Trials Experience

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

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

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Risk Summary

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

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

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

Data

Animal Data

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

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

8.2 Lactation

Risk Summary

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

8.4 Pediatric Use

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

8.5 Geriatric Use

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

13 NONCLINICAL TOXICOLOGY

13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

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

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

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

13.2 Animal Toxicology and/or Pharmacology

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

Distributed by:

Bausch + Lomb, a division of

Valeant Pharmaceuticals North America LLC

Bridgewater, NJ 08807 USA

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

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

VOL. 156 NO. 4 ■ APRIL 15, 2019

IN THE NEWS

Patients with migraines are more likely to have a concurrent diagnosis of DED than those who do not. The study out of the University of North Carolina found 5,352 patients (7.3%) had a diagnosis of migraine headache and 9,638 (13.2%) had DED. **The chance of having DED with migraine was 1.72x higher** than it was for patients without migraine. Still, the association may not reflect cause and effect if unidentified confounders account for the results.

Ismail OM, Poole ZB, Bierly SL, et al. Association between dry eye disease and migraine headaches in a large population-based study. March 7, 2019. [Epub ahead of print].

Genetics may factor into keratoconus and high corneal curvature, a new study in *Eye & Contact Lens* reports. The results of the study showed a fairly high corneal curvature heritability from at least two family members (parent and a child).The heritability rate in the anterior surface was 58.61% in K2 and 55.82% in K1. Researchers found the heritability of posterior corneal curvature was slightly higher— 63.42% in K2 and 59.67% in K1.

Heydarian S, Hashemi H, Yekta A, et al. Heritability of corneal curvature and Pentacam topometric indices: a population-based study. Eye Contact Lens. February 28, 2019. [Epub ahead of print].

Researchers in Australia suggest **patients only need to wait two weeks for a new spectacle prescription after uncomplicated cataract surgery**. Refraction, both subjective and automated, didn't change significantly over the six-week study period, and neither did mean corneal thickness or mean uncorrected distance and near visual acuities.

Al-Mahrouqi H, Oraba SB, Al-Habsi S, et al. Retinoscopy as a screening tool for keratoconus. Cornea. January 9, 2019. [Epub ahead of print].

ODs May Diagnose Alzheimer's One Day

OCT-A can show changes before symptoms occur.

By Rebecca Hepp, Managing Editor

Researchers have yet again proven Alzheimer's can be diagnosed before symptoms are even present—using optical coherence tomography angiography (OCT-A). The Duke University team used OCT-A to evaluate 70 eyes from 39 Alzheimer's patients, 72 eyes from 37 participants with mild cognitive impairment (MCI) and 254 eyes from 133 controls. Participants also underwent cognitive evaluation with a mini-mental state examination.[1]

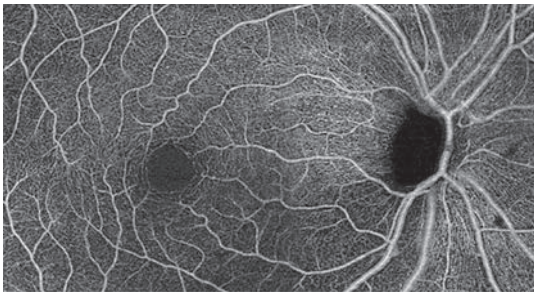
After comparing the retinal microvasculature in each group, they found that Alzheimer's patients had significantly reduced macular vessel density, perfusion density and ganglion cell-inner plexiform layer (GC-IPL) thickness compared with MCI participants and controls. There was no difference in superficial capillary plexus vessel density or perfusion density between MCI participants and controls. Other parameters such as foveal avascular zone area and central subfield thickness did not differ significantly between groups.[1]

Alzheimer's patients showed significantly decreased GC-IPL thickness over the inferior and inferonasal sectors compared with MCI participants and significantly decreased GC-IPL thickness over the entire superonasal, inferior and inferonasal sectors compared with controls.[1]

The researchers note that changes in the retinal microvasculature may mirror small-vessel cerebrovascular changes in Alzheimer's, helping eye doctors detect the disease earlier.[1]

"Ultimately, the goal would be to use this technology to detect Alzheimer's early, before symptoms of memory loss are evident, and be able to monitor these changes over time in participants of clinical trials studying new Alzheimer's treatments," Sharon Fekrat, MD, study author, said in a press release.[2]

1. Wu M, Liu X, Han J, et al. Association between sleep quality, mood status, and ocular surface characteristics in patients with dry eye disease. Cornea. December 31, 2018. [Epub ahead of print].
2. Hyon JY, Yang HK, Han SB. Dry eye symptoms may have association with psychological stress in medical students. Eye Contact Lens. January 14, 2019. [Epub ahead of print].



Using OCT-A to evaluate the retinal vasculature could help detect Alzheimer's earlier.

NEWS STORIES POST EVERY WEEKDAY MORNING AT www.reviewofoptometry.com/news

Maestro *Unlimited*

Your **Integrated Platform** for **High Quality Imaging** and **Efficient Data Management**

Speed of Use

Robotic[1] OCT & Fundus Camera All in One

HIGH RESOLUTION OCT IMAGE

ROBOTIC OCT

TRUE COLOR FUNDUS IMAGE

REFERENCE DATABASE

new

GLAUCOMA HOOD REPORT[2] 3D WIDE 12x9mm SCAN

FREE TOPCON CLOUD STORAGE[3]

CENTRALIZED DATA MANAGEMENT

TOPCON

YOUR VISION. OUR FOCUS.

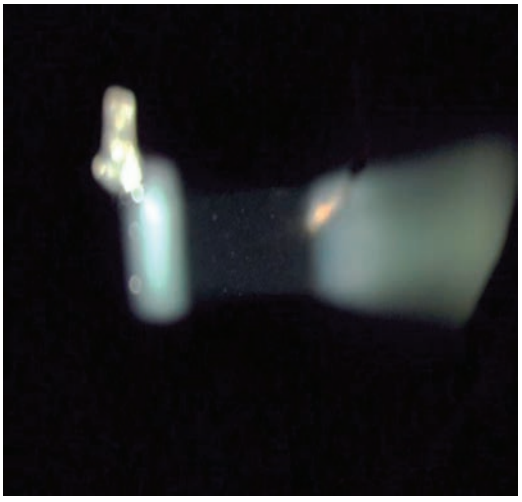
3D OCT-1 Maestro
3D OPTICAL COHERENCE TOMOGRAPHY

topconhealth.com | topconmedical.com

1. Auto alignment, auto focus, auto capture. auto capture. 2. Not available in all countries. Please check with your local distributor for availability. 3. With a purchase of 3D OCT-1 Maestro and/or DRI OCT Triton series.

Non-infectious Uveitis, Meet Biologics

Contemporary approaches to uveitis treatment should include biologic therapy, according to two recent studies. One noted an association between tumor necrosis factor-alpha inhibitors (TNFi) and long-term drug-induced remission of ocular inflammation, visual stability and corticosteroid function.[1] The other provides a review of the biologic agents clinicians are currently using to successfully treat non-infectious uveitis, as well as therapeutics currently under investigation.[2]



Adalimumab and infliximab are considered second-line therapeutics for most forms of non-infectious uveitis.

TNFi Therapy

Researchers in the United Kingdom carried out a prospective cohort study of infliximab and adalimumab to treat non-infectious ocular inflammatory disease.[1] From 2006 to 2014, they followed 43 adults with non-infectious uveitis or scleritis, 34 of whom were taking infliximab and nine were on adalimumab.[1]

The median time on infliximab and adalimumab was 3.2 years and 2.4 years, respectively. Treatment induced sustained remission in 39 patients (91%) after a median of 1.2 years on a TNFi. Researchers discovered that 22 (51%) experienced one relapse and five (12%) had two relapses. While 54% had at least one adverse event, serious adverse events necessitating hospitalization or cessation of medication occurred in only 9% of patients. In eight patients who had active inflammation, cystoid macular edema and vitritis were the main features.

This prospective report suggests long-term TNFi is associated with no attrition of quality of life, despite the need for ongoing treatment and mild side effects. Serious adverse events were an infrequent but appreciable risk. Despite the inhibitors' successes, the researchers call for wider treatment options and further assessment of which etiologies respond best to specific therapies.[1]

Research Roundup

Data supporting the efficacy of biologics for uveitis have led to adalimumab's FDA approval for most forms of non-infectious uveitis and clinical trials for other biologic pharmaceuticals. Limited large multicenter prospective clinical trials exist examining the efficacy of these biologics; therefore, much of the published research on biologics for uveitis includes small prospective trials, retrospective series and observational studies of uveitis control in patients on biologics for other approved systemic indications. A recent review assessed the findings from these sources to highlight the current and investigational biologic agents.[2]

The review found that adalimumab and infliximab are considered second-line therapeutics for most forms of non-infectious uveitis but may be considered first-line agents in uveitis associated with Behçet's disease and juvenile idiopathic arthritis. It also strongly recommends adalimumab and infliximab before etanercept for the management of ocular inflammatory disease.[2]

Researchers have documented the efficacy of rituximab, a B-cell inhibitor, in the treatment of scleritis, ocular cicatricial pemphigoid, orbital inflammatory disease and many forms of non-infectious uveitis. Tocilizumab and interferon therapy also appear to be efficacious in the management of refractory uveitic macular edema. Meanwhile, Phase II clinical trials are investigating the efficacy of Janus kinase inhibitors.[2]

Although certain biologics can be first-line agents for the treatment of some forms of uveitis, the review notes that biologics are considered second-line or third-line agents for the majority of these patients. The most common scenario in which a biologic agent is used in non-infectious uveitis is for patients for whom conventional immunomodulatory therapy is poorly tolerated or incompletely effective.[2]

1. Sharma SM, Damato E, Hinchcliffe AE, et al. Long-term efficacy and tolerability of TNF-apha inhibitors in the treatment of non-infectious ocular inflammation: an eight-year prospective surveillance study. Br J Ophthalmol. March 12, 2019. [Epub ahead of print].
2. Biologics for the treatment of noninfectious uveitis: current concepts and emerging therapeutics. Thomas AS. Curr Opin Ophthalmol. March 5, 2019. [Epub ahead of print].

Don’t get stuck in traffic.

Learn what it takes to get your practice built on time, on budget and functioning properly.

Building your new office is the single largest investment you will make for your practice. Naturally, this process can be overwhelming and will lead to numerous questions such as where to start, who to trust, what to do next, etc.

Think about the children’s game, RED LIGHT/GREEN LIGHT. The game is simple, run as fast as you can when you hear “GREEN LIGHT”, proceed slowly when you hear “YELLOW LIGHT” and stop when you hear “RED LIGHT”. The same process applies when working on your new practice. Keep in mind that just like in the game, a GREEN LIGHT doesn’t mean you’re on the fast track to the end, nor does a RED LIGHT mean you’re finished, essentially it’s how much time is typically needed to complete the different steps of your journey.

Keep in mind the more information you gather at the beginning the better. More information early on means less change orders and costly delays at the end. This gets you into your new space on time and saves you money. A great resource for getting this information is your peers. It’s also wise to seek out companies who understand your needs. There are experienced firms out there, such as The Eye Designs Group, who know your business and would be ideal to have on your team.

Red Light:

Inspections & Permit Issues: These are unavoidable and are part of every project. Working with professionals who understand the local codes and have relationships with local inspectors can give you a leg up on getting through “area specific” codes and guidelines.

Construction/Weather Delays: Delays are part of every project and many are out of your control. It is advisable to extend your timeline with the realistic expectation that delays may occur, which is why we recommend that you target two dates. First, a “Soft Opening” where you can start seeing patients and second, a “Grand Opening” where all of the finish details are completed.

Local Cabinetmaker/Non-commercial Materials: A local cabinetmaker is fine for the general back office cabinetry, but when it comes to your displays, which help you create a productive and memorable customer experience, work with a specialist who understands how to display and merchandise your products to maximize patient revenue. Proper spacing, product positioning, merchandising, lighting, branding and display maintenance all factor into an effective customer experience – the lost sale of not doing it correctly can add up to thousands of dollars in lost revenue

Example of displays by local cabinetmaker.

Example of displays & design by industry specialist the Eye Designs Group.

Also, be sure to work with only commercial grade materials since they are designed to handle the wear of a high volume practice.

Yellow Light:

Wish List: Spend time assembling a list of your wants and needs for your practice. This can be location, design, layout, etc. A great resource for targeting all of your practice needs is a detailed “Space Analysis” that is offered complimentary by certain industry design firms.

Research: As stated previously, information is key. Use time on the front end to research contractors, architects and specialized design firms who know your business. It’s important to select the right team. Use caution and understand that most architects may have designed a medical office, but never an optometric practice and are unaware of the nuances critical to your success.

Budget: Prepare a budget for the project. A well planned budget is key in keeping you on track and reaching your goals.

Green Light:

Obtain a Location: Looking for a location can be both frustrating and exciting. If you enter into it with a strong understanding of your needs it will allow you to look at the choices pragmatically and select the one that is best for your bottom line.

Interior Design: If you work with a design professional who is familiar with your business and you enter into this stage of the project already having spent time deciding on your design ideas, it can be exciting and enjoyable. Utilizing a design firm that specializes in optical environments is ideal.

Frame Displays: It’s time to trust the professionals to build you the displays that will showcase your products in the best way possible. Just as with interior design, hiring an ophthalmic professional firm will minimize frustration and will achieve the best possible result.

Your office represents your brand so it’s important to put your best foot forward. Patients make decisions based on visual input, you don’t get a second chance to make a first impression. Knowing when to depend on experts, as well as hiring the right team is key to achieving an outstanding result. Throughout the process there may be frustrating RED and YELLOW LIGHT moments, as well as exciting GREEN LIGHTS. Remember the end goal and stay on track to reach the finish line.

For more information contact the author:

Dan Sloan
Senior Designer
Eye Designs LLC
eyedesigns.com
800.346.8890

Dan has over 25 years of experience designing successful optical retail environments nationwide and has contributed to numerous publications and journals.

A Busy Legislative Year Lies Ahead

After being rejected just a month earlier, optometrists in Arkansas reworked their scope of practice proposal just enough to assuage state lawmakers' lingering concerns. The newly composed legislation—HB 1251—was approved on March 20 by the state's Senate 25-8 (with two abstentions). The bill aims to modernize optometry by updating its definition as well as that of ophthalmic surgery. It was passed by the House on March 6, 70-19.

Photo: Barbara Starkey, OD/Arkansas Optometric Association

The passage of Arkansas's HB 1251 will update the profession's definition and expand the scope of practice for optometrists.

The bill's "bipartisan support is a testament to the importance primary eye doctors deliver," says Barbara Starkey, OD, president of the Arkansas Optometric Association. "The most exciting aspect of the progress made is that families across the state are just one step away from having much greater access to comprehensive eye health and vision care, with doctors of optometry being authorized to practice near the fullest extent of our training."

The state's definition for the "practice of optometry" had previously excluded exclude surgical procedures of the lid, adnexa or visual system, which requires anything other than a topical anesthetic. In the new definition, those restrictions have been removed.

Additionally, the legislation, removes previous prohibition against ODs using ophthalmic lasers for surgical procedures.

The original bill—the one that was rejected last month—was one of exclusion, meaning the state's optometry board would independently approve indications with the exclusion of certain procedures. "The exclusive language was removed," explains Dr. Starkey. "The bill is actually inclusive after [it was] amended."

Sweeping the Nation

The move comes as part of a slew of changes to optometric scope of practice legislation across the nation. State governments and optometric advocates are working hand in hand to expand the profession this legislative session. The trend comes on the heels of advice from a joint report issued by the federal departments of Health and Human Services (HHS), Labor and Treasury. That report, *Reforming America's Healthcare System Through Choice and Competition*, advocates for reduced regulations on non-MD providers, including optometrists.

Other states looking to examine restrictions to optometry this legislative session include:

• ***Iowa.*** House Bill HF310 was first introduced on February 7th. It passed the House on February 26th and was read by the Senate the next day. If passed, the bill would give optometrists the capability to administer subconjunctival injections, intralesional injections (for treatment of chalazia), and injections of local anesthetics for the purposes of draining an abscess on the eyelid.[3]

• ***Maryland.*** The profession is heavily regulated in this state, but SB447—introduced February 4th—aims to repeal certain provisions that require ODs to refer some patients to ophthalmologists and alters the types of therapeutic pharmaceutical agents a ODs can administer or prescribe. This will expand the state's optometrists' ability to prescribe for glaucoma.[4]

• ***Massachusetts.*** This New England state stands alone as the only one remaining where optometrists cannot prescribe for glaucoma. Now, with the introduction of bill H.1923 (Docket: HD2185), the long-time holdouts may finally have glaucoma indications. A second relevant bill, H.1925 (Docket: HD2197), even looks to study the harm the state's intransigence has caused.[5,6]

• ***Minnesota.*** Optometry's first licensure law passed in Minnesota in 1901, but the state hasn't kept pace with scope expansion leaders Oklahoma and Kentucky. In fact, ODs in the state still face obstacles even administering legend drugs. A new bill there—HF891—proposes to remove these limitations.[7] It was introduced to the state's Health and Human Services Policy committee February 7th.

(continued on page 10)

www.katena.com

DID YOU MISS THESE FLASH SALES?

DON'T MISS ANOTHER!

~~DuraPlug Temporary Plug~~
~~$99.00~~
02/14/2019

~~AmbioDisk 12 mm amniotic membrane~~
~~$299.00 per disk~~
11/26/2018

~~Foreign Body Set~~
~~$325.00~~
01/29/2019

Create an account and receive news and promotional offers

katena
DESIGNED FOR SIGHT®

800.225.1195 • info@katena.com • www.katena.com

KW-Adv-013119-Rev0

(continued from page 8)

• ***Nebraska.*** The Optometry Practice Act is looking to achieve some of the same advancements seen in the Arkansas bill, including removing the restriction on the use of lasers and the addition of the application of pharmaceutical agents consistent with optometric education with oversight by the state's optometry board.[8]

• ***New York.*** The Empire State is looking to expand its optometrists' capabilities by updating the way they can prescribe oral medications. S04035 relates to the use of oral medications by optometrists, while A06397 relates to providing education to certain professions regarding prescribing opioids.[9,10]

• ***Texas.*** If HB 3505 passes, the state's board will be permitted to regulate optometrists and determine its own scope of practice.[11] It was introduced on March 18th.

• ***Nevada.*** Assembly Bill 77, introduced February 4th, offers various changes to the state's practice of optometry, including revising the requirements for certification to prescribe pharmaceuticals and treat glaucoma. It also eliminates a legal requirement to refer a patient to an ophthalmologist if the patient's glaucoma is caused by diabetes. It also proposes to permit assistants to aid in fitting contact lenses.[12]

• ***Alabama.*** SB114, which was first read on March 19th, seeks to add certain surgical procedures to optometry's repertoire, including some laser procedures, but excluding laser retinal surgery, penetrating keratoplasty, lamellar keratoplasty or radial kertotomy. The bill also prohibits ODs from performing corneal transplants or any surgery performed with general anesthesia, among several others.[13]

1. Trackbill. An act to amend the definition of "practice of optometry"; to expand the types of ophthalmic surgery that may be performed by optometrists; to permit the prescription and administration of certain drugs through all routes of administration by optometrists; to modernize the practice of optometry; and for other purposes. trackbill.com/bill/arkansas-house-bill-1251-to-amend-the-definition-of-practice-of-optometry-and-to-modernize-the-practice-of-optometry/1651071/. Accessed March 21, 2019.
2. Arkansas Medical Society. HB 1251 passes out of committee: call your senator today. www.arkmed.org/news/2019/03/hb-1251-passes-out-of-committee-call-your-senator-today/. March 19, 2019. Accessed March 21, 2019.
3. Iowa Legislature. House file 310. www.legis.iowa.gov/legislation/BillBook?ga=88&ba=HF310. Accessed March 21, 2019.
4. Maryland Senate bill 447. legiscan.com/MD/bill/SB447/2019. Accessed March 21, 2019.
5. The 191st General Court of the Commonwealth of Massachusetts. Bill H.1923: an act modernizing optometric patient care. malegislature.gov/Bills/191/HD2185. Accessed March 21, 2019.
6. The 191st General Court of the Commonwealth of Massachusetts. Bill H.1925: an act studying the impacts of hte diagnosis restrictions on optometrists. malegislature.gov/Bills/191/H1925. Accessed March 21, 2019.
7. Minnesota Legislature Office of the Revisor of Statutes. HF 891. www.revisor.mn.gov/bills/bill.php?f=HF0891&y=2019&ssn=0&b=house#actions. Accessed March 21, 2019.
8. Nebraska 196th Legislature. Legislative bill 528. nebraskalegislature.gov/FloorDocs/106/PDF/Intro/LB528.pdf. Accessed March 21, 2019.
9. New York State Assembly. Bill no. S04035. nyassembly.gov/leg/?bn=S04035&term=2019. Accessed March 21, 2019.
10. New York State Assembly. Bill no. A06397. nyassembly.gov/leg/?bn=A06397&term=2019. Accessed March 21, 2019.
11. LegisScan. Texas House bill 3505: relating to the authority of the Texas Optometry Board. capitol.texas.gov/Search/DocViewer.aspx?ID=86RHB035051B&QueryText=%22optometry%22&DocType=B. Accessed March 21, 2019.
12. LegisScan. Nevada Assembly bill 77: makes various changes to provisions governing the practice of optometry. legiscan.com/NV/text/AB77/2019. Accessed March 21, 2019.
13. TrackBill. Alabama SB114. trackbill.com/bill/alabama-senate-bill-114-optometrists-practice-of-optometry-defined-secs-34-22-1-34-22-42-amd/1728523/. Accessed March 21, 2019.

Don't Skip Pediatric Oculomotor Testing

Optometrists should include oculomotor skills testing for all pediatric eye exams, especially for children with suspected sensory processing disorder (SPD), according to a new study in *Optometry and Vision Science*. Since optometrists are at the front line in the diagnosis, care and treatment of children with SPD—and the number of children with neurosensory disorders is on the rise—this test is especially significant, the study noted.

Researchers from Western University of Health Sciences found children with SPD exhibited deficient saccades and pursuits compared with typically developing children.

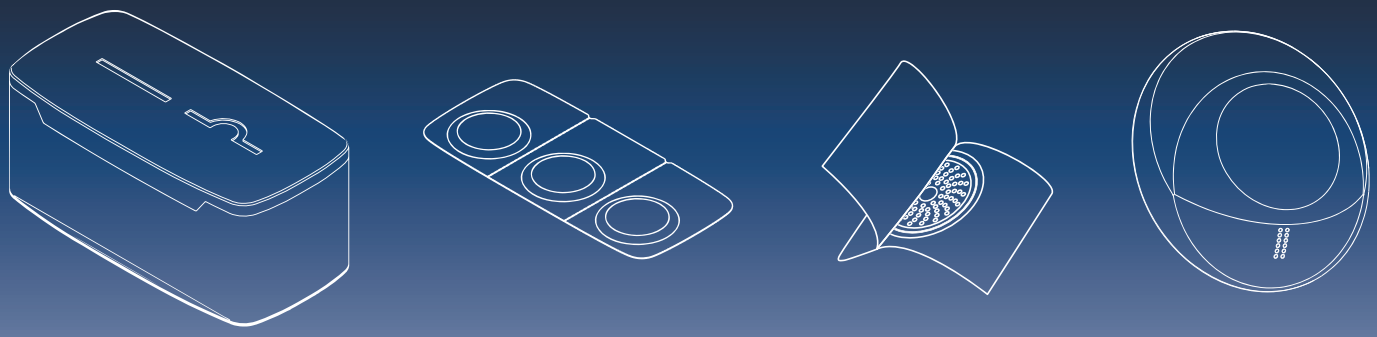
The study shows children with SPD demonstrated decreased oculomotor skills on all tests compared with typically developing children.

Due to the significant differences in oculomotor function in children with SPD and the increasing number of children with neurosensory disorders, optometrists should consider oculomotor testing on all pediatric patients and particularly in children with SPD, researchers said. If patients without an SPD diagnosis score below average with Northeastern State University College of Optometry's testing, optometrists should conduct an in-depth history and referral for further evaluation, if necessary.

"This is an opportunity for optometrists to work with occupational therapists, speech and language pathologists, and other professionals to provide these children with comprehensive multidisciplinary care and treatment," the authors conclude.

Walker K, Redman-Bentley D, Remick-Waltman K, et al. Differences in oculomotor function between children with sensory processing disorder and typical development. Optom Vis Sci. 2019;96(3):172-79.

Now Available!



EASY, CLEAN, PORTABLE.

A Unique Approach to Daily Disposable Soft Toric Lenses

The 1day Miru Toric flat pack is designed using SmartTouch™ Technology which minimizes lens handling and contamination concerns so contact lenses can be worn more comfortably and hygienically.

1day Miru toric employs a unique Smart Fit™ design that naturally orients the lens correctly no matter which way it is inserted.

For a trial pair, please email information@menicon.com

Menicon

Miru 1day Menicon Flat Pack

CCT Measures the Same in the Elderly

The measurement tool you use for central corneal thickness (CCT) can affect the result in some patient populations and not in others, according to a new study.

In young and healthy patients, ultrasound pachymetry tends to measure CCT higher than noncontact specular microscopy–based pachymetry, a team of German researchers explain. Their research shows the difference in CCT measurements between the two devices disappears in elderly patients (70.6 ± 10.7 years) and even reverses glaucoma patients, with optical pachymetry recording higher values in that group.

Young healthy patients had statistically significantly different CCT readings from each tool, but elderly and glaucoma patients showed no statistical different between the pachymetry readings, although ultrasound provided a slightly thinner CCT measurement than optical pachymetry for glaucoma subjects. Optical pachymetry usually provides thinner readings than ultrasound, suggesting a slight reversal when measuring glaucoma patients, the study suggests.

The researchers conclude that the loss of any difference in CCT readings in these two patient populations must be due to the structural and biochemical changes from aging and the glaucoma disease process—meaning the devices could be interchangeable for these specific patients. Possibly, they suggest, an increase in collagen crosslinking and a change in the components of the extracellular matrix may develop "in a way that the speed of ultrasound in the cornea becomes higher and as a result CCT values become lower."

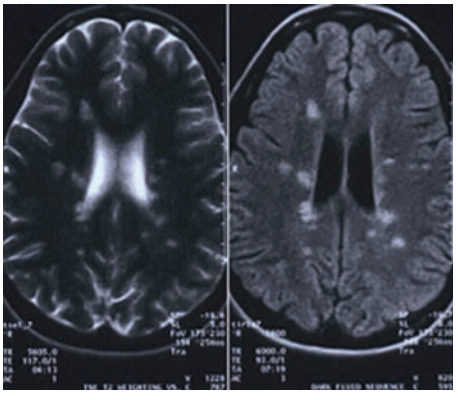
Pillunat KR, Waibel S, Spoerl E, et al. Comparison of central corneal thickness measurements using optical and ultrasound pachymetry in glaucoma patients and elderly and young controls. J Glaucoma. March 6, 2019. [Epub ahead of print].

A Call for Updated IIH Testing Criteria

Researchers exploring ways to narrow diagnostic capabilities may have come upon a technique that is highly specific to idiopathic intracranial hypertension (IIH) without papilledema, according to a newly published report in the *Journal of Neuroophthalmology*. The method will provide better direction in the diagnosis of exclusion, instead of the series of tests used to rule out other etiologies that present with similar bilateral optic disc edema of unknown cause.

The Boston-based research team confirmed updated diagnostic criteria proposals suggesting that a combination of any three of four magnetic resonance imaging (MRI) features can identify IIH when present in patients with chronic headache and no papilledema. The team looked at the brain MRIs from 80 patients with IIH with papilledema, 33 patients with chronic headache and elevated opening pressure and 70 control patients with infrequent episodic migraine. They found that:

(1) Reduced pituitary gland height was moderately sensitive for IIH with papilledema (80%) but had low specificity (64%).



To detect IIH in patients with chronic headaches but no papilledema, these MRI guidelines could help.

(2) Increased optic nerve sheath diameter was less sensitive (51%) and only moderately specific (83%).

(3) Flattening of the posterior globe was highly specific (97%) but had low sensitivity (57%).

(4) Transverse venous sinus stenosis was moderately sensitive for IIH with papilledema (78%), but of undetermined specificity.

Of patients with chronic headache and elevated opening pressure, 30% had three or more of these MRI features, suggesting IIH without papilledema in those patients. The researchers explained that a combination of any three of these four MRI features was nearly 100% specific, with a sensitivity of 64%. ■

Mallery R, Rehmani O, Woo J, et al. Utility of magnetic resonance imaging features for improving the diagnosis of idiopathic intracranial hypertension without papilledema. J. Neuroophthalmol. February 26, 2019. [Epub ahead of print].

SUBMICRON STRONG

Engineered with SM Technology™ for efficient penetration at a low BAK level (0.003%)[1,2]

~2× GREATER PENETRATION to the aqueous humor[2*]

*Compared to LOTEMAX® GEL (loteprednol etabonate ophthalmic gel) 0.5%. Clinical significance of these preclinical data has not been established.

LOTEMAX® SM
(loteprednol etabonate ophthalmic gel) 0.38%

SMALL & MIGHTY
SUBMICRON PARTICLES

PROVEN STRENGTH

- 30% of LOTEMAX® SM patients had complete ACC resolution vs vehicle (15%) at Day 8 (N=371, $P<0.0001$)[1,3†]
- 74% of LOTEMAX® SM patients were completely pain-free vs vehicle (49%) at Day 8 (N=371, $P<0.0001$)[1,3‡]

†Pooled analysis of Phase 3 clinical studies. **Study 1:** 29% LOTEMAX® SM (N=171) vs 9% vehicle (N=172). **Study 2:** 31% LOTEMAX® SM (N=200) vs 20% vehicle (N=199); $P<0.05$ for all.

‡Pooled analysis of Phase 3 clinical studies. **Study 1:** 73% LOTEMAX® SM (N=171) vs 48% vehicle (N=172). **Study 2:** 76% LOTEMAX® SM (N=200) vs 50% vehicle (N=199); $P<0.05$ for all.

Indication

LOTEMAX® SM (loteprednol etabonate ophthalmic gel) 0.38% is a corticosteroid indicated for the treatment of post-operative inflammation and pain following ocular surgery.

Important Safety Information

- LOTEMAX® SM, as with other ophthalmic corticosteroids, is contraindicated in most viral diseases of the cornea and conjunctiva including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, and also in mycobacterial infection of the eye and fungal diseases of ocular structures.
- Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, defects in visual acuity and fields of vision. If LOTEMAX® SM is used for 10 days or longer, IOP should be monitored.
- Use of corticosteroids may result in posterior subcapsular cataract formation.

Important Safety Information (cont.)

- The use of steroids after cataract surgery may delay healing and increase the incidence of bleb formation. In those with diseases causing thinning of the cornea or sclera, perforations have been known to occur with the use of topical steroids. The initial prescription and renewal of the medication order should be made by a physician only after examination of the patient with the aid of magnification such as slit lamp biomicroscopy and, where appropriate, fluorescein staining.
- Prolonged use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In acute purulent conditions, steroids may mask infection or enhance existing infections.
- Employment of a corticosteroid medication in the treatment of patients with a history of herpes simplex requires great caution. Use of ocular steroids may prolong the course and may exacerbate the severity of many viral infections of the eye (including herpes simplex).
- Fungal infections of the cornea are particularly prone to develop coincidentally with long-term local steroid application. Fungus invasion must be considered in any persistent corneal ulceration where a steroid has been used or is in use. Fungal cultures should be taken when appropriate.
- Contact lenses should not be worn when the eyes are inflamed.
- There were no treatment-emergent adverse drug reactions that occurred in more than 1% of subjects in the three times daily group compared to vehicle.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit **www.fda.gov/medwatch** or call **1-800-FDA-1088**.

Please see brief summary of Prescribing Information on adjacent page.

References: 1. LOTEMAX SM [prescribing information]. Bridgewater, NJ: Bausch & Lomb, Incorporated. **2.** Cavet ME, Glogowski S, DiSalvo C, Richardson ME. Ocular pharmacokinetics of submicron loteprednol etabonate ophthalmic gel, 0.38% following topical administration in rabbits. Poster presented at 2015 ARVO Annual Meeting; May 4, 2015; Denver, Colorado. **3.** Data on file. Bausch & Lomb, Inc.

BAUSCH + LOMB

Visit www.LOTEMAXSM.com

LOTEMAX® SM
(loteprednol etabonate ophthalmic gel) 0.38%

BRIEF SUMMARY OF PRESCRIBING INFORMATION

This Brief Summary does not include all the information needed to use LOTEMAX® SM safely and effectively. See full prescribing information for LOTEMAX® SM.

LOTEMAX® SM (loteprednol etabonate ophthalmic gel) 0.38%

For topical ophthalmic use
Initial U.S. Approval: 1998

INDICATIONS AND USAGE

LOTEMAX® SM is a corticosteroid indicated for the treatment of post-operative inflammation and pain following ocular surgery.

DOSAGE AND ADMINISTRATION

Invert closed bottle and shake once to fill tip before instilling drops. Apply one drop of LOTEMAX® SM into the conjunctival sac of the affected eye three times daily beginning the day after surgery and continuing throughout the first 2 weeks of the post-operative period.

CONTRAINDICATIONS

LOTEMAX® SM, as with other ophthalmic corticosteroids, is contraindicated in most viral diseases of the cornea and conjunctiva including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, in mycobacterial infection of the eye and fungal diseases of ocular structures.

WARNINGS AND PRECAUTIONS

Intraocular Pressure (IOP) Increase: Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, defects in visual acuity and fields of vision. Steroids should be used with caution in the presence of glaucoma. If this product is used for 10 days or longer, intraocular pressure should be monitored.

Cataracts: Use of corticosteroids may result in posterior subcapsular cataract formation.

Delayed Healing: The use of steroids after cataract surgery may delay healing and increase the incidence of bleb formation. In those diseases causing thinning of the cornea or sclera, perforations have been known to occur with the use of topical steroids. The initial prescription and renewal of the medication order should be made by a physician only after examination of the patient with the aid of magnification such as slit lamp biomicroscopy and, where appropriate, fluorescein staining.

Bacterial Infections: Prolonged use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In acute purulent conditions of the eye, steroids may mask infection or enhance existing infection.

Viral infections: Employment of a corticosteroid medication in the treatment of patients with a history of herpes simplex requires great caution. Use of ocular steroids may prolong the course and may exacerbate the severity of many viral infections of the eye (including herpes simplex).

Fungal Infections: Fungal infections of the cornea are particularly prone to develop coincidentally with long-term local steroid application. Fungus invasion must be considered in any persistent corneal ulceration where a steroid has been used or is in use. Fungal cultures should be taken when appropriate.

Contact Lens Wear: Contact lenses should not be worn when the eyes are inflamed.

ADVERSE REACTIONS

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice. Adverse reactions associated with ophthalmic steroids include elevated intraocular pressure, which may be associated with infrequent optic nerve damage, visual acuity and field defects, posterior subcapsular cataract formation, delayed wound healing and secondary ocular infection from pathogens including herpes simplex, and perforation of the globe where there is thinning of the cornea or sclera. There were no treatment-emergent adverse drug reactions that occurred in more than 1% of subjects in the three times daily group compared to vehicle.

USE IN SPECIAL POPULATIONS

Pregnancy: Risk Summary: There are no adequate and well controlled studies with loteprednol etabonate in pregnant women. Loteprednol etabonate produced teratogenicity at clinically relevant doses in the rabbit and rat when administered orally during pregnancy. Loteprednol etabonate produced malformations when administered orally to pregnant rabbits at doses 4.2 times the recommended human ophthalmic dose (RHOD) and to pregnant rats at doses 106 times the RHOD. In pregnant rats receiving oral doses of loteprednol etabonate during the period equivalent to the last trimester of pregnancy through lactation in humans, survival of offspring was reduced at doses 10.6 times the RHOD. Maternal toxicity was observed in rats at doses 1066 times the RHOD, and a maternal no observed adverse effect level (NOAEL) was established at 106 times the RHOD. 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 loteprednol etabonate by oral gavage on gestation days 6 to 18, to target the period of organogenesis. Loteprednol etabonate produced fetal malformations at 0.1 mg/kg (4.2 times the recommended human ophthalmic dose (RHOD) based on body surface area, assuming 100% absorption). Spina bifida (including meningocele) was observed at 0.1 mg/kg, and exencephaly and craniofacial malformations were observed at 0.4 mg/kg (17 times the RHOD). At 3 mg/kg (128 times the RHOD), loteprednol etabonate was associated with increased incidences of abnormal left common carotid artery, limb flexures, umbilical hernia, scoliosis, and delayed ossification. Abortion and embryofetal lethality (resorption) occurred at 6 mg/kg (256 times the RHOD). A NOAEL for developmental toxicity was not established in this study. The NOAEL for maternal toxicity in rabbits was 3 mg/kg/day. Embryofetal studies were conducted in pregnant rats administered loteprednol etabonate by oral gavage on gestation days 6 to 15, to target the period of organogenesis. Loteprednol etabonate produced fetal malformations, including absent innominate artery at 5 mg/kg (106 times the RHOD); and cleft palate, agnathia, cardiovascular defects, umbilical hernia, decreased fetal body weight and decreased skeletal ossification at 50 mg/kg (1066 times the RHOD). Embryofetal lethality (resorption) was observed at 100 mg/kg (2133 times the RHOD). The NOAEL for developmental toxicity in rats was 0.5 mg/kg (10.6 times the RHOD). Loteprednol etabonate was maternally toxic (reduced body weight gain) at 50 mg/kg/day. The NOAEL for maternal toxicity was 5 mg/kg. A peri-/postnatal study was conducted in rats administered loteprednol etabonate by oral gavage from gestation day 15 (start of fetal period) to postnatal day 21 (the end of lactation period). At 0.5 mg/kg (10.6 times the clinical dose), reduced survival was observed in live-born offspring. Doses ≥ 5 mg/kg (106 times the RHOD) caused umbilical hernia/incomplete gastrointestinal tract. Doses ≥ 50 mg/kg (1066 times the RHOD) produced maternal toxicity (reduced body weight gain, death), decreased number of live-born offspring, decreased birth weight, and delays in postnatal development. A developmental NOAEL was not established in this study. The NOAEL for maternal toxicity was 5 mg/kg.

Lactation: There are no data on the presence of loteprednol etabonate 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 LOTEMAX® SM and any potential adverse effects on the breastfed infant from LOTEMAX® SM.

Pediatric Use: Safety and effectiveness of LOTEMAX® SM in pediatric patients have not been established.

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

NONCLINICAL TOXICOLOGY

Carcinogenesis, Mutagenesis, Impairment of Fertility: Long-term animal studies have not been conducted to evaluate the carcinogenic potential of loteprednol etabonate. Loteprednol etabonate was not genotoxic *in vitro* in the Ames test, the mouse lymphoma tk assay, or in the chromosomal aberration test in human lymphocytes, or *in vivo* in the mouse micronucleus assay. Treatment of male and female rats with 25 mg/kg/day of loteprednol etabonate (533 times the RHOD based on body surface area, assuming 100% absorption) prior to and during mating caused preimplantation loss and decreased the number of live fetuses/live births. The NOAEL for fertility in rats was 5 mg/kg/day (106 times the RHOD).

Bausch + Lomb, a division of Valeant Pharmaceuticals North America LLC
Bridgewater, NJ 08807 USA

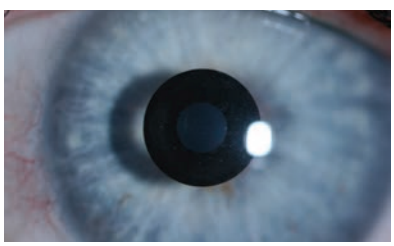
LSM.0091.USA.19
Based on 9669600-9669700 Revised: 02/2019

Contents

Review of Optometry April 15, 2019

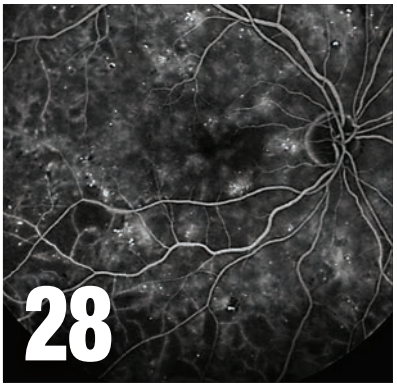
CORNEAL DISEASE REPORT

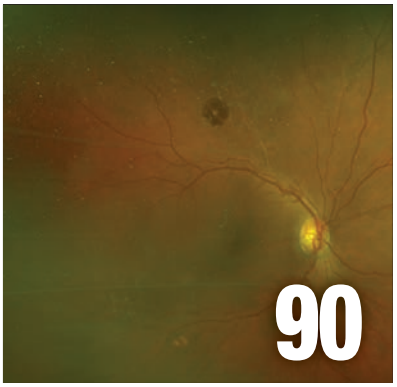
ALSO INSIDE



Departments

Review of Optometry April 15, 2019





REVIEW® OF OPTOMETRY

BUSINESS OFFICES
11 Campus Blvd., Suite 100
Newtown Square, PA 19073

CEO, INFORMATION SERVICES GROUP
Marc Ferrara
(212) 274-7062 • mferrara@jobson.com

PUBLISHER
James Henne
(610) 492-1017 • jhenne@jobson.com

REGIONAL SALES MANAGER
Michele Barrett
(610) 492-1014 • mbarrett@jobson.com

REGIONAL SALES MANAGER
Michael Hoster
(610) 492-1028 • mhoster@jobson.com

VICE PRESIDENT, OPERATIONS
Casey Foster
(610) 492-1007 • cfoster@jobson.com

VICE PRESIDENT, CLINICAL CONTENT
Paul M. Karpecki, OD, FAAO
pkarpecki@jobson.com

PRODUCTION MANAGER
Scott Tobin
(610) 492-1011 • stobin@jobson.com

SENIOR CIRCULATION MANAGER
Hamilton Maher
(212) 219-7870 • hmaher@jhihealth.com

CLASSIFIED ADVERTISING
(888) 498-1460

SUBSCRIPTIONS
$56 a year, $88 (US) in Canada,
$209 (US) in all other countries.

SUBSCRIPTION INQUIRIES
(877) 529-1746 (US only)
Outside US Call: (845) 267-3065

CIRCULATION
PO Box 81
Congers, NY 10920
Tel: (Toll Free): (877) 529-1746
Outside US: (845) 267-3065

jmi

CEO, INFORMATION SERVICES GROUP
Marc Ferrara

SENIOR VICE PRESIDENT, OPERATIONS
Jeff Levitz

VICE PRESIDENT, HUMAN RESOURCES
Tammy Garcia

VICE PRESIDENT, CREATIVE SERVICES & PRODUCTION
Monica Tettamanzi

CORPORATE PRODUCTION DIRECTOR
John Anthony Caggiano

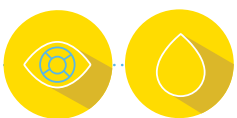
VICE PRESIDENT, CIRCULATION
Emelda Barea

xiidra® (lifitegrast ophthalmic solution)5%

Xiidra is the

FIIRST & ONLY

eye drop FDA-approved to treat both the **signs** and **symptoms** of Dry Eye



PROVEN TO TREAT THE SIGNS OF INFERIOR CORNEAL STAINING IN 12 WEEKS AND SYMPTOMS OF EYE DRYNESS IN AS LITTLE AS 2.

Xiidra helped provide symptom relief from eye dryness in some patients at week 12, 6, and as little as 2—and a measurable reduction in signs of inferior corneal staining in just 12 weeks. So see how Xiidra may be right for your patients.

Get to know Xiidra at Xiidra-ECP.com

Four randomized, double-masked, 12-week trials evaluated the efficacy and safety of Xiidra versus vehicle as assessed by improvement in the signs (measured by Inferior Corneal Staining Score) and symptoms (measured by Eye Dryness Score) of Dry Eye Disease (N=2133).

Indication

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

Important Safety Information

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

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

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

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

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

For additional safety information, see accompanying Brief Summary of Safety Information on the adjacent page and Full Prescribing Information on Xiidra-ECP.com.

Shire

xiidra® (lifitegrast ophthalmic solution) 5%
Rx Only

BRIEF SUMMARY:
Consult the Full Prescribing Information for complete product information.

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

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

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

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

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

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

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

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

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

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

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

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

Shire

Manufactured for: Shire US Inc., 300 Shire Way, Lexington, MA 02421.
For more information, go to www.Xiidra.com or call 1-800-828-2088.

Last Modified: 01/2018 S33769

REVIEW OF OPTOMETRY

PRINTED IN USA

FOUNDING EDITOR, FREDERICK BOGER
1891-1913

EDITORIAL OFFICES
11 CAMPUS BLVD., SUITE 100
NEWTOWN SQUARE, PA 19073

SUBSCRIPTION INQUIRIES
1-877-529-1746

CONTINUING EDUCATION INQUIRIES
1-800-825-4696

EDITOR-IN-CHIEF • JACK PERSICO
(610) 492-1006 • JPERSICO@JOBSON.COM

MANAGING EDITOR • REBECCA HEPP
(610) 492-1005 • RHEPP@JOBSON.COM

SENIOR EDITOR • BILL KEKEVIAN
(610) 492-1003 • BKEKEVIAN@JOBSON.COM

ASSOCIATE EDITOR • CATHERINE MANTHORP
(610) 492-1043 • CMANTHORP@JOBSON.COM

ASSOCIATE EDITOR • MARK DE LEON
(610) 492-1021 • MDELEON@JOBSON.COM

SPECIAL PROJECTS MANAGER • JILL HOFFMAN
(610) 492-1037 • JHOFFMAN@JOBSON.COM

ART DIRECTOR • JARED ARAUJO
(610) 492-1032 • JARAUJO@JOBSON.COM

DIRECTOR OF CE ADMINISTRATION • REGINA COMBS
(212) 274-7160 • RCOMBS@JOBSON.COM

JOBSON MEDICAL INFORMATION LLC

Outlook

By Jack Persico, Editor-in-Chief

Regaining Vision

Helping people see clearly is in optometry's DNA. What can we do to make it more central to your day?

Optics used to be easy. Or, if not easy *per se*, at least an area of uncontested expertise for optometrists. Assessing the ocular media, determining a patient's manifest refraction and manipulating the results with corrective lenses was a critically important segment of the broad, sprawling world of eye care where ODs really stood out.

Lately, though, some may feel that the optics of vision correction have gotten away from them.

Multifocal and extended depth-of-focus lenses rely on more sophisticated (some might say esoteric) optical principles than plain vanilla spherical lenses do. With patients increasingly interested in reducing their reliance on spectacle wear, you now need to have at your fingertips an understanding of several new corrective lens design concepts, product offerings and indications for use.

If you're planning to expand your practice or upgrade old equipment, you might be enticed by one of the new digital phoropters that can fine-tune a refraction down to 0.05D increments. Are you excited—or intimidated—by that prospect? No, it doesn't mean you'll be endlessly flipping dials as you cycle through options parsed in twentieths of a diopter ("Which is better, 17 or 18?"). But it's a new way to think and talk about the most traditional experience in optometry: refraction and glasses.

Even the time-honored tenets of myopia have been challenged of late by the surge of interest in controlling, rather than merely correcting, the condition. You may be left scratching your head as you ponder the vagaries of induced peripheral defocus creating a change in the anatomy of the eye. How, exactly, are you supposed to harness this ill-defined effect with nothing more than an Rx pad and a pen?

In short, optics got hard in a hurry.

Unfortunately, the momentum in optometry long ago shifted to medical eye care. That's where most of the education and excitement seems to be nowadays. This publication has been one of the chief advocates of medical optometry for decades, going back even to the 1930s—in a sense, we're as guilty as anyone. We're proud of our tradition of advocacy, but maybe we could do a little more to connect with our roots, and yours.

That's why I'm pleased to call out an article in this issue that seeks to update and explain some of those tricky topics. On page 70, Southern College of Optometry's Dan Fuller, OD, discusses the principles of extended depth-of-focus lenses in an array of products that can be worn on or implanted in the eye. And our bimonthly Focus on Refraction department, launched in 2015, has been steadily reintroducing important optical concepts into *Review*.

Medical eye care is indeed the future of optometry. But it doesn't have to push vision care out of the spotlight along the way. Try to carve out a little mental space to catch up with the surprisingly fast-moving world of optics. We'll do the same. Tell us what you want to learn more about! We'll be glad to help. ■

Delegate and Refocus

The future calls for significant changes in optometric practice. Are you ready?

By Paul M. Karpecki, OD, Chief Clinical Editor

One of my goals is to do whatever I can to elevate the profession of optometry. If I'm asked to be involved in something that doesn't do this, I decline. And the reason is simple: we have a profession of kind, compassionate and striving individuals who do what is best for our patients. However, I worry that our only enemy is ourselves or, more specifically, fear, complacency and apathy. Helen Keller once said, "We may have found a cure for most evils; but we have found no remedy for the worst of them all, the apathy of human beings."

Optometry is a great profession; we serve the public in medical, optical and contact lens needs and we are a trusted provider. But sometimes this success breeds complacency, or worse yet, apathy due to fear or disregard of the future. All of our efforts to advance the profession are futile if any of these negative elements are present. So it's time to start thinking about how to best position ourselves for the opportunities at hand and take action today.

Sears, Toys"R"Us, Blockbuster and Lehman Brothers are all great examples. These companies became complacent in their accomplishments and disregarded the future—even when it was upon them. They believed what worked well now wouldn't need to change. Jeff Bezos, the founder and CEO of Amazon, on the other hand, says he is driven by the fact that "what's dangerous is not to evolve and grow." Here's how *we* can evolve for the future.

Delegate

It's probably time to have staff do more so you can focus on what's most important in growing your practice and serving patient's needs. The most valuable staff members will also want the opportunity to do more and contribute to patients' vision and quality of life.

Many ODs are afraid to delegate refraction. But a recent study from Southern College of Optometry showed that new autorefraction tools suitable for staff use, such as VMax Vision's voice-activated subjective refractor (VASR), are just as accurate as an experienced eye doctor's manual reaction, or possibly more so.

In this study, faculty members with more than 80 years of combined experience conducted the manual phoropter refraction, while a second-year student using the VASR system had never performed a manual refraction. Results showed 14% of patients had better acuity with the VASR (>1 line Snellen compared with the manual refraction), 3% of subjects had worse acuity with VASR (>1 line worse refraction) and 83% were essentially the same.

Right now these systems are only available to optometry, but this level of accuracy may one day be open to anyone. Amazon has already moved into pharmacy delivery and other areas of healthcare—why not optical? This should make us think carefully of future threats and how to prepare for them. Even if this never happens, preparing for it will ensure your practice is better positioned for the future.

Go Medical

You need to determine what your primary patient type is going to be in the future. And it will likely be in the area of medical eye care. The current ophthalmology shortage has created a significant demand that will be even more apparent in the coming years. Some are becoming desperate, and one colleague attending a major hospital group's meeting heard an executive propose a physician's assistant with an autorefractor as a solution.

Many, like this executive, still don't know optometry's role in medical eye care. We need to educate our patients better, and we must do more to seize the medical eye care opportunity. If the logistics of medical eye care seem daunting, consider outsourcing your management needs to companies, such as Optometric Medical Solutions, that handle the credentialing, insurance verification, medical logistics and training. Attend meetings and conferences that focus on workshops to enhance your ability to conduct medical eye exams and treat conditions ranging from blepharitis to age-related macular degeneration (AMD).

By delegating, we can see 20% more patients with no additional time. Adding 20% more medical eye care appointments, especially in the areas of dry eye, diabetes, AMD and glaucoma, can position our practices for the future and help more patients in greater need. ■

Note: Dr. Karpecki consults for companies with products and services relevant to this topic.

Hypochlorous Acid Solution

NOW Available *Without* a Prescription

zenoptiq™

Hypochlorous Acid Solution

Daily Eyelid & Eyelash Cleanser

- Naturally removes foreign matter
- Nontoxic, nonirritating
- Has been shown in studies to reduce bacteria/microbes
- Formulated to relieve symptoms of MGD, Blepharitis and Dry Eye
- Available in 0.01 % HOCL spray and 0.0085% HOCL gel

LEARN MORE AT

zenoptiq.com

Paragon BioTeck, Inc.

FOCUS Laboratories

(866) 752-6006 – FocusLaboratories.com

FLM190-0119-01

Go Puddle-Jumping

Take a page out of my grandson's book and jump in some mud puddles, metaphorically speaking. Just choose those puddles wisely. **By Montgomery Vickers, OD**

My grandson, Graham (he's eight), and I went for a walk one warm Texas morning. As I watched him grind up the sidewalk, I noticed he consistently went out of his way to hit every mud puddle. I realized that the real world slowly teaches us to avoid the puddles. But when you are still full of childhood-induced insanity, you never avoid the most exciting, sloppiest challenge you can find.

Are you avoiding the puddles?

In Graham's world, he can choose: either dive right into a mess or steer around it. In our world, you don't have to find the mud puddle. The mud puddle finds you.

Puddles In Our Path

Sometimes I think ODs are the only professionals in the world who, with a smile on our faces, happily sign up for abuse from just about anybody.

We mindlessly gnaw on rubbery chicken and countless salads while our friendly neighborhood sales rep "gently" berates us to do all we can to increase *his* income.

We blindly worship at the altar of every single vision plan because we are afraid we will lose our patients to some rinky-dink box store doctor and his fake designer frames.

We grieve the death of our self-worth when we see a colleague with his new car, genetically engineered third wife and family full of spelling bee champions and football heroes.

We love to do what my dad always called "waller." For you Yankees, that's how folks in my world pronounce "wallow," where some nasty beast rolls around in the mud because he wants to.

Choose Another Road

Maybe we need to change our attitude. It's time we open up, get brave and dive in. I know the more creative of you are already fist-pumping and ready to do something. You're tired of being told you need to be this, buy that or sign up for the other. Why not just say "no!"? It's time to declare our freedom, our joy and our rightful place in the world! These ideas may help:

1. Send money to your local association's PAC. Your license is in the hands of some lawyer or car dealer who decided to be a state legislator because he had too much time on his hands. Washington, DC, can't help you. Go local, my friend.

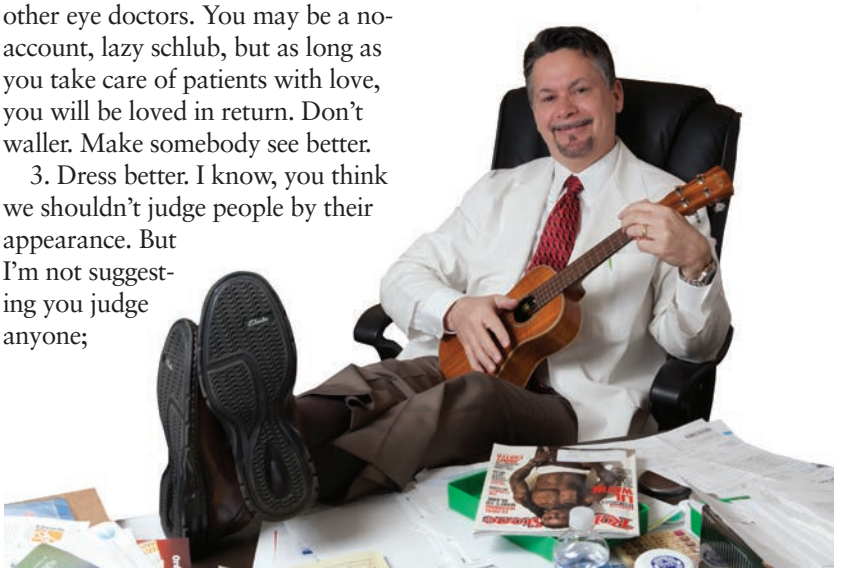
2. Quit comparing yourself to other eye doctors. You may be a no-account, lazy schlub, but as long as you take care of patients with love, you will be loved in return. Don't waller. Make somebody see better.

3. Dress better. I know, you think we shouldn't judge people by their appearance. But I'm not suggesting you judge anyone; I'm suggesting *they* are judging *you*. Totally different. If your preferred professional image is Hawaiian shirt and laid back, at least wash and iron the darn thing and own more than one pair of flip flops, OK?

4. Ask your patients how they are doing. Not how their eyes are doing, how *they* are doing. It will make you a better doctor and a better person and they will spend their lives helping your office prosper. (Tip: write it on the chart so you remember it next year!)

5. Turn off the TV. You are already nuts, so why pour even more insanity into your skull? (You can watch the weather, sports and Avengers movies, but that's it!)

Step up, doctors! Choose the mud you jump in and steer around the mud you don't want. If my grandson can do it, so can you! ■



COMING 2019

Open your eyes to what's on the horizon in dry eye.

Sign up for updates at **TearCare.com**

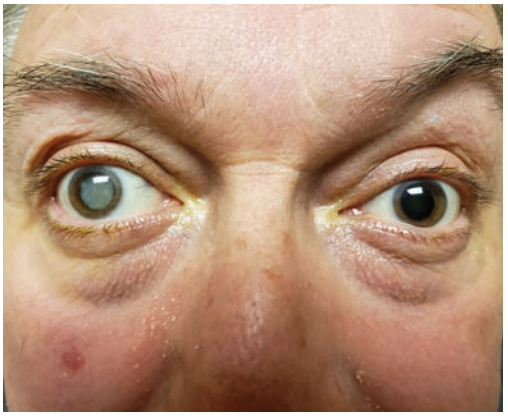
TearCare is indicated for the application of localized heat when the current medical community recommends the application of a warm compress to the eyelids. Such applications would include Meibomian Gland Dysfunction (MGD), Dry Eye, or Blepharitis.

Bad Pupil

When checking the cause of an APD, leave no question unanswered.

Edited by Paul C. Ajamian, OD

Q I recently saw a patient with a mature hand-motion cataract who also had an obvious afferent pupillary defect (APD) in that same eye. Is the cataract the cause?



Was a dense cataract the cause of this patient's APD?

A "It is important to understand that a cataract, no matter how asymmetric in presentation, will never cause a relative afferent pupillary defect in that eye," says Kelly Herron, OD, of Omni Eye Services in Atlanta. "It may seem counterintuitive, but instead of acting like a filter, a cataract can actually increase the light stimulus compared with the other eye."

If there is an APD present, even in the setting of a mature, unilateral cataract, another etiology must be suspected and investigated. One can detect an APD when there is asymmetric damage to the afferent visual system. This damage can occur anywhere from the retina to the anterior part of the optic tract. Considering the seriousness of the pathology usually responsible for an APD, it is essential to check pupils thoroughly at every exam and explain an APD, if present.

When checking for an APD, use a bright light and hold it close enough to isolate the pupillary response for each eye. Dr. Herron recommends a binocular indirect ophthalmoscope as a reliably bright source. An APD that is apparent immediately with the swinging flashlight test is significant and usually obvious to the clinician. To catch smaller APDs, Dr. Herron advises performing the "three-second swinging flashlight test," where the light source is held for three seconds in front of each pupil to watch for a quicker release in one of the pupils.

Also, have the patient fixate at a distance target to confirm that the convergence/accommodative response is not in play. If there is a question whether an APD is present, perform supportive subjective tests, such as light brightness comparison between eyes. Unilateral abnormalities found in any test will also point toward a diagnosis of an APD.

In-depth History

Once the diagnosis of an APD is made, a thorough chief complaint and history should guide the rest of your exam and workup. Pathology responsible for causing an APD can include significant amblyopia, major retinal issues and optic neuropathy. "I typically take a systematic approach and start with the patient's current symptoms and then move on to the systemic and ocular history," Dr. Herron says.

"Since this patient's visual symptoms are at least in part due to the cataract, we chose to focus on other associated issues," Dr. Herron notes. After basic glaucoma history questions, she explored neurological and giant cell arteritis possibilities.

The answer was not clear until Dr. Herron asked her patient about any history of eye/head trauma or poor vision/patching as a child. At first, the patient denied any injury, but upon further questioning, he revealed that he remembered being in a car accident years ago. This prompted the team to continue their exam with tonometry, gonioscopy and a dilated fundus exam that revealed increased IOP, angle recession and a traumatic cataract in the right eye only.

"Our diagnosis of an APD in the setting of angle recession glaucoma made sense with our clinical findings and lack of any other concerning symptoms or health history," Dr. Herron says. "The cataract was removed, revealing a significantly cupped optic nerve consistent with glaucoma. If the etiology remained unclear, a systemic or neurology workup would have been indicated.

"Checking pupils is essential to every exam and can reveal many important findings about the eyes and brain," Dr. Herron says. "Investigate and explain an APD to ensure your clinical findings make sense and the patient gets the proper workup and care." ■

DID YOU KNOW?

KEELER

has slit lamps!

For over 100 years, we have been creating innovative products. The Keeler slit lamp is one of them – designed with you and your patients in mind. The KSL delivers a visually pleasing, customizable device equipped with excellent, high-quality optics.

SLIT LAMP FEATURES

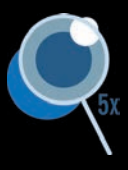
Sharp & clear Keeler Optics

KSL-H series: tower illumination

KSL-Z series: lower illumination

Digital-ready & full digital units

3x magnification drum (10x, 16x, 25x)



5x magnification drum (6x, 10x, 16x, 25x, 40x)

Unique 1mm square for Uveitis evaluation

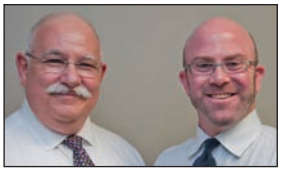
Bright & white LED illumination

We also carry portable slit lamps!

VISIT OUR WEBSITE FOR MORE PRODUCT DETAILS

www.keelerusa.com / 800-523-5620

Keeler



Hyperopia: What's it Good For?

It's why we can get through each day without experiencing extreme alterations in our vision.

By Marc B. Taub, OD, MS, and Paul Harris, OD

In theory, we begin each day with our +0.75 to +1.00 of hyperopia in reserve. We check our digital devices and engage with their "retinal" displays. When we look up, our vision is clear but our refraction is slightly less hyperopic. We don't notice this, however, because we have a buffer.

As we make our way through the day, this happens more and more, and we give up some hyperopia. If we eat healthy and exercise, though, our chances of ending the day the same way we started it, with no blur at distance, increase. Sleep helps restore our buffer, and, when we wake up the next day, the cycle repeats itself.

Building Blocks

The two elements that factor into understanding accommodative stress and hyperopia are the dark focus of accommodation and the hysteresis effect. The rest position of accommodation is at optical infinity or beyond. The dark focus is where our eyes focus in a dark space, 1.00D to 1.50D in front of us.[1,2]

Hysteresis is a dynamic lag between an input and an output that disappears if the input varies slower than the output. After accommodating at near for a sustained period and shifting back out to distance, there is a lag in how long it takes for accommodation to fully make its way back to baseline. It may undo 80% to 85% of the shift in a few minutes but can also take a few hours.[1] The refraction doesn't actually change from moment to moment, but the hysteresis effect can make it seem like the hyperopia is disappearing as the day goes on and explains why an emmetropic patient may complain of some intermittent distance blur later in the day.

If we put the entire amount on a +0.75 hyperopic patient in the form of glasses, they will have clear vision in the morning. As they use their digital devices, however, they will look up and notice intermittent distance blur, which typically gets worse as the day progresses. The full correction artificially makes hyperopic patients emmetropic and may consume or "occupy" their buffer so that it is unable to act like a cushion and allow the patient to perform their daily tasks and still come away "unharmed."

All of this leads to a lens-prescribing directive, which is: unless some specific task requires full correction, leave at least +0.75 of hyperopia at distance uncorrected.

Preserving buffers by not fully compensating all the hyperopia at distance or at near is a hallmark of prescribing. Long-term, we want buffers to be present, but we also don't want to force a patient into making their buffer bigger. Prescribing just the right amount of plus is key to maintaining good visual function and stabilizing refractive condition over time. ■

Case Example

This 10-year-old male patient's visual readings were as follows:

- Unaided visual acuity at distance: 20/20 OD, OS, OU
- Distance retinoscopy: +1.00 OD, +1.00 OS
- Binocular balance: +1.00 20/20 OD, +1.00 20/20 OS
- Best-corrected visual acuity or manifest: +0.50 20/15 OD, +0.50 20/15 OS, 20/10 OU
- Distance phoria: ½ prism diopter of exophoria
- Near retinoscopy: +1.50 spheres OU
- Fused cross-cylinder: +1.25 OD, OS
- Phoria through fused cross-cylinder: 6 prism diopters of exophoria
- Positive relative accommodation: -2.50 gross lens
- Negative relative accommodation: +3.25 gross lens

The patient did not get plus for distance but did get some plus for near. When some plus is worn for near in this kind of case, it decreases the amount of accommodative effort, causing less of a hysteresis effect and keeping distance measurements from fluctuating. We gave him:

- OD plano / +0.75 add, OS plano / +0.75 add

We rarely give the full plus at near, as is obvious by our choice to give less than the near retinoscopy and the full fused cross-cylinder, because we need to leave a small amount of buffer in the accommodative mechanism at near.

1. Ebenholtz SM. Accommodative hysteresis: a precursor for induced myopia? Invest Ophthalmol Vis Sci. 1983;24:513-5.
2. Neveau C, Stark L. Hysteresis in accommodation. Ophthalmic Physiol Opt. 1995:15(3):207-16.

Understanding Extended Depth of Focus (EDOF)

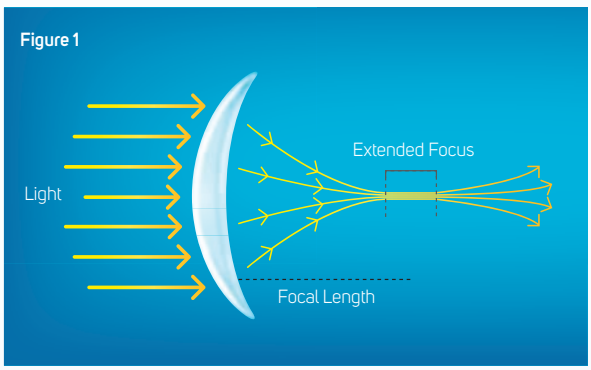
Depth of Focus Defined

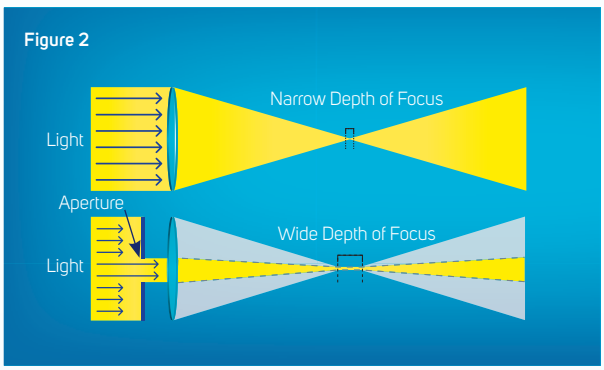
Depth of focus (DOF) is the range of distance along the visual axis, over which an image may be focused and perceived as a clear image. Simply, it is the range of clear vision. (Figure 1)

Depth of focus (DOF) is relative to the aperture that allows light into the eye. If the aperture is large, the DOF is narrow; if the aperture is small, the DOF is large. (Figure 2)

Extended depth of focus (EDOF) allows uninterrupted visual correction, from near to distance, across a larger range.

Peg Achenbach, OD, FAAO
Vice President, Professional Services and Clinical Science for VTI





Pinhole Optics – Optics 101

To see an image clearly, light rays must fall on the fovea. Aberrant light rays fall on the retina outside the fovea and on the peripheral retina. These rays are not clear and can cause blur. A pinhole limits aberrant light rays inside the eye. The pinhole, whether an occluder type or 'induced aperture' pinhole, limits the aberrant rays that hit other parts of the retina so that only the light rays coming straight through and directly hitting the fovea enter the eye. This creates a clear image at near, intermediate and distance. The clarity of the image is independent of the distance away from the eye.

These principles will help you better understand the optics behind the NaturalVue® (etafilcon A) Multifocal 1 Day Contact Lens design.[1]

The NaturalVue® Multifocal uses the principle of pinhole optics in its design. The distance power is focused in the center of the lens. The plus power increases rapidly, smoothly, continuously out from the center. The brain and the visual cortex suppress the power it does not need. These high amounts of plus are enough to induce the 'peripheral blur', which creates a virtual aperture or 'pinhole' effect. This effect results in an extended depth of focus and clear range of vision. The Neurofocus Optics® technology makes this lens very different from most designs on the market today.

The NaturalVue® Multifocal:

- Provides clear distance, intermediate, and near vision with spectacle-level visual acuity and stereoacuity[2]
- Creates an effective ADD up to +3.00D for a simplified fit[2]
- Is available in 0.25D steps from +4.00D to -12.25D

For additional information, please contact Dr. Peg Achenbach at **pachenbach@vtivision.com** or VTI Technical Consultation at 1-844-VTIVISION (1-844-884-5367) ext. 102, or **TechnicalConsultation@vtivision.com**.

1. Patents Awarded – MULTIFOCAL OPHTHALMIC LENS WITH INDUCED APERTURE, See https://vtivision.com/about/patents/ for details.
2. VTI data on file 2015. N=59. Data assessed after 1 week of wear.

MKT-VTI-AP1 r0

VTI REDEFINING VISION


DR: See Something? Say Something

Now that treatment can slow progression and even reverse severity, optometrists can get at-risk patients into a regimen sooner. **By Jay M. Haynie, OD, and Diana Shechtman, OD**

One in three Americans is living with diabetes or prediabetes, according to a 2017 report from the Centers for Disease Control and Prevention.[1] That's an astonishing statistic—and a call to arms for the entire medical community.

Optometrists have mostly been able to stay on the sidelines of the fight against diabetes. Historically, general practitioners advised on prevention, endocrinologists managed patients systemically and retina specialists addressed the ocular impact. But new diagnostic tools and better treatment options are making our role in diabetes care increasingly more prominent.

The question we must now ask ourselves is whether early intervention is in the best interest of our patient. Complications of diabetes are the leading cause of functional vision loss in working-aged adults, and optometrists handle the majority of primary eye care in this country. Mild and moderate cases of nonproliferative diabetic retinopathy (NPDR) are typically followed in a clinical setting; however, when a patient reaches severe NPDR we should consider referring the patient to a retina specialist for an evaluation that includes fluorescein angiography to assess retinal ischemia. Factors to consider when making such a referral can include duration of diabetes, control of glucose and hemoglobin A1c values, as well as the patient's compliance.

The Rise of a New Treatment Era

Managing patients with diabetic eye disease was considerably more difficult back when panretinal photocoagulation (PRP) was the best, and often only, option available to them. Once anti-VEGF injections were approved for age-related macular degeneration, experts naturally began wondering if the anti-angiogenic properties of these drugs could work in diabetic eye disease as well. In a word: yes.

Several clinical trials have defined a new standard of care for the treatment of diabetic macular edema with intravitreal anti-VEGF injections. In 2012, the RISE and RIDE clinical trial for the treatment of DME with Lucentis (ranibizumab, Genentech) concluded that this approach was safe and effective; soon thereafter, it became an important first-line therapy for DME. In 2014 the FDA approved a second compound, Eylea (aflibercept, Regeneron) for DME, following publication of the VISTA and VIVID studies.

Expanding beyond the treatment of DME, Lucentis was approved in 2017 to treat all complications of diabetic retinopathy, even in the absence of DME, following the results of RISE and RIDE. Over a 36-month period, treatment with Lucentis was found to result in a two-step reduction in the level of severity of diabetic retinopathy. Phase III results of the PANORAMA study of Eylea use in moderately severe to severe NPDR concluded that Eylea was also effective in causing a two-step reduction of the level of severity of DR in up to 80% of patients. The FDA is scheduled to comment on the approval of Eylea for the treatment of NPDR this year.

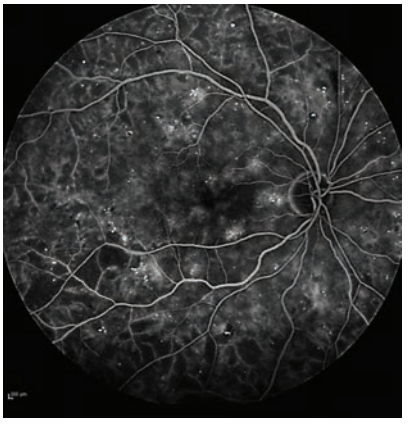


Fig. 1. Fluorescein angiography confirmed severe NPDR with significant capillary nonperfusion in the temporal fundus.

Severe NPDR is classified using the 4-2-1 rule: Make the diagnosis when a patient has dot-blot hemorrhages in all *four* retinal quadrants, venous beading in *two* quadrants or intraretinal microvascular abnormalities in *one* quadrant. The risk of progressing to proliferative diabetic retinopathy (PDR) for a patient with severe NPDR in a 12-month period is up to 50%.

Our job as optometrists is to educate our patients on the risk of visual loss secondary to diabetic retinopathy (DR). Given the results of landmark clinical trials, we are now obligated to refer patients sooner than we once may have. A recent case seen by Dr. Haynie highlights this era of change.

An Ounce of Prevention

Case by Dr. Haynie

A 72-year-old white female was referred for evaluation of DR. Her

DISCOVER LOTEMAX® SM: SUBMICRON STRONG

LOTEMAX® SM
(loteprednol etabonate ophthalmic gel) 0.38%

Join your peers for a webinar presentation introducing the exciting new advancements of LOTEMAX® SM, the newest loteprednol etabonate formulation from Bausch + Lomb

REGISTER FOR ONE OF THE FOLLOWING WEBINAR SESSIONS:

MARGUERITE MCDONALD, MD
Tuesday, April 9th • 6:00 PM ET | 3:00 PM PT

MITCHELL JACKSON, MD
Wednesday, April 24th • 8:00 PM ET | 5:00 PM PT

RANDALL THOMAS, OD
Wednesday, May 8th • 8:00 PM ET | 5:00 PM PT

PAUL KARPECKI, OD
Wednesday, April 10th • 7:30 PM ET | 4:30 PM PT

AUDREY TALLEY ROSTOV, MD
Thursday, April 25th • 9:00 PM ET | 6:00 PM PT

RAJESH RAJPAL, MD
Wednesday, May 15th • 6:00 PM ET | 3:00 PM PT

Dates and speakers are subject to change or substitution.

THIS LIVE WEBINAR PRESENTATION WILL COVER:

- **OVERCOMING CHALLENGES** of ocular drug delivery
- **LOTEMAX® SM FORMULATION** features designed with the patient in mind
- **NEW SM TECHNOLOGY™** in LOTEMAX® SM
- **THE PROVEN EFFICACY AND SAFETY** of LOTEMAX® SM

This promotional webinar is sponsored by Bausch + Lomb. No CME/CE or food will be provided for this program. Only physicians and healthcare professionals involved in providing patient care or product recommendations may attend this educational program.

REGISTER NOW AT www.reviewofoptometry.com/LotemaxSMWebinar2019

INDICATION

LOTEMAX® SM (loteprednol etabonate ophthalmic gel) 0.38% is a corticosteroid indicated for the treatment of post-operative inflammation and pain following ocular surgery.

IMPORTANT SAFETY INFORMATION

- LOTEMAX® SM, as with other ophthalmic corticosteroids, is contraindicated in most viral diseases of the cornea and conjunctiva including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, and also in mycobacterial infection of the eye and fungal diseases of ocular structures.
- Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, defects in visual acuity and fields of vision. If LOTEMAX® SM is used for 10 days or longer, IOP should be monitored.
- Use of corticosteroids may result in posterior subcapsular cataract formation.
- The use of steroids after cataract surgery may delay healing and increase the incidence of bleb formation. In those with diseases causing thinning of the cornea or sclera, perforations have been known to occur with the use of topical steroids. The initial prescription and renewal of the medication order should be made by a physician only after examination of the patient with the aid of magnification such as slit lamp biomicroscopy and, where appropriate, fluorescein staining.

IMPORTANT SAFETY INFORMATION (CON'T)

- Prolonged use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In acute purulent conditions, steroids may mask infection or enhance existing infections.
- Employment of a corticosteroid medication in the treatment of patients with a history of herpes simplex requires great caution. Use of ocular steroids may prolong the course and may exacerbate the severity of many viral infections of the eye (including herpes simplex).
- Fungal infections of the cornea are particularly prone to develop coincidentally with long-term local steroid application. Fungus invasion must be considered in any persistent corneal ulceration where a steroid has been used or is in use. Fungal cultures should be taken when appropriate.
- Contact lenses should not be worn when the eyes are inflamed.
- There were no treatment-emergent adverse drug reactions that occurred in more than 1% of subjects in the three times daily group compared to vehicle.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit **www.fda.gov.medwatch** or call **1-800-FDA-1088**.

Please see Brief Summary of full Prescribing Information on adjacent page.

BAUSCH + LOMB

LOTEMAX® SM
(loteprednol etabonate ophthalmic gel) 0.38%

BRIEF SUMMARY OF PRESCRIBING INFORMATION

This Brief Summary does not include all the information needed to use LOTEMAX® SM safely and effectively. See full prescribing information for LOTEMAX® SM.

LOTEMAX® SM (loteprednol etabonate ophthalmic gel) 0.38%

For topical ophthalmic use
Initial U.S. Approval: 1998

INDICATIONS AND USAGE

LOTEMAX® SM is a corticosteroid indicated for the treatment of post-operative inflammation and pain following ocular surgery.

DOSAGE AND ADMINISTRATION

Invert closed bottle and shake once to fill tip before instilling drops. Apply one drop of LOTEMAX® SM into the conjunctival sac of the affected eye three times daily beginning the day after surgery and continuing throughout the first 2 weeks of the post-operative period.

CONTRAINDICATIONS

LOTEMAX® SM, as with other ophthalmic corticosteroids, is contraindicated in most viral diseases of the cornea and conjunctiva including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, in mycobacterial infection of the eye and fungal diseases of ocular structures.

WARNINGS AND PRECAUTIONS

Intraocular Pressure (IOP) Increase: Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, defects in visual acuity and fields of vision. Steroids should be used with caution in the presence of glaucoma. If this product is used for 10 days or longer, intraocular pressure should be monitored.

Cataracts: Use of corticosteroids may result in posterior subcapsular cataract formation.

Delayed Healing: The use of steroids after cataract surgery may delay healing and increase the incidence of bleb formation. In those diseases causing thinning of the cornea or sclera, perforations have been known to occur with the use of topical steroids. The initial prescription and renewal of the medication order should be made by a physician only after examination of the patient with the aid of magnification such as slit lamp biomicroscopy and, where appropriate, fluorescein staining.

Bacterial Infections: Prolonged use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In acute purulent conditions of the eye, steroids may mask infection or enhance existing infection.

Viral infections: Employment of a corticosteroid medication in the treatment of patients with a history of herpes simplex requires great caution. Use of ocular steroids may prolong the course and may exacerbate the severity of many viral infections of the eye (including herpes simplex).

Fungal Infections: Fungal infections of the cornea are particularly prone to develop coincidentally with long-term local steroid application. Fungus invasion must be considered in any persistent corneal ulceration where a steroid has been used or is in use. Fungal cultures should be taken when appropriate.

Contact Lens Wear: Contact lenses should not be worn when the eyes are inflamed.

ADVERSE REACTIONS

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice. Adverse reactions associated with ophthalmic steroids include elevated intraocular pressure, which may be associated with infrequent optic nerve damage, visual acuity and field defects, posterior subcapsular cataract formation, delayed wound healing and secondary ocular infection from pathogens including herpes simplex, and perforation of the globe where there is thinning of the cornea or sclera. There were no treatment-emergent adverse drug reactions that occurred in more than 1% of subjects in the three times daily group compared to vehicle.

USE IN SPECIAL POPULATIONS

Pregnancy: Risk Summary: There are no adequate and well controlled studies with loteprednol etabonate in pregnant women. Loteprednol etabonate produced teratogenicity at clinically relevant doses in the rabbit and rat when administered orally during pregnancy. Loteprednol etabonate produced malformations when administered orally to pregnant rabbits at doses 4.2 times the recommended human ophthalmic dose (RHOD) and to pregnant rats at doses 106 times the RHOD. In pregnant rats receiving oral doses of loteprednol etabonate during the period equivalent to the last trimester of pregnancy through lactation in humans, survival of offspring was reduced at doses 10.6 times the RHOD. Maternal toxicity was observed in rats at doses 1066 times the RHOD, and a maternal no observed adverse effect level (NOAEL) was established at 106 times the RHOD. 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 loteprednol etabonate by oral gavage on gestation days 6 to 18, to target the period of organogenesis. Loteprednol etabonate produced fetal malformations at 0.1 mg/kg (4.2 times the recommended human ophthalmic dose (RHOD) based on body surface area, assuming 100% absorption). Spina bifida (including meningocele) was observed at 0.1 mg/kg, and exencephaly and craniofacial malformations were observed at 0.4 mg/kg (17 times the RHOD). At 3 mg/kg (128 times the RHOD), loteprednol etabonate was associated with increased incidences of abnormal left common carotid artery, limb flexures, umbilical hernia, scoliosis, and delayed ossification. Abortion and embryofetal lethality (resorption) occurred at 6 mg/kg (256 times the RHOD). A NOAEL for developmental toxicity was not established in this study. The NOAEL for maternal toxicity in rabbits was 3 mg/kg/day. Embryofetal studies were conducted in pregnant rats administered loteprednol etabonate by oral gavage on gestation days 6 to 15, to target the period of organogenesis. Loteprednol etabonate produced fetal malformations, including absent innominate artery at 5 mg/kg (106 times the RHOD); and cleft palate, agnathia, cardiovascular defects, umbilical hernia, decreased fetal body weight and decreased skeletal ossification at 50 mg/kg (1066 times the RHOD). Embryofetal lethality (resorption) was observed at 100 mg/kg (2133 times the RHOD). The NOAEL for developmental toxicity in rats was 0.5 mg/kg (10.6 times the RHOD). Loteprednol etabonate was maternally toxic (reduced body weight gain) at 50 mg/kg/day. The NOAEL for maternal toxicity was 5 mg/kg. A peri-/postnatal study was conducted in rats administered loteprednol etabonate by oral gavage from gestation day 15 (start of fetal period) to postnatal day 21 (the end of lactation period). At 0.5 mg/kg (10.6 times the clinical dose), reduced survival was observed in live-born offspring. Doses ≥ 5 mg/kg (106 times the RHOD) caused umbilical hernia/incomplete gastrointestinal tract. Doses ≥ 50 mg/kg (1066 times the RHOD) produced maternal toxicity (reduced body weight gain, death), decreased number of live-born offspring, decreased birth weight, and delays in postnatal development. A developmental NOAEL was not established in this study. The NOAEL for maternal toxicity was 5 mg/kg.

Lactation: There are no data on the presence of loteprednol etabonate 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 LOTEMAX® SM and any potential adverse effects on the breastfed infant from LOTEMAX® SM.

Pediatric Use: Safety and effectiveness of LOTEMAX® SM in pediatric patients have not been established.

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

NONCLINICAL TOXICOLOGY

Carcinogenesis, Mutagenesis, Impairment of Fertility: Long-term animal studies have not been conducted to evaluate the carcinogenic potential of loteprednol etabonate. Loteprednol etabonate was not genotoxic *in vitro* in the Ames test, the mouse lymphoma tk assay, or in the chromosomal aberration test in human lymphocytes, or *in vivo* in the mouse micronucleus assay. Treatment of male and female rats with 25 mg/kg/day of loteprednol etabonate (533 times the RHOD based on body surface area, assuming 100% absorption) prior to and during mating caused preimplantation loss and decreased the number of live fetuses/live births. The NOAEL for fertility in rats was 5 mg/kg/day (106 times the RHOD).

Bausch + Lomb, a division of Valeant Pharmaceuticals North America LLC
Bridgewater, NJ 08807 USA

LSM.0091.USA.19
Based on 9669600-9669700 Revised: 02/2019

medical history included Type II diabetes for 17 years. Visual acuity measured 20/20 in each eye. Dilated fundus exam revealed findings consistent with severe NPDR in each eye. Fluorescein angiography was performed, confirming severe NPDR in each eye with significant capillary nonperfusion (ischemia) in the temporal fundus (*Figure 1*).

Following a long discussion with the patient about the risk of progression to PDR, she consented to treatment with Lucentis at 12- to 16-week intervals. Serial fluorescein angiography over two years confirms no progression of ischemia or evidence of PDR (*Figure 2*).

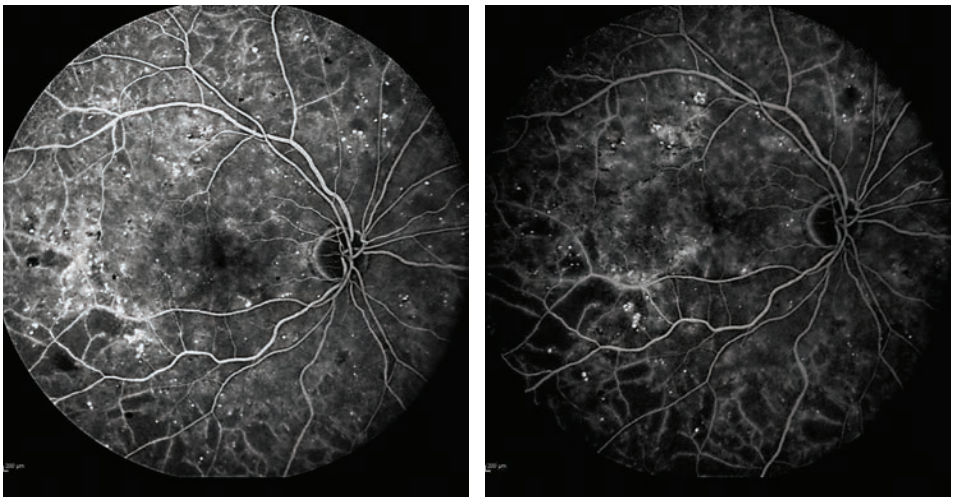


Fig. 2. After beginning anti-VEGF treatments, the patient's subsequent fluorescein angiograms at one and two years into the regimen (left and right images, respectively) confirmed no progression of ischemia or evidence of proliferative diabetic retinopathy.

Of course, there's no way to conclusively know that the anti-VEGF regimen is wholly responsible for the absence of progression in this case. But the results of the RISE/RIDE and PANORAMA clinical trials give us confidence in considering a referral for anti-VEGF treatment in patients with severe NPDR with or without diabetic macular edema (DME).

Imaging is Imperative

Commentary by Dr. Shechtman

As optometric physicians, we need to do more than just familiarize ourselves with various treatment options for complications associated with DR, such as DME and PDR. In an evolving era of diabetes management, we also need to recognize the benefits of early intervention. The RISE/RIDE, PANORAMA and VIVID/VISTA studies, as well as DRCR.net Protocol W, have all shown benefits of anti-VEGF in reversing the severity scale of diabetic retinopathy. The recent approval of Lucentis for NPDR with or without DME indicates the beginning of a paradigm shift in the management of this condition.

We know that a patient's level of diabetic retinopathy dictates risk for proliferative disease development, and thus the rationale for earlier intervention may be based on such risk. Although staging of severe NPDR has been characterized by the 4:2:1 rule, in my practice we feel many cases remain underestimated in terms of staging. We use ultra-widefield angiography (UFWA) in every patient who has at least moderate NPDR. In our opinion, the assessment of UWFA depicting the presence of capillary nonperfusion and subtle neovascularization may be more accurate in the staging of the disease.

Although anti-VEGF therapy may be a treatment option for severe NPDR, laser PRP is still a viable alternative, especially given compliance concerns and a patient's socioeconomic status.

A recent expert panel concluded that PRP can be considered for certain high-risk patients with severe NPDR.[2] In our practice, we have found that combination therapy with PRP and anti-VEGF agents for severe cases of DR may be a good approach for individual cases.

For optometrists, the question of when to refer is not always straightforward. The OD should consult with a local retina specialist to establish protocols for their referral patterns and treatment and management preferences. Knowing that we may in fact be able to rewrite a DR patient's prognosis with a single well-timed referral, the conventional approach of "watchful waiting" until severity progresses to frank neovascularization may be on the wane moving forward. ■

Dr. Shechtman wishes to thank Wilfredo Lara, MD, for his contributions to this commentary.

1. Centers for Disease Control and Prevention. National diabetes statistics report, 2017. US Department of Health and Human Services; 2017.
2. Wong TY, Kawasaki R, Ruamviboonsuk P, et al. Guidelines on diabetic care: the international council of ophthalmology recommendations for screening, follow-up, referral and treatment based on resource settings. Ophthalmology. 2018;125(10):1608-22.

HEIDI Q.T. PHAM-MURPHY, OD
VISIONS OPTOMETRY

Are you in?

Attract new patients, gain competitive marketing advantages, and experience enhanced rewards and savings with the VSP Global® Premier Program.

Visit **ImIn.PathToPremier.com** to learn how.

PREMIER PROGRAM
BY VSP GLOBAL®

FOLLOW US! @VSPPROVIDERS

PEER • REVIEWED • PRA • ARTICLE

Corneal Disease Report

Corneal Manifestations of Systemic Diseases

We review the clinical presentation and management of four conditions a routine slit lamp exam might reveal. **By Nurit Ariel Wilkins, OD, Saleha Munir, OD, and Moran Roni Levin, MD**

Many systemic diseases have ocular manifestations, and it is common for patients to present to their eye doctor with ocular symptoms. Optometrists are often the first to encounter these patients and play a significant role in identifying and managing ocular manifestations of systemic diseases. Eye care providers must work closely with the appropriate medical provider to improve outcomes. In this review, we will describe the clinical presentation, etiology and management of four systemic diseases—Sjögren's syndrome (SS), atopic disease, graft-vs.-host disease (GVHD) and facial nerve palsy secondary to a variety of systemic etiologies.

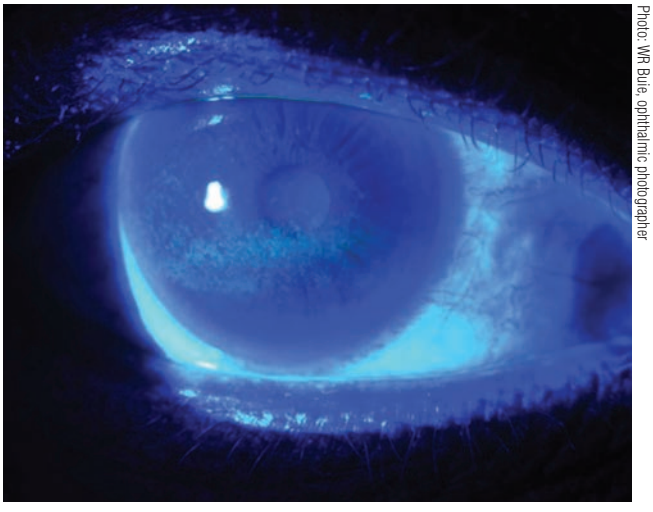


Photo: WR Buie, ophthalmic photographer

Fig. 1. This is a typical fluorescein staining pattern in a patient with severe dry eye from Sjögren's syndrome.

Sjögren's Syndrome

This is a chronic autoimmune disease that affects the exocrine glands of mucus membranes, including the lacrimal and salivary glands.[1] SS is the second most common rheumatologic disease, commonly affecting woman in their fourth or fifth decade.[2] Secondary disease is associated with autoimmune conditions such as rheumatoid arthritis, systemic lupus erythematousus and Wegner's granulomatosis.[3] Lymphocytic infiltration and inflammation of the lacrimal gland leads to decreased production of tears.[1] The reduction in aqueous secretion leads to dryness of the ocular surface and a reduced ability to remove debris, waste and microbes, which normally drain with the tears.

Keratoconjunctivitis sicca (KCS), or dry eye disease, is a key finding in SS and in many inflammatory, autoimmune and collagen-vascular disorders. KCS is a multifactorial disease that involves changes in the tear film, resulting in damage to the ocular surface.[4] SS-related dry eye is associated with aqueous deficiency, although these patients may also have evaporative tear loss. Corneal manifestations range from punctate epithelial erosions to severe sight-threatening complications such as ulcers, perforation and scarring (*Figures 1 and 2*). Corneal ulcers associated with SS

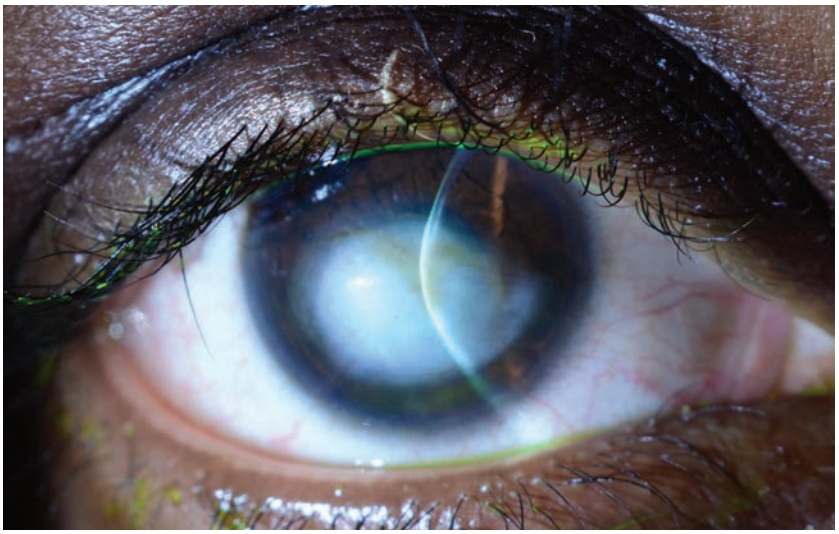


Photo: WR Buie, ophthalmic photographer

Fig. 2. This patient with Sjögren's syndrome has a central corneal scar following corneal perforation.

are sterile, usually located centrally and are circular or oval in shape and less than 3mm in size.[2] These require prompt referral to a cornea specialist to prevent irreversible vision loss.

Evaluation of patients with SS requires a thorough history and clinical examination of the cornea, conjunctiva and eyelids. Clinicians should stain the ocular surface with fluorescein and assess tear film break-up time (TBUT) to evaluate the tear film stability and epithelial integrity. Fluorescein staining of the epithelium indicates increased epithelial permeability.[5] The tear film exhibits reduced volume and quality in KCS, and a thin tear meniscus is suggestive of aqueous deficiency.[6] The Shirmer test, which can quantify aqueous deficiency and lacrimal function, will often yield a result of less than 5mm in five minutes in patients with SS.[5]

The goals of managing patients with SS include treating symptoms of KCS and preventing sight-threatening corneal complications. The first-line treatment is lubrication of the ocular surface with artificial tears, gels and ointment. Tear preservation with punctal occlusion is useful in patients with aqueous deficiency and staining of the ocular surface.[7] Ocular surface inflammation should be treated prior to insertion of punctal plugs. Anti-inflammatory therapy may include topical cyclosporine, steroids and oral tetracycline.[8] Lifitegrast is a new small-molecule integrin antagonist that is useful in the treatment of KCS. The essential fatty acids, omega-3s, have both anti-inflammatory properties as well as efficacy in preventing tear evaporation by improving tear quality.[9] Research shows a diet rich in essential fatty acids or nutritional supplementation improves patient symptoms based on the Ocular Surface Disease Index score.[10] Sources of omega-3 essential fatty acids include cold-water fish, such as tuna and salmon, as well as flaxseed, chia seed and green leafy vegetables.

Atopic Disease

Allergic eye disease can be categorized as atopic keratoconjunctivitis, vernal keratoconjunctivitis or seasonal keratoconjunctivitis.

Atopic keratoconjunctivitis (AKC) is associated with systemic allergic diseases such as environmental allergies, asthma and eczema. It is a chronic type IV hypersensitivity immune inflammatory response with episodes of exacerbation and remission. Chronic AKC can affect the eyelids, conjunctiva, cornea or lens.

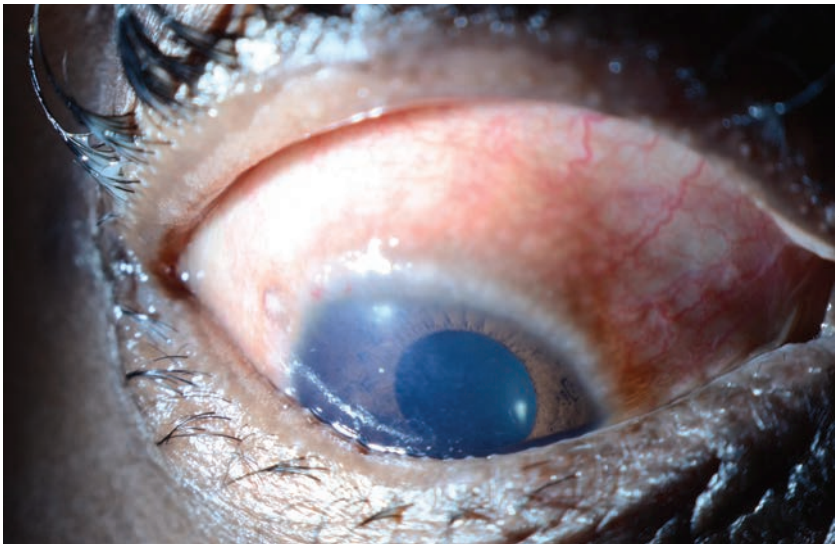


Photo: WR Buie, ophthalmic photographer

Fig. 3. This patient with vernal keratoconjunctivitis presented with limbal Horner-Trantas Dots.

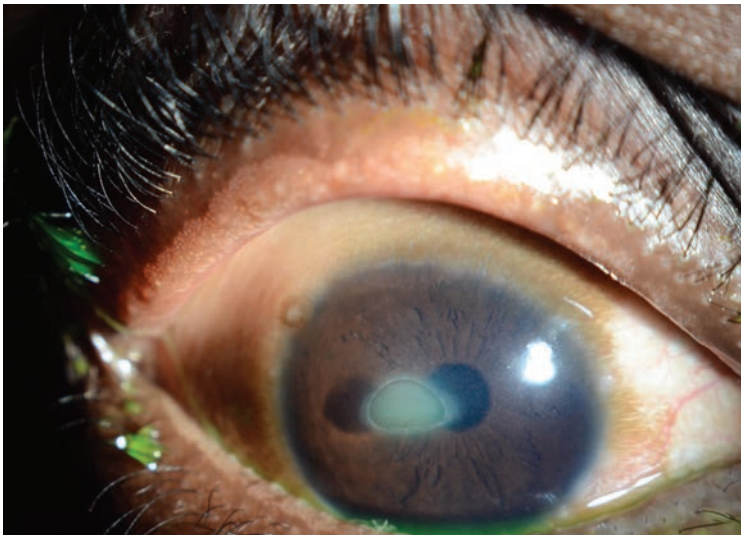


Photo: WR Buie, ophthalmic photographer

Fig. 4. Shield ulcers are possible in patients with vernal keratoconjunctivitis.

Eyelid complications of AKC include periorbital atopic dermatitis, blepharitis, lid thickening, scarring and maderosis, ectropion or entropion.[11] Conjunctival manifestations of ACK include papillae on the tarsal conjunctiva, cicatricial changes and symblepharon formation. Anterior subcapsular cataracts are associated with atopic disease, and posterior subcapsular cataracts can result from chronic steroid use.

Corneal manifestations of AKC include superficial punctate keratopathy, filaments and neovascularization. Trauma from repeated eye rubbing or inflamed conjunctiva can result in corneal erosions, scarring and corneal ectasias such as keratoconus.[11] Corneal infections with *Staphylococcus aureus* or herpes simplex virus are more

Table 1. Treatment Summaries for Corneal Manifestations of Systemic Diseases

Disease	Etiology	Corneal Treatment
Sjögren's Syndrome	• Autoimmune inflammation and infiltration of the lacrimal gland	Treatment of keratoconjunctivitis sicca: • Ocular surface lubrication with artificial tears, gel and ointment • Tear preservation with punctal occlusion • Prevention of tear evaporation with omega-3 fatty acids • Reduction of inflammation with topical cyclosporine, lifitegrast, steroids or oral tetracycline • Epithelial support with autologous serum tears • Ocular surface protection with scleral contact lenses • Referral to cornea specialist for management of complications including ulcer and necrosis
Atopy	• Type IV hypersensitivity immune inflammatory response • Allergic response to environmental allergens • IgE-mediated response with release of mast cells and inflammatory markers	• Avoidance of allergens • Cool compresses • Ocular lubrication with artificial tears • Topical H-1 receptor antagonists, mast-cell stabilizers or combination drops • Topical cyclosporine • Tacrolimus • Topical corticosteroids • Referral to cornea specialist for treatment of shield ulcers or keratoconus
Ocular GVHD	• Allogeneic hematopoetic stem cell transplantation	• Treatment of keratoconjunctivitis sicca (as above) • Removal of filaments or superficial epithelial debridement • Partial tarsorrhaphy • Limbal cell transplantation • Fornix reconstruction • Amniotic membrane graft
Facial Nerve Palsy	• Tumor • Infection • Stroke • Trauma • Surgery • Idiopathic (Bell's palsy)	• Protection of ocular surface (as above) • Tarsorrhaphy for incomplete eyelid closure • Botulinum toxin injections can be used to temporarily paralyze the levator muscle • Gold or platinum weight implantation

Flarex®

(fluorometholone acetate ophthalmic suspension) 0.1%

NOW JOINING THE EYEVANCE™ FAMILY

of ophthalmic treatment options

eyevance™ pharmaceuticals

FLA-004 01/2019

common in patients with AKC, as are squamous neoplasia of the conjunctiva or cornea.

Seasonal keratoconjunctivitis is caused by an allergic response to allergens such as grass, pollen, animal dander or dust and can recur with seasonal changes. This is an IgE-mediated response with release of mast cells and inflammatory markers. Symptoms include conjunctival injection, watery or mucoid discharge and chemosis.

Vernal keratoconjunctivitis occurs in response to environmental allergens and is worse during the spring.[12] It is more common in males with a peak incidence in childhood and typically resolves in early adulthood. Ocular signs of vernal keratoconjunctivitis include cobblestoning of the conjunctiva, corneal neovascularization and limbal Horner-Trantas dots (*Figure 3*). Corneal complications of vernal keratoconjunctivitis can includes progression to shield ulcers (*Figure 4*).

Management of allergic eye diseases, including seasonal, atopic and vernal keratoconjunctivitis, should focus on treating both chronic symptoms and acute flares. Patients should avoid allergens and employ supportive care such as cool compresses and ocular lubrication to improve symptoms. Artificial tears not only lubricate the ocular surface, but can dilute pathogens and decrease itching. Topical H-1 receptor antagonists, mast-cell stabilizers or combination drops can control itching in seasonal and vernal keratoconjunctivits, but are less effective in AKC. For severe AKC, topical treatment with cyclosporine drops or tacrolimus is warranted. Topical corticosteroids may be indicated for exacerbations but are not recommended for long-term use due to side effects. Vasoconstrictor drops should be avoided in allergic eye disease due to rebound hyperemia.

Graft-vs.-host Disease

GVHD is a collection of complications occurring after allogeneic hematopoietic stem cell transplantation, which is performed for a variety of benign or malignant hematological diseases, inherited metabolic disorders and autoimmune diseases.[13] During the procedure, stem cells are harvested from bone marrow, peripheral blood or placental blood from donors who are human leukocyte antigen matched.[13-16] Alloreactivity occurs between the donor lymphocytes and host tissue to destroy the tumor, but also attacks non-malignant cells, which results in GVHD.[17]

This condition occurs primarily in the skin, liver and gastrointestinal system and may also involve the

lungs, esophagus and oral and ocular mucosa.[13,18-20] Risk factors for both acute and chronic GVHD include female donor to male recipient, unrelated donor, older-aged recipient and stem cells extracted from the peripheral blood.

Ocular GVHD occurs in approximately 40% to 60% of patients receiving allogeneic hematopoietic stem cell transplantation, and it is considered a poor prognostic factor for mortality.[20-24] Conjunctival hyperemia in the setting of systemic GVHD is highly suggestive of acute ocular GVHD.[25] The occurrence and severity of acute ocular GVHD correlates with the severity of the systemic disease.[13]

This multifactorial disease primarily manifests as KCS and also involves destruction and fibrosis of the conjunctiva and lacrimal gland. This may lead to decreased aqueous tear production along with meibomian gland dysfunction.[14] Conjunctival involvement may present in varying degrees, from mild hyperemia to pseudomembranous conjunctivitis to cicatricial changes with symblepharon formation (*Figure 5*).

Corneal manifestations of ocular GVHD are similar to those of KCS, including punctate epithelial keratopathy. Patients may present with painful epithelial erosions and filamentary keratitis. Additional corneal complications include limbal stem cell deficiency, non-healing ulcers, stromal thinning and necrosis, which may progress to corneal perforation. Less frequent ocular manifestations of GVHD may include uveitis, scleritis, retinal complications and cataract and glaucoma due to prolonged steroid use.[13,26]

When evaluating patients who have undergone hematopoetic stem cell transplantation, clinicians must obtain a thorough medical and ocular history, perform a comprehensive eye exam at baseline and repeat the exam 100 to 200 days after transplantation. TBUT with fluorescein dye and Schirmer test without anesthesia are useful tools for this population.

In treating the corneal manifestations, the same systematic approach should be taken to manage symptoms of KCS and prevent sight-threatening complications. Filamentary keratitis requires careful removal of filaments. Epithelial support with autologous serum tears or amniotic membrane may help treat symptoms and prevent worsening of corneal disease.[25] Scleral contact lenses may help prevent complications by providing continuous hydration to the corneal surface.[27] These treatments may prevent surgical intervention.

Comanagement with a cornea specialist is recommended in severe cases such as non-healing epithelial

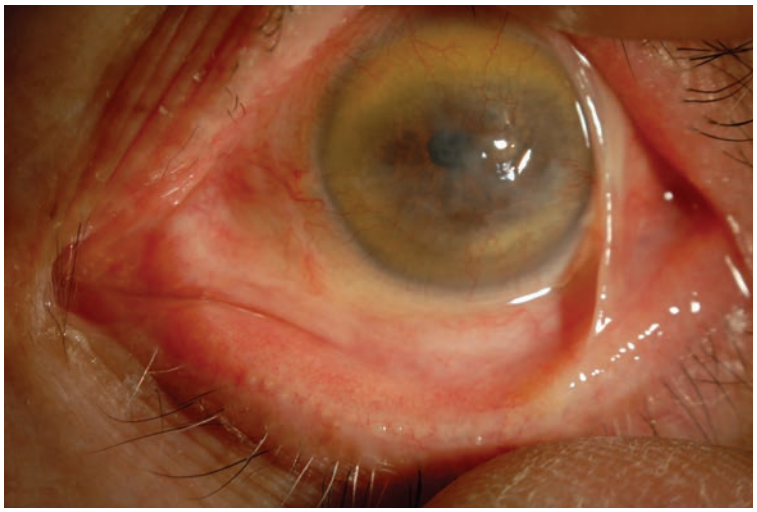


Photo: W. Munir, MD

Fig. 5. Patients with severe ocular GVHD may present with symblepharon and corneal neovascularization.

defects or risk of perforation, which may require tarsorrhaphy, limbal cell transplantation, fornix reconstruction or corneal transplantation.[27]

Facial Nerve Palsy

Many systemic diseases can lead to facial nerve palsy, including infection, tumor and stroke. Facial palsy may also result from trauma, surgery or may be idiopathic (Bell's palsy). Bell's palsy is the most common etiology, although evidence suggests that herpes simplex may be the cause of facial nerve palsies thought to be idiopathic.[28,29] Of patients with Bell's palsy, 83% have a good recovery.[30] Ramsay-Hunt syndrome, which results from herpes zoster infection, is associated with painful paralysis and is less likely to have complete recovery than Bell's palsy.[30]

Optometrists frequently care for patients with facial nerve palsy and treat resulting symptoms of epiphora and dry eye. Patients may present with these symptoms acutely, or may be referred from another medical specialist treating them for tumor, infection or trauma.

The most common corneal manifestation of facial nerve palsy is corneal exposure, which can range in severity from mild dryness to corneal ulceration and blindness. Exposure results from lack of corneal protection when lagophthalmos is present. Facial nerve palsy causes loss of orbicularis function and blink response. Lack of Bell's reflex and reduced corneal sensation increase the risk of corneal injury from lagophthalmos.

These patients require a comprehensive eye examination that specifically focuses on the eyelids and cornea. When evaluating eyelids, clinicians should look for lid-globe congruity, lower eyelid retraction and symmetry of the palpebral fissure between the two eyes. In addition, ensure the puncta is patent and check whether it is everted or rotated inwards. This should be evaluated during active blinking to also check for incomplete eyelid closure.[31]

The corneal evaluation includes identifying areas of dryness on the unprotected corneal surface (*Figure 6*). Clinicians should check the tear meniscus for thickness and quality of tears, including whether there is debris or foamy build-up. Clinicians can evaluate the tear meniscus by adding fluorescein, but too much fluid will increase the tear lake (*Figure 7*).

The main treatment goal for patients with facial nerve palsy is to protect the cornea and preserve good visual acuity. This requires a multidisciplinary approach, often encompassing otolaryngology surgeons and oculoplastics specialists.[28] The optometrist's role is to protect the ocular surface, treat any exposure keratopathy and prevent complications, such as corneal perforation, by implementing techniques described above, as well as by offering solutions for

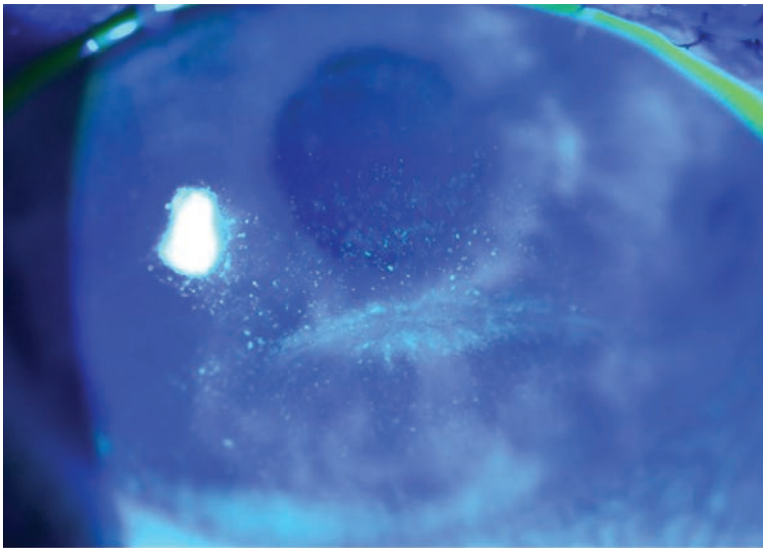


Photo: WR Buie, ophthalmic photographer

Fig. 6. This patient with lagophthalmos from facial nerve paralysis has interpalpebral corneal staining.

temporary lid closure such as adhesive tapes or masks.

Surgical management by an oculoplastics specialist is indicated when supportive therapy inadequately controls symptoms or in worsening of corneal disease. Tarsorrhaphy is indicated when incomplete eyelid closure occurs in combination with reduced corneal sensation, as this combination increases risk of corneal perforation.[32] Botulinum toxin injections can be used to temporarily paralyze the levator muscle, inducing a ptosis that protects the cornea and may prevent the need for tarsorrhaphy is some patients.[32] Gold or platinum weight implantation is an effective treatment for patients with paralytic lagophthalmos.[33] Once the risk of corneal ulceration is eliminated, patients may undergo brow ptosis repair or blepharoplasty for improved cosmesis.

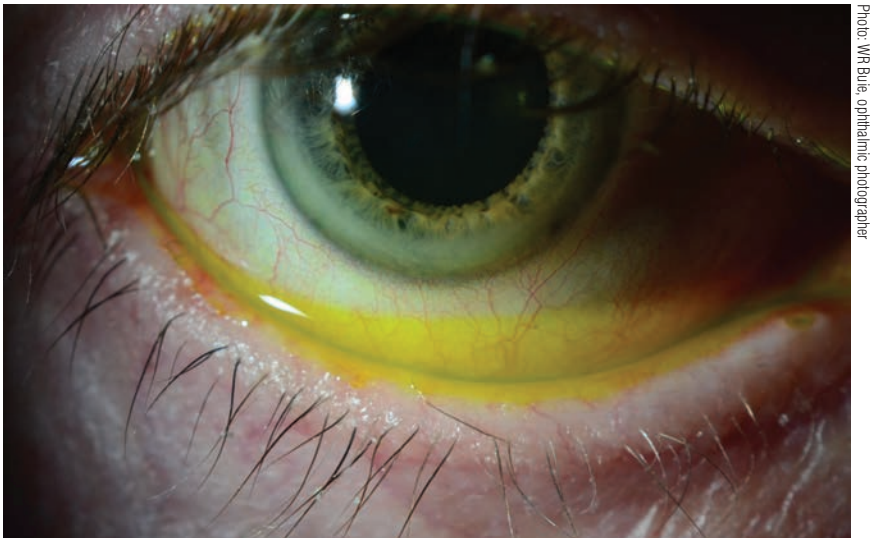


Photo: WR Bule, ophthalmic photographer

Fig. 7. This evaluation of the tear film with fluorescein reveals a high tear lake in a patient with paralytic lagophthalmos following surgery for squamous cell carcinoma of the parotid gland.

These are just a few of many systemic diseases that affect the cornea. Optometrists must work with other sub-specialists to manage the disease, control ocular symptoms and prevent serious visually threatening complications. ■

Drs. Wilkins, Munir and Levin are faculty at the University of Maryland School of Medicine in the Department of Ophthalmology and Visual Sciences.

1. Mavragani CP, Moutsopoulos HM. Sjögren syndrome. CMAJ. 2014;186(15):E579-86.
2. Nassiri N, Djalilian A, Hamrah P, Pglugfelder S. Dry Eye. In: Krachmer JH, Mannis MJ, Holland EJ, eds. Cornea. St. Louis: Mosby/Elsevier; 2011:919-44.
3. Vitali C, Bombardieri S, Jonsson R, et al. Classification criteria for Sjögren's syndrome: a revised version of the European criteria proposed by the American-European Consensus Group. Ann Rheum Dis. 2002;1:554-8.
4. The definition and classification of dry eye disease: report of the Definition and Classification Subcommittee of the International Dry Eye WorkShop. Ocul Surf. 2007;5:75-92.
5. Methodologies to diagnose and monitor dry eye disease: report of the Diagnostic Methodology Subcommittee of the International Dry Eye WorkShop. Ocul Surf. 2007;5:108-52.
6. GN Foulks GN. Clinical guidelines for management of dry eye associated with Sjögren disease. Ocul Surf. 2015;13(2):118-32.
7. Baxter SA, Laibson PR. Punctal plugs in the management of dry eyes. Ocul Surf. 2004;2:255-65.
8. Management and therapy of dry eye disease: report of the Management and Therapy Subcommittee of the International Dry Eye WorkShop. Ocul Surf. 2007;5:163-78.
9. Barabino S, Horwath-Winter J, Messmer EM, et al. The role of systemic and topical fatty acids for dry eye treatment. Prog Retin Eye Res. 2017 Nov;61:23-34.
10. The Dry Eye Assessment and Management Study Research Group. n–3 fatty acid supplementation for the treatment of dry eye disease. N Engl J Med. 2018;378:1681-90.
11. Patel N, Venkateswaran N, Wang Z, Galor A. Ocular involvement in atopic disease: a review. Curr Opin Ophthalmol. 2018;29(6):576-81.
12. Andalibi S, Haidara M, Bor N, Levin M. An update on neonatal and pediatric conjunctivitis. Current Ophthalmology Reports. 2015;3(3):158-69.
13. Munir SZ, Aylward J. A review of ocular graft-versus-host disease. Optom Vis Sci.2017;94:545-55.
14. Hessen M, Akpek EK. Ocular graft-versus-host disease: Curr Opin Allergy Clin Immunol. 2012;12:540-7.
15. Espana EM, Shah S, Santhiago MR, Singh AD. Graft versus host disease: clinical evaluation, diagnosis and management. Graefes Arch Clin Exp Ophthalmol. 2013;251:1257-66.
16. Nassar A, Tabbara KF, Aljurf M. Ocular manifestations of graft-versus-host disease. Saudi J Ophthalmol. 2013;27:215-22.
17. von Bonin M, Bornhäuser M. Concise review: the bone marrow niche as a target of graft versus host disease. Stem Cells. 2014;32:1420-8.
18. Sung AD, Chao NJ. Acute graft-versus-host disease: Are we close to bringing the bench to the bedside? Best Pract Res Clin Haematol. 2013;26:285-92.
19. Magenau J, Runaas L, Reddy P. Advances in understanding the pathogenesis of graft-versus-host disease. Br J Haematol. 2016;173:190-205.
20. Qian L, Wu Z, Shen J. Advances in the treatment of acute graft-versus-host disease. J Cell Mol Med. 2013;17:966-75.
21. Ogawa Y, Kim SK, Dana R, et al; International Chronic Ocular Graft-vs-Host-Disease (GVHD) Consensus Group: proposed diagnostic criteria for chronic GVHD (Part I). Sci Rep. 2013;3:3419.
22. Na K-S, Yoo Y-S, Mok JW, et al. Incidence and risk factors for ocular GVHD after allogeneic hematopoietic stem cell transplantation. Bone Marrow Transplant. 2015;50:1459-64.
23. Wang JCC, Teichman JC, Mustafa M, et al. Risk factors for the development of ocular graft-versus-host disease (GVHD) dry eye syndrome in patients with chronic GVHD. Br J Ophthalmol. 2015;99:1514-18.
24. Townley JR, Dana R, Jacobs DS. Keratoconjunctivitis sicca manifestations in ocular graft versus host disease: pathogenesis, presentation, prevention, and treatment. Semin Ophthalmol. 2011;26:251-60.
25. Shikari H, Antin JH, Dana R. Ocular graft-versus-host disease: a review. Surv Ophthalmol. 2013;58:233-51.
26. Jagasia MH, Greinix HT, Arora M, et al. National Institutes of Health consensus development project on criteria for clinical trials in chronic graft-versus-host disease: I. The 2014 Diagnosis and Staging Working Group report. Biol Blood Marrow Transplant J. 2015;21:389-401.e1.
27. Harthan JS, Shorter E. Therapeutic uses of scleral contact lenses for ocular surface disease: patient selection and special considerations. Clin Optom (Auckl). 2018;10:65-74.
28. Rahman I, Sadiq SA. Ophthalmic management of facial nerve palsy: a review. Surv Ophthalmol. 2007;52(2):121-44.
29. Musani MA, Farooqui AN, Usman A, et al. Association of herpes simplex virus infection and Bell's palsy. J Pak Med Assoc. 2009;59(12):823-5.
30. Peitersen E. Bell's palsy: the spontaneous course in 2500 peripheral facial nerve palsies of different aetiologies. Acta Otolaryngol. 2002;549(Suppl):4-30.
31. Lane C. Management of ocular surface exposure. Br J Ophthalmol. 2012;96:471-72.
32. Lee V, Currie Z, Collin JR. Ophthalmic management of facial nerve palsy. Eye (Lond). 2004;18(12):1225-34.
33. Yu Y, Sun J, Chen L, Liu L. Lid loading for treatment of paralytic lagophthalmos. Aesth Plast Surg. 2011;35:1165.

PEER • REVIEWED • PRA • ARTICLE •

Corneal Disease Report

New Tools to Tame Keratoconus

The OD's armamentarium has never been so full and now includes everything from contact lenses to new medical procedures. By Brian Chou, OD

The conditions ODs dread managing are those that highly impact patients' lives but for which few treatments truly succeed. Keratoconus was one of them, because management frequently involved eyeglass remakes, several contact lens prescriptions, rigid contact lenses that displaced and caused discomfort and, for the optometrist, historically inadequate third-party reimbursement.

But in the past two decades, several new options have turned this frustrating treatment paradigm on its head. Today, Intacs (Addition Technologies) and corneal cross-linking (CXL) are new medical strategies, in addition to advanced hybrid and scleral contact lenses. Keratoconus is now an opportunity more than it is an obstacle. ODs can make the most of the opportunity by updating their understanding of the disease and its many therapies.

New Attention, Old Disease

Keratoconus is a well-recognized contraindication for undergoing LASIK because excimer ablation can further weaken and destabilize the keratoconic cornea, making vision much worse. Nonetheless, the rise of LASIK has indirectly benefited those with keratoconus. Since the first FDA approval of an excimer laser for LASIK in 1999, increased screenings for LASIK candidacy have identified many patients who were previously unaware of their keratoconus. Technologies such as corneal topography, Scheimpflug imaging and optical coherence tomography (OCT) have also helped identify more keratoconus patients (*Figure 1*).

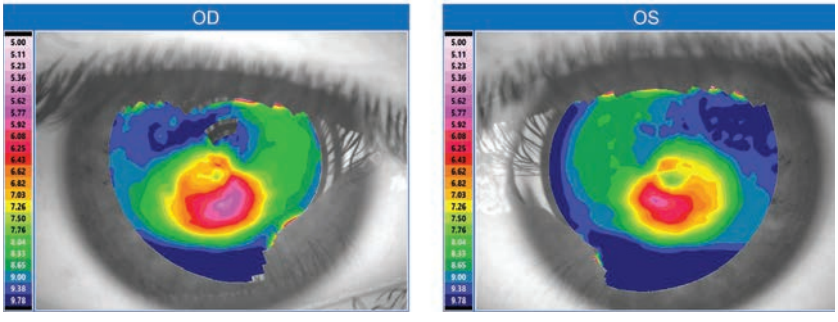


Fig. 1. This topographical map is typical for a keratoconus patient.

Unlike corneal topography, which only measures the anterior cornea surface, Scheimpflug imaging and OCT can measure both the anterior and posterior corneal surfaces and perform pan-corneal pachymetry. These measures are valuable for diagnosis because keratoconus often demonstrates abnormal anterior and posterior corneal curvatures in conjunction with corneal thinning. With these improved screenings, the known population with keratoconus has grown, and mild "forme fruste" cases that formerly escaped diagnosis are more readily detected. Previous estimates suggest one in

1,800 has keratoconus, but a 2017 population study in the Netherlands suggests it is closer to one in 375.[1,2]

Although previous research suggested unilateral keratoconus was possible, today's diagnostics tools show these are in fact highly asymmetric cases. A thorough clinical exam often demonstrates tell-tale abnormalities of keratoconus in the patient's "good" eye.[3] Furthermore, patients with pellucid marginal degeneration (PMD) now add to the growing list of identified keratoconus patients. Experts agree that keratoconus and PMD are the same underlying disease but with different clinical presentations.[3] Still, some researchers believe PMD is a different disease—patients with "crab-claw" corneal topographies on axial view represent inferior keratoconus much more frequently than PMD, for example.[4]

The greater awareness of keratoconus has spurred significant development of new and improved interventions that augment the established legacy treatments.

Image: SynergEyes

Fig. 2. Silicone hydrogel skirt UltraHealth hybrid lens.

Therapy Standbys: PK and Corneal RGPs

During the 19th century, researchers proposed some radical surgical interventions for keratoconus, including translocation of the pupil away from the corneal apex, incarceration of the iris in a corneal incision to create a stenopaic slit pupil, and chemical and thermal cautery of the cornea—none of which took hold.[5] It wasn't until 1936 when Castroviejo performed the first penetrating keratoplasty (PK) for keratoconus in New York that the role of surgery took form.[6] Since then, PK has been the dominant, albeit end-of-the-line, surgical intervention. Many patients undergoing PK experience a protracted recovery, still need to wear rigid surface contact lenses to obtain functional vision and often require a chronic maintenance dose of topical corticosteroids to prevent graft rejection.

Restoring vision in keratoconus has revolved around corneal rigid gas permeable (RGP) contact lenses, with glasses and soft contact lenses serving a smaller number with mild disease. Although corneal RGPs do not retard disease progression, they serve to improve vision, a task often undermined by limited contact lens tolerability. Among RGP wearers in the Collaborative Longitudinal Evaluation of Keratonus study, 27% reported lens discomfort, excluding participants who had already discontinued RGP lens wear before study enrollment.[7] Other patients report problems with corneal RGP lenses ejecting and dislodging, as well as handling difficulty.

Incremental Improvement

During the '80s and '90s, the efforts to improve treatment were largely unsuccessful. Epikeratoplasty gained brief surgical traction, as it frequently improved uncorrected and best-spectacle corrected visual acuity.[8] But it fell out of favor quickly because the visual outcome of PK was generally preferable.[8,9] The now-defunct SoftPerm hybrid lens sought to combine the benefit of RGP optics with soft lens comfort and stability. However, problems were common with this lens design, including junctional separation in 29.1% of cases, peripheral corneal neovascularization in 25% and discomfort in 29.1%.[10] Other contact lens efforts included thick soft lens designs, such as the Flexlens Tri-curve keratoconus (X-Cel Contacts) to mask corneal irregularity and the Flexlens piggyback (X-Cel Contacts), which has a countersunk anterior cut-out to hold a corneal RGP lens. Two semi-scleral lenses that surfaced in the early 2000s were the Epicon (Specialty UltraVision) 13.5mm diameter molded RGP lens and MacroLens (C&H Contact Lens), which came in sizes between 13.9mm and 15.0mm; both have since been discontinued.

In late 2011, Alden Optical (now part of Bausch + Lomb Specialty Vision Products) introduced the NovaKone toric lens, a thick soft lens made with hioxifilcon D designed to mask corneal irregularity.[11] In 2012, B+L announced a global licensing agreement with UltraVision CLPL for KeraSoft IC, a lathed thick silicone hydrogel lens for irregular corneas, including those with keratoconus.[12] All these lenses have a thickness of greater than 0.40mm, so even with a latheable silicone hydrogel material the resulting Dk/t does not meet the Holden-Mertz criteria of 24 x 10^{-9} units to avert hypoxia in daily wear. Clinically, the observed absence of corneal hypoxic findings in wearers of these thick lenses suggests that a significant amount of tear exchange occurs during lens wear.

The newer-generation hybrid contact lenses for keratoconus launched

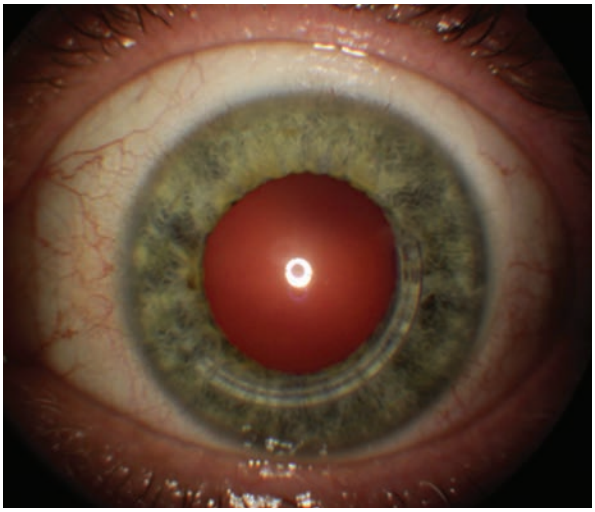


Fig. 3. Intacs for keratoconus, showing inferotemporal placement of a single segment.

with SynergEyes KC in 2006, SynergEyes ClearKone in 2009 and the silicone hydrogel skirt hybrid lens, SynergEyes UltraHealth in 2013 (*Figure 2*). These lenses, unlike their SoftPerm predecessor, do not suffer from junctional separation and offer greater parameter customization and generally better outcomes. Their promise is to offer rigid quality vision with the centration, stability and comfort of a soft contact lens. As with corneal GP lenses, if hybrid lenses cause epitheliopathy and associated wearing discomfort, piggybacking may help.[13]

Medical Management Gamechangers

Since the first Intacs surgery for keratoconus in 1997, reports continue to corroborate that it can improve unaided and best-spectacle corrected visual acuity and reduce corneal irregularity (*Figure 3*).[14-16] Unlike excimer photoablative surgery, which subtracts from the corneal tissue in the visual axis, Intacs intracorneal ring segments bolster the mid-peripheral corneal thickness and indirectly reduce central corneal curvature. In 2004, Intacs received humanitarian device exemption FDA approval for treating keratoconus when corneal transplantation is the only remaining option to improve a patient's functional vision.[17]

Just a year before Intacs's FDA approval, researchers introduced corneal crosslinking (CXL) for keratoconus. Since then, the procedure has garnered significant interest due to its technical simplicity and ability to slow or halt progression while reducing corneal irregularity. Avedro received FDA approval for its crosslinking system (called KXL) in 2016; the modality is increasingly accepted as a standard treatment for patients with progressive keratoconus (*Figure 4*).[18]

Now that this treatment is available, detecting keratoconus before significant clinical progression is crucial to minimize loss of best-spectacle corrected acuity, reduce risk of corneal scarring and the need for PK. Since the disease generally self-arrests by the third to fourth decade of life, no consensus exists yet on whether CXL has a role for older keratoconus patients.[19]

As the understanding of CXL matures, clinicians must come to an agreement on what defines progression. Characteristics of progression include steepening of the anterior and posterior cornea surfaces, thinning of the cornea and worsening best-spectacle corrected visual acuity, although it remains debatable how much change in these indicators qualifies as progression. Furthermore, progression can be difficult to determine in patients who are wearing corneal RGP contact lenses due to corneal molding and spectacle blur. A true determination in these cases would require a complete RGP wash-out and monitoring for several months, if not longer, which is generally impractical.

Epi-on vs. Epi-off

The Avedro KXL system is indicated for treatment of progressive keratoconus in patients ages 14 and older by first debriding the corneal epithelium.[18] While the "Dresden protocol" with epithelial removal is an established standard, some corneal surgeons are now

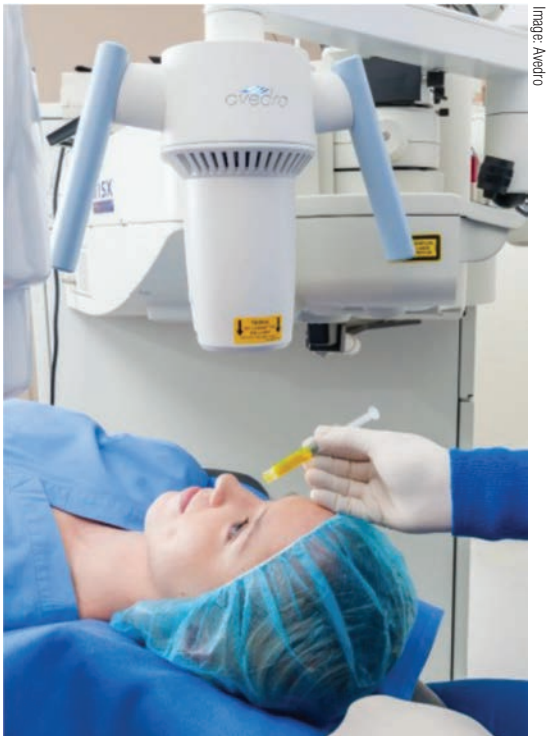


Image: Avedro

Fig. 4. The Avedro KXL in action.

Passionate About Patient Experience?

OF COURSE YOU ARE.

Exceed their expectations with our complete line of digital refraction devices.
Set your practice apart with the most advanced Phoroptor® ever, **Phoroptor® VRx**,
and our pixel-perfect **ClearChart® 4** family of digital acuity systems.

WATCH OUR NEW SERIES AT:
PASSIONATEABOUTEYECARE.COM

Reichert® TECHNOLOGIES
PASSIONATE ABOUT EYE CARE

performing variations of CXL, including trans-epithelial (epi-on) application of riboflavin drops. The proposed benefits of epi-on CXL are faster recovery and less post-operative discomfort. There is debate over how well riboflavin can permeate into the corneal stroma without epithelial debridement.

So far, studies show similar outcomes between epi-on and epi-off CXL.[20] In a 2018 meta-analysis, researchers found that, "analysis of the limited number of comparative studies available seems to demonstrate that standard CXL and trans-epithelial CXL have a comparable effect on visual, refractive, pachymetric and endothelial parameters at one year."[20] A double-masked clinical trial sponsored by Avedro commenced in 2017 with the intent of submitting data to the FDA on the epi-on procedure.[21,22] Trans-epithelial CXL may fall within optometric scope of care for certain states with regulatory approval and industry acceptance of safety and efficacy.

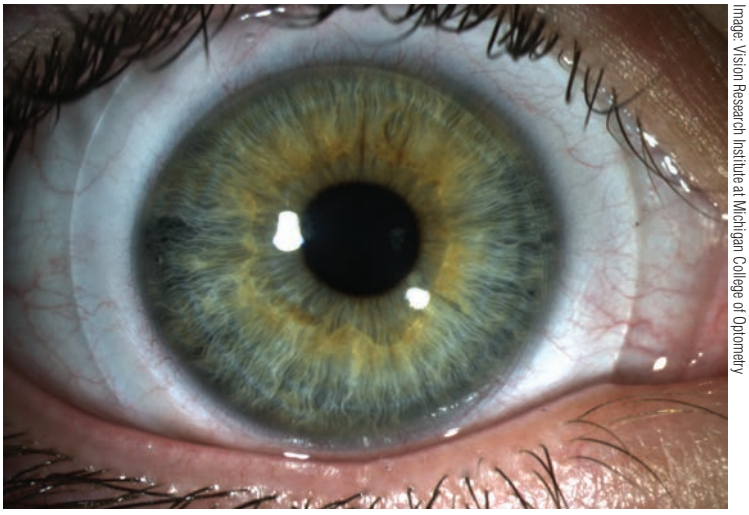


Image: Vision Research Institute at Michigan College of Optometry

Fig. 5. Scleral lens showing optimal landing onto the bulbar conjunctiva while vaulting over the corneal surface.

Other variations of trans-epithelial CXL are under investigation as well, including the addition of iontophoresis, which uses a voltage gradient across the cornea to draw riboflavin into the stroma. One study found significant visual and refractive improvements 12 months after trans-epithelial CXL with iontophoresis, though the average improvement in corneal topography readings was slightly lower than the Dresden protocol in the same period.[23] Despite the faster clinical recovery of visual performance with iontophoresis, the authors still recommend standard CXL for patients younger than 24 years of age. However, one case series found a high rate of early postoperative epithelial complications undermining the purported advantages of trans-epithelial CXL.[24] Other variants of the Dresden protocol include performing CXL in combination with Intacs and photorefractive keratectomy. While the Dresden protocol is the current standard for CXL, it is likely that the favored CXL procedure will evolve.

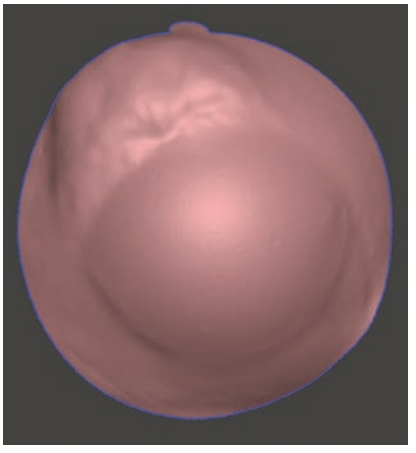


Image: EyePrint Prosthetics

Fig. 6. This is 3D image of the impression of a patient's eye with a filtration bleb.

Contact Lens Game-changers

Notwithstanding the many advances for keratoconus, no therapy so far can replicate the smooth refracting surface and visual quality as well as a rigid contact lens. For the vast majority with keratoconus—even those who have undergone CXL and Intacs—rigid contact lens optics are still necessary for optimal vision. In this area, scleral lenses have revolutionized contact lens treatment for keratoconus.

Because scleral lenses vault over the sensitive corneal surface and land on the relatively insensitive bulbar conjunctiva overlying the sclera, they generally provide exceptional wearing comfort (*Figure 5*). They

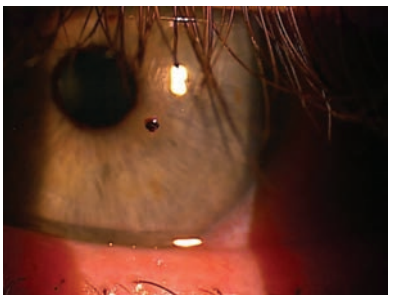
Increased Coverage

In the wake of Avedro's KXL system approval and industry-wide adoption, 62 insurance carriers now cover the procedure, up from just three at the beginning of 2017.[1] However, medical insurance coverage for CXL is only for the standard FDA-approved epi-off Dresden protocol. In addition, private-paying patients undergoing CXL are facing an increased cost as of July 1, 2017, when Avedro raised pricing for its system's two photosensitizing agents, Photrexa and Photrexa Viscous, from $595 to $2,850 per eye.[2] This was to reflect a more sustainable pricing, according to the company.[2]

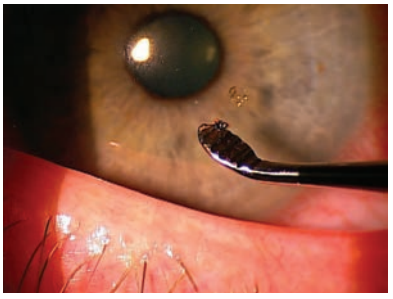
1. Avedro. Is crosslinking covered by insurance? www.livingwithkeratoconus.com/is-cross-linking-right-for-me/is-cross-linking-covered-by-insurance/?nabe=6081452870205440:1. Accessed March 1, 2019.
2. Avedro takes heat for its riboflavin price increase. Review of Ophthalmology. July 6, 2017. www.reviewofophthalmology.com/article/avedro-takes-heat-for-its-riboflavin-price-increase. Accessed March 1, 2019.

EyeRes™

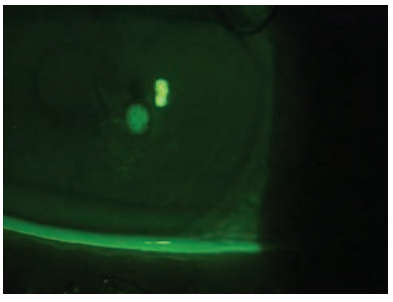
Digital Imaging Systems



See *the condition . . . .*



Treat *the condition . . .*



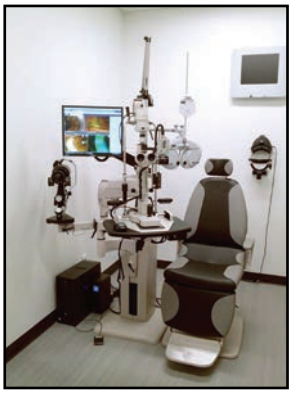
Monitor *the recovery . .*

Photos courtesy of Mile Brujic, O.D.

Make A Difference by Using this Versatile System:

Anterior-segment imaging, Retinal imaging, and Infrared imaging all from an ***Eye*****Res**™ slit lamp and ***Eye*****Res**™ digital imaging system.

Save time, money, and space while enhancing the patient's appreciation for your expertise.



www.TelScreen.com

Call* 800.769.4933 *today or
email Wes Harris at wes.harris@telscreen.com

TelScreen

trap non-preserved saline against the ocular surface and are thus an effective treatment for severe dry eye.[25] Research shows scleral lenses reduce biomarkers of dry eye in keratoconus.[26]

One study found that most keratoconus patients strongly prefer scleral lenses over traditional corneal RGP and hybrid contact lenses for vision and wearing comfort.[27] Unlike corneal RGP lenses, scleral lenses are stable on the eye in various fields of gaze, are not subject to dislodging or decentering and are not susceptible to exogenous debris under the lens once seated on the eye. Because scleral lenses vault the cornea, they do not subject the patient to spectacle blur and visual drift after lens removal. In addition, the ability to specify front-surface toricity with scleral lenses can address residual astigmatism better than corneal RGPs due to the greater stability of scleral lenses.

Some scleral lens designs allow for asymmetrical lens specifications to pattern the ocular shape. For example, BostonSight's scleral allows for a quadrant-specific toric haptic system, and the Zenlens design (Bausch + Lomb) can incorporate microvaults to avoid compressing conjunctival obstacles such as pingueculae.

An impression-based prosthetic cover shell, EyePrintPro (EyePrint Prosthetics), can also provide scleral lens benefits for patients with keratoconus and may be particularly helpful for those with elevated conjunctival lesions, such as filtration blebs and pingueculae (*Figure 6*). According to Christine Sindt, OD, President of EyePrint Prosthetics, the company's shell can "more closely predict and align the visual axis with a more even tear layer over the cornea. The true rotational stability of the device enables the use of premium optics, like multifocal and prism, in any direction, not just as a ballast. It also allows for more accurate predictions of clearances."

The present-day renaissance for managing keratoconus is highlighted by several viable treatments—including CXL and scleral lenses—that compellingly improve the lives of many of these patients. Resources such as the National Keratoconus Foundation (www.nkcf.org) and Scleral Lens Education Society (www.sclerallens.org) offer valuable information for both patients and practitioners. Optometrists committed to this specialty can forget the frustrations of the past and enjoy the professional fulfillment of helping these patients while gaining shelter from the market forces disrupting mainstream optometry. ■

Be Careful with Billing

Since prescribing contact lenses for keratoconus requires greater expertise and chair time, these services command higher fees and reimbursements from third-party payers with provisions for medically necessary contact lenses. This also means these third-party payers are increasingly scrutinizing payments for this category by way of friendly "quality" audits and more ominous "targeted" audits. Providers must be careful to adhere to proper billing and coding practices as described by their provider manuals and agreements. For example, some vision plans with necessary contact lens authorizations will reimburse for keratoconus regardless of severity of the disease. Other plans require the keratoconus to meet certain severity criteria before qualifying for reimbursement.

Some ambiguity exists with billing and coding for major vision plans. For example, EyeMed Vision Care currently reimburses contact lens services and materials for keratoconus at a higher level if the patient has "moderate/advanced" disease. EyeMed's present claim form connects moderate/advanced disease with the ICD-10 classification for "unstable" disease, even though severity and stability are independent characteristics. For example, a 70-year-old keratoconus patient can have advanced disease (e.g., exhibit Munson's sign) despite having stable ectasia. Conversely, a 15-year-old with mild or forme fruste keratoconus topographical pattern may have progressing, unstable keratoconus. Due to the inability of the ICD-10 codes to indicate severity of keratoconus, EyeMed has updated its provider manual to clarify that qualification for "moderate/severe" disease status is based on the presence of at least one of the following: corneal scarring, topographical steep K of 53D or higher, corneal thickness less than 476µm, or an unmeasurable refraction. In situations of ambiguity, always consult the vision plan's representatives and provider manual for guidance.

In an interview on this topic, Denis Humphreys, OD, VSP's director of optometry, said, "While VSP supports medically necessary contact lenses (NCL) for 'unstable,' 'stable' and 'unspecified' keratoconus, we don't pay doctors a higher amount based on the severity of the disease (i.e., a specific diagnosis code). Our NCL maximum payable amounts do not vary by diagnosis code and are inclusive of chair time required for lens fitting and evaluation." Dr. Humphreys added, "VSP billing for NCL always requires an appropriate diagnosis that supports clinical findings and reflects a suitable type of contact lens fit. Our billing and reimbursement procedures are detailed in the Contact Lenses section of the VSP Provider Reference Manual, which is available online to all member doctors."

Other aspects of our updated understanding of keratoconus have not permeated into the administrative systems for rendering care. The ICD-10 classification system still allows the provider to code for unilateral keratoconus, even though the global consensus is that there is no such thing.[3] Additionally, since PMD and keratoconus are believed to represent different presentations of the same disease, most cases of "crab-claw" topographies should be coded using the ICD-10 code for keratoconus and not for peripheral corneal degeneration.[3]

Dr. Chou practices in San Diego at ReVision Optometry, where he directs a referral-based keratoconus clinic. He also provides industry-supported workshops for eye care practitioners on prescribing scleral contact lenses. Dr. Chou reported the first case of Intacs surgery for keratoconus in the US during his fellowship in 1999 at Jules Stein Eye Institute, UCLA School of Medicine, and served as a clinical investigator for the SynergEyes KC lens prior to its FDA approval.

1. Kennedy RH, Bourne WM, Dyer JA. A 48-year clinical and epidemiologic study of keratoconus. Am J Ophthal. 1986;101(3):267-73.
2. Godefrooij DA, de Wit GA, Uiterwaal CS, et al. Age-specific incidence and prevalence of keratoconus: a nationwide registration study. Am J Ophthalmol. 2017;175:169-72.
3. Gomes JA, Tan D, Rapuano CJ, et al. Global consensus of keratoconus and ectatic diseases. Cornea. 2015;34(4):359-69.
4. Koc M, Tekin K, Inanc M, et al. Crab claw pattern on corneal topography: pellucid marginal degeneration or inferior keratoconus? Eye. 2018;32:11-18.
5. Arnalich-Montiel F, Alio del Barrio JL, Alio JL. Corneal surgery in keratoconus: which type, which technique, which outcomes? Eye Vis (Lond). 2016;3:2.
6. Castroviejo R. Keratoplasty for the treatment of keratoconus. Trans Am Ophthalmol Soc. 1945;26:127-53.
7. Zadnik K, Barr JT, Edrington TB. Baseline findings in the Collaborative Longitudinal Evaluation of Keratonus (CLEK) Study. Invest Ophthalmol Vis Sci. 1998:39:2537-46.
8. Waller SG, Steiner RF, Wagoner MD. Long-term results of epikeratoplasty for keratoconus. Cornea. 1995;14(1):84-8.
9. Wagoner MD, Smith SD, Rademaker WJ, et al. Penetrating keratoplasty vs epikeratoplasty for the surgical treatment of keratoconus. J Refract Surg. 2001;17(2):138-46.
10. Özkurt Y, Oral Y, Karaman A, et al. A retrospective case series: use of SoftPerm contact lenses in patients with keratoconus. Eye Contact Lens. 2007;33(2):103-5.
11. Alden Optical. NovaKone: a soft contact lens for keratoconus. Bausch + Lomb Specialty Vision Products. http://aldenoptical.com/products/soft-specialty/novakone/novakone. Accessed March 1, 2019.
12. Bausch + Lomb announces availability of KeraSoft IC contact lenses for keratoconus and other irregular corneas. Eyewire. January 1, 2012. http://eyewiretoday.com/2012/01/09/20120109-bausch__lomb_announces_availability_of_kerasoft_ic_contact_lenses_for_keratoconus_and_other_irregular_corneas. Accessed March 1, 2019.
13. Scheid T, Kaplan E. A Novel keratoconic piggyback fitting utilizing a SiH lens and a Synergeyes KC hybrid. http://siliconehydrogels.org/in_the_practice/mar_08.asp. March 2008. Accessed March 1, 2019.
14. Colin J. Intacs may be useful for select keratoconus correction. Ocular Surgery News. April 15, 1999.
15. Chou B, Boxer Wachler BS. Intacs for a keratocone: A promising new option? Review of Optometry. 2000;137(5):97-98.
16. Boxer Wahler BS, Chandra NS, Chou B, et al. Intacs for keratoconus. Ophthalmology. 2003;110(5):1031-40.
17. U.S. Food and Drug Administration. Humanitarian Device Exemption (HDE). Intacs prescription inserts for keratoconus. www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfhde/hde.cfm?id=H040002. Accessed March 1, 2019.
18. Avedro. Avedro receives FDA approval for Photrexa Viscous, Photrexa and the KXL system for corneal cross-linking. https://investors.avedro.com/news-releases/news-release-details/avedro-receives-fda-approval-photrexar-viscous-photrexar-and. April 18, 2016. Accessed March 1, 2019.
19. Rabinowitz YS. Keratoconus. Surv Ophthalmol. 1998;42(4):297-319.
20. Daizong W, Benhao S, Qi L, et al. Comparison of epithelium-off versus transepithelial corneal collagen cross-linking for keratoconus: a systematic review and meta-analysis. Cornea. 2018;37(8):1018-24.
21. Avedro. Avedro announces enrollment of first patient in u.s. pivotal phase 3 epi-on corneal cross-linking trial for progressive keratoconus. https://investors.avedro.com/news-releases/news-release-details/avedro-announces-enrollment-first-patient-us-pivotal-phase-3-epi. June 18, 2018. Accessed March 1, 2019.
22. Study to evaluate the safety and efficacy of epi-on corneal cross-linking in eyes with progressive keratoconus. www.clinicaltrials.gov/ct2/show/NCT03442751. Accessed March 1, 2019.
23. Lombardo M, Giannini D, Lombardo G, Serrao S. Randomized controlled trial comparing transepithelial corneal cross-linking using iontophoresis with the Dresden Protocol in progressive keratoconus. Ophthalmology. 2017;124(6):804-12.
24. Chow SSW, Chan TCY, Wong IYH, et al. Early epithelial complications of accelerated transepithelial corneal crosslinking in treatment of keratoconus: a case series. International Ophthalmology. 2018;38(6):2635-38.
25. Bavinger JC, DeLoss K, Mian SI. Scleral lens use in dry eye syndrome. Curr Opin Ophthalmol. 2015;26(4):319-24.
26. Carracedo G, Blanco MS, Martin-Gil A, et al. Short-term effect of scleral lens on the dry eye biomarkers in keratoconus. Optom Vis Sci. 2016;93(2):150-7.
27. Bergmanson JP, Walker MK, Johnson LA. Assessing scleral contact lens satisfaction in a keratoconus population. Optom Vis Sci. 2016;93(8):855-60.

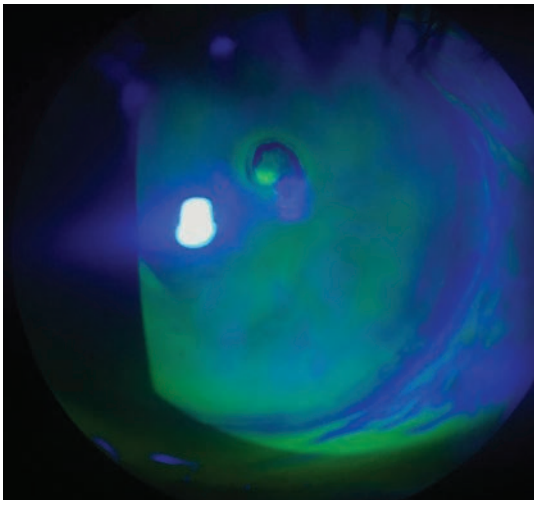
My Patient Has Recurrent Corneal Erosion… Now What?

Managing this condition right the first time may keep its recurrence at bay.

By Jessica Finch Crouch, OD

With constant, eye-drying, unblinking screen use becoming ever more the norm, ocular surface disease (OSD) is more prevalent than ever. As OSD worsens, patients can start to develop recurrent corneal erosions (RCE), a painful condition that exposes their corneal nerve endings. These patients will likely complain of eye pain upon awakening, with accompanying photophobia and epiphora. They may also present with conjunctival injection, blurred vision and difficulty even keeping their eyes open. It is not unusual to note a drastically worsened Snellen acuity.

The optometrist's job is to ensure patients' health and vision. RCE can compromise both. Management of those susceptible to this condition requires a correct diagnosis and close follow-up to care for and treat not only the RCE but any underlying conditions, such as epithelial basement membrane dystrophy (EBMD) and dry eye disease (DED), that play a role in its recurrence.



This positive fluorescein staining shows a central epithelial defect with healing margins and inferior pooling from RCE at the patient's second visit.

Day One Do's and Don'ts

The epithelial cells must heal before you can add a steroid to control the inflammation. Most often, once the defect is healed, the stromal edema will resolve as well. At the patient's initial visit, place a bandage contact lens (BCL) for comfort. If chemosis is present, a lens with a base curve of 8.6mm is usually necessary.

To prevent infection, apply a broad-spectrum antibiotic drop, such as a fluoroquinolone, until the next visit; however, it is inadvisable to use Besivance (besifloxacin 0.6%, Bausch + Lomb) in the case

About this Series

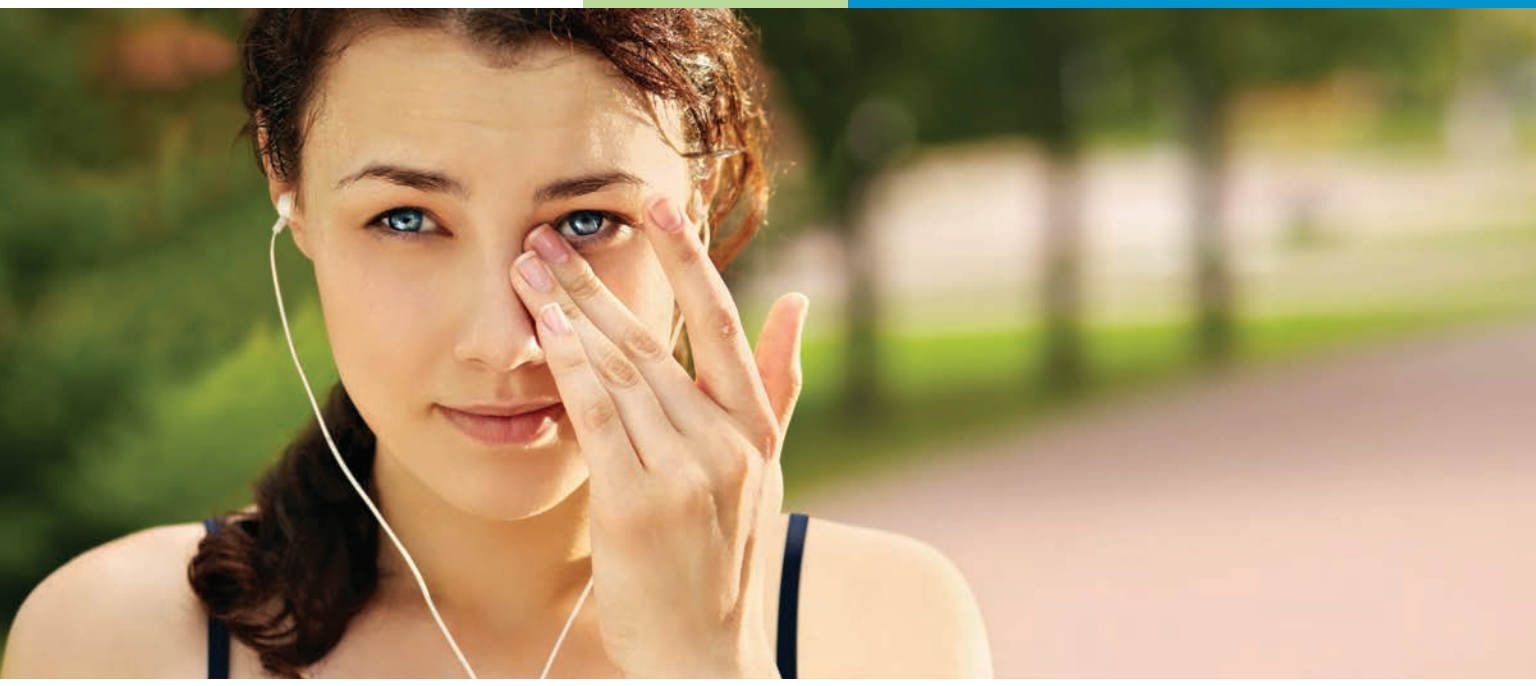
To help optometrists strengthen their protocols for managing conditions that require ongoing—perhaps life-long—care, this series explains the steps to take after confirming a diagnosis, from day one through long-term management. Each installment in the five-part "Now What?" series will cover a different chronic condition:

March—glaucoma
April—RCE
May—diabetic retinopathy
June—scleritis
July—AMD

Be sure to check www.reviewofoptometry.com for any articles you may have missed.

Biotruth #31

Dryness is the #1 problem for contact lens wearers[1]



The solution? Biotrue® MPS contains hyaluronan to help provide up to 20 hours of moisture[2]

Look at the feedback from contact lens wearers who self-report dryness. They're pretty happy with Biotrue® MPS.

96% agree it helps prevent dryness[3]

97% agree lenses stay moist and comfortable all day long[3]

97% agree lenses stay comfortable when using digital devices[3]

No wonder Biotrue® is the #1 multi-purpose solution used in more households.* Recommend Biotrue®—for up to 20 hours of moisture.[2]

*Highest household penetration among multi-purpose solutions; IRI Data MULO 52 weeks ending 08/12/18.

REFERENCES: 1. The Multi-sponsors Survey's 2017 study of the US consumer contact lens market. December 2017. **2.** In vitro studies evaluated the rate of release of sodium hyaluronate (HA), a conditioning agent in the Biotrue® multi-purpose solution, from both conventional and silicone hydrogel contact lenses over a twenty-hour time period. HA was adsorbed on all traditional and silicone hydrogel contact lenses tested upon soaking in the solution overnight. HA is then released from the lenses throughout at least a twenty-hour time period when rinsed with Hank's balanced salt solution at a rate mimicking tear secretions. The in-vitro performance of Biotrue® multi-purpose solution suggests that it will provide lens conditioning throughout a twenty-hour time period. **3.** Results of an online survey of contact lens wearers with self-reported dryness on a regular basis who completed an evaluation program for Biotrue® multi-purpose solution (n=348). Survey results include patients who strongly agreed, agreed, or slightly agreed (on a 6-point agreement scale).

BAUSCH+LOMB
See better. Live better.

A Recurring Diagnosis

The initial evaluation is key, as is gaining the patient's history of both the current episode and all prior ones. Since the erosions are a known diagnosis and are recurrent, it is important to re-examine the patient with a new perspective and capture any underlying conditions.

Instilling a Fluress or proparacaine drop will help with the patient's comfort while you examine them. The story of an RCE is usually easily predicted: frequent eye pain upon awakening, with accompanying photophobia and epiphora. The patient may also complain of conjunctival injection, blurred vision and difficulty keeping their eye open. If there is accompanying EBMD or DED, the complaints may also consist of asthenopia, fluctuating vision and burning, which more often occurs at the day's end.

Upon initial examination, staining with fluorescein may show a loss of epithelium, thus a positive epithelial defect, if the RCE is active. If the epithelial cells are healing by the time the patient appears for a visit, you may only see irregular epithelial cells in the place of the RCE, which can still cause irritation and discomfort. If there is a defect, it should be measured, as this is how the healing process is quantitatively assessed and tracked. Note whether it is a true defect with positive staining of fluorescein or rather, pooling of fluorescein. If it is pooling, the epithelial cells are intact; however, there may be stromal loss or a depression present, which causes the pooling. If unsure, use a dry cotton tip applicant to soak up the fluorescein; if no staining is seen, the epithelial cells are fully intact; however, if the area re-stains, an epithelial defect is present. Be sure to also note the amount of inflammation present: is there conjunctival injection only or are their stromal folds and inflammation underlying the epithelial defect as well? Are fine keratic precipitates visible with an anterior chamber reaction and is the upper lid showing erythema and edema as a protective reaction to the erosion?

Pay attention to the size, shape and pattern of the eroded epithelium. Stained tracks among the corneal epithelium are an indication to evert the upper eyelid to check if a foreign body is present, which would change the diagnosis from a true RCE. If the patient has tried to endure the erosion without treatment for several days, more of an inflammatory response is expected. This also puts the patient at a higher risk for infection. Do not let an overabundance of inflammation steer you away from the proper initial course of action, and be certain to note any signs of infection, such as infiltrates or an ulcer, before proceeding with treatment, as this would drastically alter your course of treatment and management.

of an epithelial defect due to the formulation of the suspension. Besifloxacin 0.6% is formulated with DuraSite (InSite Vision), a polycarbophil, edetate disodium dihydrate and sodium chloride vehicle.[1] Be mindful of reported adverse effects including corneal edema and glaucomatous damage.[1,2] DuraSite blocks the trabecular meshwork and can be toxic to the ocular surface when used in medications prescribed at a large and intensive dose.[2] Prescribed at low doses, drugs that contain DuraSite may cause corneal edema, inflammation and adverse effects even after only a single dose.[3] The suspension has a bioadhesive delivery system, which allows for longer drug release time; therefore, it should be avoided in RCE patients.[4]

Starting treatment with one drop of a topical fluoroquinolone every two hours may be necessary if the chance of infection is higher. Reduce it to one drop four times a day once the erosion begins to heal and until the BCL is removed.

Prescribing an oral antibiotic such as doxycycline 50mg (one tablet taken twice daily), aids the healing process and prevents the risk of perforation. Normally, you'd be concerned about perforation if an ulcer is present; however, even with RCEs, doxycycline can be an effective treatment aid.[5] By chelating metal ions that are structurally essential for the corneal epithelium, doxycycline irreversibly inhibits corneal matrix metalloproteinases (MMPs), such as MMP-2 activity since it is Ca2+ dependent, as the antibiotic partially extracts the tightly bound ion from the active hemidesmosome site of the protein.[6] In addition to inhibiting MMP activity, it also inhibits the synthesis of MMPs and proinflammatory cytokines, such as IL-1.[6]

The broad-spectrum antibiotic also kills migratory keratocytes responsible for the formation of scar tissue, which in turn allows full coverage of epithelial basal cells to form and the development of stratified epithelium. Researchers observed this at a minimum concentration of 100µm, which is similar to that required in other tissues.[6] In addition, by using doxycycline at a low dose of 50mg BID, the benefit is still seen without the negative side effects of gastritis and phototoxicity.

Be sure to ask the patient about their job and daily activities. If they report that they're frequently in a dusty or dirty environment or engage in heavy lifting, it may be necessary for them to wait to return to work until the epithelium heals to lower the chance of infection. Once the epithelium is healed, the doxycycline can be discontinued; however, it is safe to keep the patient on the antibiotic for a full month or more at this low dose until the risk is minimized. Recommending over-the-counter pain relievers, prescribing a topical cycloplegic or suggesting a cold gel pack will also keep the patient more comfortable.

LOMBART
SERVICE SOLUTIONS

A CONFIDENT DIAGNOSIS STARTS WITH YOUR EQUIPMENT

We have dedicated, factory-trained technicians across the country available to service your instruments. Additionally, our Clinical Support team can remotely access your advanced technology products to troubleshoot quickly.

INSTRUMENT REPAIRS

Our certified ophthalmic Service Technicians conduct on- and off-site repairs nationwide, helping you minimize downtime and treat your patients. Our extensive parts inventory enable us to get you up and running quickly, oftentimes in only one visit. We're here for you – if we sell it, we service it.

PREVENTATIVE MAINTENANCE

Improve performance and extend the life of your instruments by having us check functionality, clean, calibrate, and complete a general service of your equipment at regular intervals. We complete multi-point inspection checklists to fine-tune your lane from top to bottom.

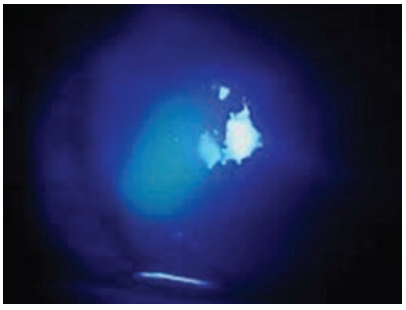
PHOROPTER CLEANING

A phoropter cleaning is not simply wiping down the external lenses. We break the instrument down and clean/lubricate every piece, repair/replace all worn parts, align all cylinder lenses, cross cylinder lens axes, and readout scales, then perform a complete functional performance check against OEM specifications.

RELOCATION SERVICES

Office moves can be hectic and complicated. It's not worth the risk of damaging your expensive instruments – we can help. Our trained service technicians safely pack, move, reinstall, and recalibrate your instruments. We also provide temporary storage solutions in some cases – just ask!

ASK US ABOUT COMPREHENSIVE PROTECTION PLANS
FOR YOUR ENTIRE OFFICE. 800.LOMBART



This active RCE, seen with positive fluorescein staining, shows an epithelial defect nasally, measuring 1.5mm x 2.4mm.

Two-day Follow-Up

These patients need close monitoring and should return for a follow-up visit within two days. Be sure the patient knows to call if they experience any reduction in vision, as you may want to see them sooner than scheduled. Removal of the BCL may be necessary to fully assess the healing defect with subsequent staining of fluorescein. If the cells are present but irregular, it may be safe to only use artificial tear lubrication, over-the-counter ointment QHS and continue the doxycycline for the full course of treatment. If the defect is still present, a replacement BCL should be placed on the eye; however, if the defect is larger or is not healing well, other treatment courses may be necessary.

Dealing with Complications

If the defect is slow to heal, or does heal but the epithelium breaks down again, it's time to turn to a complication protocol. Usually, if the epithelium regresses, it does so following the removal of the BCL where the cells are not fully adherent yet. In one study of 13 clinically successful cases where an 8.6mm BCL was used for an abrasion for an average of 24.9 hours, five cases had persistent corneal epithelial defects, despite clinical improvement or reported resolution of symptoms.[7] Another showed that treatment with only a bandage contact lens had a 25% recurrence rate.[8] If this occurs, consider using an amniotic membrane. This is used often in our practice to aid the restoration of the epithelium faster while reducing the risk of haze.

Using Amniotic Membranes

Studies show that amniotic membranes are helpful in the healing process through anti-inflammatory cytokines and peptides that promote tissue repair.[8,9] They acheive this by reducing both inflammation and scarring as well as angiogenic actions (by inhibiting MMPs).[8,9] However, they are not considered a curative treatment.[8,9]

Currently, three manufacturers offer these products, which come in both dehydrated and cryopreserved forms, each with their own benefits and drawbacks. However, for a diagnosis of RCE, either membrane would support the epithelial healing process.[10]

The Prokera (Bio-tissue) is a cryopreserved amniotic membrane recognized for wound healing, inhibiting angiogenesis, reducing inflammation and minimizing corneal scarring and pain.[11] It has anti-inflammatory effects and contains neurotrophic factors that may promote corneal nerve regeneration.[11] Due to its considerable diameter, it covers large areas of epithelial defects as well as the limbus.[11] Some patients may tolerate the large ring better with taping of the upper eyelid closed or partially closed. The product comes in Slim or Plus options. The Slim is slightly more comfortable for the patient and is therefore typically used initially. If the Slim dissolves in less than a week and the defect is still present, a Plus can be used.

Follow-up should be within four to seven days, giving the epithelial defect time to restore. If the defect is smaller or the patient cannot tolerate the ring, a dehydrated membrane is a good option.

The BioDOptix (Integra) is a dehydrated amniotic membrane that retains devitalized cellular components and has growth factors, such as vascular endothelial growth factor (VEGF), platelet-derived growth factor and insulin-like growth factor, as well as interleukins and tissue inhibitors of metalloproteases shown to modulate inflammation.[12,13] It comes in 2cm x 3cm or 1.5cm x 2cm sizes.

To use this membrane, first lubricate the cornea with an artificial tear. Carefully grab the edge of the membrane disc with a pair of jewelers forceps and place the stromal (dull) side of the disc down on the lubricated cornea over the epithelial defect. A pair of paddle forceps works best for this since the tips are flat, thus reducing the risk of tearing the membrane. If the cornea is lubricated well enough, the disc should immediately adhere to the surface and rehydrate on contact. Do not try to smooth wrinkles or bubbles if any are present. A BCL can then be placed directly over the membrane for added protection and comfort.

The AmbioDisk (Katena) is also a dehydrated amniotic membrane. The product comes in 9mm, 12mm and 15mm sizes. The membrane is preserved in a process known as purion, in which key restorative elements such as epidermal growth factor, interleukin-10, VEGF and many others are preserved from their original state.[14] The allograft is placed with the basement membrane side down, adjacent to a dry corneal surface, which can then be smoothed out with non-toothed

Coding Connection

By John Rumpakis, OD, MBA, Clinical Coding Editor

RCE: Code Correctly, Again and Again

The condition may be frustrating to treat, but the coding doesn't have to be.

Recurrent corneal erosion (RCE) is a painful and frustrating condition for both patients and practitioners. Patients struggle with the ongoing discomfort, while practitioners struggle with stabilizing the condition long-term. The patient encounters necessary for RCE can also cause coding angst. Here's what you need to know.

Historical Perspective

Many RCE conditions are present because of a prior incident to the cornea such as a corneal foreign body that never healed properly. Thus, coding considerations for RCE should include a thorough history of the previous injury or insult to the eye, in addition to the current methods of evaluation and treatment plans.

The ICD-10 stipulates that, with injury-related sequelae, we are obligated to code the sequelae first and the original injury second. For example, if a corneal foreign body was removed from the right eye months ago and the area did not heal properly, causing an RCE, the ICD-10 coding attached to the office visit would be:

H18.831: Recurrent erosion of cornea, right eye

T15.01XS: Foreign body in cornea, right eye, sequela

You must claim the current condition as the primary diagnosis, which tells the carrier what we are dealing with today; the second diagnosis tells the carrier the original injury that occurred and that today is a sequela of that.

Today's Encounter

Coding the office visit follows the standard rules regarding E/M coding, based on your history, physical examination, medical decision making and if the patient is new or established. In most cases, this would be a 99202/03 or a 99213/14, depending on the individual patient.

The treatment options for RCEs range from surgical debridement of the area and application of a bandage contact lens to a phototherapeutic keratectomy (PTK) procedure or a stromal puncture, depending on what your scope of practice allows. Here are the CPT codes for each therapy:

65435: Removal of corneal epithelium; with or without chemocauterization (abrasion, currettage)

65600: Multiple punctures of the anterior cornea (e.g., for corneal erosion, tattoo)

S0812: PTK

92071: Fitting of a contact lens for treatment of ocular surface disease

Both 65435 and 65600 are surgical procedures; 65435 is a minor procedure with a global period of less than 90 days, while 65600 is a major surgical procedure with a global period of 90 days. The rules here differ significantly.

Coding for an office visit on the same day as a minor surgical procedure is rarely done because the visit itself is already incorporated into the surgical code and reimbursement. However, this is not the case with major surgical procedures. To bill an office visit on the same day as a major surgical procedure, append modifier -57 (decision to perform major surgery) to the E/M office visit code.

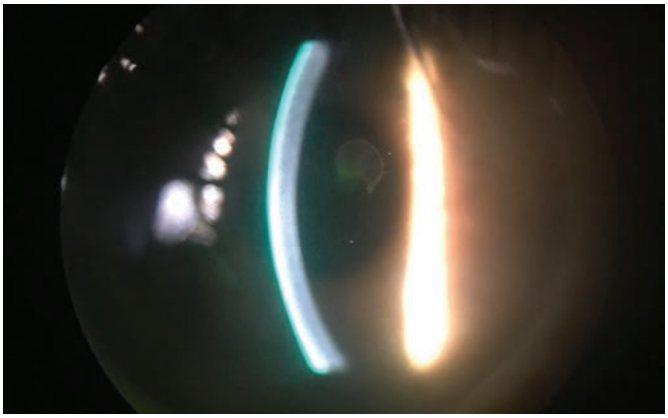
So, if you were to perform an office visit and debridement only, you would code just the 65435 in most cases. If you were to perform an office visit and multiple punctures of the anterior cornea, you would code 992XX-57 and 65600. Keep in mind that the global period with 65435 is zero days and the global period with 65600 is 90 days.

PTK, if within the scope of your licensure, is generally not a reimbursable procedure because it is a level II HCPCS code (S), which is generally payable by the patient. If you submit to a third-party carrier, be sure to obtain a properly completed Advance Beneficiary Notice form to ensure that if the carrier denies the claim you are reimbursed by the patient.

Lastly, don't forget the CCI edits with respect to the bandage contact lens, 92071. Billing an office visit and a bandage contact lens fit (992XX and 92071) are allowed and are covered if performed on the same date of service. However, if a bandage lens is fit on the same day as any surgical procedure, you cannot bill for it.

Recurrent corneal erosion is a condition that often requires constant and periodic monitoring within your practice. Understanding both the contemporary management techniques and the subsequent medical coding compliance issues is key to successful encounters. In doing so, you can reduce your audit risk exposure and rejected claims—a significant benefit to a well-run, compliant and profitable practice.

Send your own coding questions and comments to rocodingconnection@gmail.com.



This patient has a central epithelial defect with healing margins. It's slightly difficult to discern whether it is a true defect without fluorescein staining.

forceps. A bandage contact lens or suture material can be used to allow the membrane to retain adherence to the cornea.

With any of these procedures, it is imperative that the patient keep the eye lubricated with preservative-free artificial tears, not only for comfort, but for healing purposes. The patient's current antibiotic and steroid drop regimen is fine to keep after placing the membrane on the eye.

Research shows that using an amniotic membrane rather than a BCL allows the patient to potentially go longer before recurrence of the erosion. One study resulted in a 25% recurrence rate within one year after a three-month treatment period with a bandage contact lens, while in a similar study, after treatment with an amniotic membrane, only a 10% recurrence rate was seen within one year.[8,15]

If an amniotic graft is used, be sure to follow up within five to seven days, giving the membrane time to promote surface healing.

Fourth Follow-up

At the five-to-seven day follow-up, if the epithelial defect is still present, place another amniotic membrane; however, if the epithelium is healed but the cells are irregular, a bandage contact lens can give enough coverage for the epithelium to smooth over until it is completely adherent. Throughout the process, lubrication is key, which should be stressed to the patient. In addition to the oral antibiotic and broad-spectrum antibiotic drop, using preservative-free artificial tears will support a healthy environment for the cornea to heal. Once the membrane or BCL is permanently removed, the patient should add an over-the-counter ointment at bedtime, such as Muro 128 sodium chloride (Bausch + Lomb) ointment to prevent a breakdown of the epithelium overnight. Since Muro 128 ointment is a hypertonic agent, it provides better coverage and relief from any corneal edema present, while also being preservative-free, unlike other over-the-counter gels and ointments.

If inflammation is still present or anterior stromal haze has developed, add a steroid such as loteprednol, fluorometholone or prednisolone acetate twice daily, until the inflammation has resolved and the haze is reduced. Even if a little inflammation and haze presists, once the epithelium is present, adding a low-dose steroid has its benefits.[16] Research shows MMPs accumulate in tears of patients with any ocular surface disease and are mainly made from granulocytes.[16] MMPs are especially abundant when accompanied by a coinciding systemic or autoimmune disease that involves ocular tissue and exacerbates an inflammatory response.[16] There is a greater upregulation of MMPs in corneal disorders where collagen is destroyed and MMP-2 and MMP-9 are widely present in patients who have corneal melts and recurrent corneal erosions. Signaling of IL-6 is then activated which induces the inflammatory response of the corneal stroma.[17]

Steroid drops can be used to control this cascade reaction by reducing inflammation, thus decreasing the amount of MMPs present in the tear film which then diminishes the trans-signaling of IL-6. Overall, when the tear film has a minimal amount of MMPs present, epithelial adherence to the basement membrane is greatly increased.

Getting to the Root

ODs must address the underlying condition of the recurrent erosion, whether it's previous trauma, EBMD or a form of chronic OSD (e.g., ocular rosacea, blepharitis, meibomian gland dystrophy, exposure keratitis).

Do not forget to examine the fellow eye closely, as some erosions can be thought to have only occurred from previous trauma when the patient actually has EBMD. This is an autosomal dominant condition where point mutations in the TGFBI gene on chromosome-5 are considered responsible for some erosions. EBMD can also be known as map-dot-fingerprint dystrophy, Cogan's microcystic dystrophy or anterior basement membrane dystrophy. In this dystrophy, extra sheets of

basement membrane extend abnormally into the epithelium. In turn, the epithelium growing anteriorly becomes entrapped in the extra sheets causing clumping and poor adherence.[18] This can cause poor vision, constant discomfort and foreign body sensation, glare and halos, and of course recurrent corneal erosions. If there is previous anterior stromal haze or scarring from trauma or numerous erosions, the prognosis for a good outcome may decline. Often, if there is already corneal haze and scarring, the epithelium may not heal well. Likewise, if DED is a factor, the epithelial cells may regenerate at a slower rate, which increases the chance for the epithelium to break down and heal with residual anterior stromal haze or scarring.

In most cases, the RCE will continue to occur unless the underlying condition is managed and addressed. Moreover, there can be more than one etiology, as many times EBMD and DED are both collaborating factors in the recurrent erosions. Prescribing a dry eye drop such as Xiidra (lifitegrast, Shire) or Restasis (cyclosporine, Allergan), along with 2,000mg daily dose of omega-3 fatty acids will help reduce any unwarranted inflammation of the lid margin. Therapy can also include warm compresses with lid massage, artificial tears four to six times daily, and Muro 128 ointment at bedtime. If anterior blepharitis is diagnosed, lid hygiene will need to be discussed as well.

Avenova spray is a great tool for the lid margin, along with tea tree oil shampoo (for *Demodex*) or over-the-counter lid scrubs. For more severe cases, autologous serum can be prescribed, which is compounded from the patient's own blood. The serum contains a mixture of growth factors and cytokines, similar to the human amniotic membranes, and should be kept cold at all times while being dosed every two hours while awake.[19] Research shows that by addressing the DED, the incidence for recurrent erosions are significantly reduced.[19]

Lifestyle Changes

Patient education plays a large role in not only the healing of an RCE but also the prevention of one. The patient needs to understand that corneal erosions can be an ongoing issue and may not always have the best outcome if severe enough. Use the explanation that the surface skin cells of the cornea have sloughed off because they are loose and non-adherent; this creates a visual for the patient to better understand.

Once healed, it is important to prevent further episodes from occurring, which is why clinicians prescribe dry eye therapy, especially the ointment at bedtime. After the patient understands the importance of the prophylactic treatment, they are much more willing to be compliant.

The difficulty comes, however, when the patient does not heal well and has residual anterior stromal haze affecting the quality of the vision. Sometimes all that is needed is an updated spectacle or contact lens prescription or the use of a low-dose steroid for several weeks to minimize the haze. During the management of an RCE, if the patient is not healing well, starting the conversation early is beneficial, as their expectations will be realistic for the final visual outcome. Reassure them that you are applying every measure for a good outcome and stress the magnitude of the rigorous drop schedule. If the haze is severe, at times, a specialty contact lens such as a scleral or hybrid lens can help the patient gain better best-corrected vision. The quality of the tear film should never be taken for granted, as it can greatly enhance the vision, especially if there is residual haze; therefore, treatment for dry eye disease should be initiated.

Surgical Intervention

If the erosions continue and medical treatment fails, a surgical procedure may be necessary. Clinicians may need to coordinate with local corneal specialist; however, depending upon the procedure, some can be completed in-office.

Anterior stromal puncture (ASP) is a treatment that is useful for RCEs that occur in the peripheral cornea and can be done in the exam lane. Due to the risk of corneal scarring, it is not recommended when the erosion is central or mid-peripheral. Superficial punctures are made with a 25- or 27-gauge bent needle, piercing the epithelium to Bowman's layer in 0.5mm spot treatments. This can also be done using a Nd: YAG laser, giving short bursts of energy to the cornea, which are more repeatable and shallower, thus diminishing the amount of scarring created than if by hand.[19] In one review, ASP did have a recurrence rate of 40% and needed additional treatment.[20]

Epithelial debridement is also an in-office procedure that is commonly done, in which a Merocel spear and blunt spatula are used to remove the central 7mm to 10mm of loose, central epithelium.[19] A bandage contact lens or an amniotic membrane can then be placed on the eye, along with the appropriate drop regimen; however, due to the high recurrence rate, this

procedure is usually combined with extra steps.

Superficial keratectomy (SK) is an out-patient procedure, usually done in the operating room, in which the loose epithelial cells are removed with a Merocel spear, ensuring that the eye is not undertreated. This is then followed by treatment of the underlying basement membrane with a diamond burr which rejuvenates the membrane to allow strong, anchoring adhesions to the new epithelial cells when healing.[21] After the SK, the postoperative care management in regards to lubrication and the BCL or amniotic membrane will be similar to the treatment and management for an RCE. The patient will also be on a soft steroid, antibiotic and NSAID taper schedule over several weeks.

Phototherapeutic keratectomy (PTK) is another common surgical option in which the epithelium is removed either by hand or an argon fluoride excimer laser. The laser is then used to emit ultrashort pulses of 193nm to ablate the irregular areas and opacities on a submicron level of Bowman's layer and the outer 5µm to 7µm of the stroma, without damaging the middle stroma.[22] This allows for the epithelium to regrow and form strong adhesions to the anterior stroma.[19]

PTK is widely used for corneal opacities, such as corneal scars, Salzmann's nodular degeneration, recurrent erosions and EBMD. This procedure with the excimer laser removes enough of the superficial Bowman's layer to allow formation of a new basement membrane with stronger adhesion structures.[22] The postoperative care for PTK is the same as with SK.

It is important to keep all physicians caring for the patient (e.g., referring doctor, primary care physician, rheumatologist) informed of the diagnosis and treatment. Many underlying conditions can affect the health of the ocular surface, especially autoimmune diseases, such as rheumatoid arthritis, systemic lupus erythematosus, or diabetes mellitus. If the patient has one of these medical conditions, they can be expected to heal slower and may need to be monitored more closely as it is not uncommon to hit a roadblock during the treatment process.

When writing a letter, be sure it is informative but succinct. It should include the diagnoses, treatment and management, as well as your concern for healing in relation to the patient's systemic conditions. It is always beneficial to correspond with other physicians as this opens the path of friendly communication between colleagues, allowing them to know you can be a reliable referral source and have the patient's best interest in mind.

Other considerations to keep in mind are any systemic medications that the patient may already be taking that could inhibit the healing process of the erosion. Medications such as antihistamines, anticholinergics or anxiolytics and antidepressants are commonly prescribed and cause extra overall dryness, as well as ocular surface dryness and irritation. Be sure to view the entire picture and recognize what treatment is best suited for that particular patient.

Recurrent corneal erosions are common and are something that we, as clinicians, can treat and manage. There are many treatment options from over-the-counter ointments to prescription drops and oral medication, from bandage contact lenses to human amniotic membranes, as well as many environmental additions that can all help in the healing of RCEs. ■

Dr. Finch Crouch is an optometrist at Eye Centers in Louisville, Kentucky.

1. Highlights of Prescribing Information: Besivance. www.accessdata.fda.gov/drugsatfda_docs/label/2009/022308lbl.pdf. April 2009. Accessed March 11, 2019.
2. Ness P, Mamalis N, Werner L, et al. an anterior chamber toxicity study evaluation Besivance, AsaSite, and Ciprofloxacin. Am J Opthalmol. 2010;150(4):498-504.
3. Opitz D, Harthan J. Review of azithromycin ophthalmic 1% solution (Azazite) for the treatment of ocular infections. Ophthalmology and Eye Diseases. 2012:4(2):1-14.
4. Goecks T, Werner L, Mamalis N, et al. Toxicity comparison of intraocular azithromycin with and without a bioadhesive delivery system in rabbit eyes. J Cataract Refract Surg. 2012;38(1):137-45.
5. Wang L, Tsang H, Coroneo M. Treatment of corneal erosion syndrome using the combination of oral doxycycline and topical corticosteroid. Clinical and Experimental Ophthalmol. 2008;36(1):8-12.
6. Smith V, Cook, S. Doxycycline – a role in ocular surface repair. Br J Ophthalmol. 2004;88(5):619-25.
7. Buglisi J, Knoop K, Levsky M, Euwema M. Experience with bandage contact lenses for the treatment of corneal abrasions in a combat environment. Military Medicine. 2007;172(4):411-13.
8. Huang Y, Sheha H, Tseng S. Self-retained amniotic membrane tranplantation for recurrent corneal erosion. J Clin Exp Ophthalmol. 2013;4:272.
9. Shimmura S, Shimazaki J, Ohashi Y, Tsubota K. Antiinflammatory effects of amniotic membrane transplantation in ocular surface disorders. Cornea. 20(4):408-13. 1 May 2001.
10. Cook M, Tan E, Mandrycky C. Comparison of cryopreserved amniotic membrane and umbilical cord tissue with dehydrated amniotic membrane/chorion tissue. J Wound Care. 2014;23(10):465-74.
11. John T, Tighe S, Sheha H, et al. Corneal nerve regeneration after self-retained cryopreserved amniotic membrane in dry eye disease. J Ophthalmol;2017:640498.
12. Werner S, Gross R. Regulation of wound healing by growth factors and cytokines. Physiological Reviews. 2003;83(3):835-70.
13. Liu J, Sheha H, Fu Y, et al. Update on amniotic membrane transplantation. Expert Rev Ophthalmol. 2010;5(5):645-61.
14. Koob T, Lim J, Zabek N, Massee M. Cytokines in single layer amnion allografts compared to multilayer amnion/chorion allografts for wound healing. J Biomed Mater Res Part B. 2015;103(5):1133-40.
15. Fraunfelder F, Cabezas M. Treatment of recurrent corneal erosion by extended-wear bandage contact lens. Cornea. 2011;30(2):164-66.
16. Smith V, Rishmawi H, Hussein H, Easty D. Tear film MMP accumulation and corneal disease. Br J Ophthalmol. 2001;85(2):147-53.
17. Sakimoto T, Sawa M. Metalloproteinases in corneal diseases: degradation and processing. Cornea. 2012;31(Suppl1):S50-6.
18. Edell E, Bernfeld E, Woodward M, Bunya V. Epithelial basement membrane dystrophy. American Academy of Ophthalmology. eyewiki.aao.org/Epithelial_basement_membrane_dystrophy. February 17 2017. Accessed March 1, 2019.
19. Miller D, Hasan S, Simmons N, Stewart M. Recurrent corneal erosion: a comprehensive review. Clinical Ophthalmology. 2019;13(2):325-35.
20. Reidy J, Paulus M, Gona S. Recurrent erosions of the cornea: epidemiology and treatment. Cornea. 2000;19(6):767-71.
21. Piracha A. The benefits of pre-treating corneas. Review of Ophthalmol. 2010;16(4).
22. Garg S, McColgin A, Steinert R. Phototherapeutic Keratectomy. American Academy of Ophthalmology. www.aao.org/munnerlyn-laser-surgery-center/phototherapeutic-keratectomy-3. November 12, 2013. Accessed March 12, 2019.

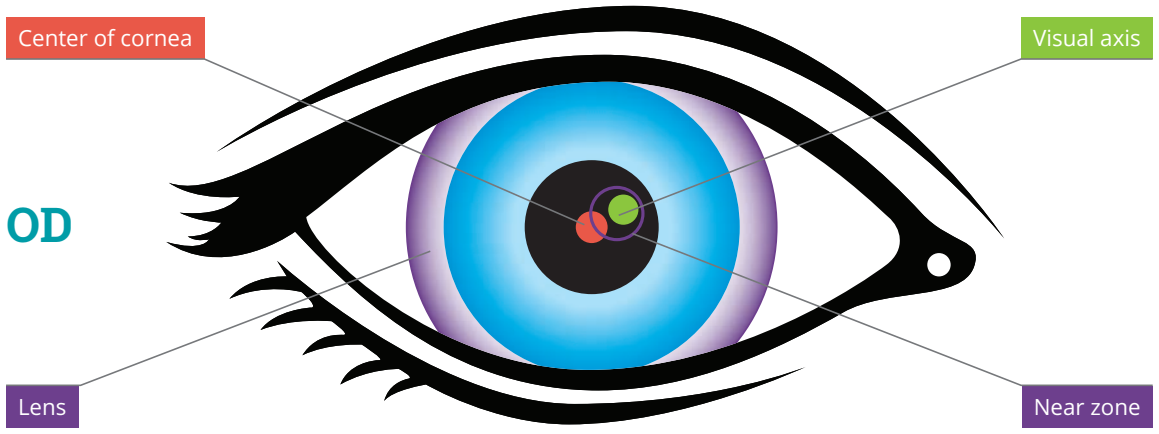
NEW!

Multifocal Optical Alignment for Scleral Lenses

Zen™ Multifocal

scleral lens for presbyopia

We've customized custom scleral lenses even more. For presbyopic patients, new Zen™ Multifocal lenses align the center-near zone over the visual axis instead of the center of the cornea. In soft contact lenses, this has been shown to provide clear near vision. The result? More ability to fine-tune your fitting. So if you have trouble with multifocal scleral lenses, don't wait for the stars to align. **Align the optics.**



Decentered optics align the near zone over the visual axis instead of the center of the cornea.

Parameters & Benefits

- **ADD Powers:** +1.00D to +3.50D in 0.25D steps
- **Variable Center-Near Zone:** 1.5mm to 3.0mm in 0.5mm steps
- **Diameters:** 14.8mm, 15.4mm – Zen™ RC scleral lens
  16.0mm, 17.0mm – Zenlens™ scleral lens
- **SmartCurve™ technology:** Modify only the parameters you want
- **MicroVault™ technology:** Vault over elevations on the sclera
- **Prolate and oblate profiles:** Fit a wide variety of corneal shapes
- **Fitting:** Uses existing Zenlens™ or Zen™ RC fitting sets

Our expert fitting consultants will help you determine the appropriate lens, with unlimited lens exchanges and cancellations for 90-days. **We're there for you, every parameter of the way.**

LEARN MORE: CALL 800-253-3669
OR VISIT BAUSCH.COM/ZENLENS

Visit bauschsvp.com for important safety information

BAUSCH + LOMB

2 CE Credits
(COPE approved)

PEER • REVIEWED • PRA • ARTICLE •

Corneal Disease Report

Be an Ocular Foreign Body Fixer

You have the tools and the knowledge to be your community's ocular foreign body expert. Here's how to incorporate these skills into your practice.

By Caroline B. Pate, OD

Ocular foreign bodies typically arise following an acute injury to the eye. When this occurs, patients often report directly to the emergency department, even though optometrists have the tools and ability to medically manage many of these emergent cases.

The Centers for Disease Control and Prevention (CDC) estimates that more than 2.4 million emergency department visits each year are for eye-related trauma or disorders.[1] Of the emergency department visits related to eye trauma, ocular foreign bodies account for an estimated 24% of cases. The majority of these cases are men of working age.[1]

Optometrists should be proactive in educating their patients regarding what to do in the case of an ocular emergency such as a foreign body. In addition, ODs should make sure their office staff is properly trained to identify and triage these emergency patients.

Release Date: April 15, 2019
Expiration Date: April 15, 2022
Estimated Time to Complete Activity: 2 hours

Jointly provided by Postgraduate Institute for Medicine (PIM) and Review Education Group

JOINTLY ACCREDITED PROVIDER™ INTERPROFESSIONAL CONTINUING EDUCATION

Educational Objectives: After completing this activity, the participant should be better able to:

- Prioritize patients with ocular foreign bodies and know the important questions to ask during a detailed history.
- Perform careful ocular examination including pertinent testing and imaging, if needed.
- Provide anesthesia and remove various foreign bodies (metallic, vegetative, stone, insect) using the proper instrument and approach.
- Administer and/or prescribe antibiotics, corticosteroids or cycloplegia as appropriate.
- Describe when and where to refer patients whose injury is beyond the scope of the primary care optometrist.
- Provide appropriate follow-up and offer patient education regarding safety practices and eye protection.

Target Audience: This activity is intended for optometrists engaged in the care of patients with ocular foreign bodies.

Accreditation Statement: In support of improving patient care, this activity has been planned and implemented by the Postgraduate Institute for Medicine and Review Education Group. Postgraduate Institute for Medicine is jointly accredited by the Accreditation Council for Continuing Medical Education, the Accreditation Council for Pharmacy Education, and the American Nurses Credentialing Center, to provide continuing education for the healthcare team. Postgraduate Institute for Medicine is accredited by COPE to provide continuing education to optometrists.

Faculty/Editorial Board: Caroline B. Pate, OD, University of Alabama at Birmingham School of Optometry.

Credit Statement: This course is COPE approved for 2 hours of CE credit. Course ID is **62000-AS**. Check with your local state licensing board to see if this counts toward your CE requirement for relicensure.

Disclosure Statements:

Dr. Pate has nothing to disclose.

Managers and Editorial Staff: The PIM planners and managers have nothing to disclose. The Review Education Group planners, managers and editorial staff have nothing to disclose.

History is Key

While the diagnosis of an ocular foreign body is often fairly easy to make, be sure to start with a thorough problem-focused case history. Symptoms typically include foreign body sensation, redness, pain, irritation, tearing, photophobia, blepharospasm and possible blurred vision, depending on the location of the foreign body.[2]

The nature of the injury, suspected material involved and timing are all important to discuss and document in the medical record. The context of the injury is important to help identify if the foreign body was projectile in nature (e.g., grinding or metal striking metal), thus raising your suspicion for an intraocular foreign body and the potential need for further imaging.

Having an idea of what the foreign material may be can help identify the risk of potential complications and may influence your management options. Foreign bodies of organic (e.g., insect parts or animal hairs) or vegetative material are associated with a higher rate of infection.[2-3] Inert foreign bodies such as glass or high-grade plastic are generally better tolerated and do not cause as much of an inflammatory response.[4]

Determine, as best as you can, how long the suspected foreign body has been present because duration can increase the risk of associated inflammation, infection and rust.[2-5]

Be sure to document the place and activity of the injury as well as whether or not the patient was wearing safety eye wear at the time of the injury, which can be important for liability issues such as worker's compensation claims.

Ocular Examination

After a detailed history, obtain visual acuity before performing any procedures or instilling drops. If the patient is in significant discomfort and unable to open their eye due to intense blepharospasm or pain, a drop of topical anesthetic such as proparacaine may be instilled prior to visual acuity measurements. Preliminary testing should include pupil evaluation and extraocular motility.

Fig. 1. Using a lid retractor, double evert the lid to check the superior fornix.

Foreign bodies can involve any part of the globe, so thoroughly evaluate both eyes for conjunctival, corneal and intraocular foreign bodies. It's common for patients to have more than one foreign body depending on the nature of the incident. In any case of suspected ocular foreign body, always evert the eyelids.

For a more thorough evaluation of the superior fornix, double lid eversion can be accomplished using a lid retractor (*Figure 1*). Following a drop of topical anesthetic, single lid eversion is performed on the upper lid. Then use the lid retractor to "hook" the superior edge of the everted lid and lift gently upward and outward to expose the superior fornix. The superior fornix may then be directly visualized outside the slit lamp to further evaluate for foreign bodies or to perform conjunctival irrigation to help dislodge any debris that may be trapped. An external light source may be needed for better visualization.

Carefully examine the anterior segment, including the cornea and conjunctiva, using the slit lamp to evaluate for the presence of foreign bodies. If the foreign body involves the cornea, diffuse edema and epithelial disruption may be present. Instill fluorescein dye (preferably without anesthetic) to evaluate for evidence of epithelial defects. Multiple vertically oriented linear abrasions should raise suspicion for an embedded foreign body under the upper lid.

To assess for the presence of a full-thickness defect of the globe, perform a Seidel test by painting the wound with fluorescein dye and observing for aqueous leakage, which appears as a "dark waterfall" with the cobalt blue filter.

Apart from evidence of a ruptured globe with a positive Seidel sign or shallow anterior chamber, suspect intraocular foreign bodies in cases with an irregular pupil contour, iris transillumination defects, lens opacities or a persistent iritis.[6-7]

It's possible for small foreign bodies to enter the globe and then have a self-sealing entry point due to the

heat of a penetrating injury.[7] Sometimes patients with intraocular foreign bodies present with a vague history of something getting in their eye but have no obvious external changes, so they initially dismiss the incident.

Intraocular foreign bodies can enter through the cornea (65%), sclera (25%) or at the limbus (10%).[6,8] Most end up in the posterior segment (58% to 88%), while the remainder stay in the anterior chamber (10% to 15%) or lens (2% to 8%).[4,6,9-11]

Dilate the pupil and examine the posterior segment to further evaluate for penetrating foreign bodies, especially in cases with a projectile etiology such as hammering metal on metal or grinding.

Imaging may be necessary to further evaluate for intraocular foreign bodies. X-ray or computed tomography (CT) scans of the orbits with 1.0mm to 1.5mm axial and coronal cuts can help detect and localize intraocular foreign bodies when suspected.[3,12] Magnetic resonance imaging is contraindicated in cases of metallic foreign bodies. With penetrating injuries, the globe should be stabilized and shielded without pressure, and the patient referred urgently to a specialist for management. Instruct the patient to avoid any food or drink as they may need to undergo same-day surgery to remove the intraocular foreign body. If not addressed urgently, complications such as traumatic endophthalmitis or metallosis may result.

If the foreign body involves the cornea, assess the location in relation to the visual axis and depth of the penetration using a thin optic section beam and document it in the medical record. Superficial corneal foreign bodies typically don't penetrate past Bowman's membrane, the tough layer that separates the epithelium and stroma.[13] Superficial injuries to the corneal epithelium typically heal quickly within 24 to 48 hours without residual scarring.[13,14]

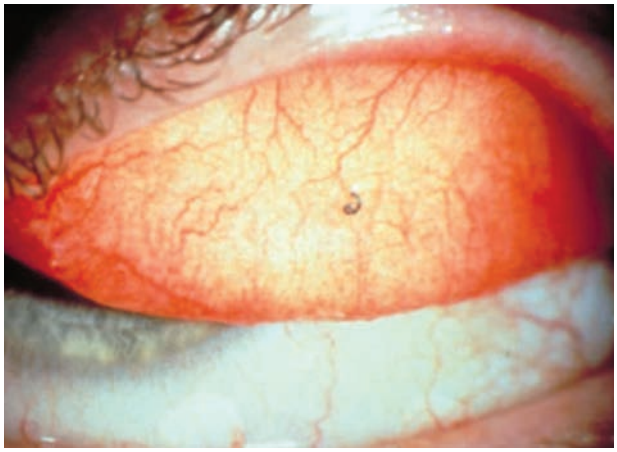


Fig. 2. Everting the lids can reveal a conjunctival foreign body.

When the corneal foreign body does penetrate beyond Bowman's membrane, it disrupts layers of the cornea that have no mechanism to replace damaged cells and will likely leave a permanent scar.[13] When it's difficult to assess the level of corneal penetration, an anterior segment optical coherence tomography of the cornea may be helpful.

Ocular Foreign Body Removal

Prior to removing an ocular foreign body of the cornea or conjunctiva, obtain a signed informed consent form from the patient giving permission to perform the procedure to remove the foreign body. Informed consent involves discussing the nature of the condition, the proposed procedure, any risks associated with the procedure (which may include potential scarring, infection, vision loss or perforation), the alternatives to the procedure and the prognosis or consequence if the procedure is not performed.[15] Always take time to address and answer any questions the patient may have before proceeding.

Table 1. Have These Tools Handy

- Eyelid speculum
- Lid retractor
- Fluorescein strips
- Topical anesthetic drops
- Sterile cotton tip applicators (for superficial conjunctival foreign bodies)
- Sterile saline or eyewash
- Disposable needle (25-gauge 5/8")
- Spud
- Loop
- Jeweler's forceps
- Algerbrush

• ***Conjunctiva.*** Be sure to examine both the bulbar and palpebral conjunctiva thoroughly, including everting the upper lids, for the presence of suspected foreign bodies (*Figure 2*). After assessing the number, location and depth of the conjunctival foreign bodies, removal can be accomplished using irrigation, a sterile cotton-tipped applicator, spud, sterile disposable needle or jeweler's forceps after topical anesthesia (*Table 1*).

If the foreign body is relatively superficial, the simplest method of removal is attempting to forcefully irrigate the eye so that it dislodges the foreign body, which can then be easily removed with a moistened cotton-tipped applicator or jeweler's forceps. For foreign bodies that aren't easily dislodged by irrigation or by swabbing the eye with a cotton-tipped applicator, try using a spud or sterile disposable needle. Inform the patient that a small subconjunctival hemorrhage may result following removal of a bulbar conjunctival foreign body.[16]

• ***Cornea.*** Foreign bodies lodged here can be removed using a variety of instruments, including a small-gauge disposable needle, a foreign body spud or a loop. Sterile disposable needles come in a variety of

diameters (gauges) and lengths—the 25-gauge 5/8-inch size needle is popular for corneal foreign body removal due to its short length and minimal flexure.

A foreign body spud, often referred to as a golf club spud due to its characteristic shape, allows the clinician to excavate and gently "flick" the foreign body off of the cornea. The dislodged foreign body can then be retrieved using jeweler's forceps. Magnetic spuds help gently lift a metallic foreign body off the cornea and then easily retrieve it.

A foreign body loop can be used to remove loosely embedded corneal foreign bodies. Due to its flexibility, a loop can be quite helpful for children or uncooperative patients.

A sterile cotton-tipped applicator is not a good choice for an embedded corneal foreign body due to the bulkiness of the tip of the applicator, which may embed the foreign body further or cause unnecessary adjacent epithelial disruption.

For patients with a strong blink reflex despite instillation of bilateral topical anesthetic, a lid speculum may be required to move the lids out of the way.

Regardless of which instrument is used to remove the corneal foreign body, be sure to educate the patient about the importance of maintaining fixation throughout the procedure. To help the patient fixate using their opposite eye, put a fixation target from the slit lamp into place.

Once the patient is anesthetized and properly positioned behind the slit lamp, hold the instrument between your thumb and forefinger like a pencil and stabilize your hand against the patient's cheek. Make sure to always approach the cornea tangentially to help avoid corneal perforation. While viewing outside of the slit lamp, bring the instrument towards the cornea until the instrument is positioned in front of the foreign body. Then move into position behind the slit lamp oculars to safely position the instrument at the temporal peripheral edge of the foreign body, where you can gently lift it off the cornea using a delicate flicking motion.

Once you've removed a metallic foreign body, examine the cornea for the presence of any rust (*Figure 3*). After the metal has been in the cornea for approximately 12 hours, it will start to oxidize and form a rust ring in adjacent tissues.[5,16]

Case Report: Follow Directions for Proper Eye Protection

A 54-year-old African American male presented with bilateral painful red eyes for nine days. The patient reported a leak in a ventilation pipe at his place of employment (a pipe fabrication plant) that he walked by daily and felt he may have gotten debris in his eyes. He denied any grinding activities or striking metal on metal. He was wearing his glasses at the time of the injury but was not wearing the required safety glasses over his habitual correction as required by his employer.

His current medical history was remarkable for Type 2 diabetes, hypertension and high cholesterol, all of which were currently managed with medications. Best-corrected visual acuity was 20/30+2 OD and 20/30 OS. Pupils were reactive with no afferent pupillary defect. Extraocular motilities were full with no restrictions.

Slit lamp examination revealed 2+ injection of the bulbar conjunctiva OD and 3+ injection OS. The upper eyelids were everted and no foreign bodies were observed. One corneal metallic foreign body was noted OD and multiple diffuse metallic corneal foreign bodies were noted OS with associated corneal edema and epithelial defects. Seidel testing was negative. The irises were intact in both eyes.

After obtaining informed consent, proparacaine 0.5% was instilled in both eyes. The metallic foreign bodies were removed behind the slit lamp with a spud, and an Algerbrush was used to remove a small amount of residual rust from the left eye. Then the fornices were irrigated to remove any residual debris. The patient was dilated and no further intraocular foreign bodies were noted.

A bandage contact lens was placed onto the left eye and the patient was prescribed topical moxifloxacin 0.5% TID and nepafenac 0.1% TID OU in addition to preservative-free artificial tears for comfort. The patient was counseled on the importance of proper eye protection while at work and instructed to return to the office for follow up in 24 hours. In addition, due to the clinical presentation of multiple foreign bodies and nature of the injury, an X-ray of the orbits was ordered to rule out intraocular foreign bodies, which was negative.

This case demonstrates that although the patient was wearing glasses at the time of injury, they were inadequate for preventing material from entering in from the sides of his eyewear. As a result of not wearing the fit-over safety eye protection as required by his workplace, the patient proceeded to return on three additional occasions with similar presentations, despite being educated at each visit on the importance of proper eye protection. The patient's employer was notified regarding the multiple occurrences.

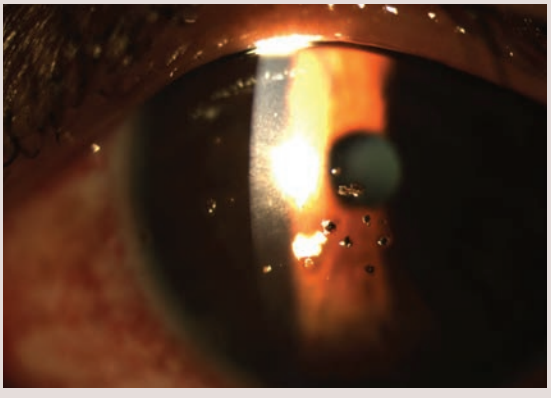


Photo: Tammy Than, OD

Not wearing proper eye protection at work landed this patient in the OD's chair. Unfortunately, counseling on the importance of eye protection didn't stop him from returning more than once with oculuar foreign bodies.

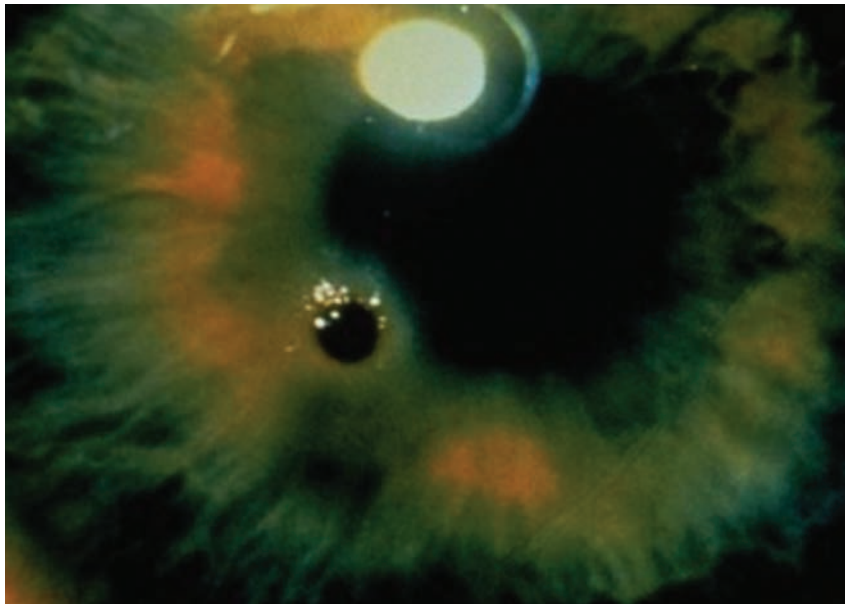


Photo: Paul Ajamian, OD

Fig. 3. Check for rust after removing a metallic corneal foreign body.

You may be able to remove some rust with a disposable needle or the jeweler's forceps and then use a low-speed motorized burr (Algerbrush) to remove the remaining rust. The 0.5mm burr is preferred for rust ring removal and should be properly disinfected prior to its use. Disposable dental burrs are also available.

Inform the patient of the procedure and, if necessary, demonstrate the slight buzzing sound that they may hear from the motorized burr. Approach the cornea tangentially with the Algerbrush as the burr head rotates on the cornea to remove the rust ring. Some pressure should be applied during the procedure, keeping in mind that the battery-powered Algerbrush has a built-in mechanism to stop rotating when a certain amount of resistance is encountered—this helps to prevent the instrument from penetrating Bowman's membrane.[16]

Following the procedure, a small crater-like epithelial defect will remain. In the event that residual rust remains or the risk of the procedure prohibits full removal of remaining rust, any residual rust will eventually dissipate or rise to the epithelial surface during the healing process, and you can remove it at a later time or leave it in place if it's not impeding the healing process.[7,13,17] Residual rust may also create additional inflammation and slow the healing process, so try to remove as much of the rust as possible.[5]

According to CDC recommendations, any reusable equipment used during the process of conjunctival or corneal foreign body removal should be thoroughly disinfected. This can be accomplished using a 15-minute soak in 1:10 diluted bleach or a 20-minute soak in 2% glutaradehyde.[18,19] You can also use an autoclave to sterilize your instruments.

Management and Follow Up

Following corneal foreign body removal, a residual epithelial defect may remain with surrounding corneal edema and conjunctival injection. Depending on the amount of time the foreign body was in the eye, a secondary anterior uveitis may also occur. This should resolve with the appropriate treatment as the cornea heals. Manage the patient in the same way you would treat a patient with a corneal abrasion.

Postoperative management for both conjunctival and corneal foreign body removal should include placing the patient on a topical broad-spectrum antibiotic for one week to help prevent infection. Pain management is patient specific and often depends on the extent and depth of the residual corneal defect. Topical or systemic therapy may be initiated. Cycloplegia with 1% cyclopentolate or 5% homatropine BID to TID not only assists with ocular pain from ciliary spasm, but also helps decrease the secondary iritis that can accompany the trauma. Topical ophthalmic non-steroidal anti-inflammatory agents can assist in pain control, although they may delay the healing process.[20]

In cases with a residual defect or significant pain, consider a bandage contact lens to promote healing while decreasing the risk of future recurrent corneal erosions. Keep in mind that bandage contact lenses should not be used in cases with an organic etiology. Pressure patching is often unnecessary.[21] Preservative-free artificial tears during the day and topical ointment at bedtime can aid in patient comfort and assist in lubricating the cornea during healing.

Follow these patients every 24 hours until the cornea shows improvement and a restored epithelium. Once the cornea has re-epithelialized, a topical steroid (alone or a combination antibiotic-steroid) can be added to reduce inflammation, scarring and the risk of subepithelial infiltration. In cases of organic corneal foreign bodies, wait until the cornea shows healing before employing steroids due to the risk of potentiating infection.[7] Consider placing an amniotic membrane for severe, central or deep corneal defects that have the greatest risk for scarring and reduced vision.

Remind patients during their annual visits that you are available and equipped to handle eye emergencies, and they're welcome to reach you should they have an after-hours eye emergency. Make a point to understand your patient's day-to-day activities, including their occupation and hobbies and any safety risks they may encounter. By being proactive, you can help reduce the costly, and often unnecessary, emergency room visits related to eye emergencies, including ocular foreign bodies. Finally, emphasize to your patients the importance of safety practices and proper eye protection for the prevention of future ocular foreign body episodes. ■

Dr. Pate is an associate professor at the University of Alabama at Birmingham School of Optometry.

Billing and Coding for Ocular Foreign Bodies

CPT Considerations

When a patient presents with complaints related to a conjunctival or corneal foreign body, a procedure code rather than an exam code should be used for the foreign body removal.

Codes Typically Used in Optometric Practice	
65205	Removal of foreign body, external eye; conjunctival superficial
65210	Removal of foreign body, external eye; conjunctival embedded (includes concretions), subconjunctival or scleral nonperforating
65220	Removal of foreign body, external eye; corneal, without slit lamp
65222	Removal of foreign body, external eye; corneal, with slit lamp

Each of these codes require the –RT or –LT modifier, which should correspond with the specific ICD-10 used.

An office visit is already included in the surgical procedure code, and an exam code should not be billed in addition to the 652XX code. In addition, a bandage contact lens fit is not allowed to be billed on the same day as the minor corneal surgical procedure. The one exception to this would be if you discover another problem that is unrelated to the minor surgical procedure that needs to be addressed during the same office visit, in which a -25 modifier would be used with the appropriate 99XXX E/M code.

The above CPT codes are bundled codes. This means that if there are two or more foreign bodies in the same tissue in the same eye, only one code for the procedure can be billed, no matter how many foreign bodies you remove. But, if the patient has foreign bodies in both the cornea and conjunctiva of the same eye, you can report both 65210 and 65222 separately (with modifier -51). If the patient has foreign bodies in two separate eyes, you can report the same code with the –RT and –LT modifiers separately; however, many carriers will adjust the reimbursement for bilateral procedures on the same day. The global period associated with these procedures is zero days.

ICD-10 Options

It can certainly be a challenge to code ocular foreign bodies with all of the ICD-10 options related to trauma and ocular injuries. For example, if a patient presents to your office with a foreign body in his left cornea from a rose bush while working on building a fence in his backyard, you would code the patient as listed below:

- T15.02XA: foreign body in cornea, left eye, initial encounter
- W60.XXXA: Contact with nonvenomous plant thorns and spines and sharp leaves, initial encounter
- Y92.017: Garden or yard in single-family (private) house as the place of occurrence of the external cause
- Y93.H: Activities involving exterior property and land maintenance, building and construction

Many carriers are not yet requiring the W or Y ICD-10 codes; however, we should become accustomed to using them as they may be required in the future.

Upon follow-up the next day for the above example, a 992XX office visit would now be the appropriate choice, along with T15.02XD, with the "D" indicating a subsequent encounter if the patient is not under active management, for which you would continue to use the "A" in the seventh position. Only when the patient is not being actively managed do you change the diagnosis to the "D" or subsequent visit status. Sequela, indicated by an "S" in the seventh position, is used for complications or conditions that arise as a direct result of the condition.

1. Haring RS, Canner JK, Haider AH, Schneider EB. Ocular injury in the United States: Emergency department visits from 2006-2011. Injury. 2016;47(1):104-8.
2. Fraenkel A, Lee LR, Lee GA. Managing corneal foreign bodies in office-based general practice. Aust Fam Physician. 2017;46(3):89-93.
3. Bowling B, Kanski JJ. Kanski's Clinical Ophthalmology: A Systematic Approach. 8th ed. Edinburgh: Elsevier; 2016:878-81.
4. Upshaw JE, Brenkert TE, Losek JD. Ocular foreign bodies in children. Pediatr Emerg Care. 2008;24(6):409-14.
5. Shetler J, Lighthizer N. Foreign body removal in 12 steps. Rev Optometry. 2015;152(1):22-9.
6. Loporchio D, Mukkamala L, Gorukanti K, et al. Intraocular foreign bodies: a review. Surv Ophthalmol. 2016;61(5):582-96.
7. Bronner A. No insult to injury: managing foreign body removal. Rev Optometry. 2017;154(1):47-54.
8. Rathod R, Mieler WF. An update on the management of intraocular foreign bodies. Retin Physician. 2011;8(3):52-5.
9. Jonas JB, Knorr HL, Budde WM. Prognostic factors in ocular injuries caused by intraocular or retrobulbar foreign bodies. Ophthalmology. 2000;107(5):823-8.
10. Katz G, Moisseiev J. Posterior segment intraocular foreign bodies: an update on management. Retin Physician. 2009;6(3):32-4.
11. Zhang Y, Zhang M, Jiang C, Qiu HY. Intraocular foreign bodies in China: clinical characteristics, prognostic factors, and visual outcomes in 1,421 eyes. Am J Ophthalmol. 2011;152(1):66-73.e1.
12. Nie S, Wang Z, Liu W, Liang X. Clinical application of X-ray, B-scan, and CT in the diagnosis of ocular foreign bodies. Eye Sci. 2013;28(1):11-4.
13. Gurwood AS. That's gonna leave a mark. Rev Optometry. 2017;154(8):98.
14. Leinert J, Griffin R, Blackburn J, McGwin G Jr. The epidemiology of lawn trimmer injuries in the United States: 2000-2009. J Safety Res. 2012;43(2):137-9.
15. Eftekhari K, Binenbaum G, Jensen AK, et al. Confidence of ophthalmology residents in obtaining informed consent. J Cataract Refract Surg. 2015;41(1):217-21.
16. Casser L, Fingeret M, Woodcome HT. Atlas of Primary Eyecare Procedures. 2nd ed. New York; McGraw Hill; 1997:156-9, 170-3.
17. Crowther KS, Ellingham RB. Complicated removal of corneal foreign bodies 18 months after laser in situ keratomileusis. J Cataract Refract Surg. 2005;31(4):851-2.
18. Tyhurst KN, Hettler DL. Infection control guidelines – an update for the optometric practice. Optometry. 2009;80(11):613-20.
19. Rutala WA, Weber DJ. Guideline for disinfection and sterilization in healthcare facilities, 2008. Centers for Disease Control and Prevention. www.cdc.gov/infectioncontrol/guidelines/disinfection. Accessed January 19, 2019.
20. Weaver CS, Terrell KM. Evidence-based emergency medicine. Update: do ophthalmic nonsteroidal anti-inflammatory drugs reduce the pain associated with simple corneal abrasion without delaying healing? Ann Emerg Med. 2003;41(1):134-40.
21. Menghini M, Knecht PB, Kaufmann C, et al. Treatment of traumatic corneal abrasions: a three-arm, prospective, randomized study. Ophthalmic Res. 2013;50(1):13-8.

OSC QUIZ

You can obtain continuing education credit through the Optometric Study Center. Complete the test form and return it with the $35 fee to: Jobson Healthcare Information, LLC, Attn.: CE Processing, 395 Hudson Street, 3rd Floor New York, New York 10014. To be eligible, please return the card within three years of publication. You can also access the test form and submit your answers and payment via credit card at *Review Education Group* online, www.reviewsce.com.

You must achieve a score of 70 or higher to receive credit. Allow four weeks for processing. For each Optometric Study Center course you pass, you earn 2 hours of credit from Pennsylvania College of Optometry.

Please check with your state licensing board to see if this approval counts toward your CE requirement for relicensure.

1. Which demographic is most likely to present with an ocular foreign body?
a. Men of working age.
b. Women of working age.
c. Children under age 13.
d. Patients over age 70.

2. Which question would help identify whether the patient has the potential for an intraocular foreign body?
a. "How long ago did the injury happen?"
b. "What were you doing at the time of the injury?"
c. "What material did you encounter during the injury?"
d. "What is your level of pain?"

3. Which type of foreign body typically carries the highest risk of infection?
a. Metal.
b. Plastic.
c. Glass.
d. Organic material.

4. Which foreign body tends to be the most tolerated and has the least reactivity?
a. Glass.
b. Metal.
c. Animal hair.
d. Vegetative material.

5. Which instrument is most appropriate to use for double lid eversion?
a. Cotton-tipped applicator.
b. Lid retractor.
c. Algerbrush.
d. Nylon loop.

6. Which would most likely indicate a retained foreign body under the upper eyelid?
a. Linear vertical staining of the cornea.
b. Positive Seidel test.
c. History of a high-speed projectile.
d. Presence of a rust ring.

7. Signs of a ruptured globe include all of the following, *except*:
a. Positive Seidel test.
b. High IOP.
c. Shallow anterior chamber.
d. Abnormal shape of the pupil.

8. Intraocular foreign bodies enter the globe most commonly through the:
a. Cornea.
b. Sclera.
c. Limbus.
d. Lid.

9. Most intraocular foreign bodies end up in which area of the eye?
a. Posterior chamber.
b. Anterior chamber.
c. Iris.
d. Lens.

10. All of these are expected findings following a superficial corneal foreign body injury, *except*:
a. Corneal edema.
b. Traumatic iritis.
c. Iris transillumination.
d. Conjunctival injection.

11. Which imaging technology would be most helpful to assess the level of penetration of a corneal foreign body?
a. X-ray.
b. CT.
c. Anterior segment OCT.
d. MRI.

12. Informed consent should contain all of the following, *except:*
a. Understanding of the nature of the patient's condition.
b. Risks associated with the procedure to be performed.
c. Alternatives to the procedure to be performed.
d. Responsibility to pay for the procedure if insurance does not cover it.

13. For superficial conjunctival foreign bodies, which method of removal should be attempted first?
a. Disposable needle.
b. Spud.
c. Irrigation.
d. Algerbrush.

14. All of these instruments are recommended for removal of an embedded corneal foreign body, *except*:
a. Spud.
b. Disposable needle.
c. Cotton-tipped applicator.
d. Nylon loop.

15. When using an instrument designed for foreign body removal, the cornea should be approached in which manner?
a. Perpendicular.
b. Tangential.
c. Circumferential.
d. Superficial.

16. After approximately how many hours will a rust ring begin to appear on a cornea with an embedded metallic foreign body?
a. 12.
b. 24.
c. 48.
d. 72.

17. The Algerbrush has a built-in mechanism so that it stops when it reaches which layer of the cornea?
a. Epithelium.
b. Bowman's layer.
c. Descemet's membrane.
d. Endothelium.

18. According to the CDC, all of these methods of disinfection are appropriate for a foreign body spud, *except*:
a. 70% isopropyl alcohol prep pad.
b. Autoclave.
c. 1:10 diluted bleach.
d. 2% glutaraldehyde.

19. Following corneal foreign body removal, when should the patient typically return for follow-up?
a. 24 hours.
b. Three to five days.
c. One week.
d. As needed.

20. Which medication should typically be avoided following the initial removal of a vegetative foreign body?
a. Topical antibiotic.
b. Topical cycloplegic.
c. Topical corticosteroid.
d. Oral analgesic.

Examination Answer Sheet

Be an Ocular Foreign Body Fixer

Valid for credit through April 15, 2022

Online: This exam can be taken online at www.reviewsce.com. Upon passing the exam, you can view your results immediately and download a real-time CE certificate. You can also view your test history at any time from the website.

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.

Mail to: Jobson Healthcare Information, LLC, Attn.: CE Processing, 395 Hudson Street, 3rd Floor New York, New York 10014

Payment: Remit $35 with this exam. Make check payable to Jobson Healthcare Information, LLC.

Credit: This course is COPE approved for 2 hours of CE credit. Course ID is **62000-AS**.

Jointly provided by Postgraduate Institute for Medicine and Review Education Group.

Salus University has sponsored the review and approval of this activity.

Processing: There is a four-week processing time for this exam.

Answers to CE exam:

1. Ⓐ Ⓑ Ⓒ Ⓓ
2. Ⓐ Ⓑ Ⓒ Ⓓ
3. Ⓐ Ⓑ Ⓒ Ⓓ
4. Ⓐ Ⓑ Ⓒ Ⓓ
5. Ⓐ Ⓑ Ⓒ Ⓓ
6. Ⓐ Ⓑ Ⓒ Ⓓ
7. Ⓐ Ⓑ Ⓒ Ⓓ
8. Ⓐ Ⓑ Ⓒ Ⓓ
9. Ⓐ Ⓑ Ⓒ Ⓓ
10. Ⓐ Ⓑ Ⓒ Ⓓ
11. Ⓐ Ⓑ Ⓒ Ⓓ
12. Ⓐ Ⓑ Ⓒ Ⓓ
13. Ⓐ Ⓑ Ⓒ Ⓓ
14. Ⓐ Ⓑ Ⓒ Ⓓ
15. Ⓐ Ⓑ Ⓒ Ⓓ
16. Ⓐ Ⓑ Ⓒ Ⓓ
17. Ⓐ Ⓑ Ⓒ Ⓓ
18. Ⓐ Ⓑ Ⓒ Ⓓ
19. Ⓐ Ⓑ Ⓒ Ⓓ
20. Ⓐ Ⓑ Ⓒ Ⓓ

Post-activity evaluation questions:

Rate how well the activity supported your achievement of these learning objectives:
1=Poor, 2=Fair, 3=Neutral, 4=Good, 5=Excellent

21. Prioritize patients with ocular foreign bodies and know the important questions to ask during a detailed history. ① ② ③ ④ ⑤

22. Perform careful ocular examination including pertinent testing and imaging, if needed. ① ② ③ ④ ⑤

23. Provide anesthesia and remove various foreign bodies (metallic, vegetative, stone, insect) using the proper instrument and approach. ① ② ③ ④ ⑤

24. Administer and/or prescribe antibiotics, corticosteroids or cycloplegia as appropriate. ① ② ③ ④ ⑤

25. Describe when and where to refer patients whose injury is beyond the scope of the primary care optometrist. ① ② ③ ④ ⑤

26. Provide appropriate follow-up and offer patient education regarding safety practices and eye protection. ① ② ③ ④ ⑤

27. Based upon your participation in this activity, do you intend to change your practice behavior? (choose only one of the following options)
Ⓐ I do plan to implement changes in my practice based on the information presented.
Ⓑ My current practice has been reinforced by the information presented.
Ⓒ I need more information before I will change my practice.

28. Thinking about how your participation in this activity will influence your patient care, how many of your patients are likely to benefit? (please use a number): ☐

29. If you plan to change your practice behavior, what type of changes do you plan to implement? (check all that apply)

ⓐ Apply latest guidelines ⓑ Change in pharmaceutical therapy ⓒ Choice of treatment/management approach ⓓ Change in current practice for referral ⓔ Change in non-pharmaceutical therapy ⓕ Change in differential diagnosis ⓖ Change in diagnostic testing ⓗ Other, please specify: _____

_____

30. How confident are you that you will be able to make your intended changes?

ⓐ Very confident ⓑ Somewhat confident ⓒ Unsure ⓓ Not confident

31. Which of the following do you anticipate will be the primary barrier to implementing these changes?
ⓐ Formulary restrictions
ⓑ Time constraints
ⓒ System constraints
ⓓ Insurance/financial issues
ⓔ Lack of interprofessional team support
ⓕ Treatment related adverse events
ⓖ Patient adherence/compliance
ⓗ Other, please specify:

32. Additional comments on this course:

_____

_____

_____

_____

_____

Please retain a copy for your records. Please print clearly.

First Name

Last Name

E-Mail

The following is your: ☐ Home Address ☐ Business Address

Business Name

Address

City State

ZIP

Telephone # - -

Fax # - -

Rate the quality of the material provided:
1=Strongly disagree, 2=Somewhat disagree, 3=Neutral, 4=Somewhat agree, 5=Strongly agree

33. The content was evidence-based. ① ② ③ ④ ⑤

34. The content was balanced and free of bias. ① ② ③ ④ ⑤

35. The presentation was clear and effective. ① ② ③ ④ ⑤

By submitting this answer sheet, I certify that I have read the lesson in its entirety and completed the self-assessment exam personally based on the material presented. I have not obtained the answers to this exam by any fraudulent or improper means.

Signature _____ Date _____

Lesson 118064 RO-OSC-0419

Jennifer Lyerly, OD

Triangle Visions Optometry, Cary, NC

Dr. Lyerly was compensated by Alcon for her participation in this advertorial.

SUCCESSFUL THE KEY

Practicing in North Carolina's Research Triangle area, I see a lot of patients with high visual demands: scientists, engineers, and business people who spend long hours in the lab or office, using computers and other digital devices. With daily life involving more and more computer time for everyone, these kinds of visual demands are increasingly common, even among my younger patients. I recently examined a preschool teacher in her early 20s who presented with 20/20 uncorrected eyesight, but complaints of headaches and eyestrain. She had no previous vision correction history, but examination revealed that she was a low astigmat, which helped explain her visual symptoms. It's more than just professionals with computer jobs that are bothered by low amounts of prescriptions and digital eye strain - as a preschool teacher she is using computers and tablets more and more when instructing her students in the classroom. When I told her that contact lenses could help, she was clearly intrigued since she had never needed to wear glasses before and was apprehensive about going into spectacle wear with the active demands of her young students in the classroom. And with Alcon's toric soft contact lens portfolio, I knew that I had truly unique lenses with the technology and design to support the kind of vision and comfort she deserves.

Providing the best contact lens-wearing experience possible means prescribing lenses that combine the right material, surface technology, and design to meet our patients' individual needs. This is particularly important for astigmats — they need their contact lenses to help support tear film stability to stay comfortable all day long, but also remain stable on their eyes for clear vision, no matter what they are doing.[1-3] Unfortunately, this dual need often goes unmet. Astigmats commonly cite discomfort, dryness, and vision problems as reasons for discontinuing contact lens wear.[4]

I fit Alcon toric contact lenses on my patients because they combine unique materials and optical designs to support the tear film stability and rotational stability that I look for in a toric lens. This Dual Stability is essential to my astigmatic patients' lens-wearing success.

Alcon's Dual Stability. Different lens materials have different physical properties, and therefore require different toric designs to maximize on-eye stability. Alcon toric contact lenses merge unique materials, surface technologies, and toric designs to support tear film and rotational stability.[6-14]

Tear Film Stability

Blink-Activated Moisture features the release of PVA with every blink to support tear film stability[6-8]

SmartShield® Technology resists deposits and supports tear film stability[10-13]

On-Eye Stability

PRECISION CURVE® Design is a dual thin zone design that allows both eyelids to apply equal pressure to keep the lens in the correct orientation

PRECISION BALANCE 8|4® Design is a modified prism-ballast design that has two anchor points for stabilization

Important information for AIR OPTIX® for Astigmatism (lotrafilcon B) contact lenses: For daily wear or extended wear up to 6 nights for near / far sightedness and astigmatism. Risk of serious eye problems (i.e., corneal ulcer) is greater for extended wear. In rare cases, loss of vision may result. Side effects like discomfort, mild burning or stinging may occur.

References 1. Craig JP, Willcox MDP, Argueso P, et al. The TFOS International Workshop on Contact Lens Discomfort: report of the contact lens interations with the tear film subcommittee. *Invest Ophthalmol Vis Sci*. 2013;54:TFOS123-TFOS156. **2.** Lindsay R. Soft Toric Lens Design and Fitting. In: Efron N, ed. *Contact Lens Practice*. Philadelphia, PA: Elsevier; 2018:95-102. **3.** Epstein A, Remba M. Hydrogel toric contact lens corrections. In: Bennett E, Weissman B, eds. *Clinical Contact Lens Practice*. Philadelphia, PA: Lippincott Williams & Wilkins; 2005:515-548. **4.** Multi Sponsor Surveys Inc. The 2014 Gallup target market report on the market for toric contact lenses. August 2014. **5.** Mann A, Tighe B. Contact lens interactions with the tear film. *Exp Eye Res*. 2013;117:88-98. **6.** Pruitt J, Lindley K, Winterton L. Triple-action moisturisers for increased comfort in daily disposable lenses. *Optician* 2007;11:27-28. **7.** Marx S, Muller C, Sickenberger W. Subjective pre-lens tear film stability of daily disposable contact lenses using ring mire projection. *Cont Lens Anterior Eye*. 2015;38:e5.

SEE LOOK FEEL

CONTACT LENS WEAR IN ASTIGMATS IS DUAL STABILITY

A stable tear film promotes ocular health, clear vision, and comfort,[5] while rotational stability keeps the correcting cylinder of a toric lens at the appropriate axis during wear. There is also an important link between these two forms of stability — toric lenses interact with the eyelid to ensure correct positioning on the eye,[3] but lens surface dryness resulting from tear film breakup can increase friction between the eyelid and lens, leading to unwanted rotation or oscillation with blinking. A stable tear film therefore plays an important role in on-eye toric lens stability.[3]

Alcon toric lenses provide the Dual Stability required to meet the needs of today's astigmatic patients, no matter what their lifestyle needs. For astigmats who are candidates for daily disposable contact lenses, I recommend DAILIES® AquaComfort Plus® Toric contact lenses. With Blink-Activated Moisture, DAILIES® AquaComfort Plus® Toric lenses release the hydrophilic polymer polyvinyl alcohol (PVA) with every blink to support tear film stability,[6-8] while the PRECISION CURVE® lens design supports stable on-eye performance.[9] For patients better suited for monthly replacement lenses, AIR OPTIX® for Astigmatism lenses combine Smart-Shield® Technology to resist deposits and support tear film stability[10-13] and the PRECISION BALANCE 8|4® lens design for rotational stability and excellent visual acuity.[14]

Fitting toric contact lenses also presents an important opportunity for practices. Nearly 50% of people have astigmatism of 0.75D or greater in at least one eye,[15] making a large proportion of our patients potential candidates for toric contact lenses. Studies show leaving even low amounts of astigmatism uncorrected is associated with much higher rates of contact lens drop out. In my experience, patients who wear contact lenses return more frequently for exams,[16] providing more opportunities for comprehensive eye care — generating more practice revenue. Most importantly, with the Dual Stability of Alcon toric contact lenses, I know that I am setting my patients up for success. Like many other astigmats I see in my practice, wearing DAILIES® AquaComfort Plus® Toric contact lenses gave my young symptomatic patient the chance to enjoy the vision and comfort she deserves!

8. Wolffsohn JS, Hunt OA, Chowdhury A. Objective clinical performance of 'comfort enhanced' daily disposable soft contact lenses. *Cont Lens Anterior Eye*. 2010;33:88-92 **9.** Alcon data on file, 2010. In a subject-masked clinical trial (n=93). **10.** Guillon M, Maissa C, Wong S, et al. Tear film dynamics over silicone hydrogel contact lenses with different lipid deposition profiles. *Optom Vis Sci*. 2014;91:E-abstract 145196. **11.** Nash W, Gabriel M. Ex vivo analysis of cholesterol deposition for commercially available silicone hydrogel contact lenses using a fluorometric enzymatic assay. *Eye Contact Lens*. 2014;40:277-282. **12.** Nash W, Gabriel MM, Mowrey-McKee M. A comparison of various silicone hydrogel lenses; lipid and protein deposition as a result of daily wear. *Optom Vis Sci*. 2010;87:E-abstract 105110. **13.** Lemp J, Kern J. On-eye performance of lotrafilcon B lenses packaged with a substantive wetting agent. Presented at the American Optometric Association Annual Meeting, June 21-25, 2017. Washington, D.C. **14.** Alcon data on file, 2005. In a randomized, subject-masked, multi-site clinical study with over 150 patients; significance demonstrated at the 0.05 level. **15.** Young G, Sulley A, Hunt C. Prevalence of astigmatism in relation to soft contact lens fitting. *Eye Contact Lens*. 2011;37:20-25. **16.** Dumbleton K, Richter D, Bergenske P, Jones LW. Compliance with lens replacement and the interval between eye examinations. *Optom Vis Sci*. 2013;90:351-358.

PEER • REVIEWED • PRA • ARTICLE •

Extended Depth-of-Focus Optics:

A Guide for Optometrists

Newer devices are expanding your patients' visual landscapes. Learn more about how they function. **By Daniel Fuller, OD**

Death and taxes aside, there are some fundamental truths of life. For one, the number of presbyopes and myopes is increasing.[1] The global prevalence of presbyopia was estimated at 1.8 billion (25%) in 2015 and is anticipated to peak in 2030.[1] The population of Americans 65 and older is projected to roughly double between 2010 and 2050.[2] Myopes are estimated to represent 49.8% by 2050, posing increasing economic burdens on society.[2-6]

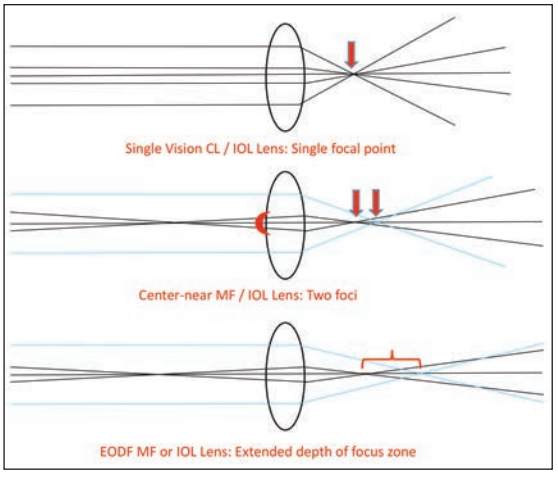


Fig. 1. A single vision lens produces a single focal point (top). A near-centered multifocal lens (MF) simultaneously creates superimposed images of distance and near zone foci (middle). Extended depth-of-focus (EDOF) lenses broaden the depth of focus to encompass a broader range of foci (bottom). The model assumes a monochromatic light source and paraxial rays to avoid confounding aberrations and for simplicity.

Lens Evolution

Not only do presbyopes and myopes share common epidemiological trends, but overlaps also exist in the evolution of corrective options. Surgical and non-surgical innovations have progressed in tandem, albeit at different rates. LASIK refractive surgery arose first to treat myopia. Some are using it successfully to create a monovision effect. More recently, its expanded indications include presbyopia, leading to the development of such terms as presby-LASIK.[7-11] Intraocular lenses (IOLs) initially corrected only the spherical component of patients' refractive errors. These now include toric, multifocal (bifocal, trifocal and aspheric), toric-multifocal and accommodating options.[12-18] Diffractive lens options continued to evolve and the next development is extended depth-of-focus (EDOF) designs.[13] But it has branched off in a few other areas, too.

Corneal inlays, for example, are another alternative surgical approach to managing presbyopia. Currently available inlays include the Flexivue Microlens (PresbiBio) and the Kamra inlay (CorneaGen).[19-21] A third option—the Raindrop Near Vision Inlay (ReVision Optics)—was recently recalled by the FDA following the shuttering of its parent company.

Alternative explanations to Helmholtz's theory on how accommodation occurs have led to scleral banding or expansion procedures to modestly restore some level of accommodation as well.[22] These alternative theories are not generally accepted.

Noninvasive procedures include a host of contact lens designs. Rigid, soft and hybrid lenses now offer multifocal designs. Rigid lenses are available in simultaneous and alternating designs while soft and hybrid lenses come in simultaneous view designs. Alternating designs in soft lenses such as the Triton lens (Gelflex) and the first diffractive bifocal, Echelon (Hydron), are no longer available, but are interesting historical footnotes.[23] Contemporary soft simultaneous vision contact lenses exist as aspheric, zonular and EDOF designs. This last design is what we will concentrate on and is of particular interest for its novel attributes.

Various topical pharmaceutical agents are also in development with varying mechanisms of action and are worth a passing mention; these expand depth-of-focus by creating a pinhole effect or restore some measure of flexibility to the aging crystalline lens.[24]

Considerable time and treasure are required to address the impact of both presbyopia and myopia by improving access to care and developing timely interventions to slow myopia's progression. This article seeks to update practitioners on EDOF by drawing parallels across corrective options.

Optical Basics

Obtaining a single point focus can be challenging when light from an object passes through corrective lenses and the optics of the eye. When a wavefront of light encounters an optical surface, three things happen: reflection, absorption and transmittance. Also, individual wavelets join to create a wavefront that is diffracted when it encounters the edge of an aperture such as the iris plane, resulting in interference. The transmitted wavefront from a point object would ideally be conjugate with that of a point image. We live in a world of polychromatic light with both paraxial and off-axis objects. The wavefronts created encounter both regular and irregular optical surfaces, resulting in a difference between the ideal and actual wavefronts we refer to as aberrations. These are the optical aberrations of refracting surfaces, which smear the focus light.

Aberrations may be characterized into lower- and higher-order ones. Lower-order aberrations represent approximately 90% of those in the eye and include the defocus errors (myopia, hyperopia, regular astigmatism and prism) we correct every day by refraction.[25] Higher-order aberrations account for the other 10% of the eye's errors and often influence the quality of patient's vision after optical or surgical intervention.[26] The clinically most important ones are spherical aberration, coma and trefoil.[27]

Because spherical aberration increases as the fourth power of the pupil diameter, the aberration will increase 16 times the change in diameter.[25] This is one reason why patients with large pupils who receive LASIK may complain of halos and it is responsible for night myopia in normal eyes.[26] Accommodation and IOL axial placement relative to the pupillary aperture affect spherical aberration as well.[25] If a corneal graft, crystalline or intraocular lens, inlay or ablation zone is decentered, coma increases. Trefoil contributes a minor part to image aberration.[28]

Correcting refractive defocus is a major factor in reducing the smear of a point focus. The shapes of refracting surfaces, aperture size and position of the elements in an optical system both axially and longitudinally affect higher aberrations and quality of vision significantly.

Intraocular Lenses

Until we perfect devices to simulate accommodation or restore natural accommodation, we must accept the inherent trade-offs present in all technologies. The key is to match the right option to an individual patient by considering lifestyle needs, comorbidities and an evidence-based approach (*Figure 1*).[12]

The majority of multifocal IOLs are refractive, diffractive and EDOF. The only FDA-approved EDOF lens available in the United States is the Tecnis Symfony (Johnson & Johnson).[29] A pinhole aperture design, the ICD-8 (AcuFocus), also provides EDOF; it recently received investigational device exemption and is currently enrolling study patients.[30]

The European Union has three offerings in this space:[31]

- The Mini Well (Sifi Medtech)
- The Wichterle Intraocular Lens-Continuous Focus (Medicem)
- The XtraFocus Pinhole Implant (Morcher)

These various designs have their own advantages. Important clinical outcomes include uncorrected distance, intermediate and near visual acuities, spectacle independence and patient satisfaction. A 2017 literature search included 74 studies that provide insights into the efficacy of multifocal IOLs.[12] The results show the overall superiority of monocular visual acuity at all distances in diffractive designs over multifocal designs, though both performed worse in the intermediate and near ranges than at distance.[12,32] However, when spectacle independence (defined as free of use at least 80% of the time) was assessed globally at distance (96.0%), intermediate (100%) and near (70%), results suggested patients are largely able to make successful neuro-adaptations.[12]

The most commonly reported symptoms among dissatisfied

patients wearing multifocals (1.3%), diffractive (2.6%) or combined designs (91.1%) are blurred vision (94.7% to 95%) and photic complaints (38.2% to 42%).[33,34] The causes of dissatisfaction reported included residual ametropia (65.5%), posterior capsular opacification (15.8%), large pupil size (14.5%) and wavefront abnormalities (11.8%).[34] To put some of this in perspective, a Cochrane meta-analysis suggested photic complaints are two to two and a half times more common in multifocal than in single vision IOLs.[35] Many causes of the reported blur are easily ameliorated.[12,32-34,36]

EDOF and trifocal designs outperform bifocal designs in optical bench testing of through focus clarity.[37] This demonstrates how the distance focus extends into the intermediate range for both EDOF and trifocals with better intermediate focus for EDOF designs and slightly better near range for the trifocal design tested.[14,37-40] There is no significant difference for halos or glare complaints (10% to 64%) between the two.[37,41,42]

Comparisons of EDOF with bifocal and trifocal designs for visual acuity are lacking. Small sample outcomes evaluating bilateral implants for subjects attaining uncorrected logMAR visual acuities of better than 0.1D (20/25) have been reported as distance (100%), intermediate (92% to 100%) and near (40%).[43] The results are inherently better than those reported above since they represent binocular findings. Nonetheless, these studies provide some insights into the efficacy of various designs. One recent study compared outcomes between four different lenses: Tecnis 1-piece monofocal, Tecnis Symfony extended range of vision, Restor +2.5D and Restor +3.0D. That study found Tecnis Symfony extended range of vision IOL and +2.5D multifocal IOL provided significantly better intermediate visual restoration after cataract surgery than the monofocal IOL or +3.0D multifocal IOL, with significantly better quality of vision with the Tecnis Symfony.

Photo: Yueren Wang, OD

Retro-illumination of the Tecnis Symfony.

The largest study to date evaluating the ICD-8 design enrolled 105 subjects who received this lens in one eye and a monofocal design in the opposing eye. They were evaluated over a six-month period, finding uncorrected binocular Snellen visual acuities at distance (20/23), intermediate (20/24) and near (20/30) with 95.9% indicating they would have the procedure again.[45]

Corneal Inlays

The intracorneal inlays for presbyopia on the market are the Kamra and Flexivue Microlens.[46] However, only the Kamra inlay uses an EDOF mechanism of action.[28]

The Kamra inlay is one of the most studied inlays in this category, with more than 20,000 implanted in more than 50 countries.[30,47] The use of a pinhole approach to extend the depth of focus preserves distance vision and binocularity over a broad range of focus.[20] The lens is inlayed in the non-dominant eye only, preferably into a femtosecond laser pocket to maximally preserve corneal nerve integrity.[20] This reduces the risk of creating dry eye issues.[48] It has been used in myopes, emmetropes, hyperopes, LASIK, monofocal pseudophakes and phakic IOL patients and shows its best results in myopes less than -1.00D and less than -0.75D of astigmatism.[20]

The outcomes are positive overall. In general, practitioners may expect a slight decrease in uncorrected distance visual acuity, stable or improved uncorrected intermediate visual acuity, and great improvement in uncorrected near visual acuities. The greatest gains at near are for hyperopes, emmetropes and myopes, in that order. Best-corrected visual acuities are rarely affected unless explantation becomes necessary or complications arise.[49-54] Contrast sensitivity does not appear to be affected in most of these studies, but higher-order aberrations can increase if the corneal thickening alters the corneal topography. This is uncommon at the depth the inlay is placed.

Complications are rare. They include those associated with refractive surgery and femtosecond laser procedures. Those unique to this procedure include epithelial flattening secondary to stromal thickening with concomitant hyperopic shift; corneal haze, epithelial iron deposits and microbial keratitis.[50] Other reported complications were more common with the original design, (ACI 7000), and were minimized with the reduction in light coming through the aperture in the newer smaller-aperture design as well as by increasing in the number of fenestrations to the aperture in the thinner design (ACI 7000 PDT).[49,50] The complications include severe night vision complaints, dependence on spectacles at near, loss of best-corrected distance visual acuity of one

line, rare decentration and epithelial deposits with the first generation version.[49,50]

Contact Lens Options

The only commercially available EDOF contact lens in the United States is the NaturalVue Multifocal 1 Day (Visioneering Technology) soft lens, which uses what the company calls neurofocus optics.[55] This novel design offers an "encompassing" add range up to +3.00D by taking advantage of EDOF optics.[55] This is important not only for presbyopes but for myopes.[56,57] It is effectively a center-distance design with increasing add power moving outward from the center.

Prototypes of a similar design have been studied by researchers at the Brien Holden Vision Institute (BHVI).[58-63] The base curve is a little flatter (8.4mm) and the diameter a little smaller (14.0mm) than the NaturalVue Multifocal.

The goal of these designs is to circumvent the common complaints and issues previously cited as shortfalls of simultaneous view designs such as ghosting, decreased quality of vision, decreased contrast sensitivity, the undue influences of pupil size, centration and illumination levels.[58]

The BHVI design has a low and high add, and was compared with a center-distance, zonular design.[58] Its EDOF design performed better in the intermediate and near zones without visual compromise in the distance compared with the zonular design.[58]

Another study compared predicted outcomes for a through focus design with low, medium and high add powers using a computer model for presbyopic emmetropes, against center-distance, zonular and center-near simultaneous view designs.[59] They found EDOF designs to be less susceptible to variations in pupil size, inherent ocular aberration and decentration relative to concentric or simultaneous view designs, and included the caveat that human trials are needed to further test their results.[59] This was tested in a prospective, participant-masked, crossover randomized study on a range of refractive errors and add powers.[60] Each lens was worn for approximately one week. They found results similar to those predicted by the through focus models and consistent with two other short-term comparisons to the same center-distance, zonular and near-center, aspheric simultaneous view designs worn on a daily basis.[60-62] The prototype in this study had a slightly flatter base curve (8.5mm) and larger diameter (14.2mm) than either the through focus part 1 or part 2 studies.[59,60,62]

Taken together, these results suggest EDOF designs may offer advantages over both center-distance, zonular and more common, center-near, simultaneous view designs for presbyopia.

Myopic Defocus

This section concentrates on the ability of EDOF lenses to create peripheral myopic defocus.[64] Mounting evidence suggests induced myopic retinal defocus (especially peripheral) may slow myopia progression significantly by ill-defined control mechanisms, which influence scleral thickness and rigidity.[64-77] Soft contact lens designs studied include bifocals, peripheral defocus, simultaneous dual focus, positive spherical aberration and EDOF ones. They are capable of reducing both spherical equivalent error and, more importantly, axial length, with fewer adverse events or complications than atropine or orthokeratology.[56,78] Little is known about rebound after discontinuation of wear or which

groups (slow or fast progressors) benefit most.[56] Early intervention appears particularly beneficial in fast progression.[79] Epidemiological data suggests a reduction in progression of myopia by 50% or more significantly reduces the burden of high myopia and its complications.[3,80,81]

A prospective, double-blind, crossover, randomized one-week trial of the EDOF BHVI prototype was compared against the dual focus design MiSight (CooperVision) and Proclear Multifocal (CooperVision) for tolerability in 30 subjects.[63] The findings suggested EDOF designs are better tolerated than the two designs often advocated for myopia control. Tolerability is important, but what about efficacy? The authors of the study cite a combination of peer-reviewed data and poster abstracts to compare some short-term data for efficacy.

The NaturalVue Multifocal center-distance lens design offers "approximately 8D to 11D of relative plus power at the edge of the pupil and approximately 20D of relative plus power at the edge of the optic zone."[57] A 2018 study reported on a multi-site, retrospective case series collating data from 32 consecutive patients with at least one six-month follow-up visit.[57] The majority, 93.6%, wore the lenses for 18 months or less. They reported seemingly impressive reductions in myopic progression of 95% or more and even suggested regression occurred in some subjects when compared with progression rates prior to using the EDOF design.[57]

All studies have limitations created by design differences, which prevent direct comparisons. Studies using case series represent relatively low-level evidence. The lack of masking, use of historical controls, lack of randomization, lack of axial length data, varying lengths of subject participation and small sample sizes are limiting.[57] Nonetheless, the results are promising.

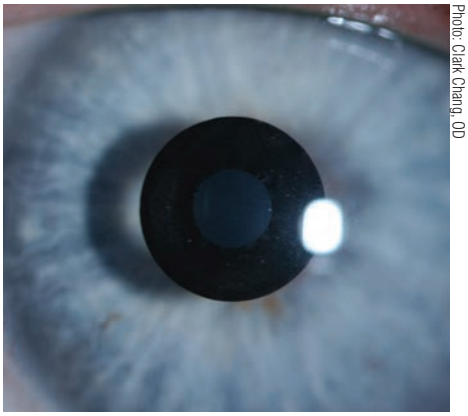


Photo: Clark Chang, OD

A patient presents with an otherwise quiet and clear cornea at 12 months after Kamra inlay implantation.

Clearly, interest in EDOF optics continues to grow, and its applications across a variety of platforms offer some advantages over other designs. It is worth your time to keep abreast of these developments and add them to your clinical toolbox for presbyopes and as off-label treatment for myopia progression. ■

Dr. Fuller is an associate professor and founding supervisor of the Cornea & Contact Lens – Refractive Surgery residency at The Eye Center, Southern College of Optometry.

1. Fricke T, Tahhan N, Resnikoff S, et al. Global prevalence of presbyopia and vision impairment from uncorrected presbyopia: Systematic review, meta-analysis, and modelling. Ophthalmol. 2018;125(10):1492-9.
2. Vincent G, Velkoff V. The next four decades the older population in the United States: 2010 to 2050. Curr Pop Report. www.census.gov/prod/2010pubs/p25-1138.pdf. May 2010. Accessed March 11, 2019.
3. Holden B, Fricke T, Wilson D, et al. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. Ophthalmol. 2016;123(5):1036-42.
4. Frick K, Joy S, Wilson D, et al. The global burden of potential productivity loss from uncorrected presbyopia. Ophthalmol. 2015;122(8):1706-10.
5. Holden B, Fricke T, Ho S, et al. Global vsion impairment due to uncorrected presbyopia. Arch Ophthalmol. 2008;126(12):1731.
6. Sade RM. The graying of America: challenges and controversies. J Law Med Ethics. 2012;40(1):6-9.
7. Vargas-Fragoso V, Alió J. Corneal compensation of presbyopia: PresbyLASIK: an updated review. Eye Vis. 2017;4:11.
8. Pallikaris I, Panagopoulou S. PresbyLASIK approach for the correction of presbyopia. Curr Opin Ophthalmol. 2015;26(4):265-72.
9. Mosquera SA, Alió JL. Presbyopic correction on the cornea. Eye Vis. 2014;1:5.
10. Luger M, McAlinden C, Buckhurst P, et al. Presbyopic LASIK using hybrid bi-aspheric micro-monovision ablation profile for presbyopic corneal treatments. Am J Ophthalmol. 2015;160(3):493-505.
11. Schlote T, Heuberger A. Multifocal corneal ablation (Supracor) in hyperopic presbyopia: 1-year results in a cross-sectional study. Eur J Ophthalmol. 2017;27(4):438-42.
12. Alio J, Plaza-Puche A, Férnandez-Buenaga R, et al. Multifocal intraocular lenses: An overview. Surv Ophthalmol. 2017;62(5):611–34.
13. Chang D, Huggins L. Understanding the role of IOL optics in postoperative vision complaints. Rev Optom. 2018;155(12):48–51.
14. Zvornicanin J, Zvornicanin E. Premium intraocular lenses: The past, present and future. J Curr Ophthalmol. 2018;30(4):267-96.
15. Gundersen K. Rotational stability and visual performance 3 months after bilateral implantation of a new toric extended range of vision intraocular lens. Clin Ophthalmol. 2018;12(7):1269-78.
16. Alió J, Simonov A, Romero D, et al. Analysis of accommodative performance of a new accommodative intraocular lens. J Refract Surg. 2018;34(2):78–83.
17. Ong H, Evans J, Allan B. Accommodative intraocular lens versus standard monofocal intraocular lens implantation in cataract surgery. Cochrane Database Syst Rev. 2014 May 5;CD009667.
18. Zhou H, Zhu C, Xu W, Zhou F. The efficacy of accommodative versus monofocal intraocular lenses for cataract patients. 2018;97(40): p e12693.
19. Binder PS. Intracorneal inlays for the correction of presbyopia. Eye Contact Lens. 2017;43:267-75.
20. Moarefi MA, Bafna S, Wiley W. A review of presbyopia treatment with corneal inlays. Ophthalmol Ther. 2017;6(1):55-65.
21. Konstantopoulos A, Mehta JS. Surgical compensation of presbyopia with corneal inlays. Expert Rev Med Devices. 2015;12(3):341–52.
22. Kleinmann G, Kim HJ, Yee RW. Scleral expansion procedure for the correction of presbyopia. Int Ophthalmol Clin 2006;46(3):1–12.
23. Rex Ghormley N. The hydron ECHELON bifocal contact lens. Int Contact Lens Clin. 1989;16(4):315-7.
24. Cole J. Can an eyedrop eliminate presbyopia? Rev Optom. 2017;154(6):42-6.
25. Lombardo M, Lomabard G. Wave aberration of human eyes and new descriptors of image optical quality and visual performance. J Cat Refract Surg. 2010;36(2):313-31.
26. Bruce A, Catania L. Clinical applications of wavefront refraction. Optom Vis Sci 2014;91(10):1278-86.
27. Lawless M, Hodge C. Wavefront's role in corneal refractive surgery. Clin Exp Ophthalmol. 2005;33(2):199-209.
28. Appelgate R, Sarver E, Khemsara V. Are all aberrations equal? J Refract Surg 2002;18(5):S556-62.
29. Johnson & Johnson Vision. TECNIS Symfony IOL | Johnson & Johnson Vision. Packag Inser 2018.
30. AcuFocus. Improving Lifestyle Vision with Small Aperture Optics. Irvine; 2016.
31. Akella SS, Juthani V. Extended depth of focus intraocular lenses for presbyopia. Curr Opin Ophthalmol. 2018;29(4):318–22.
32. Rosen E, Alió J, Dick H, et al. Efficacy and safety of multifocal intraocular lenses following cataract and refractive lens exchange: Metaanalysis of peer-reviewed publications. J Cataract Refract Surg. 2016;42(2):310-28.
33. de Vries NE, Webers CAB, Touwslager W, et al. Dissatisfaction after implantation of multifocal intraocular lenses. J Cataract Refract Surg. 2011;37(5):859–65.
34. Woodward M, Randleman J, Stulting R. Dissatisfaction after multifocal intraocular lens implantation. J Cataract Refract Surg. 2009;35(6):992–7.
35. Calladine D, Evans J, Shah S, Leyland M. Multifocal versus monofocal intraocular lenses after cataract extraction. Cochrane Database Syst Rev. 2012 Sept;9:CD003169.
36. de Vries N, Nuijts R. Multifocal intraocular lenses in cataract surgery: Literature review of benefits and side effects. J Cataract

Refract Surg. 2013;39(2):268-78.
37. Gatinel D, Loicq J. Clinically relevant optical properties of bifocal, trifocal, and extended depth of focus intraocular lenses. J Refract Surg. 2016;32(4):273-80.
38. Ruiz-Mesa R, Abengózar-Vela A, Aramburu A, Ruiz-Santos M. Comparison of visual outcomes after bilateral implantation of extended range of vision and trifocal intraocular lenses. Eur J Ophthalmol. 2017;27(4):460–5.
39. Yoo Y, Whang W, Byun Y, et al. Through-focus optical bench performance of extended depth-of-focus and bifocal intraocular lenses compared to a monofocal lens. J Refract Surg. 2018;34(4):236-43.
40. Cochener B, Boutillier G, Lamard M, Auberger-Zagnoli C. A comparative evaluation of a new generation of diffractive trifocal and extended depth of focus intraocular lenses. J Refract Surg. 2018;34(8):507-14.
41. de Medeiros AL, de Araújo Rolim AG, Motta AFP, et al. Comparison of visual outcomes after bilateral implantation of a diffractive trifocal intraocular lens and blended implantation of an extended depth of focus intraocular lens with a diffractive bifocal intraocular lens. Clin Ophthalmol. 2017;11(10):1911–6.
42. Savini G, Balducci N, Carbonara C, et al. Functional assessment of a new extended depth-of-focus intraocular lens. Eye (Lond). 2019;33(3):404-10.
43. Ganesh S, Brar S, Pawar A, Relekar KJ. Visual and refractive outcomes following bilateral implantation of extended range of vision intraocular lens with micromonovision. J Ophthalmol. 2018;2018.
44. Pedrotti E, Carones F, Aiello F, et al. Comparative analysis of visual outcomes with 4 intraocular lenses: Monofocal, multifocal, and extended range of vision. J Cataract Refract Surg. 2018;44(2):156–67.
45. Dick H, Piovella M, Vukich J, et al. Prospective multicenter trial of a small-aperture intraocular lens in cataract surgery. J Cataract Refract Surg. 2017;43(7):956–68.
46. Mehrjerdi M, Mohebbi M, Zandian M. Review of static approaches to surgical correction of presbyopia. J Ophthalmic Vis Res. 2017;12(4):413-8.
47. Lindstrom R, Macrae S, Pepose J, Hoopes P. Corneal inlays for presbyopia correction. Curr Opin Ophthalmol. 2013;24(4):281–7.
48. Efron N, Jones L, Bron A. The TFOS International workshop on contact lens discomfort: report of the contact lens interactions with the ocular surface and adnexa subcommittee. Investig Opthalmology Vis Sci. 2013;54:TFOS98.
49. Seyeddain O, Riha W, Hohensinn M. Refractive surgical correction of presbyopia with the AcuFocus small aperture corneal inlay: two-year follow-up. J Refract Surg. 2010;26:707–15.
50. Dexl A, Jell G, Strohmaier C, et al. Long-term outcomes after monocular corneal inlay implantation for the surgical compensation of presbyopia. J Cataract Refract Surg. 2015;41(3):566–75.
51. Tomita M, Kanamori T, Waring G. Simultaneous corneal inlay implantation and laser in situ keratomileusis for presbyopia in patients with hyperopia, myopia, or emmetropia: Six-month results. J Cataract Refract Surg. 2012;38(3):495–506.
52. Tomita M, Kanamori T, Waring G, et al. Small-aperture corneal inlay implantation to treat presbyopia after laser in situ keratomileusis. J Cataract Refract Surg. 2013;39(6):898–905.
53. Yilmaz Ö, Bayraktar S, Agca A, et al. Intracorneal inlay for the surgical correction of presbyopia. J Cataract Refract Surg. 2008;34(7):1921–7.
54. Yılmaz Ö, Alagöz N, Pekel G, et al. Intracorneal inlay to correct presbyopia: Long-term results. J Cataract Refract Surg. 2011;37(7):1275–81.
55. Visioneering Technology I. NaturalVue Multifocal Lens Specifications – Visioneering Technologies, Inc. Nat Multifocal Lens Specif 2018:1.
56. Sankaridurg P. Contact lenses to slow progression of myopia. Clin Exp Optom. 2017;100(5):432-7.
57. Cooper J, O Connor B, Watanabe R, Fuerst R, Berger S, Eisenberg N, Dillehay SM. Case series analysis of myopic progression control with a unique extended depth of focus multifocal contact lens. Eye Contact Lens. 2018;44:e16–24.
58. Tilia D, Bakaraju RC, Chung J, et al. Short-term visual performance of novel extended depth-of-focus contact lenses. Optom Vis Sci. 2016;93:435-44.
59. Bakaraju RC, Ehrmann K, Ho A. Extended depth of focus contact lenses vs. two commercial multifocals: Part 1. Optical performance evaluation via computed through-focus retinal image quality metrics. J Optom. 2018;11:10–20.
60. Bakaraju RC, Tilia D, Sha J, Diec J, Chung J, Kho D, Delaney S, Munro A, Thomas V. Extended depth of focus contact lenses vs. two commercial multifocals: Part 2. Visual performance after 1 week of lens wear. J Optom 2018;11:21–32.
61. Tilia D, Munroa A, Chunga J, Shaa J, Delaney S, Khoa D, Thomas V, Ehrmanna K, Bakarajua RC. Short-term comparison between extended depth-of-focus prototype contact lenses and a commercially-available center-near multifocal. J Optom. 2017;10:14-25.
62. Sha J, Tilia D, Kho D, Diec J, Thomas V, Bakaraju RC. Comparison of extended depth-of-focus prototype contact lenses With the 1-Day ACUVUE MOIST MULTIFOCAL after one week of wear. Eye Contact Lens. 2018;44:S157–63.
63. Sha J, Tilia D, Diec J, Fedtke C, Jong M, Thomas V, Bakaraju RC. Visual performance of myopia control soft contact lenses in non-presbyopic myopes. 2018;10:75–86.
64. Holden B, Sankaridurg P, Smith E, Aller T, Jong M, He M. Myopia, an underrated global challenge to vision: where the current data takes us on myopia control. Eye (Lond). 2014;28:142–6.
65. Huang J, Hung L-F, Ramamirtham R, Blasdel TL, Humbird TL, Bockhorst KH, Smith EL 3rd. Effects of form deprivation on peripheral refractions and ocular shape in infant rhesus monkeys (Macaca mulatta). Invest Ophthalmol Vis Sci 2009;50:4033-44.
66. Huang J, Hung L-F, Smith EL 3rd. Effects of foveal ablation on the pattern of peripheral refractive errors in normal and form-deprived infant rhesus monkeys (Macaca mulatta). Invest Ophthalmol Vis Sci 2011;52:6428-34.
67. Smith EL 3rd, Hung L-F, Huang J, Arumugam B. Effects of local myopic defocus on refractive development in monkeys. Optom Vis Sci. 2013;90:1176-86.
68. Smith EL 3rd, Hung L-F, Huang J, Blasdel TL, Humbird TL, Bockhorst KH. Effects of optical defocus on refractive development in monkeys: evidence for local, regionally selective mechanisms. Invest Ophthalmol Vis Sci. 2010;51:3864–73.
69. Zhu X, McBrien NA, Smith EL 3rd, Troilo D, Wallman J. Eyes in various species can shorten to compensate for myopic defocus. Invest Ophthalmol Vis Sci. 2013;54:2634–44.
70. Hung L-F, Ramamirtham R, Huang J, Qiao-Grider Y, Smith EL 3rd. Peripheral refraction in normal infant rhesus monkeys. Invest Ophthalmol Vis Sci. 2008;49:3747–57.
71. Kee C-S, Hung L-F, Qiao-Grider Y, Ramamirtham R, Smith EL 3rd. Astigmatism in monkeys with experimentally induced myopia or hyperopia. Optom Vis Sci 2005;82:248–60.
72. Kee C-S, Hung L-F, Qiao-Grider Y, Ramamirtham R, Winawer J, Wallman J, Smith EL 3rd. Temporal constraints on experimental emmetropization in infant monkeys. Invest Ophthalmol Vis Sci. 2007;48:957–62.
73. Qiao-Grider Y, Hung L-F, Kee C, Ramamirtham R, Smith EL 3rd. Recovery from form-deprivation myopia in rhesus monkeys. Invest Ophthalmol Vis Sci. 2004;45:3361–72.
74. Smith E, Campbell M, Irving E. Does peripheral retinal input explain the promising myopia control effects of corneal reshaping therapy (CRT or ortho-K) & multifocal soft contact lenses? Ophthalmic Physiol Opt. 2013;33:379-84.
75. Smith E, Huang J, Hung L, et al. Hemiretinal form deprivation: evidence for local control of eye growth and refractive development in infant monkeys. Invest Ophthalmol Vis Sci. 2009;50:5057-69.
76. Smith E, Hung L-F, Arumugam B, Huang J. Negative lens-induced myopia in infant monkeys: effects of high ambient lighting. Invest Ophthalmol Vis Sci. 2013;54:2959–69.
77. Smith E, Hung L-F, Huang J. Protective effects of high ambient lighting on the development of form-deprivation myopia in rhesus monkeys. Invest Ophthalmol Vis Sci. 2012;53:421-8.
78. Cooper J. Not focusing on myopia is shortsighted. J Pediatr Ophthalmol Strabismus. 2018;55:353-4.
79. PEDIG Study Group. Progressive-Addition Lenses versus Single-Vision Lenses for Slowing Progression of Myopia in Children with High Accommodative Lag and Near Esophoria. Invest Ophthalmol Vis Sci. 2011;52:2749–57.
80. Saw S, Gazzard G, Shih-Yen E, Chua W. Myopia and associated pathological complications. Ophthalmic Physiol Opt. 2005;25:381-91.
81. Saw S, Matsumura S, Hoang Q. Prevention of myopia and myopic pathology. Invest Ophthalmol Vis Sci. 2019;60:488-99.

SAVE THE DATE

ACADEMY 2019 ORLANDO

3rd World Congress of Optometry

WORLD COUNCIL OF OPTOMETRY

AMERICAN ACADEMY of OPTOMETRY

OCTOBER 23-27, 2019 ORANGE COUNTY CONVENTION CENTER ORLANDO, FL, USA

The American Academy of Optometry and the World Council of Optometry are joining together to offer a global platform where practitioners, students, researchers and educators can share expertise and engage in the development of optometry's future. All in one of the top tourist destinations in the world – Orlando, Florida.

FOR MORE INFORMATION VISIT

WWW.AAOPT.ORG/2019

WWW.WORLDCONGRESSOFOPTOMETRY.ORG

#ACADEMY19 #WCOCONGRESS19

Registration opens May 6, 2019.

Got a Special Interest? There's a Group For That

These organizations can help take your career to the next level.

By Catherine Manthorp, Associate Editor

It's easy to get caught up in the swing of things, especially when you're seeing patients back-to-back each day, but wouldn't it be nice if you could take a little time to further your career? Well, special interest groups allow you to do just that. And there's something for everyone—whether you're interested in volunteering in eye clinics in underserved countries, attending study groups that discuss the direction optometry is moving or conducting breakthrough research that will advance the quality of care—you just need to know where to go to find it. Look no further!

This article gives an overview of many optometric special interest groups, complete with the information necessary to decide which one is the right fit for you.

American Academy of Optometry (AAO)

The Academy was created in 1922 to "promote the art and science of vision care through lifelong learning" and provide continuing education (CE) to optometrists and vision scientists.[1] Academy members include Fellows, Candidates for Fellowship and students/residents.[1] Members enjoy access to and previews of the organization's journal, *Optometry and Vision Science*, discounted registration for the Academy's annual meeting, access to past meeting recordings and handouts and opportunities to join Sections and Special Interest Groups (SIGS).[1]

The Academy has eight Sections that each act as a "vehicle for optometrists with interest in specialty areas to meet around particular topics," according to Jenny Brown, MBA, CAE, director of membership and communications. These include: anterior segment; binocular vision, perception and pediatric optometry; comprehensive eye care; cornea, contact lenses and refractive technologies; glaucoma; low vision; optometric education; and public health and environmental vision.[1]

SIGs, on the other hand, are for "Academy members who have a special interest in areas that are too narrow to warrant a complete Diplomate program," says Ms. Brown. These groups provide a forum for clinicians interested in academic medical centers, research, neuro-ophthalmic disorders, nutrition, disease prevention, wellness, retina, vision in aging and vision science.[1] Sections and SIGs produce symposia for the Academy's annual meeting and serve as the Academy's resource in these particular topics, notes Ms. Brown.

"The American Academy of Optometry's Sections and SIGs give our members a home within the Academy where they can connect, share knowledge and collaborate on a particular topic that interests them," says President Barbara Caffery, OD, PhD.

Each fall, thousands of ODs pack the plenary session of the AAO annual conference to hear expert clinicians share their insights.

American Optometric Association (AOA)

The AOA was founded in 1898 and bills itself as "the leading authority on quality care and an advocate for our nation's health."[2] Doctors of optometry, legislators, patients and other professionals look to the AOA for advocacy, CE, tools to advance optometric practice and public awareness related to optometry, eye care and health care policy that serve to enhance and ensure quality patient care.[2]

Members have the opportunity to join AOA on Capitol Hill to discuss key issues facing the profession with legislators. Optometry's Meeting, the AOA's annual conference, serves as a conduit for clinical resources, CE events and networking possibilities.[2] The AOA has several key initiatives that advocate for the profession and the eye health care needs of the public, including its Health Policy Institute, Keyperson Network, numerous volunteer committees and the Think About Your Eyes campaign.[2]

American Society of Optometric Surgeons (ASOS)

Established in 2017, this relative newcomer provides support and resources for optometric students, physicians and educators practicing advanced optometric procedures.[3]

"We came together to exchange knowledge, share experiences and offer advice and guidance to practitioners seeking to further develop skill and expertise in these areas," says Executive Director and President Richard E. Castillo, OD, DO.

The "ideal" member is "today's optometry student, who will benefit the most from the expansion of services and the evolving scope of practice throughout their future career," explains Dr. Castillo.

Photo: ASOS

ASOS student members receive guidance on procedural technique during a workshop.

ASOS provides online educational content and hosts members-only events as well as open meetings at various venues throughout the year (e.g., SECO 2019).[3] Through the organization's online Optometric Procedures Institute, members have access to hands-on workshops to encourage procedural skill transfer and development.[3]

"For decades now, optometry has been transforming itself into a service- and procedure-based profession," says Dr. Castillo. "It continues to evolve alongside the other healthcare disciplines in response to advancements in technology and the optometric and medical knowledge base."

Those who are interested in joining can apply to either the student category or the sustaining member category, both of which require members to pay a yearly fee.[3]

College of Optometrists in Vision Development (COVD)

COVD was formed in 1971 to "establish a body of practitioners who are knowledgeable in functional and developmental concepts of vision and who will ensure that the public will receive continually improving vision care," says President Christine Allison, OD. COVD members enjoy discounted pricing to the organization's annual meeting and board certification programs as well as various other educational opportunities.[4] COVD also provides a regular e-newsletter to keep members up-to-date on the latest events and organizational happenings.[4]

Applicants can register for one of four membership plans, each of which comes with different requirements and annual fees—associate, affiliate, vision therapist or student/resident.[4]

Fellowship of Christian Optometrists (FCO)

Founded in 1986, FCO—now a section of the Christian Medical and Dental Associations (CMDA)—"envisions a world where there would no longer be people in poor or developing countries who suffer from the inability to provide for their family, or in their quality of life, by not having access to preventable eye care," says Chairman Kyle Cheatham, OD.

FCO engages in charitable mission work worldwide that combines eye care and Christian fellowship.[5] The organization holds an annual national convention and regional conferences across the country.[5] Members have access to CMDA ministries, online resources, CE and job placement services as well as networking, fellowship and mentorship opportunities.[5]

Dry Eye Disease

Many symptoms…
multiple solutions…
one company

Katena offers a broad range of solutions from the beginning to the end stage of dry eye treatment

- **Warm compress and lid hygiene - Fire and Ice Mask**
- **Punctal occlusion - EagleVision punctal plugs**
- **Meibomian gland expressors**
- **Amniotic membrane grafts - AmbioDisk™**

For more information on Katena's full line of dry eye solutions visit us at www.katena.com

800.225.1195•info@katena.com•www.katena.com

katena
DESIGNED FOR SIGHT®

KX-Adv-012419-Rev0

Photo: Intrepid

Members of Intrepid pose for a group photo.

"Those who wish to use their profession in service to others can't do it on their own," says Dr. Cheatham. "They need support from others who have experience and professional resources. FCO is able to assist in this."

Five membership plans are available with varying yearly fees—student, resident/fellow, practicing/academic doctor, associate or non-healthcare.[5]

Intrepid Eye Society

In 2015, Intrepid was born with the intention of "bringing together like-minded individuals who display all the best that optometry has to offer," says President Michael S. Cooper, OD. The organization hosts an annual meeting, is planning co-branded CE events and has a research division that will begin producing original work in the near future, according to Dr. Cooper.

"The ideal candidate illustrates the uncanny ability to educate, innovate, collaborate and socially motivate others to elevate the profession," he says. Those interested in applying must be optometrists who have been practicing for between one and 20 years who have been nominated by two members and submit a curriculum vitae.[6] The application must then be approved unanimously by the Executive Committee and a two-thirds majority of all members.[6]

"The chief benefit is that Intrepid is positioned to disrupt the way education is delivered in the future," says Dr. Cooper, who adds that the group welcomes those who are ready to accept and embrace the challenges of the ever-changing educational environment.

International Keratoconus Academy (IKA)

IKA was established in 2014 to raise awareness of the diagnosis and management of keratoconus and other forms of corneal ectasia.[7] The organization provides education at ophthalmic meetings and in virtual environments, says President and Co-founder Barry Eiden, OD. He adds that IKA is involved in ongoing research to increase the understanding of keratoconus.

Interested applicants can register online for one of three free membership plans—eye care provider, federal eye care provider or student.[7] Members enjoy access to resources on keratoconus, teleconference forums on topics related to keratoconus and discounted CE events presented by keratoconus experts from around the world.[7]

International Sports Vision Association (ISVA)

Advances in and a growing awareness of vision testing and training technology led to the founding of ISVA in 2014.[8] The organization aims to "provide a professional association for those interested in the field of sports vision," says Executive Director Gary Esterow.

The group's mission is four-fold: increase awareness of the impact vision training has on athletes, advance the delivery of sports vision care, encourage the involvement of eye care providers with expertise in the field and reduce the risk of traumatic vision- and head-related injuries.[8]

Those interested in joining can register by membership plan—professional, associate or student/resident—and all but students/residents must pay accordingly.[8] Members have the opportunity to attend the organization's annual conference.[8]

"A growing body of evidence confirms that visual abilities can be strengthened and enhanced by means of appropriate visual training," according to Mr. Esterow, who adds that this training can help all athletes achieve higher levels of performance.

National Optometric Association (NOA)

NOA came to life in 1969 during the Civil Rights Movement and "promoted optometrists of color at a time when they faced many challenges and difficulties," says President Sherrol Reynolds, OD. "NOA is dedicated to the optometric profession, improving diversity and inclusion and service to the underserved through our mission

Photo: IKA

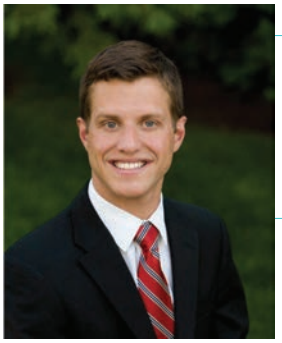
IKA board members take a break for a photo during a lecture.

Specialty Contact Lenses for the Post Surgical Cornea

Atlantis Scleral and its innovative 3D-Vault system makes managing oblate corneas easy...

But not every post-surgical patient needs or wants a scleral lens. We offer specialty lens options that are easy to fit and are cost effective alternatives to sclerals.

Join us at **Vision by Design, May 16-18th, in San Antonio, Texas,** to learn about two custom soft lens designs for post-surgical corneas.



Andrew J. Biondo, OD, FSLS
Kirkwood Eye, Missouri

The Saturday manufacturer seminar will highlight X-Cel's arsenal of custom lenses that are made for all types of post surgical eyes. From the Atlantis Scleral to custom soft designs in the Flexlens family, there is a product to fit every cornea and every budget.

X-CEL
SPECIALTY CONTACTS

Won't be attending VBD? Learn more on our website ECP Resources/Education.

800.241.9312 | www.xcelspecialtycontacts.com/education

of 'advancing the visual health of minority populations,'" according to Dr. Reynolds. NOA helps recruit minority students into schools and colleges of optometry and supports its student branch through mentorships, scholarships, networking opportunities and job placement services, she notes.

Photo: OGS

OGS members break during a meeting for a group photo.

To become a member, applicants must fill out an online application and pay the annual fee assigned to their membership category—student, regular, corporate/affiliate or associate.[9] Member benefits include an annual convention, networking, CE and complimentary events and resources.[9]

"NOA remains committed to addressing eye health disparities through advocacy and community outreach programs to underserved communities," says Dr. Reynolds.

Neuro-optometric Rehabilitation Association (NORA)

In 1990, a group of ODs met to share their experiences diagnosing and treating neurologically and cognitively injured and disabled patients, thus establishing NORA, according to Mr. Esterow, executive director. The group aims to increase awareness of neuro-optometric rehabilitation services, promote professional knowledge and research, and encourage an interdisciplinary approach.[10]

Membership is divided into five categories with different yearly fees that everyone except students/residents must pay—organization, professional, allied professional, family/survivor or student/resident.[10] Members can attend annual clinical skills workshops and NORA's annual general conference at a discounted rate.[10] They also have the opportunity to join the organization's Clinical Skills/Fellowship program to further enhance their clinical abilities and scientific knowledge.[10] Members enjoy a weekly digest with news and organizational events and have access to a bimonthly email that provides advice on marketing strategies.[10]

Optometric Cornea, Cataract and Refractive Society (OCCRS)

Now in its 16th year, OCCRS has evolved to incorporate several advanced, rapidly developing areas within optometry, according to President David Friess, OD. "OCCRS aims to provide clinical and practice management education within optometry for clinical care of anterior segment surgical patients and related topics, such as dry eye and emerging glaucoma surgical treatments," he says.

Members are invited to the organization's annual CE conference at a discounted rate and have ongoing opportunities to network, obtain clinical advice and take advantage of career advancement activities.[11] The organization provides a members-only email forum and hosts social gatherings for those interested in joining.[11]

Optometric Extension Program (OEP)

OEP, founded in 1928, started with study groups that met to discuss and spread new information in the field, says former President Paul Harris, OD. The organization now provides clinical seminars, courses and congresses of optometry that "can help take an optometrist from being a generalist to having the tools and knowledge to offer high-level, excellent-quality vision therapy in their practices," according to Dr. Harris. OEP focuses on visual health and hygiene, visual and ocular problem prevention, visual development and rehabilitation knowledge and vision and visual process enhancement.[12] Members have access to the *Journal of Behavioral Optometry* and the *Journal of Optometry and Visual Performance*.[12] Enrollment is open to everyone.[12]

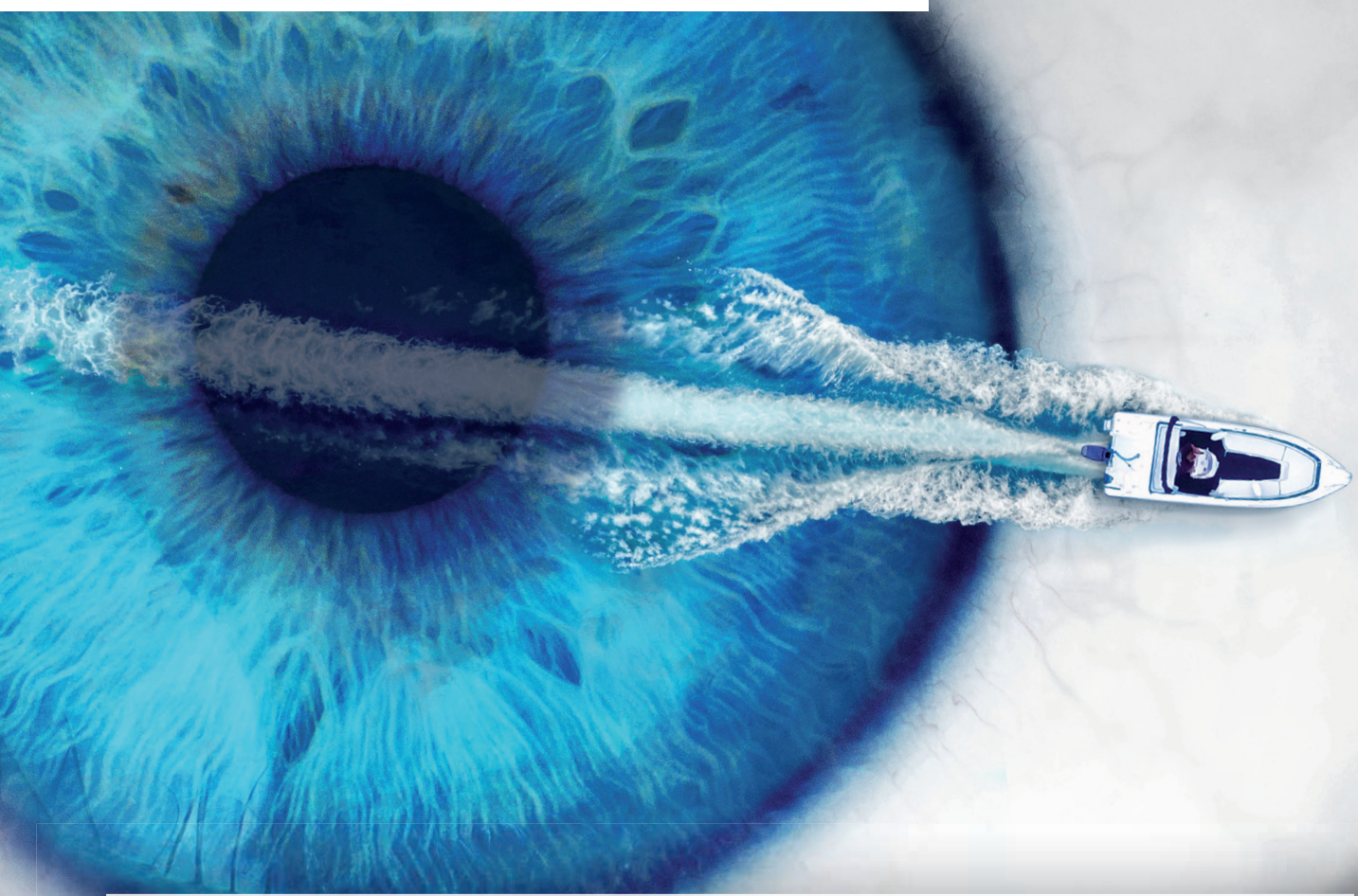
Optometric Glaucoma Society (OGS)

OGS was created in 2002 to enhance the clinical care of glaucoma patients through education and research.[13] Members have access to online resources and are invited to the society's annual meeting, held in conjunction with the AAO's annual meeting, which provides CE and networking opportunities.[13] A subscription to the *International Glaucoma Review* is included with membership, according to Executive Director Kellie Rogers.

Those interested in becoming a part of OGS are required to fill out an online application, submit letters of support from two members and provide the appropriate documentation.[13] Once the executive and membership committees review an applicant's submission to determine eligibility, an affirmative vote by the majority of members is needed.[13] Membership dues are $100 per year.[13]

NEW Cornea Scleral Profile Scan for the Pentacam®

Beyond the Cornea!



The new Pentacam® CSP Report measures, where others are just estimating

Measure beyond past boundaries when fitting scleral lenses. The new CSP Report creates 250 images within the measuring process. The tear film independent measurement with automatic release allows coverage up to 18 mm with the same fixing point.

Contact OCULUS today for more details!

Toll free 888-519-5375 Follow us!
ads@oculususa.com www.oculususa.com

OCULUS®

Optometric Retina Society (ORS)

Founded in 2003, "ORS was created to have a forum where optometrists interested in retinal disease could get together and share ideas, cases and information," says Immediate Past President Steven Ferrucci, OD. "In turn, we could become a source of education for the entire optometric community."

Members enjoy complimentary e-newsletters and the opportunity to attend the organization's annual meeting.[14] The society has three categories of membership, each with minimum requirements for joining—fellow, resident/student or fellow emeritus.[14] Membership is approved by the Membership Committee, president and a majority vote of fellows.[14] All members, except residents/students, must pay a $150 fee every two years.[14]

"Through interactions, collegial discussion and the dissemination of educational materials and ideas, individuals sharing interest in this arena may find resources that improve their abilities to educate others and to serve the welfare of patients, the scientific community and their profession," says Dr. Ferrucci.

Ocular Wellness and Nutrition Society (OWNS)

OWNS was established in 2008 for health care professionals and consumers interested in nutrition as it relates to vision and eye health.[15] The $100 membership fee gives members access to organizational resources, a fellowship program and board members and affiliated experts for mentorship and clinical support.[15] Members also have the opportunity to join the AAO's Nutrition, Disease Prevention and Wellness SIG and receive discounted rates for the University of Western States's nutrition specialist certification program and the organization's fall symposium.[15]

Photo: TFOS

TFOS members do a team bonding activity.

Students can become members of chapters at several optometry schools across the country that have OWNS liaisons serving as resources, and they enjoy lower rates.[15]

"About half of all American adults have one or more preventable chronic diseases, many of which are related to poor quality eating patterns and physical inactivity," according to member Julie Poteet, OD. "All of these chronic diseases have the capacity to affect ocular health. I see it as our duty as a profession to be able to not only treat ocular disease but prevent it as well."

Tear Film and Ocular Surface Society (TFOS)

TFOS was founded on a vision Executive Director Amy Gallant Sullivan's father had when he was in medical school. Together, the pair brought TFOS to life in 2002.

"During the past several decades, a significant international research effort has been directed toward understanding the composition and regulation of the pre-ocular tear film," Ms. Sullivan says. TFOS hosts workshops, networking events and international conferences and creates global consensus reports and campaigns, all of which Ms. Sullivan says is to "promote the importance of eye health and the need for more research and innovation, which facilitate the actions needed to help the world see better."

Membership is free, and benefits include access to a global community, career advice, fellowships, international events and networking opportunities.[16] Members also have access to travel grants, volunteer opportunities and TFOS reports, such as the landmark TFOS Dry Eye Workshop II (TFOS DEWS II).[16]

"TFOS has played an important role in promoting the progress of vision research, increasing international awareness of external eye diseases, enhancing governmental funding for tear film and ocular surface research, stimulating the development of therapeutic drugs and diagnostic devices and influencing the design and conduct of clinical trials of novel treatments for ocular surface disorders," says Ms. Sullivan.

Volunteer Optometric Services to Humanity (VOSH)

The largest all-volunteer humanitarian optometric organization in the world, VOSH was formed in 1971 to provide the gift of vision worldwide by supporting eye clinics, optometry schools and optometric educators in areas lacking sufficient eye care.[17] "As the availability of optometry increases worldwide, access to care for people who currently do not have access will also increase," says President Tracy Matchinski, OD.

Photo: VOSH

A member of VOSH examines a child from Bolivia.

Dr. Matchinski notes that anyone can join their local chapter or start a new one, adding that members pay nominal dues and participate in activities ranging from clinics to fundraising opportunities to educational events and annual meetings. The organization also offers several different programs, including VOSH Corps, the Ambassador Program, the Franklin Harms Society, the Reserves Disaster Recovery Program and the Technology Transfer Program.[17]

"As we help others, the people around us also become inspired," says Dr. Matchinski. "It is a domino effect. The good of VOSH is what we do and what we inspire others to do."

If you don't see something that calls to you, you can always create your own special interest group. After all, each of these organizations began with one person who had an idea—and one that was shared by others. Don't be afraid to go the extra mile and find these people and, combining collaboration and drive, transform your vision into reality to better the optometric profession. ■

1. American Academy of Optometry. www.aaopt.org. Accessed March 8, 2019.
2. American Optometric Association. www.aoa.org. Accessed March 8, 2019.
3. American Society of Optometric Surgeons. asos.clubexpress.com. Accessed March 8, 2019.
4. College of Optometrists in Vision Development. www.covd.org. Accessed March 8, 2019.
5. Fellowship of Christian Optometrists. cmda.org/fellowship-of-christian-optometrists. Accessed March 8, 2019.
6. Intrepid Eye Society. intrepideyesociety.com. Accessed March 8, 2019.
7. International Keratoconus Academy. www.keratoconusacademy.com. Accessed March 8, 2019.
8. International Sports Vision Association. www.sportsvision.pro. Accessed March 8, 2019.
9. National Optometric Association. nationaloptometricassociation.com. Accessed March 8, 2019.
10. Neuro-optometric Rehabilitation Association. noravisionrehab.org. Accessed March 8, 2019.
11. Optometric Cornea, Cataract and Refractive Society. www.occrs.org. Accessed March 8, 2019.
12. Optometric Extension Program. www.oepf.org. Accessed March 8, 2019.
13. Optometric Glaucoma Society. optometricglaucomasociety.org. Accessed March 8, 2019.
14. Optometric Retina Society. www.optometricretinasociety.org. Accessed March 8, 2019.
15. Ocular Wellness and Nutrition Society. www.ocularnutritionsociety.org. Accessed March 8, 2019.
16. The Tear Film and Ocular Surface Society. www.tearfilm.org. Accessed March 8, 2019.
17. Volunteer Optometric Services to Humanity. vosh.org. Accessed March 8, 2019.

Environmental Protection

External organisms cause more aggressive cases of microbial keratitis than those native to the eye. Daily disposable use reduces the risk. **Edited by Joseph P. Shovlin, OD**

Q I recently heard a lecture about the different organisms that can cause infection in contact lens wearers. The lecturer made a point of separating these organisms into two different categories: environmental organisms and endogenous organisms. What are some examples of each and how do the two groups of organisms differ from each other?

A Organisms derived from either environmental or endogenous sources are similar in that they can all cause microbial keratitis (MK) in contact lens wearers, according to Fiona Stapleton, PhD. But they differ in their origins.

Environmental organisms exist in our external surroundings and are usually not part of the normal human microbiota. Examples of this class of organisms that cause MK include gram-negative bacteria, such as *Pseudomonas aeruginosa* and *Serratia marcescens*, and other types of organisms, such as filamentous fungi like *Fusarium* spp. and *Aspergillus* spp. and protozoa like *Acanthamoeba* spp., she notes. Dr. Stapleton adds that these organisms are more likely to be associated with MK in warmer or more tropical climates.[1] She lists water, soil, vegetation, dust and airborne particles as environmental sources of organisms.

Dr. Stapleton notes that endogenous organisms, on the other hand, include those derived from the skin, such as coagulase-negative *Staphylococci* and *Staphlococcus aureus*, in the upper respiratory tract, such

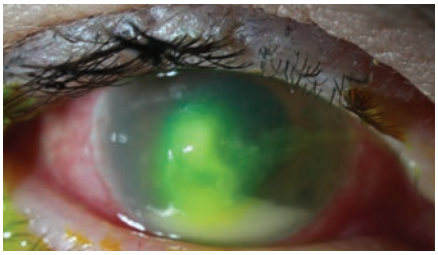
Corneal Scrape Results For Daily Disposable Wearers and Other Soft and Silicone Hydrogel Lens Wearers From Three Geographic Sites[5]

Scrape Result	Daily Disposable Wearers (n=55)		Non–Daily Disposable Soft and SiHy Wearers (n=200)	
CULTURE-NEGATIVE	**35**	**64%**	**99**	**50%**
GRAM-POSITIVE BACTERIA*	**9**	**16%**	**27**	**14%**
Staphylococcus aureus	0	0%	4	2%
Coagulase-negative *staphylococci*/other *staphylococci*	8	15%	15	8%
Streptococcus pneumoniae	0	0%	1	1%
Streptococcus viridans	1	2%	1	1%
Corynebacterium sp.	0	0%	3	2%
Other gram-positive bacteria	0	0%	3	2%
ENVIRONMENTAL ORGANISMS**	**11**	**20%**	**74**	**37%**
Gram-negative bacteria	**10**	**18%**	**64**	**32%**
Pseudomonas aeruginosa or spp.	9	6%	53	27%
Serratia marcescens	1	2%	8	4%
Klebsiella oxygenate	0	0%	2	1%
Other gram-negative bacteria	0	0%	1	1%
***Nocardia* spp.**	**0**	**0%**	**2**	**1%**
Acanthamoeba	**0**	**0%**	**5**	**3%**
Fungi	**1**	**2%**	**3**	**2%**
Fusarium dimerum	1	2%	0	0%
Acremonium spp.	0	0%	1	1%
Trichosporon mucoides	0	0%	1	1%
Candida spp.	0	0%	1	1%

*Gram-positive bacteria included endogenous species and excluded *Nocardia* spp.

**Environmental organisms included Gram-negative bacteria, fungi, *Acanthamoeba* spp. and *Nocardia* spp.

Photo: Aaron Bronner, OD



***Pseudomonas aeruginosa* is one of the leading causes of contact lens–related MK.**

as *Streptococcus pneumoniae* and *Streptococcus viridans*, and in the gastrointestinal tract, such as *Escherichia coli* and *Klebsiella* spp.

Breeding Grounds

Contact lenses and ocular surfaces interact with these organisms in one of two ways, according to Dr. Stapleton, either through direct contact (e.g., showering in lenses) or indirect contact (e.g., handling of lenses).

Many studies agree that, depending on the geographic area, the majority (60%) of contact lens-related MK cases are caused by *Pseudomonas aeruginosa* and that environmental organisms make up about 75% of all culture-proven contact lens-related infections.[1-4] In daily disposable contact lens wearers with MK, however, a study that Dr. Stapleton led found that significantly fewer infections were caused by environmental organisms.[5] Dr. Stapleton suggests that this could be due to the lack of a storage case, which she adds may act as a vector for certain organisms.

Ward Off the Threat

Dr. Stapleton stresses that the type of causative organism has a major impact on the outcome of the disease, including the likelihood of vision loss, subsequent ocular surgery and the duration and cost of treatment.[6] MK caused by environmental organisms tends to be more severe and vision-threatening than that caused by endogenous organisms, she says.[1,6]

Due to the high prevalence of contact lens-related MK cases caused by *Pseudomonas aeruginosa*, Dr. Stapleton notes that antibiotic treatment should have appropriate sensitivity in gram-negative bacteria. She recommends switching contact lens wearers to daily disposables to reduce the risk of severe disease in the first place. She also suggests informing contact lens users who live in or travel to warm or more tropical climates that they are more exposed to MK and educating them on proper precautions. ■

1. Stapleton F, Keay LJ, Sanfilippo PG, et al. Relationship between climate, disease severity, and causative organism for contact lens-associated microbial keratitis in Australia. Am J Ophthalmol. 2007;144(5):690-8.
2. Schein OD, Poggio EC. Ulcerative keratitis in contact lens wearers. Incidence and risk factors. Cornea. 1990;9(Suppl 1):S55-8, S62-3.
3. Galentine PG, Cohen EJ, Laibson PR, et al. Corneal ulcers associated with contact lens wear. Arch Ophthalmol. 1984;102(6):891-4.
4. Green M, Apel A, Stapleton F. Risk factors and causative organisms in microbial keratitis. Cornea. 2008;27(1):22-7.
5. Stapleton F, Naduvilath T, Keay L, et al. Risk factors and causative organisms in microbial keratitis in daily disposable contact lens wear. PLoS One. 2017;12(8):e0181343.
6. Keay L, Edwards K, Naduvilath T, et al. Factors affecting the morbidity of contact lens-related microbial keratitis: a population study. Invest Ophthalmol Vis Sci. 2006;47(10):4302-8.

The Cornea's Limited Vocabulary

With only five possible dysfunctions, it should be easy to figure out what's wrong.

By Paul M. Karpecki, OD

The cornea is rather dumb. At least that's what Daniel Durrie, MD, told me during my cornea fellowship in the mid '90s. These words of wisdom from one of the top cornea and refractive surgeons have stuck with me to this day.

Unlike most other tissues, the cornea has no blood vessels or lymphatics and thus has limited potential responses to disease or injury—only five, in fact: thin, infiltrate, break down/abrade, deposit and swell (although I've added two subcategories here). Once you understand these, you can recognize and effectively manage every corneal presentation. Here's the life of a compromised cornea and its limited responses:

1. Thin

This includes keratoconus, as progression not only affects Ks and, eventually, refraction but also peripheral corneal thickness. To determine early keratoconus or pellucid marginal degeneration, look at the peripheral cornea at 5, 6 and 7 o'clock. Normally, the cornea thickens by 20µm to 50µm as you move to the periphery. A peripheral cornea that isn't at least 20µm thicker than the central cornea is suspect.

New surgical advances such as corneal crosslinking for early cases of keratotconus and deep anterior lamellar keratoplasty (DALK) are showing great success in advanced ectasia cases. Find surgeons with experience with DALK so you can best manage your patients with keratoconus. Other conditions that cause thinning include peripheral degenerations such as Terrien's or furrow degeneration (*Figure 1*).

• ***Subcategory—Ulcerate.*** Although this also fits in the category of thinning, it's on its own here because of the need for urgent management (*Figure 2*). Ulceration can be infectious or non-infectious. Corneal infections range from bacterial keratitis and herpes dendritic epithelial keratitis to the rarer fungal and parasitic forms such as *Acanthamoeba*.

It can also be non-infectious, such as those related to a neurotrophic cornea or inflammatory in cases of rheumatoid corneal melts and Mooren's ulcers.

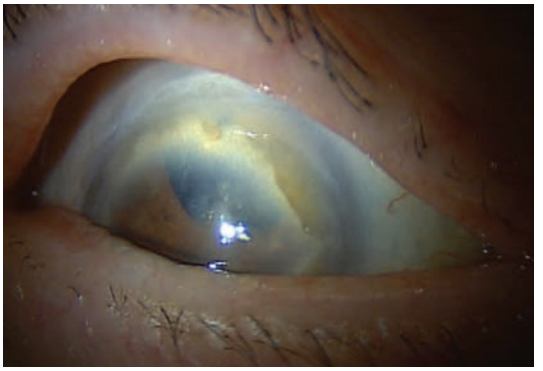


Fig. 1. Like many with Terrien's marginal degeneration, this patient has corneal thinning.

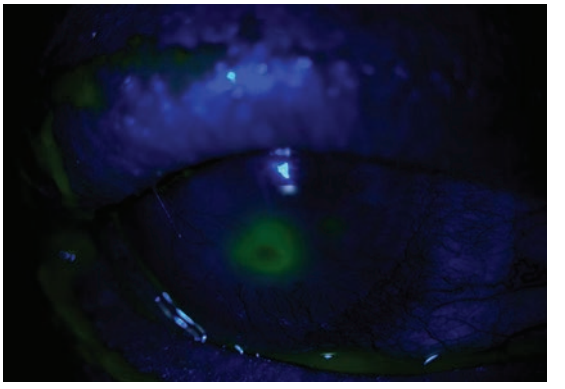


Fig. 2. Corneal ulceration requires urgent management to avoid long-term visual consequences.

2. Infiltrate

Because the vasculature is outside the cornea, white blood cells can't directly get to the tissue; however, they can infiltrate and form within the cornea. Pathogens can also penetrate or infiltrate the cornea if given an opportunity. The presentation of infiltration can vary from extreme, as in the case of an advanced microbial keratitis, to lesser degrees as seen in epidemic keratoconjunctivitis, peripheral marginal keratitis or Staphylococcal hypersensitivity.

Suppressing white blood cells to prevent corneal scarring may involve aggressive infection control when the underlying cause is infectious, or steroids when it is inflammatory (*Figure 3*). I include vascularization in this category as well, considering it is the body's response to corneal infiltration.

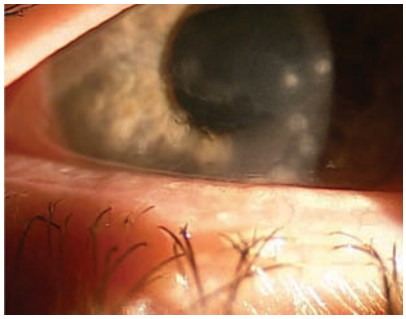


Fig. 3. Preventing corneal scarring is key when treating corneal infiltrates.

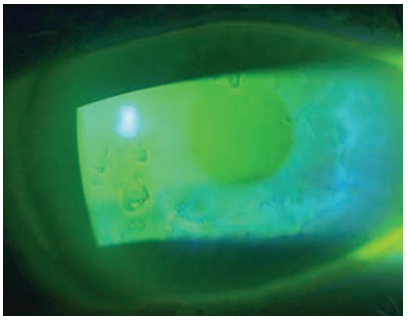


Fig. 4. Epithelial basement dystrophy can cause recurrent corneal erosion.

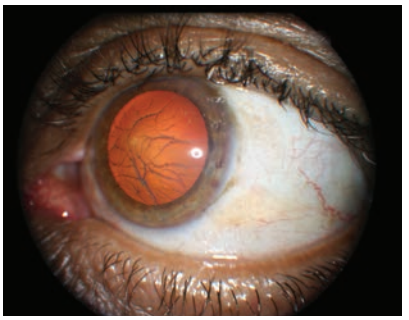


Fig. 5. Lattice corneal dystrophy is characterized by amyloid deposition.

3. Break Down/Abrade

The epithelium serves to protect the delicate nerves and structures of the cornea but can be abraded by trauma or other conditions such as recurrent corneal erosion (RCE) (*Figure 4*). My protocol for managing recurrent corneal erosion, especially recalcitrant forms, has changed over the years with the advent of amniotic membrane, which now plays an early and important role.

4. Deposit

Various compounds can accumulate in the cornea and disrupt its function (*Figure 5*). The deposits can be due to genetic causes such as corneal dystrophies, epithelial basement dystrophy with the deposition of redundant basement membrane, drugs (e.g., amiodarone) and even compounds such as copper (Wilson's disease) and cholesterol (arcus senilis, lipid keratopathy and Snyder's crystalline dystrophy).

• ***Subcategory—Scar.*** This phenomenon is arguably a deposition of scar tissue or calcium, as in band keratopathy, thus limiting the cornea's vocabulary to only five functions. Scarring has its own subcategory here simply because it is the end stage of disease for the cornea.

5. Swell

The purpose of the endothelium is primarily to prevent edema within the cornea. Our endothelial cells continuously pump fluid out of the cornea, especially in the morning to overcome the natural overnight corneal swelling. When this delicate balance is affected, as in cases of Fuchs' dystrophy, patients notice blurring, particularly in the morning, and night vision problems such as halos (*Figure 6*). Specular microscopy, once thought to be a tool reserved for cornea specialists, is making its way into primary eye care offices as the only way to monitor endothelial health and make a proper and timely referral to a cornea specialist.

This approach is a significantly different way to look at the cornea, but one I often use when seeing patients referred for unknown corneal presentations. Sometimes, categorizing the cornea's response can make a huge difference in both the final diagnosis and the optimal treatment strategy. The cornea's limited vocabulary helps all of us who manage corneal disease regularly; there isn't much else this unique and vital tissue can do, and knowing the five essential presentations is key. ■

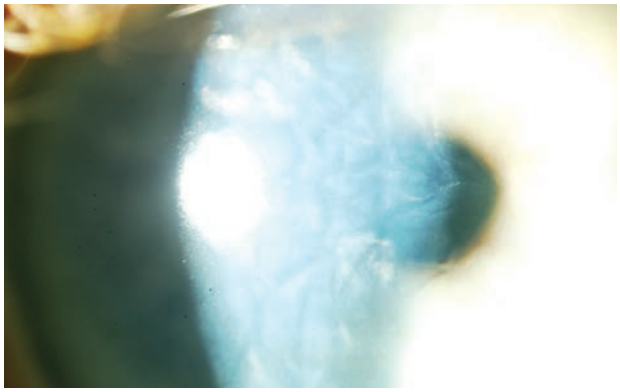


Fig. 6. Patients with Fuchs' dystrophy often have visual symptoms, such as halos, due to corneal edema.

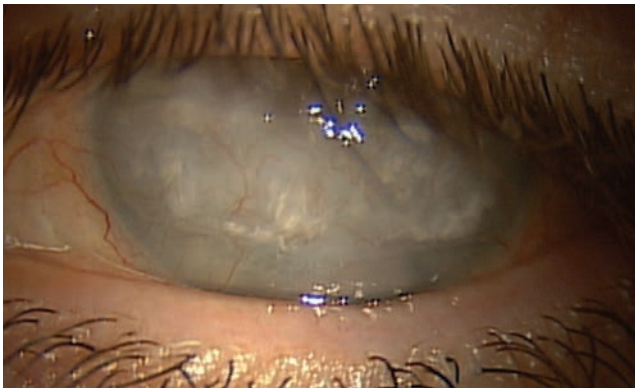


Fig. 7. This patient who experienced a central retinal artery occlusion later developed band keratopathy and corneal scarring.

Aries Rising

Can you identify the reason for this woman's severe decrease in acuity?

By Shreya Jayasimha, OD, and Mark Dunbar, OD

A 76-year-old African-American female presented for decreased vision at distance and near without correction for the past two to three years. While her ocular history was unremarkable, her medical history was positive for diabetes over the past two years and hypertension for the past 20 years, which are both medically controlled with metformin and amlodipine, respectively. Per her report, her last fasting blood sugar level measured 125mg/dL with an A1c of 5.9% and her latest blood pressure reading measured 136/80. She denies any alcohol, smoking or illicit drug use.

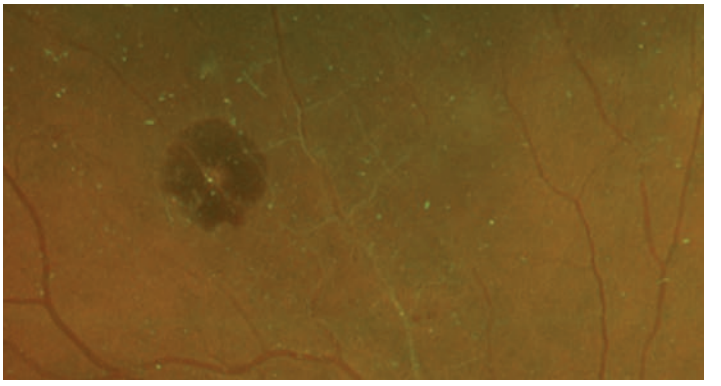


Fig. 1. These dilated fundus shots show changes to the 76-year-old patient's retina.

On examination, her best-corrected visual acuities were 20/400 OD and 20/400 OS with a fluctuating prescription due to poor patient responses. Vision was slightly reduced to counting fingers at three feet in her right eye and 20/400 in her left during glare testing. Confrontation visual fields and extraocular motilities were full for both eyes. Pupils were equal, round and responsive to light with no afferent pupillary defect.

Intraocular pressures measured 21mm Hg for both eyes. Blood pressure measurement in office was measured to be 138/86.

Anterior segment health revealed 3-4+ nuclear sclerotic cataracts with brunesence in both eyes. A dilated fundus exam revealed changes (*Figure 1*). The left eye was completely normal. Optical coherence tomography (OCT) imaging of the right eye was also performed (*Figures 2 and 3*).

Take the Retina Quiz

1. Describe the fundus appearance of the right eye.
a. Attenuated vessels with an area of retinal pigment epithelium hypertrophy superiorly.
b. Hemorrhage superiorly underlying a vessel with an adjacent area of sclerotic vessels.
c. Choroidal neovascular membrane with surrounding subretinal hemorrhage superiorly.
d. Pigment clumping superiorly with an adjacent area of sclerotic vessels.

2. What is the likely diagnosis?
a. Diabetic retinopathy.
b. Branch retinal vein occlusion.
c. Exudative age-related macular degeneration.
d. Retinal arterial macroaneurysm.

3. What is the most common underlying cause?
a. Diabetes.
b. Hypertension.
c. Carotid occlusive disease.
d. Cardiac valve disease.

4. What is the appropriate treatment for our patient?
a. Pars plana vitrectomy.
b. Argon laser photocoagulation.
c. Observation.
d. Anti-VEGF injection.

Diagnosis

Based on the history and clinical presentation, the patient was diagnosed with retinal arterial macroaneurysm (RAM) of the right eye. RAM is typically described as an idiopathic, acquired focal dilation of a major retinal arteriole that is typically located within the first three bifurcations, at branch points or at arteriovenous crossings.[1] It is also most commonly reported to occur within the superotemporal quadrant of the posterior pole.[2]

CLEAR CARE® PLUS
SUCCESS MADE SIMPLE

William Townsend, OD, FAAO

Advanced Eye Care
Canyon, TX

Dr. Townsend was compensated by Alcon for his participation in this testimonial.

My practice is located in a hot and dry part of the country, where seasonal changes and dry environments pose a significant challenge for my patients to maintain comfortable contact lens wear. For instance, with summer upon us, my patients are engaging in more outdoor activities like long walks, horseback-riding and hiking. Such activities expose them to dry air and can really take a toll on their contact lens wearing experience. While I recommend lenses with materials and surface technologies designed to help increase my patients' comfort, I truly believe that the right lens care solution can go a long way in making contact lens wear more comfortable. To me, particularly for all of my weekly and monthly replacement lens-wearing patients, that solution is CLEAR CARE® PLUS.

What makes CLEAR CARE® PLUS stand out is the wetting agent, HydraGlyde® Moisture Matrix, which envelops the lens in long-lasting surface moisture,[1,2] and makes lenses feel like new.[3] As a result, the lenses provide exceptional end-of-day comfort.[4] For these very reasons, I myself was an early user of CLEAR CARE® PLUS and was very impressed by how comfortable my eyes felt throughout the day. When I recommend CLEAR CARE® PLUS to my patients, they notice it as well. Many of them tell me that when they use CLEAR CARE® PLUS, they are able to wear their lenses (regardless of brand) for a full day without discomfort, which complements a recent study that showed an increase of 3 hours of comfortable wear time per day after using CLEAR CARE® PLUS for 30 days.[4]*

> One of my nature-loving patients raved about how she can participate in outdoor activities for long periods of time without her lenses getting dry and uncomfortable.

One of my nature-loving patients raved about how she can participate in outdoor activities for long periods of time without her lenses getting dry and uncomfortable. Especially in our climate, my patients' success with CLEAR CARE® PLUS is a true testament that the product delivers outstanding all-day comfort.[4]

My patients love how their lenses feel with CLEAR CARE® PLUS, and I can rest assured that it gives my patients exceptional protection against ocular infections while being easy for them to use.[3,5,6] At the end of the day, satisfied patients can translate into a successful practice, and CLEAR CARE® PLUS is the lens care solution that will help make that happen. By recommending that they clean and disinfect their lenses daily with CLEAR CARE® PLUS, you will help your patients, and ultimately your practice, succeed.

*Symptomatic AIR OPTIX® AQUA contact lens wearers experienced 12.1 hours of comfortable wear time compared to 8.73 hours with their habitual MPS as baseline.

References 1. Muya L, Scott A, Alvord L, Nelson J, Lemp J. Wetting substantivity of a new hydrogen peroxide disinfecting solution on silicone hydrogel contact lenses. Poster presented at the British Contact Lens Association 39th Clinical Conference & Exhibition, Liverpool, UK, May 29-31, 2015. **2.** Alcon data on file, 2014. **3.** Alcon data on file, 2016. **4.** Alcon data on file, 2016. **5.** Gabriel M, Bartell J, Walters R et al. Biocidal efficacy of a new hydrogen peroxide contact lens care system against bacteria, fungi, and Acanthamoeba species. *Optom Vis Sci*. 2014;91:E-abstract 145192. **6.** Alcon data on file, 2014.

SEE LOOK FEEL

Sponsored by Alcon A Novartis Division

In our patient, we see a whitish aneurismal dilation along the superior temporal artery with surrounding retinal hemorrhage. We also noted sheathing in several of the retinal arteries nasal to it, suggesting she had a previous vascular event, quite possibly an old branch retinal artery occlusion. No exudation or exudative retinal detachment was seen.

Discussion

Retinal arterial macroaneurysms present mainly in females in their sixth decade of life.[1] It is typically a singular and unilateral finding, although 10% of cases reported bilateral RAMs and 20% of cases reported the presence of multiple RAMs along the same vessel or multiple vessels.[2]

The underlying pathophysiology of RAM is poorly understood. One hypothesis states that vessel wall fibrosis secondary to arteriosclerosis leads to decreased wall elasticity, that in combination with increased luminal pressure creates an aneurysmal dilation of the arteriole.[3] Another hypothesis states that emboli cause damage to the endothelium of the vessel wall, rendering it weak and more likely for aneurysm formation.[4] Yet other studies have claimed that prolonged hypertension can cause chronic venous stasis, which in turn predisposes arterioles to aneurysmal dilation.[3] Regardless of the pathogenesis, the bottom line remains that a weakened vessel wall has a higher susceptibility to aneurysm formation.

RAM is rarely seen in practice. It often presents as focal dilations of a major arteriole structure that is either saccular or fusiform in shape. Saccular macroaneurysms (sac-like) balloon out on one side of the arteriole while fusiform macroaneurysms (round) balloon out on both sides of the blood vessel.[4] Exudative RAM cases are thought to be fusiform in nature while hemorrhagic RAMs are thought to be saccular.[4] The typical clinical course of a RAM involves enlargement of the arteriole, thrombosis, fibrosis and, ultimately, involution.[1]

RAMs can be categorized as exudative, hemorrhagic or quiescent. Exudative RAMs usually present with exudates found in a circinate pattern around the ruptured aneurysm with concomitant intraretinal and subretinal fluid accumulation.[2] Hemorrhagic RAMs are larger than 1DD in area, can affect central vision and typically tend to leak blood into multiple layers of the retina.[2] This is due to the fact that arteries are high flow vessels and when they rupture, they do so under significant pressure, pushing blood into multiple layers of the retina. As such, it is not uncommon to see blood in the subretinal, intraretinal, preretinal and vitreal layers of the eye.[2] Fortunately, this is not the case in our patient. Our patient has more of a quiescent RAM, in which the hemorrhages or exudation spare the macula and do not affect final visual acuity.[1]

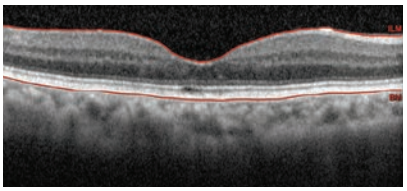


Fig. 2. OCT of our patient's right eye.

Many risk factors can predispose an individual to acquiring a RAM. Systemic hypertension is a major risk factor for the development of RAMs, accounting for 61% to 81% of cases.[2] In fact, due to the presence of sclerotic vessels found adjacent to the RAM in our patient, hypertension is likely the predominating cause. Additional major risk factors include age (>60 years old) and gender (female).[2] While not consistently observed in all cases, the literature states that conditions such as elevated lipid levels, diabetes, polyarteritis nodosa, sarcoidosis, rheumatoid arthritis and Raynaud's phenomenon are linked to RAM.[2] Differential diagnoses for this condition include, but are not limited to, diabetic retinopathy, radiation retinopathy, capillary hemangioma, Coats' disease and wet macular degeneration.[3] A thorough case history and various imaging modalities can be used to hone in on the diagnosis.

Imaging tools such as OCT of the macula, fundus photography, B-scan ultrasound and occasionally fluorescein angiography can be helpful in diagnosing retinal arterial macroaneurysms.[2] While macular OCT can highlight the presence of edema and fundus photography can monitor the course of this condition, B-scan ultrasound is typically only used in cases when direct view to the fundus cannot be attained. In fluorescein angiography studies, RAM fills up uniformly in the early phase, thereby highlighting the focal dilation of the arteriole followed by a late leakage.[4] For our patient, a baseline fundus photograph was attained to highlight the area of bleeding superotemporal to the macula with an adjacent area of sclerotic vessels.

Depending on the location and associated complications of a RAM, symptoms can vary greatly. Most patients are typically asymptomatic with RAM being an incidental finding during a dilated examination. Sudden, severe, painless vision loss associated with a RAM can be attributed to fluid or blood accumulation within the macula.[1] Based on the superotemporal location of the RAM, our patient was asymptomatic. However, when vision loss does occur, it is not necessarily permanent. Vision restoration is usually achieved in these cases unless there is extensive hemorrhaging or chronic macular edema present.[3] Ultimately, the location and severity

of a retinal arterial macroaneurysm determines the initial and final visual outcome.

Management

The natural history of this condition suggests that most RAMs involute spontaneously with a favorable visual outcome.[4] As such, most patients can be safely observed at one to three month intervals until resolution.[4] Indications for further treatment are determined based on the presence of exudates, fluid or blood within the macula as well as the persistent nature of this condition. Argon laser photocoagulation can be applied directly to the RAM to prevent it from rupturing.[4] Indirect laser can also be used to decrease oxygen consumption and reduce blood flow to the RAM, thus lowering the amount of exudation from the surrounding capillaries.[4] Anti-VEGF injections may also provide an alternative option for minimizing the presence of macular edema.[3] Finally, in the setting of a vitreous hemorrhage, pars plana vitrectomy can be performed.[2] Treatment varies on a case-by-case basis. Due to the peripheral location of the RAM, our patient is currently being monitored at monthly intervals.

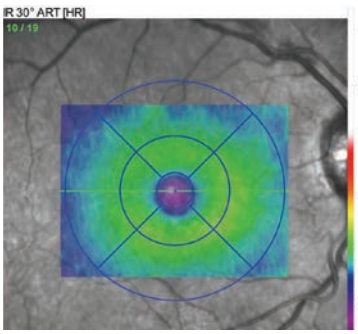


Fig. 3. This retinal thickness map reveals crucial diagnostic information.

Overall, RAMs are rare and mostly present as an incidental finding. As such, a keen eye is necessary to diagnose and treat this condition. While there are multiple treatment options available for RAMs, an established treatment protocol is yet to be determined.[1] With that said, most RAMs run a benign course with a spontaneous regression and a favorable final visual outcome. ■

Dr. Jayasimha is an optometric resident at Bascom Palmer Eye Institute in Miami.

1. Feldman B, Mozayan E, Karth P, Sjaj V. Macroaneurysm. EyeWiki. eyewiki.aao.org/Macroaneurysm. October 17, 2015. Accessed March 8, 2019
2. Venkateswaran N, Flynn H, Leung M. Managing retinal macroaneurysms. Rev Ophthalmol. 2018;25(11):50-3.
3. Ng W, Mathur R, Ting D. Diagnosis and management of retinal arterial macroaneurysm. Eyenet. www.aao.org/eyenet/article/diagnosis-of-retinal-arterial-macroaneurysm. June 2018. Accessed March 8, 2019.
4. Speilburg A, Klemencic S. Ruptured retinal arterial macroaneurysm: Diagnosis and management. J Optometry. 2014;7(3)111-76.

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

Just Zap It

Floaters are a nuisance for everyone. When they affect vision, consider referring for vitreolysis. **By Jessica Schiffbauer, OD**

Floaters are one of the most irritating complaints, as patients offer an array of different descriptions, such as black spots, bugs, spider webs and strings. Patients also complain that floaters affect their daily life, and they don't want to hear their optometrist say, "Your brain will get used to them." Fortunately, a few treatment options exist to address floaters, including vitrectomy or vitreolysis.

To ensure safety during vitreolysis, the surgeon should keep the floater in focus while the retina is out of focus.[3]

Good Candidates

A patient should be symptomatic for at least four to six months before recommending treatment. Additionally, the symptoms should be equivalent to the exam findings. Good candidates report impaired vision with certain activities and should have no previous retinal tears or detachments and no significant corneal or lens pathology that would impair a view of the vitreous.

Procedure

Vitreolysis is becoming more familiar to both practitioners and patients. It is the least invasive choice to combat floaters. The surgeon aims a YAG laser at the vitreal opacities to degrade them into smaller fragments and move them away from the visual axis. The YAG laser features a fast-pulse rise time of four nanoseconds and a small spot size.[1] Typically, about 150 to 200 pulses with approximately 3mJ to 8mJ of energy are used to treat the vitreal opacities.[2] The amount of energy depends on the size, number and location of the opacities.[1] One surgeon notes that location is key to determining the number of shots; for example, if the floaters are more posterior, less energy is necessary.[1] If a patient has multiple vitreous opacities, a vitrectomy may be a better option. Patients should be seen within a week to check intraocular pressure (IOP).

The treatment zone should be approximately 2mm to 3mm away from the lens and 2mm to 3mm from the retina.[1] These parameters are important to keep in mind to lower the risk of inducing a retinal defect, causing lens damage or pitting, or any IOP elevation.[1]

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

Risks and Benefits

While vitreolysis is a much less invasive procedure than vitrectomy, there is no guarantee that the floaters will be completely gone from the patient's vision, but hopefully they will be less bothersome. Nonetheless, an observational study shows that 93% of patients (296 eyes) were satisfied following YAG vitreolysis.[1] In a randomized clinical trial comparing YAG laser vitreolysis with sham YAG vitreolysis, 54% in the YAG laser group reported improvement in symptoms versus 9% in the sham group.[2] No adverse effects were noted. Another study recorded complication rates as low as 0.1% with vitreolysis.[2]

Risks of vitreolysis include the possibility of retinal breaks or detachments, along with cystoid macular edema. Patients may also be at risk for damage to the crystalline lens or intraocular implant and increased IOP.[4]

Vitreolysis has been around for many years, but it's starting to gain more attention because more physicians are performing the procedure and patients are looking for a less invasive way to remove their pesky floaters. Overall, vitreolysis is quite safe, painless, effective and helps improves patients' quality of life. ■

Dr. Schiffbauer practices at Virginia Eye Consultants.

1. Singh IP. Treating vitreous floaters: patient satisfaction and complications of modern YAG vitreolysis. Paper presented at the American Society of Cataract and Refractive Surgery Annual Meeting, May 7, 2016; New Orleans, LA.
2. Shah CP, Heier JS. YAG laser vitreolysis vs sham YAG vitreolysis for symptomatic vitreous floaters: a randomized clinical trial. JAMA Ophthalmol. 2017;135(9):918-23.
3. The evolving view of laser vitreolysis. Cat Refract Surg Today. https://crstoday.com/articles/the-evolving-view-of-laser-vitreolysis/the-evolving-view-of-laser-vitreolysis-2. Accessed March 5, 2019.
4. Hahn P, Schneider EW, Tabandeh H, et al. Reported complications following laser vitreolysis. JAMA Ophthalmol. 2017;135(9):973-76.

REVIEW
EDUCATION GROUP

Optometry CE Study Center

The CE You Need In 2019!

As low as
$17.50
per Credit Hour

Buy just one 2-hour course for $35 or buy as many as you need

Choose from over 50 individual CE courses

Includes the hard to find topics that fulfill your state requirements

All available in a convenient online format

Purchase Now!
www.reviewsce.com

The CE Study Center courses have been developed in conjunction with expert faculty from leading schools of optometry and are oriented toward clinical practice issues that are designed to assist eye care professionals in serving their patient's healthcare needs. CE Courses also appear in print monthly in Review of Optometry.

1-800-825-4696 • INFO@REVIEWSCE.COM
These COPE-Accredited CE courses are administered in partnership with an accredited school of optometry.

cope

SALUS UNIVERSITY
Pennsylvania College of Optometry

Earn up to 18 CE Credits*

NEW TECHNOLOGIES & TREATMENTS IN 2019 EYE CARE REVIEW EDUCATION GROUP

Nashville

PROGRAM CHAIR

Paul M. Karpecki, OD, FAAO

Douglas K. Devries, OD

Ben Gaddie, OD, FAAO

Jay M. Haynie, OD, FAAO

ABOUT

May 17-19, 2019

Join Review's New Technologies & Treatments in Eye Care May 17-19, 2019, at the Gaylord Opryland in Nashville.

This meeting provides up to 18* COPE CE credits including interactive workshops!**

LOCATION

Gaylord Opryland

2800 Opryland Drive
Nashville, TN 37214
Reservations: 615-889-1000

Key Amenities:

- Airport Shuttle
- Full service spa
- Golf
- Fitness Center

REGISTRATION

Three Ways to Register

ONLINE:
www.reviewsce.com /nashville2019

CALL:
1-866-658-1772

E-MAIL:
reviewmeetings@jhihealth.com

Registration Cost: $495

REGISTER ONLINE: WWW.REVIEWSCE.COM/NASHVILLE2019

Administered by REVIEW EDUCATION GROUP

cope *Approval pending

SALUS UNIVERSITY Pennsylvania College of Optometry

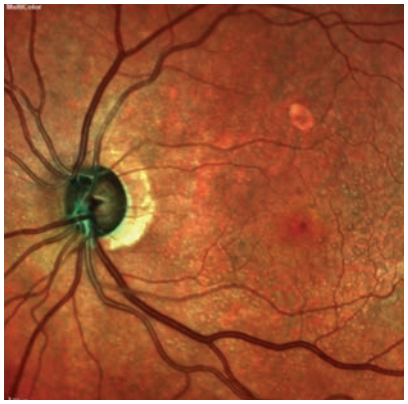
Partially supported by unrestricted educational grants from
Sun Pharmaceuticals Shire Bausch & Lomb Alcon

Review Education Group partners with Salus University for those ODs who are licensed in states that require university credit.
**Subject to change, separate registration required. See event website for complete details.

Breaking it to the Broken

Delivering bad news requires compassion and confidence. **By James L. Fanelli, OD**

In February, a new patient—a 78-year-old female—presented with complaints of sudden onset of blur, in the right eye more so than the left, for the last month. She reported that her vision in the right eye in particular was blurry, "as if I'm looking through something." She reported that her last ophthalmic examination was approximately a year and a half earlier and her doctor then had reported that everything "was fine."



This multimodal image shows the patient's left optic nerve. Note the significant neuroretinal rim thinning.

Her current medications included simvastatin, atenolol, metformin, Prilosec, Lexapro (escitalopram, Teva), vitamin supplements and ibuprofen. She did not tolerate Lopid (gemfibrozil, Pfizer), she reported.

On gross physical exam, she presented with a cane and guarded ambulation, secondary to a fibular fracture on her right side. She was also casted on her right arm, the result of a pickleball injury during which her leg was also injured. During rehab, she fell again and fractured her right radius.

She had recently moved to the area to be closer to family, but what should have been a positive lifestyle move had morphed into one medical problem after another, and the patient was understandably upset. I'll get to the relevance of this shortly.

Diagnostic Data

She was diagnosed with Type 2 diabetes 15 to 20 years earlier, with reportedly good control. She was unsure of her last A1c, but reported that her internist was not concerned with the value. She did not check her glucose levels regularly.

Her entering visual acuities were 20/40-2 OD and 20/40 OS through compound hyperopic astigmatic correction. Her best-corrected visual acuities were 20/40 OD and 20/30 OS with minimal refractive change.

Her pupils were equal, round, responsive to light and accommodation with no afferent pupillary defect. Her extraocular muscles were full in all positions of gaze. However, a slit lamp examination of her anterior segments was remarkable for moderate blepharitis in both eyes, with concurrent diffuse staining of the lower corneas. Her angles were wide open, as the patient was pseudophakic. There was no evidence of iris neovascularization in either eye and her applanation tensions were 11mm Hg OD and 12mm Hg OS.

Through dilated pupils, her intraocular lenses (IOLs) were clear and centered in the capsular bags. There was mild posterior capsular opacification in her right eye well off the visual axis, and the posterior capsule of the left eye was opened. Her cup-to-disc ratios were 0.75 x 0.90 OD and 0.6 x 0.80 OS. Her neuroretinal rims were exceedingly thin temporally in both eyes, with significant loss of the rim tissue in the right eye inferotemporally. There was mild bilateral peripapillary atrophy.

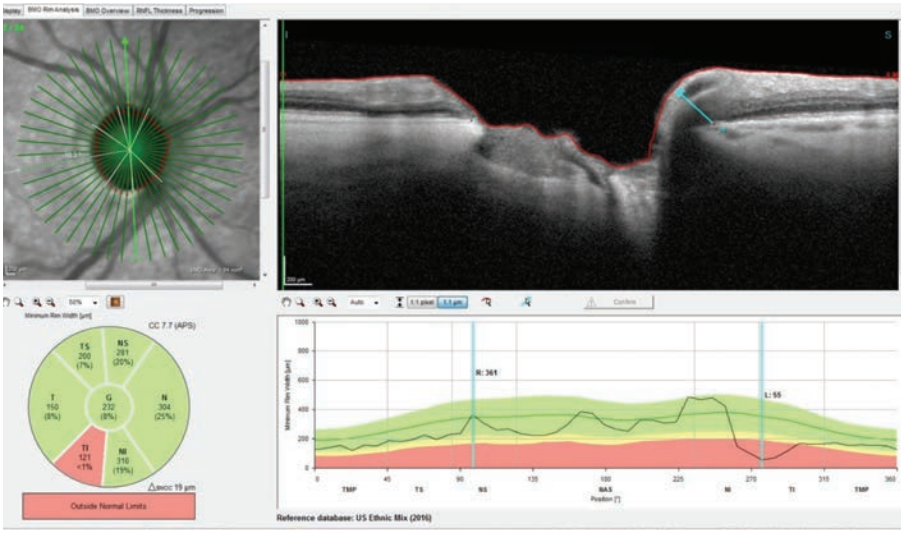
Both maculae were characterized by scattered drusen formation and retinal pigment epithelium disruption. No evidence pointed to diabetic macular edema or subretinal neovascular membrane formation. Her retinal vascular examination was consistent with mild hypertensive retinopathy as well as moderate arteriolarsclerotic retinopathy in both eyes. Her peripheral retinal evaluations were unremarkable. No evidence pointed to diabetic retinopathy in either eye.

Multicolor laser images of both posterior segments were obtained, as well as optical coherence tomography (OCT) scans of both the optic nerves and maculae. In addition, technicians obtained pachymetry readings. Her central corneal thicknesses were 512µm OD and 503µm OS. The multimodal imaging was consistent with the clinical picture of neuroretinal rim thinning and macular drusen. The OCT imaging of the optic nerves confirmed extraordinarily thin temporal neuroretinal rims and

notching, as well as ganglion cell layer loss in both eyes, with loss extending to fixation (more so in the right eye than the left).

Diagnosis

At the initial visit, it was pretty evident that the patient presented with advanced glaucomatous damage, more so in the right eye than the left. Since this was her first visit with us, and time was limited, we did not have her undergo a threshold visual field test at this visit; rather, it was scheduled for one to two weeks later along with gonioscopic exam of the anterior chamber angles, ultrasonic biomicroscopy and anterior segment OCT imaging of the anterior chamber angles. Given her significant structural damage, as evidenced on the OCTs of both the optic nerves and ganglion cell layers in the maculae, I would expect significant visual field loss in both eyes. In fact, given that the ganglion cell loss extends OU to fixation, I would expect the field defects also to extend to fixation. And this is the most likely etiology of her entering complaint of having difficulty seeing out of the right eye.



This radial set of OCT scans through the right optic nerve demonstrate marked thinning of Bruch's membrane opening. Note the significant loss of ganglion cells in the inferotemporal rim and a thickness reading of only 55µm in the highlighted scan.

This is a straightforward case of how a patient with undiagnosed advanced glaucoma may present to your office and the findings associated with the advanced disease. However, we still have important patient management issues to work out. How do we break this bad news to her, especially given her recent history of two limb fractures, in the context of a disappointing set of circumstances associated with her relocation to the area?

Bedside Manners

Just as every case of glaucoma is different, so too are your patients. The key to delivering this kind of bad news is to get a feel for what kind of patient you are dealing with. I knew from the history that the patient gave, that she was (spiritually) broken. She had moved to a new area to start a new life and instead suffered a series of health mishaps.

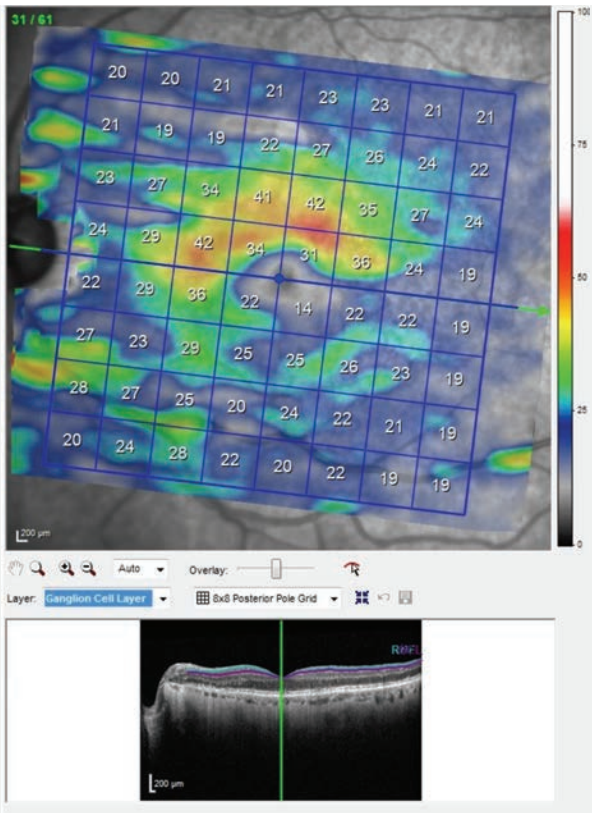
But medical information must be delivered openly, honestly and in a manner that you would want to hear if the roles were reversed. I am a straightforward kind of guy. Not all people are like me, but that is who I am.

Knowing that breaking the bad news to an already broken spirit was not going to be pleasant for the patient, I put on my best "I've got you covered" tone and laid out the findings to her. "Mrs. Jones, you and I have known each other now for about 10 minutes, and I want to tell you something about me: I'm a straight-shooter when it comes to patient care. You were referred to me because your internist wanted me to evaluate why you weren't seeing well. I wish I could tell you that this was a simple matter of changing your glasses, but it's not. For me to imply otherwise would do you a disservice, and I don't think you want me to do that. I wish it was just a matter of new glasses, but the reason why you're not seeing well is because my findings indicate that you have glaucoma, and it is affecting both eyes."

Boom: the bad news was just dropped, but I immediately follow with good news.

"The good news is that we have ways to prevent this from getting worse, and it's great that Dr. MacDonald referred you this week and not next month. We've got great medications and therapies that can help, and this is what we do well. I'll take good care of you, and we will get through this together." Now she has an ally in the process and is not alone.

Was she thrilled with the news? Of course not. Was she upset? Yes, but a little hand-holding can go a long way in cases like this. Did she ask why her previous doctor told her "everything was OK"? Yes, she did. And my response there too was positive, explaining simply that her form of glaucoma is hard to diagnose.



This is the posterior pole map of the ganglion cell layer in the macula of the patients left eye. Though this is the better eye, note the extreme thinning of the ganglion cell layer below the horizontal raphe involving fixation. The same scan of the right eye showed even more damage. With damage to this extent seen structurally, you would expect a superior arcuate visual field defect involving fixation.

Is this the verbiage you should use in your clinic? Not necessarily. This is just a snapshot of what I said in this particular situation. But it was open, honest and delivered in a way I would have wanted to receive news of this kind. As I write this, she is scheduled this afternoon for a follow-up evaluation where her visual fields will most likely demonstrate field loss involving fixation. And she will be greeted with a warm smile, a hand shake/holding and a "how are you doing?" open-ended question.

Delivering bad news is our job. It's part of managing glaucoma. Pawning off bad news for another provider to deliver is shirking our responsibility as health care providers. Most of what we do is deliver good news, but not always. It may seem counterintuitive, but learning to deliver bad news in a compassionate way makes us better clinicians. ■

Advertisers Index

This advertiser index is published as a convenience and not as part of the advertising contract. Every care will be taken to index correctly. No allowance will be made for errors due to spelling, incorrect page number or failure to insert.

Product **Review**

Pharmaceuticals

New Combo Glaucoma Drug

Aerie Pharmaceuticals recently received approval for Rocklatan, a medication that combines the rho-kinase inhibitor netarsudil with glaucoma therapy mainstay latanoprost. The drug is indicated for once-daily dosing. According to the company, one key advantage is the complementary nature of the two agents. Netarsudil works by restoring aqueous outflow through the trabecular meshwork, while latanoprost increases outflow through the uveoscleral pathway.

Lower Concentration Steroid

Bausch + Lomb recently added a new formulation to its Lotemax line of topical steroids. Called Lotemax SM, this gel-based product contains loteprednol at a slightly lower concentration than previous formulations (0.38% vs. 0.5%). The drug's submicron formation, which earns it the 'SM' designation, encourages faster drug dissolution in tears and provides twice the aqueous penetration as other formulations, B+L says. It also has the lowest preservative percentage (0.003% benzalkonium chloride) in a loteprednol formulation, according to the company.

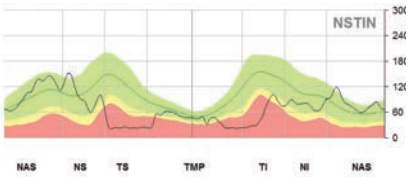
OCT Software Updates

Epithelial Thickness Mapping

The Cirrus HD-OCT from Zeiss can now do epithelial thickness mapping. This new functionality makes the device's anterior segment module more useful in a number of ways, according to the manufacturer. Specifically, it improves pre-op and post-op assessment of refractive surgery patients, allows monitoring of the cornea's response to treatment and aids in managing ocular surface disorders such as dry eye and progressive corneal diseases such as keratoconus, the company says.

New Glaucoma Report

The Spectralis OCT from Heidelberg has updated its ordering of the retinal nerve fiber layer graph, doing away with the conventional TSNIT sequence in favor of a new NSTIN approach that places the temporal quadrant in the center for easier viewing. "This portion of the disc is crucial for everyday visual function, and identification of abnormal thinning in this region is essential for managing glaucoma," said Donald Hood, PhD, in a Heidelberg press release. The new format is based on Dr. Hood's diagnostic approach.



Better Vascular Assessment

The ever-expanding role of OCT angiography just got a little bigger. Optovue recently launched a new scan called AngioWellness for the company's AngioVue device. Optovue says using it will allow practices to quickly assess and diagnose new pathologies in patients with diabetes and those at risk for glaucoma. AngioWellness combines structural information on retinal and ganglion cell thickness with objective metrics on retinal vasculature in a single report, a company press release explains.

Lid Hygiene

Topical Spray for Blepharitis

Patients with blepharitis or a similar lid-related condition might get help from a new 0.02% pure hypochlorous acid solution called Bruder Hygienic Eyelid Solution. Safe for long-term daily use, it contains no alcohol, oil, sulfates, parabens or added fragrance, according to Bruder. It's designed to assist in the removal of foreign material and debris on and around the eyelid margins.

Bruder Hygienic Eyelid Solution is available in 1 fl. oz. (30mL) and 2 fl. oz. (60mL) bottles.

Refraction and Optical Dispensing

Combination Autorefractor/Digital Phoropter

If you're looking to speed up your refractions, Luneau's new Eye Refract digital refraction system might be able to help. The device combines a wavefront aberrometer with a digital phoropter and allows for both autorefraction and subjective refinement on a single instrument in just three minutes, Luneau says.

New In-office Edging Option

If your practice performs in-house spectacle fabrication, or is thinking of adding this service, a new lens edger from Essilor Instruments could help you make it a success. Called Mr. Blue Infinite Vision, the device was designed to improve reproduction of lens shapes of all types, prevent axis deviation and to manage jobs more efficiently by eliminating unnecessary steps, the company says. ■

Merchandise Offered

Faculty

ASSISTANT PROFESSOR POSITIONS: PEDIATRICS, PRIMARY CARE/OCULAR DISEASE

Full-time non-tenure track faculty positions for the Chicago College of Optometry

Responsibilities: Candidates are expected to be highly knowledgeable in the field of pediatric or primary care and ocular disease and develop and teach courses and/or laboratories in the subject area. The primary care candidate must also be able to provide direct patient care and clinical instruction to professional students as well as residents, and be involved in interdisciplinary practice with other educational professionals.

Candidates must be willing to actively participate in curricular assessment, professional development, student counseling and service activities within the college, university and the scientific community. Successful candidates are also expected to be involved in research and scholarly activities, and have a sincere commitment to optometric education, community service and patient care. Primary duties include, but are not limited to:

a) **Teaching**

- Developing and delivering lectures and/or laboratories for related areas, as assigned;
- Embracing and enhancing the didactic
- philosophies in the O.D. program;
- Maintaining and expanding the high quality clinical practice environment for optometry students on rotation;
- Precepting students on clinical rotation at the Midwestern University Eye Institute;

b) **Service**

- Helping to maintain and grow the state of the art optometry program with a strong interdisciplinary focus that meets the needs of patients in the surrounding community; is efficient, patient friendly, and cost-effective;
- Working closely together with all optometry and ophthalmology faculty to provide a complete range of eye and vision care services;
- Participating in leadership roles in state, regional, and national optometry organizations;
- Participating on College and University committees, as assigned;
- Participating in College and University service activities.

c) **Scholarly activity**

Engaging in research and scholarly activity, including presentations at scientific meetings, research, and publication in peer reviewed journals sufficient to qualify for academic advancement in a non-tenure track position.

Qualifications: Candidates must possess a Doctor of Optometry degree from an ACOE-accredited institution, must have completed an ACOE-accredited residency, and must be eligible for an illinois optometric state license. Primary eye care clinical expertise is also required.

Salary will be commensurate with qualifications and experience
Review of applications will begin immediately and continue until the position is filled

Contact information: Interested applicants should apply online at www.midwestern.edu and include curriculum vitae and letter of interest specifying the position and college that he/she wishes to be considered for. Application packet should include curriculum vitae and letter of interest. Inquiries may be directed to Dr. Melissa Suckow, Dean; Midwestern University: msucko@midwestern.edu.

Midwestern University is an Equal Opportunity/Affirmative Action employer that does not discriminate against an employee or applicant based upon race, color, religion, gender, national origin, disability, or veterans status, in accord with 41 C.F.R. 60-1.4(a), 250.5(a), 300.5(a) and 741.5(a).

Practice For Sale

Career Opportunities

Continuing Education

Professional Opportunities

Continuing Education

Ocular Symposium

Lectures in Ocular Diagnosis and Treatment

Formal Lectures for Optometrists
by Noted Subspecialists in Ophthalmology

Friday, Saturday, Sunday
May 31 - June 1-2, 2019
24 hours CE (8 hours each day)
COPE APPROVAL PENDING

SAN FRANCISCO, CALIFORNIA

Refractive Surgery	Glaucoma	Cataract Surgery
Oculoplastics	Corneal Disease	Retina Update
Neuro-ophthalmology	Retinal Disease	Ocular Pediatrics

For information call or write:
Ocular Symposium • P.O. Box 640327 • San Francisco • CA • 94164
(415) 278-9940 • FAX (415) 345-1165
e-mail: ocularsymp@aol.com

Dr. Travel Seminars, LLC
In Partnership With The NJ Society of Optometric Physicians

Buenos Aires, Argentina to Santiago, Chile Cruise

NCL's Star
February 29 - March 14, 2020 (14 Night Cruise)
Sailing to Multiple Stops in Argentina & Chile

Optional Private Group Tours in all Ports-of-Call

Optional Pre & Post Cruise Stays & Tours in Argentina, Chile & Peru

NJSOP Society of Optometric Physicians
All Programs Are in Partnership With the New Jersey Society of Optometric Physicians

COPE
Dr. TRAVEL SEMINARS, LLC is a COPE approved provider
Course approved for 12 CE

Special Amenities: $100 + Choose Free Drinks, Specialty Dining or Internet

"An Educational Feast for the Comprehensive Optometric Physician"
Presented by Ron Melton, OD, FAAO, & Randall Thomas OD, FAAO

Additional Seminar Cruises (12-16 C E):
Dalmatian Coast Cruise: June 28 - July 8, 2019 - Randall Thomas, OD, FAAO
Venice to Rome - Celebrity Cruise Line - Special Pricing through April 19
Baltic Sea Cruise: July 22 - 31, 2020 - *NCL's 'Getaway'*
Round Trip Copenhagen - Leo Semes OD, FAAO, Professor Emeritus, UAB
Christmas Week: December 22-29, 2019 - Royal Caribbean's 'Allure of the Seas'
Eastern Caribbean Sailing - Edward Paul, Jr., OD, PhD, FIALVS

www.DrTravel.com 800-436-1028

Equipment and Supplies

WHY PAY RETAIL???

Pretesting Tables of all shapes and sizes at Wholesale Prices.

Search the word PRETESTING at EBAY

Save hundreds even thousands on all your pretesting needs.
Or call: 316-734-4265

Do you have CE Programs?

CONTACT US TODAY
FOR CLASSIFIED ADVERTISING
Toll free: **888-498-1460**
E-mail: **sales@kerhgroup.com**

REVIEW OF OPTOMETRY

Targeting Optometrists?

CLASSIFIED ADVERTISING WORKS

• JOB OPENINGS • CME PROGRAMS
• PRODUCTS & SERVICES • AND MORE...

Contact us today for classified advertising:
Toll free: **888-498-1460**
E-mail: **sales@kerhgroup.com**

KERHGROUP

Meetings + Conferences

May 2019

■ **1-3.** *Montana Optometric Association Annual Conference.* Hilton Garden Inn, Missoula, MT. Hosted by: Montana Optometric Association. Key faculty: Anthony DeWilde, Seema Nanda, Mark Wright. CE hours: 18. For more information, email Marti Wangen at mwangen@rmsmanagement.com, call 406-443-1160 or go to www.mteyes.com.

■ **2-6.** *Art & Science of Behavioral Vision Care.* Sheraton Framingham Hotel & Conference Center, Framingham, MA. Hosted by: Optometric Extension Program Foundation. Key faculty: John Abbondanza. CE hours: 35. For more information, email Karen Ruder at karen.ruder@oep.org, call 410-561-3791 or go to www.oepf.org.

■ **5.** *SUNY CE-NY.* SUNY College of Optometry, New York City. Hosted by: SUNY College of Optometry. CE hours: 6. For more information, email Betsy Torres at btorres@sunyopt.edu, call 4212-938-5830 or go to www.sunyopt.edu/cpe.

■ **8.** *NJ-AAO Educational Dinner Lecture.* Jumping Brook Country Club, Neptune City, NJ. Hosted by: New Jersey Chapter—American Academy of Optometry. CE hours: 2. For more information, email Dennis Lyons at dhl2020@aol.com, call 732-920-0110 or go to www.aaopt.org/membership/us-and-international-chapters/njchapter.

■ **16-19.** *POA Spring Congress.* Kalahari Resorts Poconos, Pocono Manor, PA. Hosted by: Pennsylvania Optometric Association. Key faculty: Alan Kabat, Randall Thomas, Ron Melton. CE hours: 32. For more information, email Ilene Sauertieg at ilene@poaeyes.org or go to pennsylvania.aoa.org/education-and-events/2019-spring-congress.

■ **17-19.** *New Technologies & Treatments in Eye–Nashville.* Gaylord Opryland Resort & Convention Center, Nashville, TN. Hosted by: Review Education Group. Key faculty: Paul Karpecki, Doug Devries, Ben Gaddie, Jay M. Haynie. CE hours: 18. For more information, email Lois DiDomenico at reviewmeetings@jhihealth.com or go to www.reviewsce.com/nashville2019.

■ **19.** *Optowest.* Anaheim Marriott Suites, Anaheim, CA. Hosted by: California Optometric Association. Key faculty: Raman Bhakhri, Justin Kwan. CE hours: 8. For more information, email Brenda Stewart at brends@coavision.org, call 916-226-5035 or go to www.coavision.org/i4a/pages/index.cfm?pageid=3278.

■ **30-June 1.** *Michigan Great Lakes Eyecare Conference.* Amway Grand Plaza Hotel, Grand Rapids, MI. Hosted by: Michigan Optometric Association. Key faculty: Denise Valenti, Lillian Kalaczinski, Jordan Keith, Jane Grogg, Andrew Morgenstern. CE hours: 20. For more information, email info@themoa.org, call 517-482-0616 or go to www.glecmi.org.

■ **31-June 2.** *Cape Cod CE and Family Weekend.* Sea Crest Beach Hotel, North Falmouth, MA. Hosted by: Massachusetts Society of Optometrists. CE hours: 8. For more information, email info@maoptometry.org or go to maoptometry.org.

June 2019

■ **1-2.** *Spring Seminar.* Indiana Unversity, Bloomington, IN. Hosted by: Indiana University School of Optometry. CE hours: 16. For more information, email Cheryl Oldfield at iusoce@indiana.edu, call 812-856-3502 or go to expand.iu.edu/browse/iuso-ce/programs/iuso-ce-spring-both.

■ **1-3.** *Annual Ocular Disease Update.* Big Cedar Lodge, Ridgedale, MO. Hosted by: Oklahoma College of Optometry. Key faculty: Kelly Malloy, Walter Whitley, Joseph Shetler. CE hours: 16. For more information, email Callie McAtee at mcateec@nsuok.edu, call 918-316-3602 or go to optometry.nsuok.edu.

■ **2.** *Breakfast & Learn.* SUNY College of Optometry, New York City. Hosted by: SUNY College of Optometry. CE hours: 4. For more information, email Betsy Torres at btorres@sunyopt.edu, call 4212-938-5830 or go to www.sunyopt.edu/cpe.

■ **5-9.** *VT1/Visual Dysfunctions.* NOVA Southeastern University, Fort Lauderdale, FL. Hosted by: Optometric Extension Program Foundation. Key faculty: Paul Harris. CE hours: 35. For more information, email Karen Ruder at karen.ruder@oep.org, call 410-561-3791 or go to www.oepf.org.

■ **6-9.** *UOA Annual Congress.* Zermatt Utah Resort, Midway, UT. Hosted by: Utah Optometric Association. CE hours: 21. For more information, email Alyssa White at alyssa@utaheyedoc.org, call 801-364-9103 or go to www.utaheyedoc.org.

■ **7-9.** *Everything Therapeutic: Houston.* University of Houston, Houston Health 1 Building. Hosted by: University of Houston College of Optometry. Key faculty: Bruce Onofrey, Seema Nanda, Joe Wheat, Susan Cotter, Justin Schweitzer. CE hours: 24. For more information, email optce@central.uh.edu, call 713-743-1900 or go to ce.opt.uh.edu.

■ **7-9.** *Spring Congress.* Embassy Suites By Hilton Myrtle Beach Oceanfront Resort, Myrtle Beach, SC. Hosted by: North Carolina Optometric Society. Key faculty: Josh Johnston, Daniel Fuller, Cecelia Koetting, Mohammad Rafieetary. For more information, email Christy Santacanago at christy@nceyes.org, call 919-977-6964 or go to www.nceyes.org/spring-congress.

■ **13-16.** *GOA Annual Meeting.* Westin Hilton Head Island Resort, Hilton Head, SC. Hosted by: Georgia Optometric Association. Key faculty: Christopher J. Borgman, Shaleen Ragha, Katherine M. Mastrota, Aaron Bronner. CE hours: 15. For more information, email Vanessa Grosso at vanessa@goaeyes.com, call 770-961-9866 ext. 1 or go to www.goaeyes.com.

■ **13-16.** *Optometry Association of Louisiana Annual Convention.* Crown Plaza Executive Center, Baton Rogue, LA. Hosted by: Optometric Association of Louisiana. Key faculty: Randall Thomas, Ron Melton, David K. Talley, Steve Ferruci. CE hours: 16. For more information, email Jim Sandefur at optla@bellsouth.net, call 318-335-0675 or go to optla.org.

■ **13-16.** *VOA Annual Conference.* Omni Richmond Hotel,

Richmond, VA. Hosted by: Virginia Optometric Society. Key faculty: Peter Cass, Michael Chaglasian, Clark Chang, Jason Duncan, Scott Ensor, Tami Hagemeyer, Whitney Hauser. CE hours: 20 total, 17 per OD. For more information, email Bo Keeney at office@thevoa.org go to www.thevoa.org/annual.

■ **19-23.** *Optometry's Meeting.* America's Center Convention Complex, St. Louis, MO. Hosted by: American Optometric Association and American Optometric Student Society. CE hours: 247, 44 per OD. For more information, email Fran Ghannam at fghannam@aoa.org, call 314-983-4254 or go to www.optometrysmeeting.org.

■ **20-23**. *VT3/Strabismus & Amblyopia.* The Eye Studio, Red Deer County, Alberta, Canada. Hosted by: Optometric Extension Program Foundation. Key faculty: John Abbondanza. CE hours: 28. For more information, email Karen Ruder at karen.ruder@oep.org, call (410) 561-3791 or go to www.oep.org.

■ **28-July 8.** *A Contemporary Look at Patient Eye Care—Dalmation Coast.* On Board Celebrity Cruise Line's Celebrity Constellation from Venice to Rome, Italy. Hosted by: Dr. Travel Seminars and NJ Society of Optometric Physicians. Key faculty: Randall Thomas. CE hours: 12. For more information, email info@drtravel.com, call 800-436-1028 or go to www.drtravel.com.

■ **30-July 6.** *Tropical CE–Costa Rica.* Los Suenos Marriott Ocean and Golf Resort, Herradura, Costa Rica. Hosted by: Tropical CE. Key faculty: Steven Ferrucci, William Miller. CE hours: 20. For more information, email Stuart Autry at sautry@tropicalce.com or go to www.tropicalce.com.

July 2019

■ **4-11.** *Paris and Normandy Optometric Cruise.* On Board AmaWaterways AmaLyra. Hosted by: AEA Cruises. CE hours: 10. For more information, email Marge McGrath at aeacruises@aol.com or go to www.optometriccruiseseminars.com.

■ **5-13.** *CE in Greece–Sailing Cruise on the Agean Sea.* On Board Star Flyer Sailing Ship. Hosted by: CE in Italy/Europe. Key faculty: Joseph Pizzimenti, James Fanelli, Leonard Messner, Lorraine Lombardi. CE hours: 12. For more information, email James Fanelli at amesfanelli@ceinitaly.com or go to ceinitaly.com.

■ **10-13.** *Northern Rockies Optometric Conference.* Buffalo Bill Village Resort, Cody, WY. Hosted by: Northern Rockies Optometric Conference. Key faculty: Eric Schmidt, Whitney Hauser, Valerie Kattouf. CE hours: 16. For more information, email Kari Cline at director@nrocmeeting.com or go to www.nrocmeeting.com.

To list your meeting, please send the details to:
Mark De Leon, Associate Editor
Email: mdeleon@jobson.com
Phone: (610) 492-1021

■ **10-14.** *VT1/Visual Dysfunctions.* Sandman Signature Toronto Airport, Toronto, Canada. Hosted by: Optometric Extension Program Foundation. Key faculty: Robin Lewis, Virginia Donati. CE hours: 35. For more information, email Karen Ruder at karen.ruder@oep.org, call 410-561-3791 or go to www.oepf.org.

■ **11-14.** *July Advanced Procedures.* NSUOCO Academic Wing, Tahlequah, OK. Hosted by: Oklahoma College of Optometry. Key faculty: Nathan Lighthizer, Richard Castillo, Douglas Penisten, Joseph Shetler. CE hours: 32. For more, email Callie McAtee at mcateec@nsuok.edu, call 918-316-3602 or go to optometry.nsuok.edu.

■ **11-14.** *Oregon's Meeting & Board Retreat.* Eugene Hilton Hotel, Eugene, OR. Hosted by: Oregon Optometric Physicians Association. Key faculty: Matthew Neale, Matt Hauck, Douglas Walker, Devin Gattey, Nisha Nagarkatti-Gude, Stanley Teplick. CE hours: 15. For more information, email Lynee Olson at lynne@oregonoptometry.org or go to www.oregonoptometry.org.

■ **13-14.** *Ocular Disease: Part II.* MBKU Hopping Academic Center, Fullerton, CA. Hosted by: Marshall B. Ketchum University, SCCO. CE hours: 16. For more information email ce@ketchum.edu or go to ketchum.edu/ce.

■ **13-14.** *CE in Houston Featuring the 2018-2019 Benedict in Practice Management and Administration.* UHCO Health & Biomedical Sciences Building, Houston, TX. Hosted by: University of Houston College of Optometry. Key faculty: Sam Quintero. CE hours: 16. For more information, email optce@central.uh.edu, call (713) 743-1900 or go to ce.opt.uh.edu.

■ **13-20.** *Amsterdam to London Optometric Cruise.* On Board Silversea Silver Wind. Hosted by: AEA Cruises. CE hours: 10. For more information, email Marge McGrath at aeacruises@aol.com or go to www.optometriccruiseseminars.com.

■ **18-21.** *FOA Annual Convention.* Disney's Yacht Club Resort, Orlando, FL. Hosted by: Florida Optometric Association. CE hours: 20+. For more information, email Hayley Howell at hayley@floridaeyes.org, call 850-877-4697 or go to floridaeyes.org.

■ **19-21.** *NSU Smokey Mountain Summer Conference.* Omni Grove Park Inn, Asheville, NC. Hosted by: Nova Southeastern University College of Optometry. CE hours: 18. For more information, email Vanessa McDonald oceaa@nova.edu, call 954-262-4224 or go to optometry.nova.edu/ce/index.html.

■ **21-30.** *Tropical CE–Ireland.* Belfast, Killarney, Doonbeg, Ireland. Hosted by: Tropical CE. Key faculty: Mark Mayo, Brian Mathie, Jill Autry. CE hours: 20. For more information, email Stuart Autry at sautry@tropicalce.com or go to www.tropicalce.com.

■ **22-31.** *Baltic Sea Cruise from Copenhagen, Denmark: A Clinical Compendium.* On Board Norweigian Cruise Line's Norwegian Getaway. Hosted by: Dr. Travel Seminars and NJ Society of Optometric Physicians. Key faculty: Leo Semes. CE hours: 12. For more information, email info@drtravel.com, call 800-436-1028 or go to www.drtravel.com.

Diagnostic **Quiz**

Socket Man

By Andrew S. Gurwood, OD

History

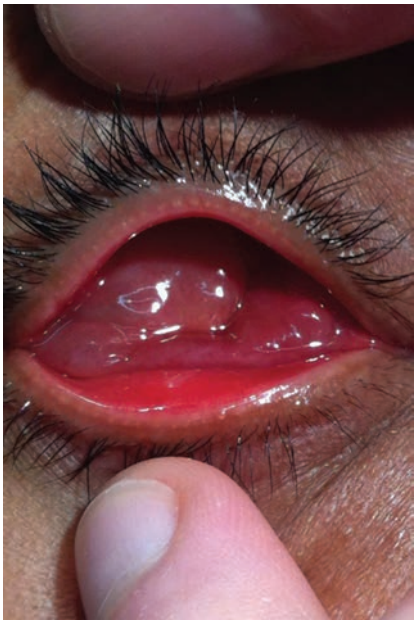
A 45-year-old black male presented with a chief complaint of worsening "discomfort" under the prosthesis which was fitted for his right eye. He explained he had acquired the prosthesis 30 years ago secondary to a childhood accident. His medical history was noncontributory and he reported no allergies of any kind.

Diagnostic Data

Best-corrected visual acuity through +0.50DS spectacles measured 20/20 OS. The pertinent external clinical data OD is demonstrated in the photograph. The lesion was not suppurative. The extraocular muscle motilities, confrontation visual fields and anterior segment findings were normal OS. His intraocular pressure measured 16mm Hg OS. A dilated fundus examination of his left eye revealed normal nerves and quiet peripheries.

Your Diagnosis

Does this case require any additional tests? What steps would you take to manage this patient? What is your diagnosis? To find out, please visit www.reviewofoptometry.com. ■



For 30 years, he's worn a prosthetic. Now, the socket of this 45-year-old patient's enucleated eye has been causing him such significant discomfort he sought medical help. How can his history combined with this presentation lead you to the root of his pain?

Retina Quiz Answers *(from page 90):* 1) b; 2) d; 3) b; 4) c.

Next Month in the Mag

Coming in May, *Review of Optometry* will present its 20th Annual Dry Eye Report.

Topics include:

- *Towards a Better Dry Eye Treatment Protocol*
- *Did the DREAM Study Change Your Approach?*
- *Cyclosporine Shoot-Out: How Do They Match Up?*

Also in this issue:

- *Interpreting Visual Fields in the Age of OCT* (Earn 2 CE Credits)
- *Catch Anterior Segment Cancer Early*
- *My Patient Has Diabetic Retinopathy—Now What?*

REVIEW OF OPTOMETRY (ISSN 0147-7633) IS PUBLISHED MONTHLY, 12 TIMES A YEAR BY JJOBSON MEDICAL INFORMATION LLC, 395 HUDSON STREET, 3RD FLOOR, NEW YORK, NY 10014. PERIODICALS POSTAGE PAID AT NEW YORK, NY AND ADDITIONAL MAILING OFFICES. POSTMASTER: SEND ADDRESS CHANGES TO REVIEW OF OPTOMETRY, PO BOX 81, CONGERS, NY 10920-0081. SUBSCRIPTION PRICES: US: ONE YEAR $56; TWO YEARS $97, CANADA: ONE YEAR $88, TWO YEARS $160, INT'L: ONE YEAR $209, TWO YEARS $299. FOR SUBSCRIPTION INFORMATION CALL TOLL-FREE (877) 529-1746 (USA); OUTSIDE USA, CALL (845) 267-3065. OR EMAIL US AT REVOPTOMETRY@CAMBEYWEST.COM. PUBLICATIONS MAIL AGREEMENT NO: 40612608. CANADA RETURNS TO BE SENT TO BLEUCHIP INTERNATIONAL, P.O. BOX 25542, LONDON, ON N6C 6B2.

BAUSCH + LOMB ULTRA® MULTIFOCAL FOR ASTIGMATISM

GO BEYOND THE EXPECTED IN 2019

An innovative multifocal toric lens
available soon as a standard offering

BAUSCH + LOMB
See better. Live better.

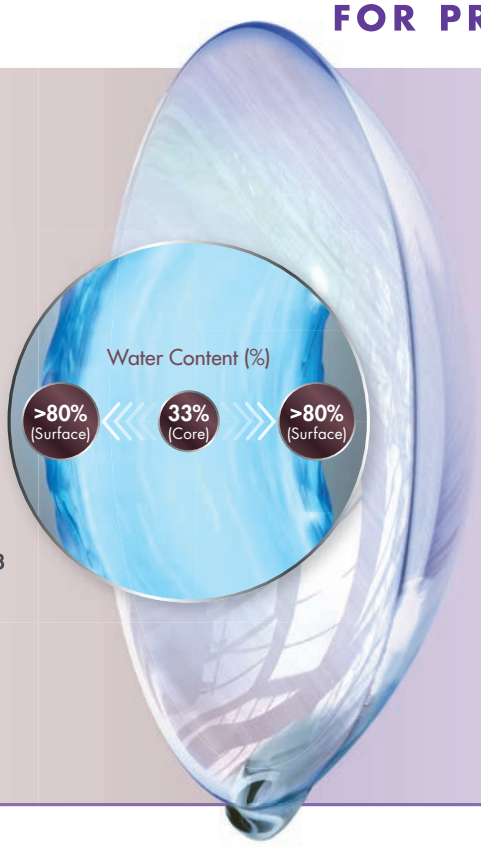
DAILIES TOTAL1® MULTIFOCAL CONTACT LENSES

A LENS THAT FEELS LIKE NOTHING

FOR PRESBYOPIC PATIENTS

The World's First and Only Water Gradient Lens

Designed for Exceptional Comfort[1-3]



Precision Profile® Design

Built to Deliver Seamless Vision at All Distances[4]

96% FIT SUCCESS

WITH 2 LENSES OR LESS PER EYE with the latest fitting process for Alcon multifocal contact lenses[5,6]

Prescribe DAILIES TOTAL1® Multifocal for your presbyopic patients today

References: 1. In an investigator- and subject-masked study over 14 days at 12 sites in the U.S. of daily disposable soft contact lens wearers who had symptoms of contact lens discomfort; n=246; Alcon data on file, 2017. **2.** 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. **3.** Thekveli S, Qui Y, Kapoor Y, et al. Structure-property relationship of delefilcon A lenses. *Cont Lens Anterior Eye.* 2012;35(suppl 1):e14. **4.** Lemp J, Kern J. Alcon multifocal contact lenses for presbyopia correction. Presented at the Canadian Association of Optometrists Congress; June 28-30, 2017; Ottawa, ON. **5.** Bauman E, Lemp J, Kern J. Material effect on multifocal contact lens fitting of lenses of the same optical design with the same fitting guide. Poster presented at the British Contact Lens Association Clinical Conference & Exhibition, June 9-11, 2017. Liverpool, UK. **6.** Merchea M, Evans D, Kannarr S, Miller J, Kaplan M, Nixon L. Assessing a modified fitting approach for improved multifocal contact lens fitting success. Paper presented at Optometry's meeting; June 20-24, 2018; Denver, CO.

Alcon A Novartis Division

See product instructions for complete wear, care and safety information. Rx only

 2/19 US-DTM-19-E-0306