REVIEW OF OPTOMETRY • VOL. 160, NO. 4 • APRIL 15, 2023 • Treating Corneal Infections • Managing Corneal

You Be The Judge: Melanoma Masquerader, P. 32 • How to Handle Non-Ocular Emergencies, P. 68

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Should You Prescribe a Glaucoma Drug for Ocular Hypertension?

PAGE 76

10TH ANNUAL CORNEA REPORT

A Game Plan for Treating

*Based on *in vitro* measurments of unworn lenses.
**Based on *in vitro* studies on unworn lenses.
†Based on lens movement, centration, and rotation at initial fitting.

References: 1. In a clinical trial to evaluate on-eye performance of TOTAL30® for Astigmatism lenses where n=69; Alcon data on file, 2021. **2.** Based on a clinical trial where n=18; Alcon data on file, 2021. **3**. In vitro analysis of lens oxygen permeability, water content, and surface imaging; Alcon data on file, 2021. **4.** In vitro analysis of lehfilcon A contact lenses outermost surface softness and correlation with water content; Alcon data on file, 2021. **5.** In vitro evaluation of bacterial adherence in commercial lenses: Alcon data on file, 2020. **6.** In vitro evaluation of bacterial biofilm in commercial lenses: Alcon data on file, 2020. **7.** Ishihara K, Fukazawa K, Sharma V, Liang S, et al. Antifouling silicone hydrogel contact lenses with a bioinspired 2-methacryloyloxyethyl phosphorylcholine polymer surface. *ACS Omega*. 2021;6:7058-7067. **8.** In vitro evaluation of lipid deposition for lehfilcon A
and commercial lenses using 3D confocal imaging; Alcon data on file, 2021.

See product instructions for complete wear, care, and safety information. Rx only

Alcon

REVIEW OF OPTOMETRY • VOL. 160, NO. 4 • APRIL 15, 2023 • Treating Corneal Infections • Managing Corneal Trauma • Combating Recurrent Erosion • Understanding Keratoconus • Handling Non-Ocular Emergencies • Considering Ocular Hypertension

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PAGE 76

10TH ANNUAL CORNEA REPORT

A Game Plan for Treating Corneal Infections

Follow this guidance to determine the cause and come up with a strategy.

Page 36

Managing Episodes of Corneal Trauma
Page 44

Know Your Options for Combating Recurrent Erosion
Page 50

Keratoconus: What Surprises the Experts?
Page 58

When Selecting a Prescription Dry Eye Treatment

DON'T MAKE HER WAIT.

Not an actual patient.

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.

NOVARTIS

Novartis Pharmaceuticals Corporation
East Hanover, New Jersey 07936-1080

xiidra® (lifitegrast ophthalmic solution)5%

CHOOSE XIIDRA

Because lasting symptom relief can start as early as 2 WEEKS[1]*

Access to Xiidra is better than ever[2]

*Xiidra reduced symptoms of eye dryness at 2 weeks (based on Eye Dryness Score compared to vehicle) in 2 out of 4 studies, with improvements observed at 6 and 12 weeks in all 4 studies.[1†]

Important Safety Information (cont)

- 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.

Please see Brief Summary of Important Product Information on adjacent page.

†Pivotal trial data
The safety and efficacy of Xiidra were assessed in four 12-week, randomized, multicenter, double-masked, vehicle-controlled studies (N=2133). Patients were dosed twice daily. **Use of artificial tears was not allowed during the studies.** The study end points included assessment of signs (based on Inferior fluorescein Corneal Staining Score [ICSS] on a scale of 0-4) and symptoms (based on patient-reported Eye Dryness Score [EDS] on a visual analogue scale of 0-100).[1]

Effects on symptoms of dry eye disease: A larger reduction in EDS favoring Xiidra was observed in all studies at day 42 and day 84. Xiidra reduced symptoms of eye dryness at 2 weeks (based on EDS) compared to vehicle in 2 out of 4 clinical trials.[1]

Effects on signs of dry eye disease: At day 84, a larger reduction in ICSS favoring Xiidra was observed in 3 of the 4 studies.[1]

References: 1. Xiidra [package insert]. East Hanover, NJ: Novartis Pharmaceuticals Corp. **2.** Data on file. DRF Fingertip Formulary® Novartis Pharmaceuticals Corp; July 2022.

XIIDRA® (lifitegrast ophthalmic solution), for topical ophthalmic use
Initial U.S. Approval: 2016

BRIEF SUMMARY: Please see package insert for full prescribing information.

1 INDICATIONS AND USAGE

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

4 CONTRAINDICATIONS

Xiidra is contraindicated in patients with known hypersensitivity to lifitegrast or to any of the other ingredients in the formulation *[see Adverse Reactions (6.2)]*.

6 ADVERSE REACTIONS

The following serious adverse reactions are described elsewhere in the labeling:

- Hypersensitivity *[see Contraindications (4)]*

6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in 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.

In five clinical trials of DED conducted with lifitegrast ophthalmic solution, 1401 patients received at least one dose of lifitegrast (1287 of which received lifitegrast 5%). The majority of patients (84%) had less than or equal to 3 months of treatment exposure. One hundred-seventy 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%-5% of the patients were blurred vision, conjunctival hyperemia, eye irritation, headache, increased lacrimation, eye discharge, eye discomfort, eye pruritus, and sinusitis.

6.2 Postmarketing Experience

The following adverse reactions have been identified during post-approval 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 serious cases of hypersensitivity, including anaphylactic reaction, bronchospasm, respiratory distress, pharyngeal edema, swollen tongue, urticaria, allergic conjunctivitis, dyspnea, angioedema, and allergic dermatitis have been reported. Eye swelling and rash have also been reported *[see Contraindications (4)]*.

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Risk Summary

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 premating 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 *[see Clinical Pharmacology (12.3) in the full prescribing information]*.

Data

Animal Data

Lifitegrast administered daily by IV injection to rats, from premating through gestation day 17, caused an increase in mean pre-implantation 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.

8.2 Lactation

Risk Summary

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 *[see Clinical Pharmacology (12.3) in the full prescribing information]*. 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.

8.4 Pediatric Use

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

8.5 Geriatric Use

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

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T2020-87

Washington Scope Bill Advances While Two Others Stall

South Dakota and Idaho were recently shot down for this year's session but will press on for 2024.

It's only a quarter of the way through the year and numerous states have already introduced legislation to expand practice privileges for their optometrists. While some have more positive progress to report than others, lessons can still be drawn from the losses that may help fight future scope battles. Here's an update on a few bills in play.

A bill expected to be heard soon by Washington's House would authorize ODs in the state to remove lid lesions, administer injections around the eye and prescribe oral steroids.

Washington

One scope expansion bill working its way to the House floor is Washington SB 5389, which passed the state's Senate on March 6th. As it stands, the legislation proposes that properly trained ODs be authorized to remove eyelid lesions, prescribe oral steroids and administer injections around the eye. The bill also states that the Washington Board of Optometry would decide on the education and training requirements needed to permit optometrists to perform the added procedures.

While the original bill also included laser procedures such as YAG capsulotomy and SLT, the use of lasers has since been removed from the proposed legislation as part of a negotiation.

During the bill's second executive session with the House Committee on Health Care and Wellness on March 29th, several amendments to the document were discussed. The hearing concluded with a majority vote to pass the bill with its amendments, the specifics of which cannot be reported on at this time.

"Making sure that optometrists and other eyecare providers have the ability to provide the care necessary is key, and this bill delivers that," remarked Washington State Representative Monica Jurade Steiner during the recent hearing.

Michael Sirott, OD, president of the Optometric Physicians of Washington, reports that because of the amendments, the state's Senate will have to vote on the bill a second time. SB 5389 will head next to the House Rules Committee and be heard by the House within a few weeks.

South Dakota

On February 28, South Dakota's House Health and Human Services voted to defer the state's laser bill, SB 87, to the 41st legislative day with a 7-6 vote, ending the bill's run in this legislative session. The bill had proposed to permit the state's ODs to perform several procedures in their education and training, including certain injections, removal of chalazion, lid lesion and foreign bodies, YAG capsulotomy, LPI, SLT and CXL. It would have also expanded pharmaceutical privileges and authorized the use of local anesthesia.

Opposers testified in the hearing that there's no need for the bill at this time, claiming that there are enough ophthalmologists in South Dakota to perform the proposed procedures. Several ODs and advocates took the stand to explain why they believed otherwise.

"There are full-time optometrists in 38 of our 66 counties," said Representative Rocky Blare of the South Dakota legislature. "Ophthalmologists are in limited areas of the state, and in some, only provide services one day a month."

Population aging is another threat to eyecare access cited by the bill's proponents. "The limited laser procedures allowed by SB 87 are key treatment options for managing glaucoma and addressing post-surgery secondary cataracts," explained Craig Dockter, OD, who has been practicing in Mobridge, SD, since 1992. "Glaucoma and cataracts are associated with aging. Nationwide, the number of patients over age 65 is estimated to increase by 42% by 2030 and will increase to 83% by 2050. The number of ophthalmologists has remained stable since 1990, and over 50% of current ophthalmologists are older than 50," said Dr. Dockter. "As our population ages, there will be a greater need for access to these procedures across the state."

(Continued on page 10)

Florida Legislature Approves, Then Amends, Bill That Would Ban OD Use of 'Optometric Physician' Title

After the state Senate advanced a controversial proposal that was met with vocal opposition, the language was revised to prevent restrictions from affecting optometry.

At least three states—Florida, Connecticut and Texas—have introduced legislation this year that would prohibit certain healthcare providers, potentially including optometrists, from using terms such as "physician" to advertise or refer to themselves in medical settings if such terms are not defined in their respective practice acts. On March 15th, Florida's bill, SB 230, passed the state Senate with a unanimous vote of 37-0. The bill now awaits a hearing in the House of Representatives and has been filed as HB 583.

At the March 15th hearing, Florida senators Gayle Harrell, Tina Scott Polsky and Jim Boyd each rose to support proposed legislation that would strip optometrists of the right to use the word "physician" as part of their professional title. Optometrists rallied opposition to the measure and won a carveout that—if enacted—would allow them to retain the designation.

Fortunately, after significant push-back from optometrists and advocates, including the Florida Optometric Association (FOA), an amendment was made to the language of the bill on March 31st. The revised document now states the following: "An optometrist licensed under chapter 463 [Florida's practice act for optometrists] may use the following titles and abbreviations as applicable to his or her license, specialty and certification: 'doctor of optometry,' 'optometric physician' and other titles or abbreviations authorized under his or her practice act."

The original version would have banned ODs from using the term "physician" as part of their title since the term isn't explicitly defined in optometry's practice act in Florida. Other allied health professionals such as dentists, chiropractors and podiatrists—all of whom have four-year post-graduate degrees, much like optometrists—wouldn't have been subjected to the same restrictions due to the inclusion of the word in their practice acts.

If HB 583 passes the Florida House and is signed into law with the amendment, it will preserve the right of the state's ODs to refer to themselves as optometric physicians—despite the term's absence from the practice act—if their medical license, specialty or certification describes them as such.

Senate Hearing Provokes Criticism

During the March 15 Florida Senate session, SB 230 sponsor Senator Gayle Harrell argued that the bill is intended to promote greater transparency between doctors and patients by requiring all healthcare practitioners to use only the language included in their profession's practice act to define their titles and licensure.

"SB 230 contains discriminatory language that clearly disparages the profession of optometry in the state of Florida," the FOA said in a statement after the hearing, prior to the bill's proposed amendment. "It is especially disturbing to note that other allied health professionals are now permitted to use the terms and titles of 'doctor and physician' in identifying themselves and their education and training, while optometrists would be prohibited from doing so."

Florida Senator Tina Scott Polsky brought this point to the attention of the committee and posed the question to Senator Harrell of why the bill—at the time—did not accept optometrists in particular as physicians. Senator Harrell responded by stating, "The term physician is used [to describe optometrists] in federal legislation for payment through Medicare and Medicaid. However, their practice act does not define them as physicians; it defines them as doctors of optometry." Because of this, she explained, under the language of the unamended bill, ODs "may call themselves doctors, but they cannot refer to themselves as physicians. They would have to change their practice act in order to do that."

The bill also outlines possible consequences for using language to describe one's medical licensure that is not explicitly noted in the bill or his or her profession's practice act. Senator Harrell explained during the hearing that the penalty for a violation "depends on the level of egregiousness of what the individual is doing," and can range from a simple motion to cease and desist to a misdemeanor or even felony charge in more extreme circumstances. She

provided an example of the latter case, noting that "if an individual is not a physician and is practicing medicine illegally, at that point, there would be a recommendation to go the criminal route."

The FOA expressed its concern about the harshness of these penalties and its attack on optometrists in its statement. "This harmful legislation imposes a felony-level penalty of 'practicing medicine without a license' against an optometrist for the use of these descriptive terms, which is an egregious and abusive overreach of governmental enforcement for a civil offense," the association argued. "To no surprise, the Florida Society of Ophthalmology stood up in support of passing this bill," the FOA noted in its statement. "However, many letters from Florida ophthalmologists around the state have been written on behalf of Florida optometrists in opposition to SB 230. It is of great significance that many MDs and DOs have responded on our behalf and voiced their opinion to the Florida legislature to oppose the potentially offensive treatment of optometrists put forth by SB 230."

During a debate prior to the final vote, Senator Jim Boyd spoke up about the discrimination of the bill against optometrists in the state, despite his decision to vote in its favor. "I've been calling my optometrist 'doctor' my whole life; most everybody in the community does," he said, adding that he has talked to a fair number of ODs whose degrees even state the specific term "optometric physician," which the original bill would prohibit Florida optometrists from calling themselves. He continued, "I understand the components related to the practice act need to be reopened, and that must be addressed. I hope that this body will be willing to reopen this discussion next year and talk about the practice act that would allow [optometrists] to be called what everybody in our community is calling them already, and that's doctor."

Following the disappointing Florida Senate verdict, Ronald L. Benner, OD, president of the American Optometric Association (AOA), commented in a press release that "Optometry will continue to look to the future and the needs of our patients as we advocate for our full recognition and scope modernization priorities and lock in more wins. It's clear today, however, that those who desperately want to turn back the clock on our advancement need a fresh reminder that our advocacy strength and know-how is also able to defeat any bill that does not clearly recognize optometry's status as the nation's primary eyecare doctors," said Dr. Benner.

The FOA and its legislative team have also mobilized to push back against SB 230. "Volunteers and members of the FOA board of trustees have been crossing the state, meeting with all practicing optometrists and students to relay the message and galvanize support, and

(Continued on page 14)

Three Weeks of Azithromycin May Benefit MGD

A recent study demonstrates that this once-a-week course is as effective as six weeks of daily oral doxycycline but with fewer adverse side effects.

In the moderate and severe stages of meibomian gland disorder (MGD), a six-week course of oral doxycycline, a tetracycline antibiotic with anti-inflammatory and lipid-regulating effects, is commonly recommended. However, compliance can be a problem, often due to the long course of therapy and frequent gastrointestinal adverse events. Systemically administered azithromycin has been reported to have a longer tissue half-life and fewer adverse events than doxycycline, making it an attractive alternative. Researchers recently indicated that a six-week course of daily oral doxycycline and oral azithromycin taken once a week for three weeks significantly improved both symptoms and objective measurements of MGD at the sixth and eighth weeks, respectively.[1]

The study, published in *JAMA Ophthalmology*, included a total of 137 eyes from 137 patients who were randomized into groups: 68 eyes in the azithromycin group and 69 eyes in the doxycycline group (female, 66.4%; mean age, 62). After initiating therapy, the study team assessed the total MGD score and Ocular Surface Disease Index (OSDI) score at the initial visit, at six weeks and at eight weeks and assessed adverse events at six and eight weeks. The prespecified equivalence margins for MGD score and OSDI score were set at ±2 and ±9, respectively.

The evidence of equivalency of both treatments in reducing MGD score was robust at the sixth week but not at the eighth week. The adjusted mean difference of total MGD scores between groups at week six and week eight were -0.33 and 0.13, respectively. The adjusted mean difference of OSDI between group scores at weeks six and week eight was -1.20. Patients treated with azithromycin had fewer gastrointestinal adverse events (4.4% vs. 15.9%). Two cases from the doxycycline group had premature discontinuation from the current project due to the unbearability of these gastrointestinal adverse events.

The researchers decided on the oral azithromycin regimen for their study with the knowledge that a single 1g dose can achieve a high tissue concentration in both the conjunctiva and tears for at least 14 days. They aimed to identify an effective treatment regimen with the fewest doses of medication and adverse events to maximize patient compliance.

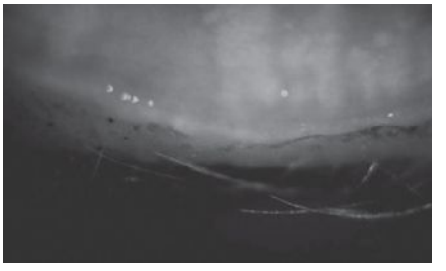

Photo: Gregory Moore, OD

Oral azithromycin and doxycycline have been commonly used in the management of moderate to severe MGD when conservative therapies fail.

Still, they intentionally chose a dosing schedule for doxycycline from the literature that would lead to the highest tissue levels of the drug to ensure a better comparison against a dosing schedule that provides the highest tissue levels of the drug, potentially the most effective for MGD treatment. However, lower dosing regimens of doxycycline may have been associated with a lower incidence of gastrointestinal adverse events.

The study concluded that the reduced dosing of azithromycin supports its use as an alternative to doxycycline for at least six weeks.

"However, longer-term follow-up is needed to determine if these outcomes persist for this chronic condition," the authors of the paper wrote.[1]

A commentary also published in *JAMA Ophthalmology* took issue with the study's design. Although there have been multiple clinical studies evaluating antibiotic treatment for MGD, there are no high-quality randomized clinical trials (RCTs) supporting their use. Major issues with prior RCTs include high attrition, selective reporting and small sample sizes with low precision and wide confidence intervals on treatment effects.[2]

"Absent such evidence previous to the study, there is a risk of declaring equivalence of the two antibiotics when the efficacy of one or both antibiotics may not be significantly better than a placebo," the commentary author wrote.

"When testing an equivalence hypothesis, the efficacy of the standard active treatment must be definitively established," she added. "This may be accomplished through inclusion of a control group in the trial allowing for a direct comparison vs. the active treatments, or alternatively, a comparison of the active groups in the trial with a historical control group of similar patients using the same outcome measures may be planned."

"For those in clinical practice who are using oral doxycycline to treat MGD with dosing as in this trial, this trial provides strong evidence that switching to azithromycin provides similar efficacy with lower risk of gastrointestinal adverse effects," the commentary concluded. "However, it must also be recognized there is a possibility that one or both treatments are no better than conservative management or no better than no treatment at all."[2]

1. Upaphong P, Tangmonkongvoragul C, Phinyo P. Pulsed oral azithromycin vs. six-week oral doxycycline for moderate to severe meibomian gland dysfunction. JAMA Ophthalmol. March 23, 2023. [Epub ahead of print].

2. Melia BM. Evaluating the evidence for treatment of meibomian gland dysfunction with oral antibiotics. JAMA Ophthalmol. March 23, 2023. [Epub ahead of print].

To treat ocular inflammation and pain following ophthalmic surgery or ocular itching associated with allergic conjunctivitis.

DEXTENZA KEEPS PATIENTS COMPLIANT AND SATISFIED[1-3*]

A hands-free advancement in ophthalmic steroid treatment.[1,4]
Easy-to-insert† and preservative-free intracanalicular DEXTENZA offers patients a satisfying post-op experience—providing up to 30 days of sustained steroid coverage.[1-5]

INDICATIONS

DEXTENZA is a corticosteroid indicated for:

- The treatment of ocular inflammation and pain following ophthalmic surgery.
- The treatment of ocular itching associated with allergic conjunctivitis.

IMPORTANT SAFETY INFORMATION

CONTRAINDICATIONS

DEXTENZA is contraindicated in patients with active corneal, conjunctival or canalicular infections, including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, varicella; mycobacterial infections; fungal diseases of the eye, and dacryocystitis.

WARNINGS AND PRECAUTIONS

Intraocular Pressure 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. Intraocular pressure should be monitored during treatment.

Bacterial Infections - Corticosteroids may suppress the host response and thus increase the hazard for secondary ocular infections. In acute purulent conditions, steroids may mask infection and enhance existing infection.

Viral Infections - 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 - Fungus invasion must be considered in any persistent corneal ulceration where a steroid has been used or is in use. Fungal culture should be taken when appropriate.

Delayed Healing - Use of steroids after cataract surgery may delay healing and increase the incidence of bleb formation.

Other Potential Corticosteroid Complications - The initial prescription and renewal of the medication order of DEXTENZA 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. If signs and symptoms fail to improve after 2 days, the patient should be re-evaluated.

ADVERSE REACTIONS

Ocular Inflammation and Pain Following Ophthalmic Surgery

The most common ocular adverse reactions that occurred in patients treated with DEXTENZA were: anterior chamber inflammation including iritis and iridocyclitis (10%), intraocular pressure increased (6%), visual acuity reduced (2%), cystoid macular edema (1%), corneal edema (1%), eye pain (1%), and conjunctival hyperemia (1%). The most common non-ocular adverse reaction was headache (1%).

Itching Associated with Allergic Conjunctivitis

The most common ocular adverse reactions that occurred in patients treated with DEXTENZA were: intraocular pressure increased (3%), lacrimation increased (1%), eye discharge (1%), and visual acuity reduced (1%). The most common non-ocular adverse reaction was headache (1%).

Please see adjacent Brief Summary of full Prescribing Information.

*93% (187/201) DEXTENZA patients were satisfied with the insert in the Phase 3 Study for the treatment of ocular inflammation and pain following ophthalmic surgery.[3]

†73.6% of physicians in Study 1, 76.4% in Study 2, and 79.6% in Study 3, for the treatment of ocular inflammation and pain following ophthalmic surgery, rated DEXTENZA as easy to insert.[2,5]

References: 1. DEXTENZA [package insert]. Bedford, MA: Ocular Therapeutix, Inc; 2021. **2.** Tyson SL, et al. *J Cataract Refract Surg*. 2019;45(2):204-212 [erratum in: 2019;45(6):895]. **3.** Data on File 00837. Ocular Therapeutix, Inc. **4.** Sawhney AS, Inventors, et al. Incept, LLC, Assignee. Drug Delivery Through Hydrogel Plugs. US Patent 8,409,606 B2. April 2, 2013. **5.** Walters T, et al. *J Clin Exp Ophthalmol*. 2016;7(4):1-11.

Dextenza®
(dexamethasone ophthalmic insert) 0.4 mg
for intracanalicular use

Scope of Practice Bill Updates

(Continued from page 5)

The last change to optometry's practice scope in South Dakota was nearly 30 years ago, highlighting the need to pass a bill like SB 87—hopefully in 2024—to align the language of the law with the current skills and training of ODs.

Idaho

Optometrists and advocates in Idaho also recently hit a roadblock in their efforts to pass scope expansion legislation. SB 1052, introduced on February 7th, had proposed that the state's ODs who received the proper training in university be authorized to perform three laser procedures: YAG capsulotomy, LPI and SLT. The bill had strong support in the Senate, but after its first reading in the House on March 13th, the bill was referred to the Ways and Means Committee, effectively—and unfortunately—killing it for this legislative session.

Opposers of the bill—including the American Medical Association—argued that optometrists don't have the proper skills to perform the proposed surgeries, despite evidence suggesting otherwise. In 10 states, for example, ODs safely and effectively treat patients with lasers. Since Oklahoma became the first state to authorize optometric laser use 25 years ago, more than 100,000 of these procedures have been performed by ODs with no increase in disciplinary actions.

To further address safety concerns, SB 1052 also stipulated that to take advantage of the new laser privileges, licensed ODs in Idaho must have completed training on laser capsulotomy, LPI and SLT during their schooling, as well as passed the national board of examiners in optometry laser exam.

"The public needs to be educated on how many hours of schooling optometrists have focused just on the eye," notes Lisa White, executive director of the Idaho Optometric Physicians (IOP), whose staff and members have been working tirelessly to advocate for the bill.

The last legal—and ultimately unsuccessful—endeavor to expand the optometric practice scope in Idaho occurred in 2020. The former bill had a wider focus than SB 1052, proposing various changes to the language used to define the practice of optometry in Idaho, which hasn't been updated since 1971. Mrs. White says that in this year's bill, the proposed practice scope changes were intentionally much more straightforward. "We just added one line: 'The practice of optometry does not include laser procedures, *except laser capsulotomy, peripheral iridotomy and laser trabeculoplasty*,'" she explains.

Despite last month's setback, the IOP and other scope expansion advocates in Idaho are not yielding in their efforts to push the legislation forward, Mrs. White assures. "Optometry and ophthalmology will meet with the Speaker of the House over the next year to come to an agreement on education and training," she says. By educating the public and lawmakers on the bill's safety and necessity, the IOP feels optimistic it may be reintroduced next legislative session.

Experts Agree on Demodex Signs, Symptoms, Not Treatment

The group was evenly split between advocating blepharoexfoliation or tea tree oil.

A panel of 12 ocular surface disease experts recently convened to form a consensus about the diagnosis, treatment, pathophysiology and signs and symptoms of *Demodex* blepharitis (DB) as part of the Demodex Expert Panel on Treatment and Eyelid Health. While clinicians shared the same view on most of these topics, the group did not reach a consensus about the best treatment or severity grading technique. Results of the project were recently published in the British journal *Eye*.

Using a modified Delphi panel process, the researchers administered three online surveys to each of the 12 practitioners, consisting of scaled, open-ended, true/false and multiple-choice questions. For questions that used a 1-9 Likert scale, a consensus was defined as median scores of 7-9 and 1-3. For all other questions, a consensus was achieved when at least eight out of 12 panelists agreed.

The panel reached a consensus on the following statements about *Demodex* blepharitis:

- DB condition is chronic (n=11).
- It is recurrent (n=12).
- The condition is often misdiagnosed (n=12).
- Inflammation is a key result (n=12).
- Collarettes (cylindrical dandruff) are the most common sign (n=10).
- Itching is the most common symptom (n=12).

Photo: Chris Sindt, OD

Ocular surface disease experts in a recent panel agreed on key signs and symptoms and effective examination strategies to best recognize *Demodex* blepharitis; however, they didn't agree on all aspects of treatment.

- DB may be diagnosed based on collarettes, mites and/or patient symptoms (n=10).
- Conjunctival injection is common (median score: 7; range: 3-8).
- Tear breakup time is impacted by the condition (n=12).
- Rosacea has a strong association with DB (n=11) and is a risk factor of DB (n=10). It was also the most-cited systemic condition seen in cases of *Demodex* blepharitis (n=9).
- DB affects patients' quality of life (median score: 7, range: 6-8).

Regarding DB diagnosis, the panel agreed that slit lamp examination is the most common method and that the visualization of mites is not required for diagnosis. As for severity grading, while 11 of 12 experts agreed this is important and clinically useful, there was no consensus about a specific scale.

The panel agreed that restoring balance to the ocular ecology is the key to managing *Demodex* infestation (median score: 8, range: 5-9) and that mechanical intervention such as lid scrubs and blepharoexfoliation is an important aspect of treatment (n=12). However, experts did not agree on the best method of treating these patients. The researchers noted in their paper, "Of the management options for DB available at the time of this panel, the group was about evenly split between blepharoexfoliation and tea tree oil as their primary strategy."

Nevertheless, the group did unanimously agree that a decision tree accounting for clinical signs and patient symptoms is the best approach to treating blepharitis. Ten of 12 also reported that heat, warm compresses and steam-based and radiant heat devices are minimally, marginally or not useful.

Due to the lack of consensus on treatment and grading methods for DB, the research team planned an additional panel to see whether experts can reach an agreement on effective management strategies.

"Increased awareness of DB in the eyecare community will raise the level of care received by patients with blepharitis and offer some a more targeted treatment strategy and better clinical outcomes," the researchers concluded.

Ayres BD, Donnenfeld E, Farid M, et al. Clinical diagnosis and management of Demodex blepharitis: the Demodex Expert Panel on Treatment and Eyelid Health (DEPTH). Eye. March 29, 2023. [Epub ahead of print].

IN BRIEF

Amblyopia No Hindrance to Academic Success. Although anecdotal experiences suggest childhood amblyopia can result in slower reading speeds and may affect children's academic self-esteem, **a recent study found no associations between a history of amblyopia and suboptimal school performance**.

The study included data from 9,939 UK-born children followed through age 17. Parents reported eye conditions, and treatment was coded by clinical reviewers. Children were grouped into the following categories: no eye conditions, strabismus alone, refractive amblyopia and strabismus/mixed amblyopia. Outcome measures included levels and trajectories for passing English, math and science (ages seven to 16), passing national exams (age 16) and intent to pursue higher education (ages 14 to 17).

The researchers reported that amblyopia status wasn't associated with performance in any of the schooling levels or intent to pursue university. They also observed no differences in terms of age-related trajectories of school performance or goals.

"These findings should reassure families, teachers, clinicians and policymakers that having amblyopia need not be considered a barrier to educational outcomes or ambitions," the researchers concluded in their paper.

Horvat-Gitsels LA, Cortina-Borja M, Rahi J. Educational attainment and trajectories at key stages of schooling for children with amblyopia compared to those without eye conditions: findings from the Millennium Cohort Study.


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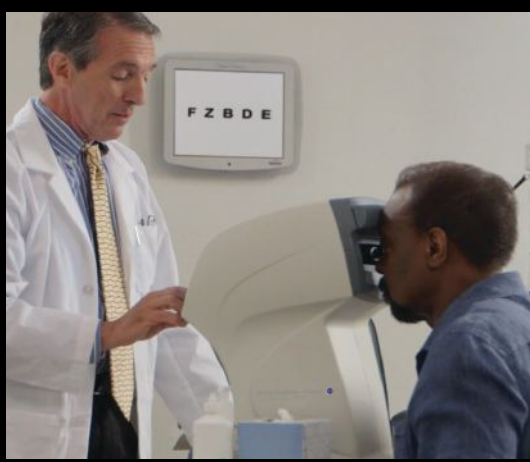

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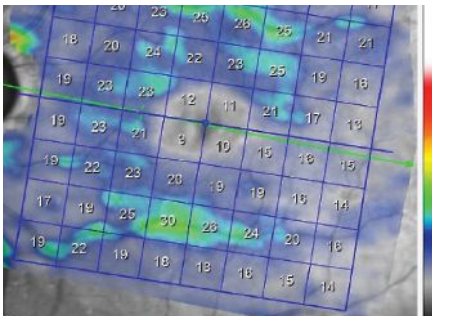
Some Oral Antihypertensives Raise Glaucoma Risk, Others Reduce It

In addition to using topical glaucoma drops, many patients also take systemic oral hypertensive medications to control blood pressure. These systemic drugs may effect glaucoma and IOP, however. A recent meta-analysis in *AJO* examined existing evidence on these drugs and reported that systemic antihypertensives may obscure elevated IOP.

The researchers examined five drug classes and gathered studies preceding December 2022, including 10 in their meta-analysis and 11 in their review. They reported that systemic beta-blockers were associated with lower odds of having glaucoma as well as lower IOP. Calcium channel blockers were linked only with higher odds of glaucoma. The researchers also reported no consistent associations among angiotensin-converting enzyme inhibitors, angiotensin receptor blockers or diuretics with glaucoma or IOP.

They wrote in their paper that their findings concerning beta blockers and IOP were similar to those of two previous studies on small clinical populations of patients with and without glaucoma. "The mechanism of action is thought to be that enough systemic beta-blocker medication reaches the anterior chamber to reduce formation of aqueous humor and reduce IOP," they wrote. "Thus, systemic beta-blockers likely protect against glaucoma by reducing IOP."

On the other hand, they noted that calcium channel blockers may increase glaucoma risk through an IOP-independent mechanism, since this drug class wasn't found to be associated with IOP. Though this finding wasn't in line with previously published research, the researchers suggested that calcium channel blockers may protect against normal-tension glaucoma by dilating ocular vessels and improving optic nerve perfusion. Overall, they noted that their data was only as good as the participants' compliance with taking the drug.



Systemic antihypertensive medications may conceal increased IOP or affect glaucoma risk in patients, recent study finds.

"Systemic beta-blockers to treat systemic hypertension may be beneficial in those at risk for glaucoma while systemic calcium channel blockers may be harmful," they concluded in their paper. "Clinicians should be aware that systemic antihypertensive medications may mask elevated IOP or positively or negatively affect risk of glaucoma."

Leung G, Grant A, Garas AN, et al. A systematic review and meta-analysis of systemic antihypertensive medications with intraocular pressure and glaucoma. Am J Ophthalmol. March 24, 2023. [Epub ahead of print].

Legislative Battles Over "Physician" Title Rankle ODs

(Continued from page 7)

our colleagues have heeded the call to action with an impressive phone and email campaign voicing their strong opposition to legislators throughout the state," the FOA noted in its statement. "Make no mistake, the FOA will remain vigilant in protecting the honorable profession of optometry and our doctor-patient relationship with Floridians," assured the association.

Similar Bills in Two Other States

Last month, Connecticut's Senate voted against SB 1016, related to the truthful representation of healthcare providers' medical degrees and licensure in advertising. As it was written, the legislation would not have affected the terms used to describe or advertise the services provided by optometrists if it had been passed. AOA noted in a recent article on its website that it had been vigilant in ensuring that such language was excluded from the bill throughout the legislative process.[1]

A similar bill in Texas, HB 2324, is still in the running and was referred most recently to the House Committee on Public Health. While this bill also currently excludes anti-optometry language, the Texas Optometric Association and the AOA continue to monitor the legislation to ensure optometrists' rights remain protected. If the bill passes, it does state that optometrists and other healthcare personnel who provide direct patient care will be required to wear a photo identification badge during all patient encounters, which lists the provider's first or last name, the hospital with which they're associated, the type of license held by the provider and, if applicable, the provider's status as a student, intern, trainee or resident.

Hopefully, the pivotal amendment to Florida's bill will be retained in any final legislation signed by the governor and will set a precedent for other states with similar aims to remove any anti-optometry language that may be present in their documents.

1. American Optometric Association. Optometry's scope wins draw new attacks from medical, ophthalmology groups. Published March 9, 2023. www.aoa.org/news/advocacy/state-advocacy/optometrys-scope-wins-draw-new-attacks-from-medical-and-ophthalmology-groups?sso=y. Accessed April 5, 2023.

Keep an eye out
for the root cause of blepharitis.

Demodex mites are the cause of chronic inflammation and associated with two-thirds of blepharitis cases.[1,2]
Demodex blepharitis (DB) is an important part of eyelid health.[3,4]

JEANETTE, real DB patient

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References: 1. Gao YY, Di Pascuale MA, Li W, et al. High prevalence of *Demodex* in eyelashes with cylindrical dandruff. *Invest Ophthalmol Vis Sci*. 2005;46(9):3089-3094. **2.** Trattler W, Karpecki P, Rapoport Y, et al. The prevalence of *Demodex* blepharitis in US eye care clinic patients as determined by collarettes: a pathognomonic sign. *Clin Ophthalmol*. 2022;16:1153-1164. **3.** Aumond S, Bitton E. The eyelash follicle features and anomalies: a review. *J Optom*. 2018;11(4):211-222. **4.** Fromstein SR, Harthan JS, Patel J, Opitz DL. *Demodex* blepharitis: clinical perspectives. *Clin Optom (Auckl)*. 2018;10:57-63.

US--2300052 2/23

Researchers Identify Progression Pattern of Myopic Tractional Maculopathy

A recent analysis in *Retina* demonstrated in highly myopic patients that long-term visual acuity of eyes with epiretinal membrane (ERM) was relatively stable but significantly affected by progression of myopic retinoschisis and macular hole.

Researchers in China assessed 610 highly myopic eyes (AL ≥26mm) of 610 patients 18 and older. All participants underwent exams including BCVA, slit lamp, fundoscopy and OCT at enrollment, two-year follow-up or any time they received vitreoretinal surgery within the two years.

The prevalence of ERM, myopic retinoschisis and macular hole increased from 26.7%, 12.1% and 4.4% at enrollment to 41.1%, 18.2% and 9.5% at the two-year follow-up, respectively. ERM progressed in 21.8% of eyes, but visual acuity did not decline significantly in these eyes. Myopic retinoschisis progressed in 6.8% of eyes, and macular hole progressed in 14.8% of eyes. The researchers detected greater BCVA reduction in eyes with myopic retinoschisis or macular hole progression. Multivariate analysis showed longer AL, more severe posterior staphyloma and absence of dome-shaped macula were associated with myopic tractional maculopathy progression.

ERM, myopic retinoschisis and macular hole progression were all related to a lower rate of dome-shaped macula. Logistic regression analyses showed the absence of dome-shaped macula increased the risk of ERM progression by 1.8-fold, myopic retinoschisis progression by 7.6-fold and macular hole progression by 5.6-fold.

"A possible explanation may be that dome-shaped macula, acting as a macular buckle, alleviates tractional forces over the fovea," the researchers wrote in their paper. "The influence of macular atrophy and choroidal neovascularization on myopic tractional maculopathy were not investigated in this study, but future studies on these complications are needed."

Meng J, Chen Y, Cheng K, et al. Long-term progression pattern of myopic tractional maculopathy: outcomes and risk factors. Retina. March 27, 2023. [Epub ahead of print].

Photo: Diana Shechtman, OD

The presence and progression of pathological lesions in the macula, such as the ERM seen here, greatly affect patients' visual function.

NAION Predominantly Found in White Patients

A new study in *AJO* addressed the question of whether NAION is truly experienced by a mostly white population, finding it to indeed be so.

The researchers collected data from academic centers in Atlanta and New York. All NAION patients evaluated in these centers from 2014 to 2022 were included in the retrospective study. To assess racial accessibility of services, a similar number of idiopathic intracranial hypertension (IIH) patients seen in the same services were also included.

Patients' self-reported race at neuro-ophthalmic examination were collected, then compared with Census data in 2020 for Georgia and New York, as well as the total US population.

Researchers found both locations reflected a high majority of white patients reporting NAION, with rates totaling 91.1% in Atlanta and 78.9% in New York. Black patients comprised 7.3% of patients seen in Atlanta and 3% in New York, while Asian patients only made up 1.2% of Atlanta patients and 5.9% of those in New York. The NAION group also reflected a much higher proportion of white individuals than the IIH group.

When compared to the states and general US populations, the white percentage of cases was also higher. The white population is 55.7% in Georgia, 60.5% in New York and 68.6% in the US.

The study authors concluded that "our results of a disproportionate percentage of white patients with NAION are in overall agreement with previously published data, confirming that patient inclusion in recent large clinical trials likely was not biased and represents the population of patients with NAION in the US."

The study authors noted that they cannot entirely rule out that patient access at the two clinics does not reflect some aspect of racial bias for NAION patients. However, the racial distribution of IIH patients makes this possibility unlikely. Both institutions also see patients with most insurances as well as those with no insurance.

Previous literature has suggested racial differences seen with NAION may be due to differences in optic disc topography or because white patients may have smaller cup-to-disc ratios than other races.

Banc A, Kupersmith M, Newman NJ, Biousse V. Race distribution in non-arteritic anterior ischemic optic neuropathy. Am J Ophthalmol. March 21, 2023. [Epub ahead of print].

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FEATURES

REVIEW OF OPTOMETRY • Vol. 160, No. 4 • April 15, 2023

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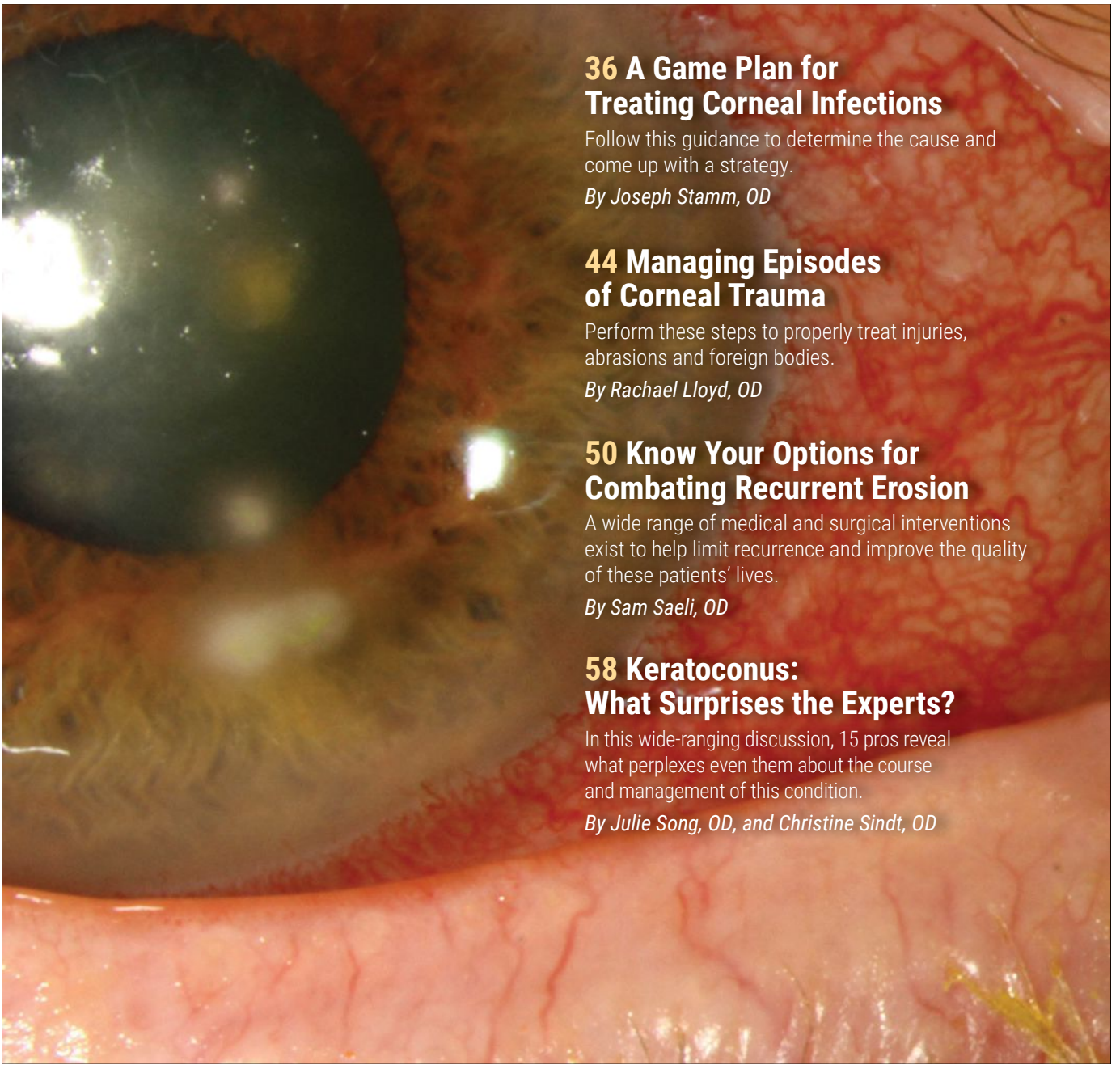

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#02 OF SERIES

KERATOCONUS and CROSS-LINKING

Practice Considerations in Managing Keratoconus and Cross-Linking

Nicole Albright, OD
Clinic Director,
Moses Eyecare Center
An independent optometry practice in Merrillville, IN

KEY TAKEAWAYS

- Managing keratoconus (KC) meets patients' needs as part of a medical-model optometric practice.
- There is no global period for cross-linking; each follow-up visit is billed as an office visit.
- The progressive KC patients I have referred for cross-linking have become loyal patients.

Many optometrists are shifting towards a medical model of practice, managing chronic conditions with ocular manifestations, including dry eye, glaucoma, and diabetes. Diversifying the services you offer can better meet the needs of your patients.

Managing keratoconus (KC) is a great way to "lean in" to that more comprehensive medical model of optometric care. About 70% of KC patients first present to an optometrist's office,[1] which means that we have a unique opportunity to identify this progressive disease and refer patients for the FDA-approved iLink® cross-linking procedure in the early stages, before there is permanent vision loss. After treatment, we can continue to address the patient's vision needs over time.

Collaborating with cornea specialists in the care of KC patients has provided comprehensive patient care and strengthened my relationships with ophthalmologists in the community. When they realize that we share a common goal of helping our KC patients, it opens the door not only to specialty contact lens fitting and follow-up care after cross-linking, but to collaboration and referrals in other areas, as well.

Follow-up care after iLink® cross-linking is similar to that required for PRK, with five or more visits and one or more contact lens re-fittings in the first year being typical. After that, KC patients will continue to need vision care and annual medical eye care appointments to monitor for any further corneal changes. While the timing and frequency of office visits may vary by patient and at the doctor's discretion, there is no global period for cross-linking. Any necessary post-treatment visits and diagnostic tests, such as pachymetry and topography, are typically billed separately.

I personally find scleral lens fitting and the management of progressive KC patients who are undergoing cross-linking to be among the most rewarding things I do as an optometrist. First and foremost, we offer them a treatment that can slow or halt KC progression. Furthermore, patients are so very appreciative when you can pinpoint the cause of and address their visual quality problems with contact lenses.

Modeling suggests that iLink® cross-linking saves the average patient nearly $9,000 in direct medical costs and nearly $44,000 in lifetime costs[2]—and that doesn't even include the impact on their mental health and well-being. In addition to the cost savings, it is very fulfilling to me to know that I can help protect a young person with early progressive KC from progressing to the advanced stages of the disease, potentially avoiding a lifetime of vision loss and the need for corneal transplant surgery. One study showed a 25% drop in corneal transplants after the introduction of cross-linking.[3]

Our KC patients are grateful for this care. They will rave about you on social media, refer family and friends—and generally become loyal patients. ■

With your medical management and cross-linking referrals, modeling[2] suggests that patients benefit:

$8,677
DIRECT MEDICAL COST SAVINGS PER PATIENT

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REDUCTION IN LIFETIME COSTS PER PATIENT

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INCREASE IN PATIENT QUALITY-OF-LIFE-YEARS

REFERENCES:
1. Eisenberg JS. First Treatment for Keratoconus Itself. Optometry Times, June 1, 2012. **2.** Lindstrom RL et al. J Med Econ 2021;24:410. **3.** Godefrooij DA, Gans R, Imhof SM, et al. Acta Ophthalmol 2016; 94:675-678.

INDICATIONS
Photrexa® Viscous (riboflavin 5'-phosphate in 20% dextran ophthalmic solution) and Photrexa® (riboflavin 5'-phosphate ophthalmic solution) are indicated for use with the KXL System in corneal collagen cross-linking for the treatment of progressive keratoconus and corneal ectasia following refractive surgery.

IMPORTANT SAFETY INFORMATION
Corneal collagen cross-linking should not be performed on pregnant women.
Ulcerative keratitis can occur. Patients should be monitored for resolution of epithelial defects. The most common ocular adverse reaction was corneal opacity (haze). Other ocular side effects include punctate keratitis, corneal striae, dry eye, corneal epithelium defect, eye pain, light sensitivity, reduced visual acuity, and blurred vision.
These are not all of the side effects of the corneal collagen cross-linking treatment. For more information, go to www.livingwithkeratoconus.com to obtain the FDA-approved product labeling.
You are encouraged to report all side effects to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

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BY JACK PERSICO
EDITOR-IN-CHIEF
OUTLOOK

The Empire Strikes Back

Stung by optometry's recent legislative successes, ophthalmology attempts a smear campaign—but only discredits itself in the process.

Optometry has been winning big lately, and ophthalmology doesn't like it. Think of all the scope of practice gains optometrists have notched in just the last few years. Laser procedures are on the cusp of going mainstream in optometry, with 10 states cleared and more in hot pursuit. Incisional and injectable procedures for lid lesions are already there.

At the national level, the Veterans Affairs Administration is pushing to get its optometrists parity with ophthalmologists and other MDs in administrative responsibilities and salary. The VA is also still working on a plan to set its own national standards for optometric scope of practice that would supercede any state optometry laws that don't meet the VA's. That one hasn't been rolled out yet, but will have a seismic effect on state-by-state scope battles once it does, since it'll set an appropriately high bar for the definition of optometric practice—one sanctioned by a respected federal agency. It'll get name-checked on every state scope bill going forward.

All this isn't *quite* on par with blowing up the Death Star, but the behemoth institutions of organized medicine, seeing threats to their power everywhere, are rattled nonetheless. Their counteroffensive includes the usual hatchet-job-in-local-newspaper stories that innocently claim to "help the public understand which eye doctor to see" to but then invariably paint a picture of optometry circa 1987. The most recent, and most deplorable, tactic has been a series of proposed state laws that would restrict use of the word "physician" to those practitioners with an MD or DO degree.

Ostensibly, these are being proposed to clarify the boundaries between doctors of medicine and osteopathy and, well, everyone else—nurse practitioners, physician assistants, chiropractors, podiatrists, optometrists. Anyone in the health professions who lacks an MD or DO after their name gets second-class citizen status.

The question is: why? Is there any demonstrable harm to public safety from the title a certain doctor uses? Nope, it's just gatekeeping. Ophthalmology fears the loss of its pre-eminence in the face of a growing, thriving profession of eye doctors—one double its own size—that it has no control over. So, let's be clear: this is about pettiness, not patients. Though these laws cover many healthcare disciplines, the ophthalmology groups that encouraged this effort just want to create a demeaning experience as payback for the optometry profession's hard-earned gains in skills and scope.

You can read about Florida's attempt to block optometrists from use of "optometric physician" on page 6 of our news section this month, and can always find the very latest news on our website. As of press time, this gambit by the medical lobby failed to withstand vocal opposition from optometrists in Florida, who successfully got an amendment added to protect them.

Turf wars are tiresome, and they belie the strength of one-on-one relationships between thousands of ODs and MDs in the trenches that are productive and marked by mutual respect. But until the institutions of medicine see optometrists as an ally and vital part of *their own future success*, the battles will continue. Man the X-wings. ■

BY PAUL M. KARPECKI, OD
CHIEF CLINICAL EDITOR

Impressive Innovations

Put these products and technologies on your radar.

It's hard to keep up with all the new eyecare products available today. This month, I'll point out some lesser-known innovations that help improve treatment outcomes and improve disease diagnosis. Let's dive in.

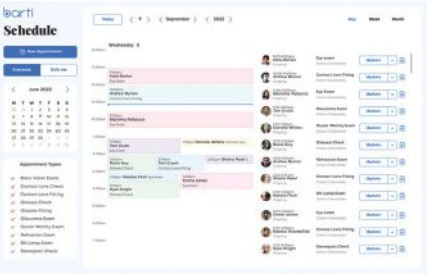
Eidon Ultra-Widefield Module

This non-mydriatic camera from iCare provides an impressive high-definition, true-to-life color, 200° image of the retina. Using confocal microscopy technology, it detects small details of the optic nerve, macula and peripheral retina, as well as pathologies that are not easily visible with other instruments.

Neurolens

Some estimates find that over 100 million Americans suffer from asthenopia. A sizable number of them could benefit from prism use in spectacles, but this option is not as commonly used as presbyopia correction or other spectacle enhancements like photochromic lenses and blue-blocking filters. However, prismatic need is greater at near than far for over 95% of the population, so uniform prism doesn't suffice.

Neurolens technology measures a patient's complete ocular alignment system, including distance and near phorias, vertical and horizontal, and even AC/A (accommodative convergence to accommodative ratio) to name a few, in less than two minutes. I have found it provides far greater accuracy than subjective measurements such as a phoropter or prism bar, and yields the exact recommended prism correction and direction. When the lenses are ordered, the prismatic need at near is increased from distance and this solves eyestrain, headaches, neck stiffness, dizziness and dry eye sensation symptoms.



The Barti EHR is configured expressly for optometric practice and requires fewer clicks than systems originally designed for ophthalmology offices.

Barti

It's about time an EHR company specifically organized for optometry emerged. The average entry in a primary eye exam electronic record is about 130 or more clicks, because most EHRs were designed for ophthalmology practices and either modified to work for optometry, or were simply used within the limitations they had. A company called Barti has found a way to decrease manual entry and eliminate the need for five or more other software packages that don't communicate. It's the easiest EHR you'll ever use, giving you more time for face-to-face interaction with your patients.

Acthar Gel

This relatively unknown medication from Mallinckrodt has been nothing short of miraculous in patients with keratitis and uveitis that are treatment-resistant. While ODs in most states can prescribe this agent through Mallinckrodt, a home health nurse works with the patient to administer and train the subcutaneous injection. Patients are typically dosed 80 units twice a week for three months, followed by 40 units twice a week for one month for non-infectious keratitis and anterior uveitis.

I use it when dealing with what I call the four R's: those **r**esistant to treatment, **r**ebounders, steroid **r**esponders and patients with **r**eimbursement issues related to other medications.

OcuSoft Lid Scrub Allergy

This eyelid allergy cleanser contains green tea extract (which reduces inflammation), tea tree oil (which reduces itching) and PSG-2, a water binding agent that reduces redness. These attributes, combined with the simple act of gently removing allergens on the eyelids and ocular adnexa, show great benefit for allergy sufferers.

Dry Eye Drink

Studies have shown that increased hydration can positively affect dry eye patients, but many don't drink sufficient water. This flavorful, fully natural drink from Bruder Healthcare allows water absorption levels to double. The combination of turmeric, DHA, taurine and green tea, as well as natural electrolytes, focuses on hydration and decreasing inflammation.

More to Come

The list of interesting products goes far beyond this one page, and next month I'll continue sharing the latest and greatest treatments and instruments making an impact in the optometry world. Stay tuned! ■

About Dr. Karpecki

Dr. Karpecki is the director of Cornea and External Disease for Kentucky Eye Institute, associate professor at KYCO and medical director for the Dry Eye Institutes of Kentucky and Indiana. He is the Chief Clinical Editor for Review of Optometry and chair of the New Technologies & Treatments conferences. A fixture in optometric clinical education, he consults for a wide array of ophthalmic clients, including ones discussed in this article. Dr. Karpecki's full disclosure list can be found in the online version of this article at www.reviewofoptometry.com.

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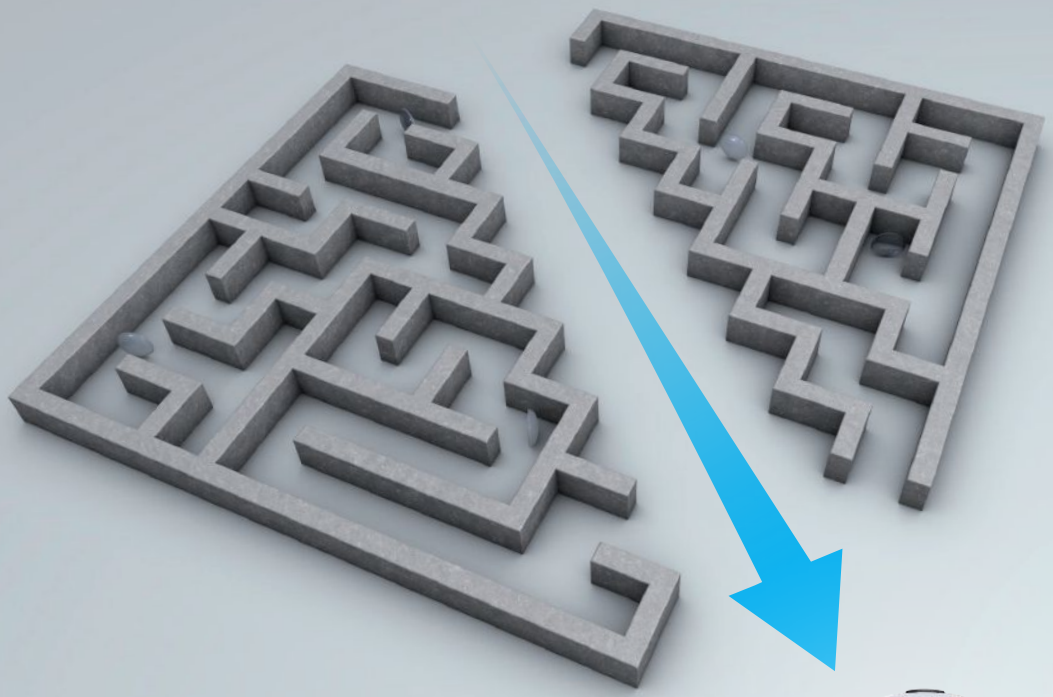

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BY MONTGOMERY VICKERS, OD

CHAIRSIDE

Love Makes the World Go Round

"Like" counts for something, too.

It's becoming spring as I write this, and I cannot help but ponder Valentine's Day 2023. Doesn't this mean that the world should be full of, oh, I don't know… LOVE? It helps to hope that it will not be full of, well, something else, at least for the purposes of this column, I guess.

When I think of our profession, I often like to quote the great philosophers who have made me the doctor I am. For example, when Gomer Pyle (see the TV series, "Gomer Pyle, USMC") was confronted with the statement, "You love Sergeant Carter, don't you?" his deeply considered answer was, "I like him, but I don't love him."

> **With apologies to The Beatles, one of my favorite optometry songs goes like this: "A love like ours could never die. As long as I accept your vision plan."**

I mean, I do love what I do, but it's not Valentinian; it's more an appreciation of the many blessings optometry has given me. It's kind of a like-love.

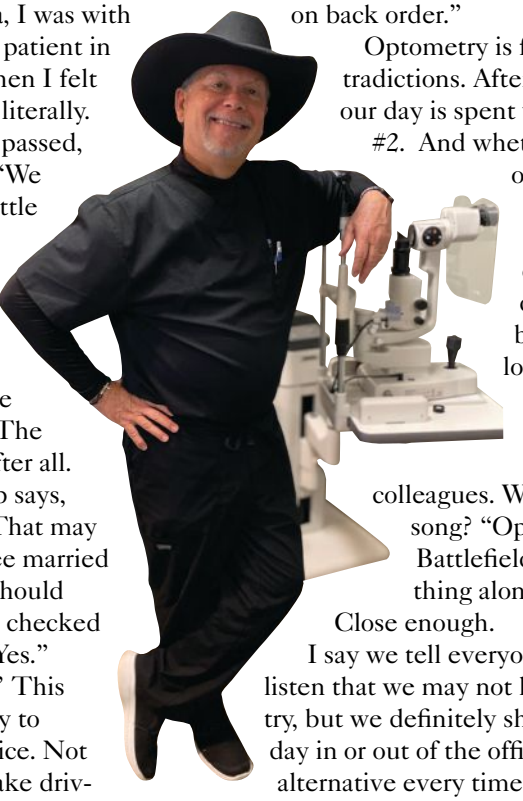
Think of your family. Can you love them without liking them? Oh, I hear you… you think I mean I totally love them all but sometimes just dislike something they have done. Same goes for patients.

With apologies to The Beatles, one of my favorite optometry songs goes like this: "A love like ours could never die. As long as I accept your vision plan."

That's all it takes to get a divorce in this business… some faceless bureaucrat sending out a list you are not on.

I like seeing and helping patients, but I love learning about them, their interests, their kids, their journeys through life, etc. This reminds me of my own journey and that we are all connected. Could it be love?

In West Virginia, I was with a new 70-year-old patient in the exam room when I felt the earth move… literally. A small tremor. It passed, and I said to her, "We either just had a little earthquake or I just fell in love with you." She laughed and said, "I felt it, too." Could it have really been love? The earth did move, after all.



The old proverb says, "Love is blind." That may explain why Renee married me. Perhaps she should have had her eyes checked before she said, "Yes."

"Love is blind." This may be a good way to market your practice. Not only could you make driving a car easier for the patients who come to you, but you could also solve their love life concerns so they can make better decisions on the front end. Too late for many, but there is still hope for some to be saved.

"Love is all you need." Yes, in all of life this is a very wonderful platitude, even though it seems to exclude other necessities such as pizza, for example. I think in optometry, this may need to be amended to something like:

"Love is all you need, plus an OCT. Love is all you need assuming your assistants aren't all having babies this year. Love is all you need if you get all your required CE done on time. Love is all you need when your EHRs aren't corrupted. Love is all you need as long as the office bathroom is fully operational. Love is all you need if the contact lenses are not on back order."

Optometry is full of contradictions. After all, much of our day is spent with #1 vs. #2. And whether we like optometry or love optometry, we treat our optometric days the same by showing love (or at least tolerance) toward our patients and colleagues. What's that song? "Optometry is a Battlefield" or something along those lines? Close enough.

I say we tell everyone who will listen that we may not love optometry, but we definitely should love each day in or out of the office. It beats the alternative every time. ■

About Dr. Vickers **Dr. Vickers** received his optometry degree from the Pennsylvania College of Optometry in 1979 and was clinical director at Vision Associates in St. Albans, WV, for 36 years. He is now in private practice in Dallas, where he continues to practice full-scope optometry. He has no financial interests to disclose.

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MOG Leads to Fog

Sudden vision loss requires a timely workup and a decisive plan.

Q A patient presented with progressive bilateral vision loss and swollen optic nerves OU. What are some considerations?

A "All optometrists should be comfortable with neuro cases so that a presentation that raises suspicion can be addressed quickly," says Steve Holbrook, OD, of The Eye Center of Southern Indiana.

Dr. Holbrook received an emergency Sunday call from a frantic daughter whose 78-year-old mother was experiencing gradual bilateral loss of vision for seven days that continued to worsen. She had been seen by her optometrist four days prior with best-corrected acuity of 20/50 OD and 20/80 OS. She was pseudophakic and had mild atrophic AMD and early nonproliferative diabetic retinopathy without macular edema. Her main finding at that visit was bilateral swelling of the optic nerves. Her health history included hypertension, high cholesterol, atrial fibrillation, anemia and obstructive sleep apnea on CPAP. She was sent to the local emergency department (ED) with the working diagnosis of papilledema and underwent CT, CTA and MRI scans, which were all negative. With no mention of her optic nerves, she was released to her primary care physician in three to five days. With her vision continuing to decline, she called her OD back the following day.

"The optometrist referred her to us but we were unable to get the patient on the phone that same afternoon," Dr. Holbrook noted. "Her vision continued to decline until two days later, when the daughter called the after-hours service not wanting to wait until Monday."

Scanning in the Wrong Places

After realizing over the phone that the patient now had counting fingers vision in each eye, Dr. Holbrook sent her to the regional teaching hospital in Indianapolis for an urgent neurologic evaluation. The patient had blood work done, a repeat MRI of the brain and orbits with and without contrast and was scheduled for a lumbar puncture.

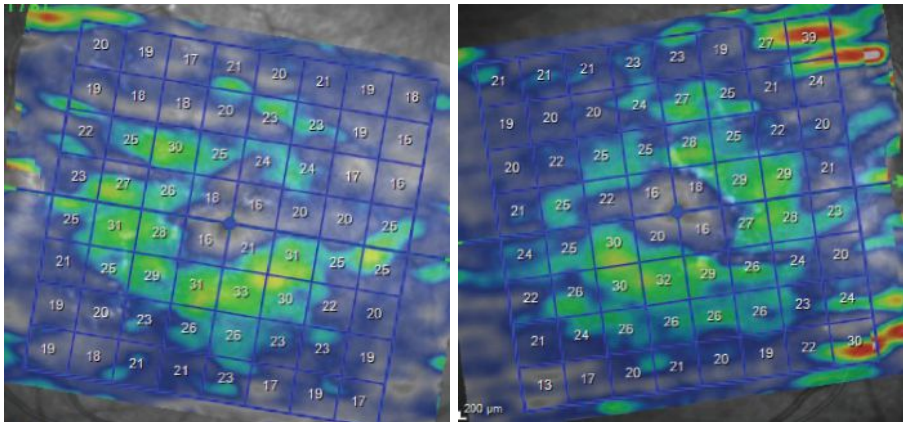
The MRI of the orbits was consistent with bilateral optic neuritis, showing abnormal enhancement in the intraorbital segment of the optic nerves with perineural inflammatory changes. She was further evaluated for paraneoplastic syndromes with CT chest, abdomen and pelvis, cerebrospinal fluid analysis and an MRI of the cervical and thoracic areas. Her myelin oligodendrocyte glycoprotein (MOG) antibody titer came back positive at 1:640 (normal is <1:10). The antibody for neuromyelitis optica spectrum disorder (aquaporin-4 or anti-AQP4) was negative.

"Our patient was diagnosed with MOG optic neuritis," Dr. Holbrook says. "This is a fairly newly described condition that optometrists should be more aware of."

Demyelination Diagnosis

MOG antibody-associated disease is an inflammatory disorder of the central nervous system characterized by attacks of immune-mediated demyelination predominantly targeting the optic nerves, brain and spinal cord. The disease has a predilection for children although any age group can be affected, as was the case of our 78-year-old. Findings include episodes of optic neuritis, acute disseminated encephalomyelitis, transverse myelitis or other central nervous system manifestations, either alone or in combination.[1]

There are overlapping features and important differences clinically, radiologically and on cerebrospinal fluid analysis that distinguish MOG antibody-associated disease from multiple sclerosis (MS) and anti-AQP4 neuromyelitis optica spectrum



Heidelberg OCT of the ganglion cell layer shows extreme thinning in both eyes.

About Dr. Ajamian **Dr. Ajamian** is board certified by the American Board of Optometry and serves as Center Director of Omni Eye Services of Atlanta. He is vice president of the Georgia State Board of Optometry and general CE chairman of SECO International. He has no financial interests to disclose.

disorder. According to Dr. Holbrook, the key eye findings are typically bilateral optic nerve head swelling, decreased vision and a wide age range.

"The MRI was very classic in this case with signs of intraorbital nerve inflammation," he noted. "The confirmative finding was the antibody titer."

Treatment Solutions

Intravenous Solu-medrol (methylprednisolone sodium succinate, Pfizer) was started 1g/day for five days, along with intravenous immunoglobulin 0.5g/kg for four days. Dr. Holbrook initially saw the patient six weeks later. Her vision had gradually improved to 20/40 and 20/100. She showed resolving nerve head swelling, with no hemorrhages noted. Her OCT revealed some restoration of cupping, temporal nerve fiber layer thinning and significant diffuse ganglion cell loss.

"She will be returning for a baseline visual field, and I scheduled her to see a neuro-immunologist (typically, an MS specialist) for probable long-term immunosuppressive therapy with either azathioprine or rituximab," Dr. Holbrook said.

Dr. Holbrook also advises colleagues to make these appointments for patients, and if patients need labs or imaging for acute problems, get them done urgently that day.

"The patient and her daughter are both extremely grateful that a timely workup was done," he said. "Take the time to help expedite treatment; don't leave anything to the patient."

When making referrals to the emergency department, give detailed instructions as to what tests to run. Communicate directly with the shift nurse and doctor verbally if you can but definitely in writing, so that they know what the differential diagnosis is. ■

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An Unprecedented Combination of Technologies Designed to Help Meet the Demands of Today[1]

The visual demands of the day are intense, says **Denise Whittam**, **OD**, of New York, New York. She says that people are spending more time on their digital devices since the start of the COVID-19 pandemic. Zoom calls and hybrid work schedules often mean people work long hours without the usual breaks that are part of an in-office routine. Indeed, adults spend 13 or more hours a day on digital devices, a 35 percent increase since 2019.[2]

Dr. Whittam

Bob Davis, **OD**, of Pembroke Pines, Florida, has heard this from his patients, too, noting that they say they pick up their phone to check messages often before they get out of bed in the morning or they're scrolling through social media or entertainment sites late into the night.

Digital device usage causes 60% less blinking which can dry out the eyes and cause discomfort.[3,4] ACUVUE® OASYS MAX 1-Day lenses have an unprecedented combination of technologies designed to help meet the demands of today.[1]

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TearStable™ Technology leverages a state-of-the-art manufacturing process[1] that optimizes wetting agent distribution throughout the lens and on the surface, resulting in longer tear film stability and reduced evaporation.[1,6,7]

Dr. Davis

Blue light filtering‡

But this lens also goes a step further with OptiBlue™ Light Filter‡, which filters 60 percent of blue violet light‡, the highest in the industry.^[1]

"I have a surprising number of patients asking me about blue light filtering‡," says **Ashley Roth**, **OD**, of Miami, Florida. "They've been asking, 'Should I wear blue light glasses on top of my contacts?' and I am so excited to give them the option to have blue light filtering‡ built into their contacts."

Dr. Davis asks his patients about blue light as well. "When I ask patients if they are concerned about blue light, many comment that their eyeglasses have blue light filtering. I'm excited to share that there's a contact lens that can filter blue light‡, he says.

Dr. Whittam says "patients come to my office concerned about blue light emitted from devices at the end of a day of digital device use." She addresses the visual effects of light scatter, halos and starburst patterns that many patients experience and tells them ACUVUE® OASYS MAX 1-Day lenses provide all-day comfort[5] and increased visual clarity.*[5]

Robust release

Johnson & Johnson Vision released both the sphere and the multifocal designs of this lens at the same time. For the presbyopic patient, this is great news with the combined technologies of TearStable™ Technology, OptiBlue™ Light Filter‡ and ACUVUE® PUPIL OPTIMIZED DESIGN.[8] Together these features combine in ACUVUE® OASYS MAX 1-Day Multifocal to deliver crisp, clear vision at all distances and in all lighting conditions[9] plus all-day comfort.[9]

That's exciting to Dr. Roth, who says, "The ACUVUE® PUPIL OPTIMIZED DESIGN is successful for my presbyopic patients, so now I will be able to offer patients using older material lenses a daily disposable silicone hydrogel lens with all the extra benefits of comfort[9] and crisp, clear vision.[9] I think this is a lens that the market has been waiting for." She says this lens is not only innovative but also incredibly useful for the majority of her patients. "I personally like to offer my patients the latest technology and will recommend these contacts to every single contact lens patient. With today's high computer use among kids and adults, I think this is a breakthrough product and will set the trend for all contact lenses in the future."

Dr. Roth

Dr. Davis agrees, saying the three benefits of this lens — TearStable™ Technology, OptiBlue™ Light Filter‡ and the Pupil Optimized Design — make this a standout lens.

Dr. Whittam adds "the optics are superb, and when patients put the lens on, it sells itself. It's a fabulous thing to be able to introduce a truly innovative lens to patients. It's our professional obligation to elevate awareness about the issues that can impact their vision and comfort."

*Versus ACUVUE® OASYS 1-Day

^Versus publicly available information for standard daily use contact lenses as of July 2022.

‡ Filtering of HEV light by contact lenses has not been demonstrated to confer any health benefit to the user, including but not limited to retinal protection, protection from cataract progression, reduced eye strain, improved contrast, improved acuity, reduced glare, improved low light vision, or improved circadian rhythm/sleep cycle. The Eye Care Professional should be consulted for more information.

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2. COVID-19: Screen Time spikes to over 13 hours per day according to Eyesafe Nielson estimates, published 3/28/20, https://eyesafe.com/covid-19-screen-time-spike-to-over-13-hours-per-day
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7. Johnson & Johnson Vision Data on File 2022. Material Properties: 1-DAY ACUVUE® MOIST, 1-DAY ACUVUE® TruEye®, ACUVUE® OASYS 1-Day with HydraLuxe™ Technology and ACUVUE® OASYS MAX 1-Day with TearStable™ Technology Brand contact lenses and other daily disposable contact lens brands.
8. Johnson & Johnson Vision Data on file 2022. CSM-ACUVUE® PUPIL OPTIMIZED DESIGN Technology: JJVC contact lenses, design features, and associated benefits.
9. Johnson & Johnson Vision Data on File 2022. Subjective Stand-Alone Claims for ACUVUE® OASYS MAX 1-Day MULTIFOCAL Contact Lenses - Exploratory Meta-analysis.

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2. JJV Data on File. CSM Subjective Responses ACUVUE® OASYS MAX 1-Day Contact Lenses - Retrospective Meta-analysis.

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BY JEROME SHERMAN, OD, AND SHERRY BASS, OD

YOU BE THE JUDGE

Melanoma Masquerader

As technology and knowledge evolve for examinations, so does the standard of care.

Nearly two decades ago, a 35-year-old, high-strung, type A personality male was referred by an OD to a highly respected retina specialist because of reduced vision in his right eye for about one month's duration. The patient reported no other symptoms or significant health history. Best-corrected visual acuity was 20/50 OD and 20/20 OS. The external exam was normal, both pupils reacted to light and no Marcus Gunn pupil was observed.

The dilated fundus examination revealed subtle fluid in the macula and trace pigmentary changes at the level of the retinal pigment epithelium (RPE) in the right eye only. The retinologist attempted to perform a fundus examination with a three-mirror lens, but the high-strung patient could not tolerate the procedure and the contact lens was dislodged several times—twice on the floor. Fluorescein angiography was performed, which revealed some ill-defined leakage in the posterior pole in the right eye only. The optic nerve head as well as the mid and far peripheral retina were judged as normal. The fellow left eye was completely normal.

The retina specialist diagnosed somewhat atypical central serous chorioretinopathy (CSCR) in this difficult to examine male patient. Note that two decades ago, OCT was in its clinical infancy and not readily available. B-scan ultrasound was available but not performed during the first several visits.

The patient returned as instructed five times over the next two years and was evaluated alternately by one of three optometrists in the practice. The condition remained essentially unchanged in both eyes. The patient missed several scheduled exams but on the last visit to the practice, the OD noted that the optic disc appeared slightly blurred in the right eye but normal in the left. A comparison to previous fundus photos suggested that the slightly blurred disc in the right eye was a new finding. The clinician reasoned that since the optic nerve head is never involved in CSCR, a different etiology must be considered.

B-scan ultrasonography was then performed for the first time, and although it did not reveal any retinal elevation, it appeared to reveal a thickened choroid extending to the optic nerve in the right eye, suggestive of an enlarging mass. Proptosis of the right globe was never observed.

The patient was immediately referred to an ophthalmic oncologist, who fully evaluated the patient including multiple scans of the globes, orbits and cranium. A somewhat unusual choroidal malignant melanoma was diagnosed, which appeared to be growing backwards into the orbit and was wrapped around the optic nerve. No typical mushroom-shaped lesion extending into the vitreal cavity was revealed by B-scan or MRI.

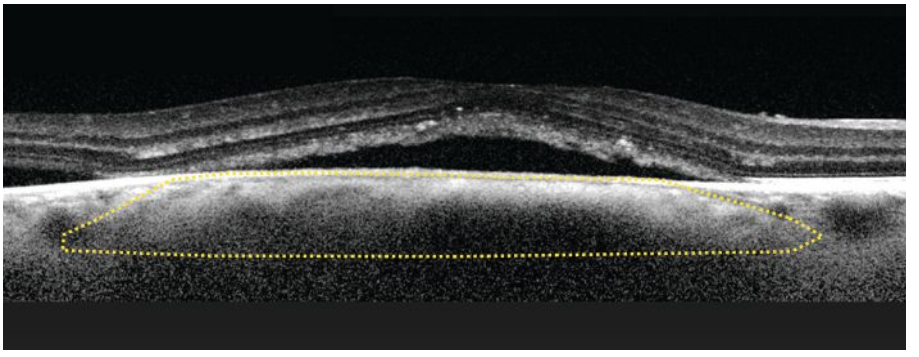

Photo: Carol Shields, MD

Subfoveal choroidal melanoma with subretinal fluid that could be misread as CSCR.

Outcome

Based upon the size of the lesion and absence of evidence of metastasis on an extensive systemic work-up, the ophthalmic oncologist recommended enucleation. The patient agreed, and the mass was later confirmed histopathologically to be a mixed cell type malignant melanoma.

Five years after uneventful ocular and systemic follow-ups, most patients with cancer are classified

About Drs. Sherman and Bass

Dr. Sherman is a Distinguished Teaching Professor at the SUNY State College of Optometry and editor-in-chief of *Retina Revealed* at www.retinarevealed.com. During his 52 years at SUNY, Dr. Sherman has published about 750 various manuscripts. He has also served as an expert witness in 400 malpractice cases, approximately equally split between plaintiff and defendant. Dr. Sherman has received support for *Retina Revealed* from Carl Zeiss Meditec, MacuHealth and Konan. **Dr. Bass** also holds the position of Distinguished Teaching Professor at the SUNY State College of Optometry. She is a Diplomate of the American Board of Optometry. She is an attending in the Retina Clinic of the University Eye Center and currently serves as the residency supervisor for the Residency in Ocular Disease at SUNY. She has no financial disclosures.

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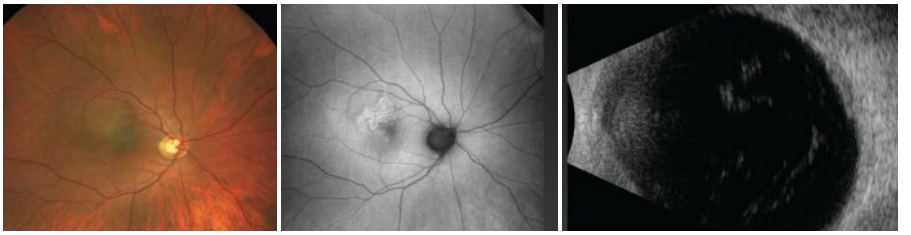

Photo: Carol Shields, MD

A comparison of fundus imaging (left), autofluorescence (middle) and ultrasound (right) for the same case as the previous image. The ultrasound B-scan appears to be the most sensitive to detect this relatively flat melanoma.

as cured. However, in this case, worsening liver enzymes at five years and a repeat liver scan revealed for the first time multiple, suspicious lesions, essentially confirming metastasis.

The patient died in the sixth year following enucleation. The family apparently initiated a lawsuit for failure to diagnose the choroidal melanoma two years earlier, but the case was reported to be dropped.

You Be the Judge

Was the retinologist culpable of malpractice for arriving at a diagnosis of CSCR that was not supported by the clinical findings?

Were the ODs who performed the follow-up exams culpable?

Were so-called flat choroidal melanomas well appreciated at the time the care was rendered?

Has technology and knowledge evolved recently that alters the standard of care in similar cases?

Our Opinion

In select cases such as this, clinicians can easily be misled and arrive at the most common diagnosis linking the symptoms, patient characteristics and clinical findings together and failing to consider a far rarer—but potentially deadly—diagnosis.

CSCR in a type A behavior, middle-aged male whose exam reveals macula fluid and RPE changes is the diagnosis that most clinicians would most likely arrive upon, at least several decades ago. Considering the guideline—"like practitioner under like circumstances"—we find the doctors involved in this tragic case not culpable of malpractice.

One could argue that clinicians should consider "worst… first" in diagnosis in order to avoid outcomes such as this. The opposing argument is that we cannot obtain MRIs and other expensive, and sometimes invasive, tests indiscriminately because of the limited health care resources available.

Most clinicians think of choroidal malignant melanoma as an elevated mass and not a flat lesion with minimal or no obvious elevation. Hopefully, our comments below will expand the clinician's knowledge about these rare tumors.

Comments

The selection of this case was initiated by a recent presentation by Carol Shields, MD, at the Macula Society 46th Annual Meeting in Miami Beach in mid-February that one of us attended (JS). Dr. Shields presented a talk, "Choroidal Melanoma Masquerading as Central Serous Chorioretinopathy." Her group at the Ocular Oncology Service at Wills Eye Hospital performed a retrospective case series review of all patients with choroidal melanoma over the past two decades initially misdiagnosed as CSCR elsewhere.

Of the 22 patients identified, 16 were male and the mean age was 48. The mean interval between initial CSCR diagnosis and suspicion of choroidal melanoma was 50 months. At tumor diagnosis, the tumor was submacular in 16 of the 22 patients. On a mean six-year follow-up, one patient of the 22 died.

The conclusion from Dr. Shields's study was that patients with presumed CSCR, especially if chronic, should be evaluated for a possible thin underlying choroidal melanoma with a dilated fundus exam and multimodal imaging.[1] Dr. Shields noted that features enabling differentiation of choroidal melanoma from CSCR included choroidal thickness asymmetry, ipsilateral choroidal surface irregularity, loss of choroidal vascular detail on OCT and lack of autofluorescence abnormalities in the fellow eye.[1] CSCR is often bilateral but asymmetric, whereas choroidal melanoma is virtually never bilateral.

Note that the patient we are reporting in this column was evaluated prior to the clinical availability of OCT and fundus autofluorescence and prior to the Shields study, emphasizing the need to consider a thin underlying choroidal melanoma in a patient with chronic, unilateral CSCR.

Hence, the standard of care has evolved somewhat over the past two decades because technology and knowledge has evolved. Although our opinion is that no culpability exists in this case, a similar case today may result, in our opinion, in culpability. Far more important, a similar case today could perhaps result in a timelier diagnosis and preservation of a life. ■

We applaud Carol Shields, MD, and Jerry Shields, MD, for their decades-long contributions in ophthalmic oncology.

1. Negretti GS, Kalafatis NE, Shields JA, Shields CL. Choroidal melanoma masquerading as central serous chorioretinopathy. Ophthalmol Retina. 2023;7(2):171-7.

NOTE: This article is one of a series based on actual lawsuits in which the author served as an expert witness or rendered an expert opinion. These cases are factual, but some details have been altered to preserve confidentiality. The article represents the authors' opinion of acceptable standards of care and do not give legal or medical advice. Laws, standards and the outcome of cases can vary from place to place. Others' opinions may differ; we welcome yours.

Multi-Specialty Perspectives on Ocular Itch Relief for Allergic Conjunctivitis

John Hovanesian, MD
Harvard Eye Associates
in Laguna Hills, CA.

Leslie O'Dell, OD
Medical Director of Medical Optometry
America in York, PA.

Bob Lanier, MD, FACAAI, FAAAI
Clinical Professor Immunology
University of North Texas Health Science
Center, Fort Worth, TX.

An estimated 66 million Americans suffer from ocular allergies.[1] In fact, ocular symptoms are second only to nasal symptoms in prevalence and itchy eyes are reportedly as bothersome as nasal congestion.[2,3] Furthermore, it's important to note that both ocular and nasal symptoms commonly present together.[2,3] In sum, patients are experiencing meaningful impacts on their quality of life as a result of seasonal allergic conjunctivitis and they seek out care from many health care specialists—from pharmacists and primary care physicians to eye doctors and allergists. Here, three specialists—an ophthalmologist, an optometrist and an allergist-immunologist—share helpful disease state and prescribing insights that can help guide decision-making and lessen the burden of disease on patients as we enter a new allergy season.

THE ALLERGIC RESPONSE

In practice, we see allergy patients every day, yet we might not always reflect much on the allergic response and why this process is relevant to the care we deliver and the recommendations we make. However, being mindful of the allergic cascade is central to how allergy in general, and itching in particular are best managed.

First, keep in mind that an allergy is actually a defense mechanism. It's our body's way of fighting off things like ragweed and grass. But this battle involves a series of chain of reactions that lead to the release of chemical mediators, including histamine. Histamine is one of the chemical granules inside a mast cell. When the mast cell is tagged by an antibody, it essentially begins to explode and blow apart. This happens quickly and these histamine granules are very irritating once they've been released. Systemically, they lead to itching and sneezing and, in the eye, they cause significant patient irritation and discomfort. Of course, histamine can be combated using antihistamines, steroids and some mast cell stabilizers, but because it's released so quickly following exposure, management can be a challenge. An awareness of this helps us appreciate why it's so important to stabilize the mast cell to control allergy as well as blunt the response to re-

HISTAMINE AND THE ALLERGIC RESPONSE

In seasonal and perennial allergies, allergens, such as grass or ragweed pollen, dust mites, and animal dander, can cause an immune reaction mediated by immunoglobulin E (IgE).[13] A cascade of events leads to mast-cell degranulation and release of histamine and other proinflammatory mediators at the site of allergen invasion.[13] The inflammatory reaction results in vasodilation, increased vascular permeability, leukocyte chemotaxis, and emigration of inflammatory cells into the surrounding tissues spaces, causing signs and symptoms of inflammation.[13]

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Table 1: Comparison of key characteristics of nasal, oral, and ophthalmic anti-allergy over-the-counter medications.

	Nasal	Oral	Ophthamic			
Drug Class	Steroid	Antihistamine	Lubricant or Astringent*	Antihistamine + Vasoconstrictor	Antihistamine + Mast Cell Stabilizer	
Example Brand(s)	Flonase Allergy Relief	Claritin Tablets	Clear Eyes Dry & Itchy Relief, Visine A.C. Itchy Relief	Visine Allergy Eye Relief Mulit-Action	Alaway	Pataday Once Daily Relief Extra Strength
Example Active Ingredients	Fluticasone propionate (glucocorticold) 50 mcg	Loratadine 10 mg	Glycerin 0.25% Zinc Sulfate 0.25%	Naphazoline HCl 0.025%, Pheniramine maleate 0.3%	Ketotifen 0.025%	Olopatadine 0.7%
Onset of Action	Full effect may take up to several days	Within 1-3 hrs, maximum effect 8-12 hrs	Itch data not reported	Within minutes	Within minutes	Within minutes
Duration of Action	24 hours	24 hours	Itch data not reported	6 hours	12 hours	24 hours
pH					4.4-6.0	6-7

* Not approved as anti-allergy drops

leased histamine. Indeed, there is significant value in treating it from both sides with dual mechanisms of action.

THE PATIENT EXPERIENCE

Many allergy sufferers endure chronic discomfort, yet they often keep their ocular complaints to themselves until they reach a more acute stage, which is when they commonly present in specialty practices. Remarkably, only 10% of patients with ocular allergy symptoms seek any professional care.[4] By the time they decide to seek care, many of these patients have ocular inflammation, itching, redness, tearing, chemosis, and eyelid swelling. This is why it's so important that health providers in all specialties ask about ocular symptoms. Patients truly are suffering in silence.

People with chronic disease are used to feeling uncomfortable and don't know any other way. It becomes normal. It's the clinician's responsibility to be proactive and look for signs and ask questions about ocular symptoms specifically. We also need to keep in mind that, before they come to see us, many patients are buying over-the-counter (OTC) oral non-sedating antihistamines and intranasal corticosteroids.[5] Some select treatment more or less at random, without talking to a pharmacist or their health care provider. The self-diagnosis and management can result in dissatisfaction with these treatments.[5] Complaints include incomplete relief, slow onset of relief, short duration of relief and reduced efficacy over time.[5] Eventually these patients discontinue use or change medications, with most citing inadequate efficacy as the primary cause.[5]

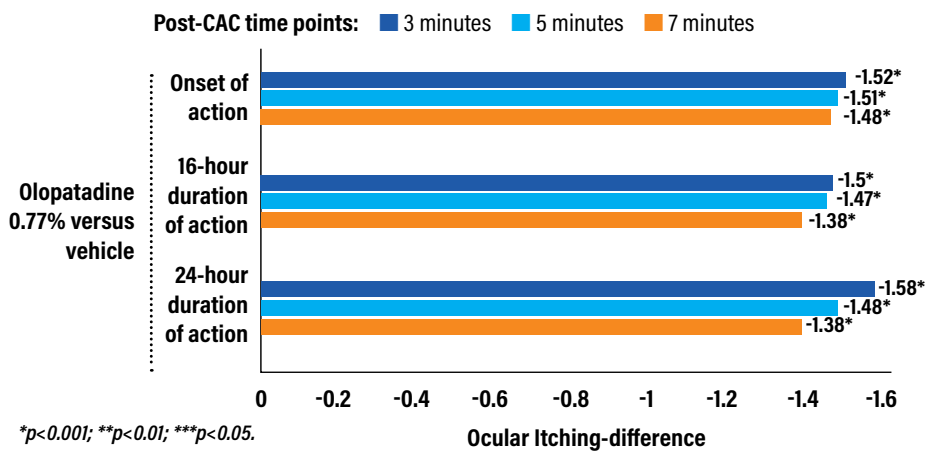
Many patients think that drugs that are approved for eye allergy itch relief all have the same efficacy on the eye. We need to re-educate patients and help them understand how allergies, and the medications they choose to treat them, will affect their entire system. Many patients who have tried oral and nasal medications and still experience itch, watery eyes and redness. Some have also tried drops that claim to provide itch relief, but that lack an antihistamine, which we know is so instrumental in combatting common allergens.

TREATMENT CATEGORIES

When we are advising patients who are suffering with itchy eyes due to allergic conjunctivitis, we have three main categories of medications for eye itch relief—over-the-counter oral, nasal, and ophthalmic medications. However, there are the key differences between

OLOPATADINE 0.77% RELIEVES EYE ALLERGY ITCH FASTER AND BETTER THAN PLACEBO CONTROL FOR A FULL 24 HOURS

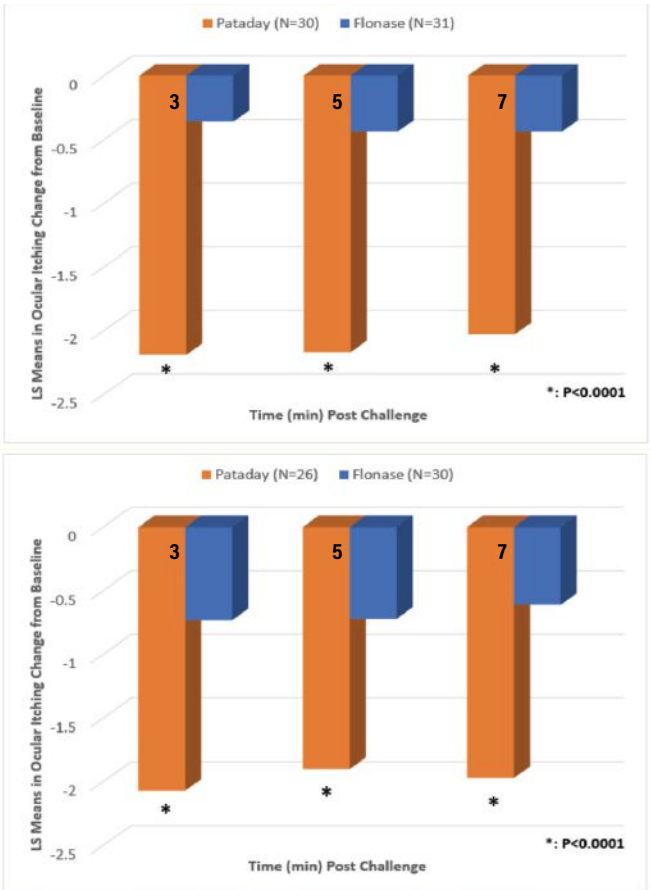
A Phase III, multi-center, double-masked, parallel group, randomized clinical trial compared the safety and efficacy of Pataday Extra Strength against vehicle using a conjunctival allergen challenge (CAC) model.[13] Following the conjunctival allergen challenge, the patient was given either vehicle or Pataday Extra Strength. Onset of action and duration of action were both assessed. As the figure illustrates, Pataday Extra Strength relieved ocular allergy itch faster and better at all measured times and was effective for 24 hours. This strong clinical evidence should give providers confidence in recommending this for their patients who do not like frequent dosing and want long-lasting relief.



Treatment differences in means after conjunctival allergen challenge (CAC): primary endpoint of ocular itching at 27 minutes (onset), 16-hours, and 24- hours post-dose administration.[13]

OLOPATADINE 0.77% VERSUS STEROID NASAL SPRAY

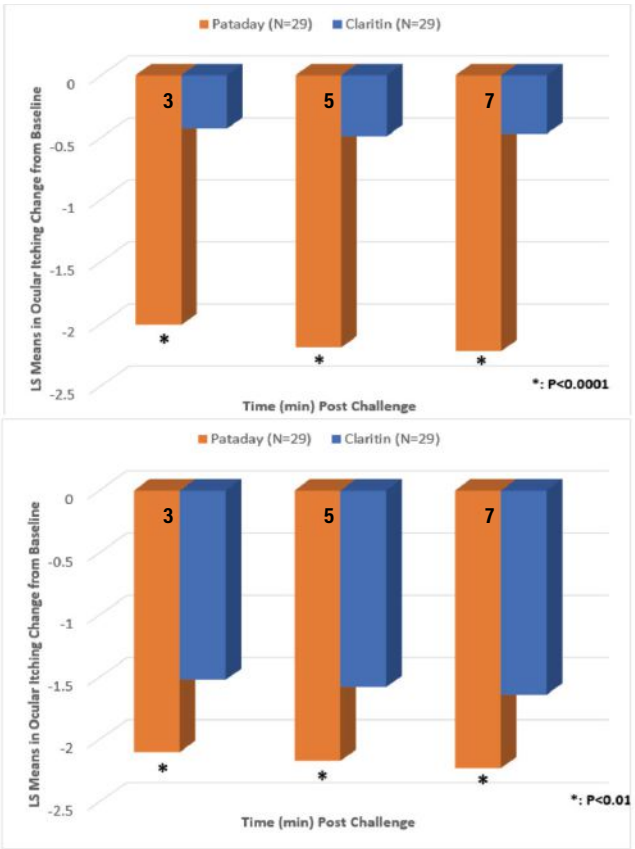
A randomized, double-masked, parallel study compared the efficacy of Pataday Once Daily Relief Extra Strength to Flonase Allergy Relief, which is a nasal steroid spray approved for relieving multiple symptoms of hay fever, including itchy eyes.[14] Participants were treated with either Pataday (n = 30) or Flonase (n = 31), and then 15 minutes later were exposed to allergen drops to trigger an allergic response. At 3, 5, and 7 minutes after allergen exposure, participants in the Pataday group reported significantly lower eye itch scores compared to those in the Flonase study group. After 2 weeks of treatment, the Pataday group continued to report significantly lower eye allergy itch scores compared to those in the Flonase group 24 hours after treatment at all measured time points.



At onset (top) and 24 hours (bottom) after treatment, mean eye itching scores were significantly lower in the Pataday® Once Daily Relief Extra Strength group compared to the Flonase® Allergy Relief group.[14]

OLOPATADINE 0.77% VERSUS ORAL ANTIHISTAMINE

In a recent study, Pataday Once Daily Relief Extra Strength (n = 29) was compared to Claritin 24-hour tablets (n = 29), which is an oral antihistamine approved for relieving multiple symptoms of hay fever, including itchy eyes.[15] Participants in the Pataday group reported significantly lower eye allergy itch scores compared to those in the Claritin study group approximately 15 minutes after treatment. And, as with the nasal spray study, eye allergy itch assessments were also conducted 2 weeks after self-treating at home. Participants in the Pataday group reported statistically significantly lower itch scores compared to those in the Claritin group 24 hours after treatment. This is important because patients often think they can take one medication and it will treat all of their different symptoms, so understanding how this compares is particularly important.



At 15 minutes (top) and 24 hours (bottom) after treatment, mean eye itching scores were significantly (P<0.0001) lower in the Pataday® Once Daily Relief Extra Strength group compared to the Claritin® Tablets 24-Hour group.[15]

these medications (*Table 1*).

With regard to nasal steroid sprays, steroids have anti-inflammatory activity and are very effective in relieving symptoms of nasal congestion and have been shown to relieve symptoms of itchy, watery eyes. However, it can take several days of regular use to achieve the full effect and is associated with side effects that should be considered before use.[6]

With regard to oral antihistamines for treatment for ocular itching, the first consideration is that they need to be absorbed and make their way through the body. However, it can take up to 1-3 hours to begin working to reduce symptoms of itch and as many as 8-12 hours to reach maximum effect.[7]

A third treatment category includes eye drops. On one hand, we're very fortunate to be able to put medicine directly on the target organ, but we must be cognizant of the fact that not all topicals are created equal. There is a lot of diversity in this category and it can be very confusing for patients due to how some of these medications are marketed. For example, some drops are marketed for "itchy" eyes but do not contain active agents that target mast cells or histamine receptors. Examples of these products include CLEAR EYES Dry and Itchy Relief[8] and VISINE A.C. Itchy Eye Relief.[9] These products are classified as lubricants and astringents, respectively, and do not contain steroids, antihistamines, or mast cell stabilizers. Rather, they are indicated for the temporary relief of discomfort due to minor eye irritations and not specifically for eye itch due to hay fever or environmental allergens.

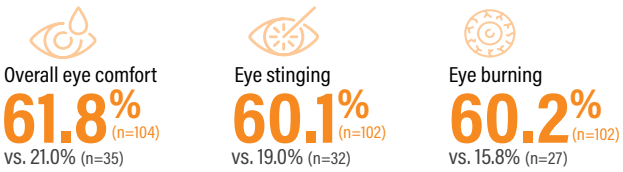
If we're looking at lubricants and astringents as a subcategory of the topical ophthalmics, another subcategory would be the combination antihistamine and vasoconstrictors. This group of medications includes drops such as Visine Allergy Eye Relief Multi-Action.[10]

OLOPATADINE 0.77% VERSUS OTHER OPHTHALMIC ANTIHISTAMINES

With topicals, tolerance is extremely important. You want a drop that offers relief with minimal irritation upon instillation. In two separate prospective, randomized, single-masked, contralateral, single-site clinical studies, comfort upon application of Pataday Once Daily Relief Extra Strength was compared to Visine Allergy Eye Relief and the other with Alaway.[16,17] The Pataday group reported significantly higher comfort scores compared to the Visine Allergy group immediately upon drop application, and at 30 seconds, 1 and 2 minutes after application and to the Alaway group immediately upon drop application, and at 30 seconds, 1 and 2 minutes after application. Furthermore, approximately 3 times more participants reported that they either preferred or strongly preferred Pataday Extra Strength over Visine Allergy based on overall comfort and symptoms of stinging and over Alaway based on overall comfort and symptoms of stinging, burning, and foreign body sensation.

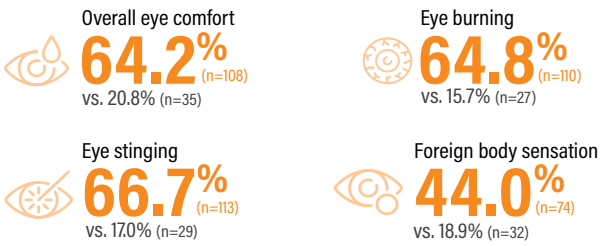
Approximately 3-times more participants preferred Pataday over Visine based on overall comfort and stinging.

Percentage of participants who reported preference or strong preference for Pataday vs. Visine Allergy:



At least 3-times more participants preferred Pataday over Alaway based on comfort, burning, and stinging

Percentage of participants who reported preference or strong preference for Pataday vs. Alaway:



These drops are indicated for allergy itch relief, but they require dosing 4 times daily, which can be burdensome and can result in rebound redness upon discontinuation. Another factor to consider is that some drops are more acidic than the natural pH of the tear film, so patients might experience mild irritation upon application. The pH of the average human tear film is close to 7.0, but Alaway with ketotifen has a pH of 4.6 to 6.0.[11]

The other drop in this category is Pataday Once Daily Extra Strength with olopatadine 0.7%. This is a dual action agent that stabilizes mast cells and blocks histamine receptors. Unlike Alaway, its effects last a full 24 hours, requiring only once daily dosing. Furthermore, the pH of Pataday Once Daily Extra Strength is 6.0. to 7.0,[12] which is similar to that of the normal human ocular surface tear film.

ONCE-A-DAY DOSING WITH OLOPATADINE 0.7%

Pataday Once Daily Relief Extra Strength is indicated for temporarily relieving itchy eyes caused by allergens, including pollen, ragweed, grass, and animal dander and hair. It is approved to be used once a day in adults and children 2 years and older and provides effects that last up to 24 hours. Since it's topical, it hits the target cells right away. It hits right away and it blocks any histamine receptors that haven't been yet sensitized. Pataday Once Daily Relief Extra Strength offers an ideal combination of benefits and can give patients something that works fast and is long-lasting.

Along with having 0.7% olopatadine, its pH reduces stinging and burning with instillation, making it very comfortable for patients. Furthermore, an effective once-a-day drop also makes it extremely convenient for patients. For example, patients who wear contact lenses don't have to take their lenses out several times during the day to redose. It's an enormous difference for patients when they can use a medication once a day and continue to have a benefit, whether it's so they can work a long day or simply not wake up the next day with symptoms. They're covered for 24 hours with Pataday Extra Strength Once Daily Relief.

HELP PATIENTS NAVIGATE OPTIONS

In summary, there are many options for itchy allergy eyes. It's complex for specialists to navigate, so imagine how overwhelming it can be for patients as they try to select among the many OTC options at a pharmacy. It's confusing, but a little guidance from us can go a long way and can help save patients the frustration of trying different types of treatments until they find one that meets their needs. As clinicians, we are armed with clinical evidence to better advise our patients.

With respect to Pataday Extra Strength, it has been shown to relieve eye allergy itch faster and significantly greater at 24 hours compared to both Claritin Tablets and Flonase Allergy. It has also been shown to be more comfortable upon application compared to Alaway and Visine Allergy Relief. Therefore, Pataday Extra Strength is a very strong option for patients with eye allergy itch who are seeking a comfortable eye drop that provides fast relief that can last up to 24 hours with just a single drop. ■

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A GAME PLAN FOR TREATING CORNEAL INFECTIONS

Follow this guidance to determine the cause and come up with a strategy.

BY JOSEPH STAMM, OD
WORCHESTER, MA

In any sporting event, knowing your opponent is the key to developing a game plan to defeat them. When you have a case of keratitis in your chair, the task is no different—you need a solid game plan to help your patient heal. Unfortunately, we, as doctors of optometry, don't always know who our opponent is when the patient walks into the office. However, we do have plenty of previous game film on the most common causes of keratitis to rely on when planning our treatment approach. This is vital, as early, accurate diagnosis and treatment will improve the patient's chances for a winning outcome.

Know Your Opponent

Before you can decide how to treat your opponent, or your patient, you must figure out if you are confronting an infectious or a non-infectious process. You'll need a different set of plays lined up for an infectious presentation such as a bacterial keratitis secondary to *Pseudomonas aeruginosa* or *Staphylococcus aureus* than you will for a corneal infiltrative event that can be managed with a topical corticosteroid or steroid/antibiotic combination drug. While the majority of infectious keratitis cases are microbial in nature, you need to keep fungi, viruses and parasites on your radar screens as potential offending pathogens.

As the majority of pathogens are unable to invade a structurally intact corneal epithelium, learning what was occurring before the patient decided to present is very important. Do they recall any trauma to the eye? If yes, what was it that hit or got in their eye? Dirt or vegetative matter greatly increases the chance you are dealing with a polymicrobial process with high risk of fungal infection. Do they work in a hospital or health care setting? If yes, you need to keep Methicillin-resistant *Staph. aureus* (MRSA) in your differential. Are they immunocompromised or diabetic, both of which increase their risk for infection? Do they have a history of oral herpes? Have they had similar episodes in the past? Last, but most importantly, are they a contact lens wearer? If so, are they caring for their lenses appropriately?

Your patient's symptoms can help further guide your differential diagnosis. The degree of pain is usually greater when there is an epithelial defect present. Significant pain may point toward a microbial origin while less pain than might be expected for their clinical presentation could point toward a herpetic or acanthamoebic origin. The timing and progression of the pain is also informative. Pain that has been low to moderate and nagging is usually associated with a less virulent pathogen compared with acute symptoms that escalated quickly.

Keratitis

The vast majority of microbial keratitis cases are associated with contact lens wear. It is estimated that the incidence of microbial keratitis is 10 times higher in contact lens wearers compared to non-wearers.[1] Improper care of lenses, extended wear and lens abuse are typically the cause of infec-

About the author

Dr. Stamm is an associate professor of optometry at the MCPHS School of Optometry in Worcester, MA, where he is chief of the Contact Lens and Dry Eye Service. He sees patients with the third- and fourth-year interns in the contact lens and dry eye clinics at the school's Eye and Vision Center, and is the instructor of record for the contact lens curriculum and the ocular surface disorders/dry eye course. Dr. Stamm is a graduate of the SUNY College of Optometry, a fellow of the American Academy of Optometry and a diplomate of the Academy's section on Cornea, Contact Lens and Refractive Technologies. He has no financial interests to disclose.

tion. Gram-negative *Pseudomonas* and gram-positive *Staph. aureus* are your major offenders in these situations. *Pseudomonas*, which readily attaches itself to the surface of a contact lens, requires rapid and aggressive treatment as it can penetrate the corneal stroma within days as it secretes proteases that induce stromal necrosis.

Carefully question contact lens wearing patients to determine if there has been any exposure of the eye, lens or storage case to water leading up to the infection. If there has been, *Acanthamoeba* must be in your differential. *Acanthamoeba* is a free-living amoeba and 85% of *Acanthamoeba* keratitis (AK) cases occur in contact lens wearers.

While you often hear about the ring-shaped infiltrate with AK, that finding actually does not present until late in the process, which often makes this a diagnosis of exclusion when antibiotic treatment proves ineffective. Early signs of AK include epithelial pseudodendrites, radial perineuritis with inflammatory cells surrounding the corneal nerves and a stromal appearance similar to stromal herpes simplex keratitis. While pain out of proportion to clinical signs is a common presentation with AK, some patients will present with little subjective symptoms.

Sizable differences exist in the prevalence of microorganisms endemic to the environment in different geographic locations. Gram-positive bacteria are more prevalent in northern California, the Northeast and mid-Atlantic regions of the United States. Gram-negative infections are more prevalent in Florida, Texas and central and southern California. Concerning fungal infections, yeasts such as *Candida* are more prevalent in colder, northern environments. Filamentous fungi such as *Aspergillus* and *Fusarium* are generally found in warmer, more humid southern environments.[2]

Examination. Once you gathered all of the patient's history, have them sit behind the slit lamp and see what you are up against. Examination with both white light and sodium fluorescein is required. Infectious ulcers tend to present as a round epithelial defect with a corresponding stromal infiltrate of a similar size. An infiltrative presentation with minimal or no epithelial defect may be inflammatory as opposed to infectious. Pay attention to the depth of the lesion, as superficial defects have a better prognosis—either you've caught a bad actor early or the pathogen is less virulent. When the lesion is deeper in the stroma, the cascade of immune cellular pathways has likely begun. Inflammatory mediators and proteases promote the progression of the infection, enable tissue necrosis and impair healing.

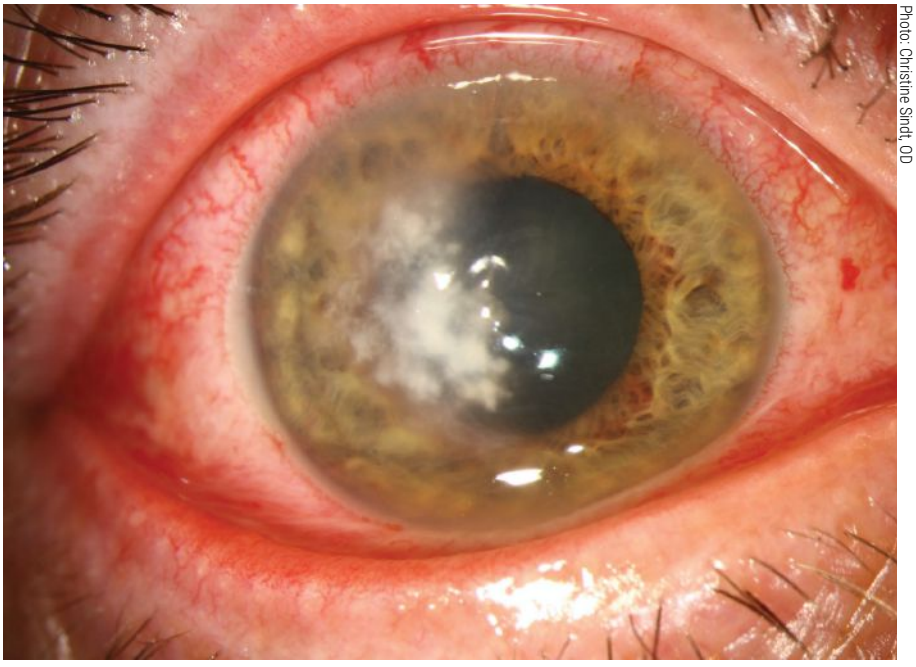

Photo: Christine Sindt, OD

Fungal lesions tend to have dry, elevated infiltrates with feathery margins. This patient has a *Fusarium* ulcer.

Culture the eye. If you are lucky, the lesion is peripheral, potentially inflammatory in nature, but certainly less visually threatening. Central ulcers require you to make quick, more decisive treatment decisions. For the average OD in practice, any lesion on the visual axis and/or greater than 2mm to 3mm in diameter, especially with an associated anterior chamber reaction and significant stromal excavation, might be something not worth trying a "Hail Mary" to treat yourself. These eyes are at extremely high risk of visual loss and may best be treated by a tertiary care cornea specialist. Always have their number in the back of your playbook—that's what they are there for.

If you want to treat eyes at this level of severity, you need to have the ability to culture the eye to identify the specific pathogen involved. According to the American Academy of Ophthalmology's 2018 Bacterial Keratitis Preferred Practice Pattern, while the majority of bacterial keratitis may be treated empirically, cultures are indicated in the following situations:[3]

(1) a corneal infiltrate is central, large (>2mm) and/or associated with significant stromal involvement or melting

(2) the infection is chronic in nature or unresponsive to broad-spectrum antibiotic therapy

(3) there is a history of corneal surgeries

(4) atypical clinical features are present that are suggestive of fungal, amoebic or mycobacterial keratitis

(5) infiltrates are in multiple locations on the cornea

TABLE 1. COMMONLY USED TREATMENT PROTOCOLS BASED ON INFECTIOUS ORGANISM CLASS

Class of Infectious Microbe	Medication of Choice	Frequency of Dosing
Bacteria	Gatifloxacin	Up to hourly tapering as cornea heals
	Moxifloxacin	
	Besifloxacin	
Resistant Bacteria	Tobramycin 14mg/mL	
	Vancomycin 10-25mg/mL	
Herpes Simplex (topical)	Trifluridine 1%	Nine times per day for seven days then five times a day for no more than 21 days
	Ganciclovir gel 0.15%	Five times a day until defect healed then three times a day for seven days
Herpes Simplex (oral)	Acyclovir 400mg	Five times a day for seven to ten days
	Valacyclovir 500mg	Two times a day for seven to ten days
	Famciclovir 250mg	
Fungi	Natamycin ophthalmic suspension	Every one to six hours depending upon severity until healed
Yeasts	Amphotericin B 0.15%	
Parasitic (*Acanthamoeba*)	Polyhexamethylene biguanide 0.02%	Hourly around the clock for 48 hours tapering with healing over several months
	Chlorhexidine 0.02%	
	Propamidine isethionate 0.1%	
	Hexamidine 0.1%	

Ideally, cultures are obtained prior to starting any form of antimicrobial therapy. Since it will take time for culture results to come back, you must initiate therapy empirically as the infection can progress rapidly without treatment. If you start empirical therapy and want to culture later, it can still be valuable, especially if your treatment does not seem effective.

Treatment. Whether treating empirically or while cultures are in process, starting with a broad-spectrum antibiotic such as a fourth-generation fluoroquinolone (gatifloxacin, moxifloxacin, besifloxacin) is indicated. The fourth-gen agents have very good broad spectrum coverage against the most commonly encountered gram-positive and gram-negative organisms. Be cautious with third-generation fluoroquinolones such as ciprofloxacin and ofloxacin, as significant resistance is developing to this class of medication. If your patient has a large (>2mm diameter) or central ulcer, start them on a loading dose in the office (one drop every 10 minutes for one hour) and then have them instill one drop every hour for the next 24 hours.

While some doctors will prescribe an ointment in place of the drop when the patient goes to sleep, it is more beneficial to have the patient wake up every hour through the night and instill a drop of antibiotic. This level of compliance must be emphasized to the patient. If the ulcer is smaller or more peripherally located after the in-office loading dose, instilling an antibiotic every one to two hours while awake may be adequate. Use size, location and depth of the ulcer to make the decision on dosing frequency.

The most common reasons for failure are undertreatment or patient non-compliance with your treatment schedule. If a family member or acquaintance has brought the patient to your office, recruit them as a part of your treatment plan. If the patient is in significant pain and has an anterior chamber reaction, consider cyclopleging them to reduce their discomfort and to reduce the risk of posterior synechia development. Never patch the patient or apply a bandage contact lens, no matter how large the epithelial defect. Trapping the necrotic material from a microbial ulcer will keep the proteases and inflammatory mediators generated by the infectious process in contact with the stroma for a longer period of time, potentiating tissue damage and slowing healing.

Patients with suspected microbial ulcers must be seen daily. The amount of improvement you see within the first few days is inversely proportional to the severity at presentation. What you are watching for is any worsening of the infection in the first few days. An infection that is worsening on fluoroquinolone monotherapy may require addition of fortified antibiotics such as tobramycin 14mg/mL and/or vancomycin 10mg/mL to 25mg/mL. If necessary, be aggressive with these drugs, alternating them every 30 to 60 minutes around the clock.

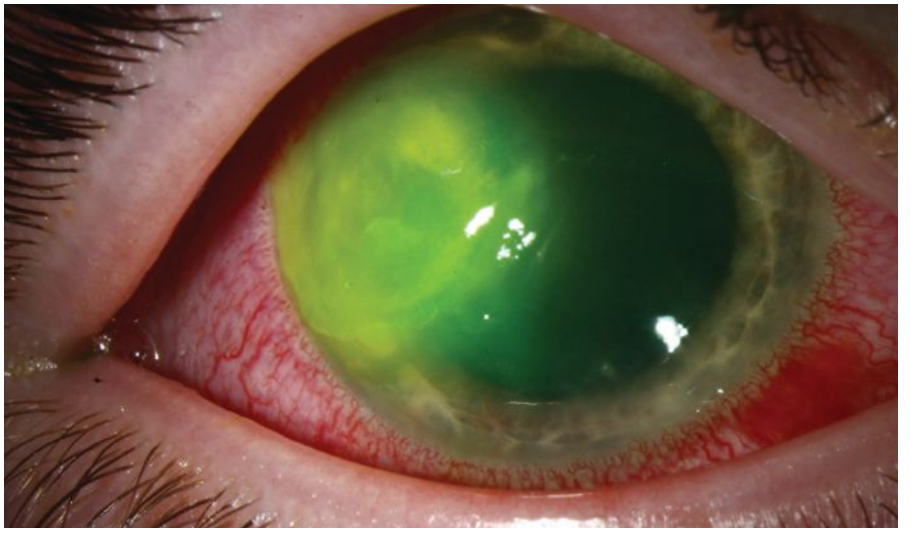

Photo: Christine Sindt, OD

This patient has *Pseudomonas* keratitis. Given the higher risk of stromal damage in gram-negative bacterial infections, your treatment regmen should be appropriately aggressive.

If the eye is still not responsive, consider a 24-hour treatment break and culture the cornea for atypical pathogens. If you suspect MRSA as your offending agent based on the patient's history (*e.g.*, they work in a hospital, live in a nursing home or are immunocompromised), understand that fluoroquinolones are not terribly effective; consider going to vancomycin 25mg/mL to 50mg/mL more quickly. Culturing these suspect MRSA infections may also reveal sensitivities to older, more readily available antibiotics, such as bacitracin and gentamicin.[4]

Bringing a steroid drop off the bench when treating a microbial keratitis can be a controversial move. Steroids will help break the inflammatory cascade and reduce risk of scarring as the eye heals. According to the Steroids in Corneal Ulcers Trial, adding a steroid to quell inflammation has not been shown to significantly improve visual outcomes except in the most severe cases.[5] That being said, many cornea specialists recommend delaying steroid use until the eye begins to show a positive response to your treatment, as steroids may worsen fungal, AK and herpes simplex infections. Keep your patient on antimicrobial therapy for several days and watch for signs of healing before considering adding a steroid.

Herpes Simplex Virus (HSV) Keratitis

This is another differential in infectious keratitis cases. HSV keratitis can present in two basic forms: an epithelial variant, in which there is active, replicating virus present, and a stromal form that is an immune inflammatory response. Each form requires a very different game plan. A careful history asking about any recent labial cold sores or previous episodes of mild, persistent eye irritation can help narrow your diagnostic focus.

Epithelial. This form of HSV keratitis often presents as a unilateral red eye with mild to moderate symptomatic irritation. It is often very easy to diagnose at the slit lamp when it presents with the classic dendriform lesion. However, HSV keratitis is known as the "great masquerader" because it may not have the easily identifiable lesion and become a diagnosis of exclusion. The central region of the tree-like branching dendritic lesions will stain with sodium fluorescein, as there is a frank, epithelial defect, and the borders will stain with rose bengal or lissamine green, as that is the location of the active viral infected cells.

Some HSV keratitis lesions are larger in size, similar to a bacterial ulcer, but with scalloped edges there is active viral infection. Use of both vital dyes is essential for the differential in these geographic HSV epithelial lesions. With either lesion morphology, reduced corneal sensitivity is an important finding.

As the virus is resident in the nerves in the trigeminal ganglion and corneal sensitivity is a function of trigeminal innervation, when the virus becomes active, it damages the nerves decreasing corneal sensitivity. When you are uncertain what you are

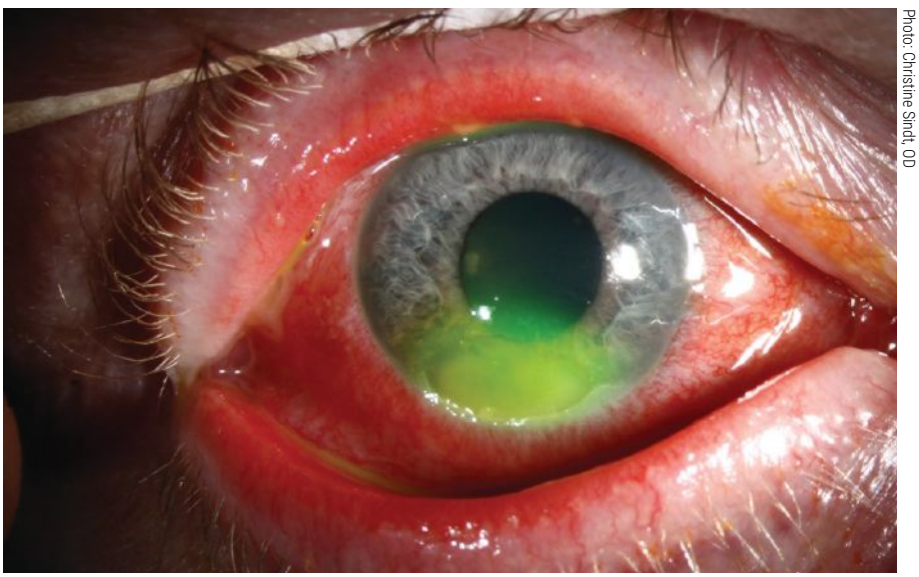

Photo: Christine Sindt, OD

This patient has microbial keratitis after abrasion from a cockle burr. Any exposure to vegetative material raises the risk of polymicrobial infection.

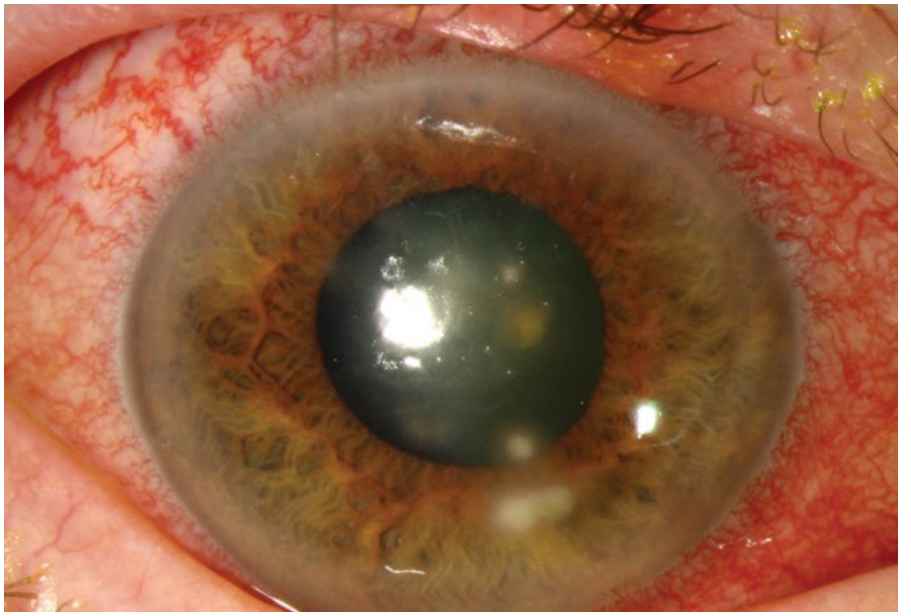
Photo: Christine Sindt, OD

This patient has HSV keratitis with stromal infiltrates.

looking at, pull a small wisp of cotton up from the end of a cotton-tipped swab and gently tap at the cornea. Do this with the non-affected eye first to see how the patient reacts, then test the affected eye. If you don't see that reflexive twitch and blink, you have a hypoesthetic cornea. This explains why many eyes with HSV keratitis look worse than the patient's symptoms might suggest.

Treatment. Topical and oral antivirals are used to treat the epithelial variant of HSK. Classic therapy is trifluridine 1% one drop nine times a day for seven days, decreasing to five times a day for no more than 21 days total if the epithelial defect is closed at that time. Use of trifluridine for over 21 days total can further damage the cornea due to its inherent cytotoxicity. Ganciclovir gel 0.15% can also be used five times a day until the epithelial defect is healed, then reduced to three times a day for seven days. It has less epithelial toxicity than trifluridine, but is often much more costly to the patient.

While not FDA approved, oral antivirals have been shown to be effective in the treatment of HSV epithelial keratitis.[6] Acyclovir 400mg five times a day, valacyclovir 500mg two times a day and famciclovir 250mg two times a day all for seven to 10 days are potential oral routes of treatment for an acute infection. There is no evidence to support that using both a topical and oral antiviral is superior to either route of administration.[7] The Herpetic Eye Disease Study also suggested that a long-term prophylactic dose of oral antivirals may be effective at reducing the rate of HSV keratitis recurrence. The prophylactic dose is one half the treatment dose for active disease.[8] Steroids should never be used with a suspect HSV keratitis, as the virus replicates much more actively if the host cells are immunocompromised.

Stromal. This variant of HSV keratitis is less common that the epithelial variant and will present with a disc-shaped area of stromal edema with or without an overlying epithelial defect. The stromal variant is thought to represent a delayed cell-mediated immune response to previous epithelial HSV exposure and may follow an episode of frank HSV epithelial keratitis.

Treatment. Aggressive topical corticosteroids with oral antivirals are the treatment, specifically prednisolone acetate 1% drops six to eight times a day for at least 10 weeks with a very slow taper as the cornea heals is indicated.[9] An oral antiviral at the same therapeutic dose as for the epithelial variant used concurrently with the corticosteroid has been shown to be effective. Prophylaxis with oral antivirals is indicated once the active infection has resolved.[6]

Stromal HSV keratitis with epithelial ulceration is rare and more difficult to manage. Topical corticosteroids are still the treatment of choice but must be used judiciously in the presence of an epithelial defect. Doubling the dosage of the oral antiviral is indicated for seven to 10 days. Patients with this variant are often better managed by a tertiary care corneal specialist.

Fungal Keratitis

This will present in a similar fashion to a bacterial microbial keratitis. Fungal lesions tend to have dry, elevated infiltrates with feathery margins. You will often see multiple adjacent satellite lesions accompanying the primary lesion. If filamentous fungi such as *Fusarium* or *Aspergillus* are the causative organism, the infiltrate may have a dull, gray appearance in its early stages and progress to a lesion that looks more like an advanced bacterial ulcer. If yeasts such as *Candida* are involved, the lesions may have better defined borders and be smaller in size. Use your history to help determine if what you are seeing is fungal in nature.

Treatment. Natamycin ophthalmic suspension is the treatment of choice for a filamentary fungal infection.[10] Natamycin is a polyene amphoteric macrolide antibiotic with antifungal properties and must be dosed according to the severity of the infection, ranging from every four to six hours to every one to two hours. More aggressive dosing is typically not required, as fungi do not replicate as quickly as do bacteria. Treatment may last over a month in some cases and should be continued beyond the observable healing of the corneal lesion. Know that natamycin is not readily available

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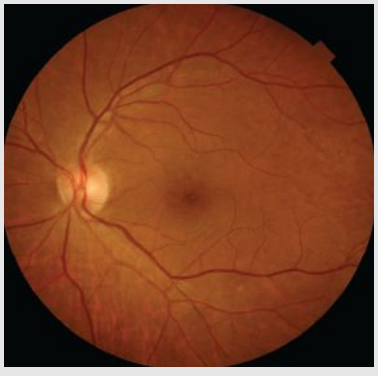
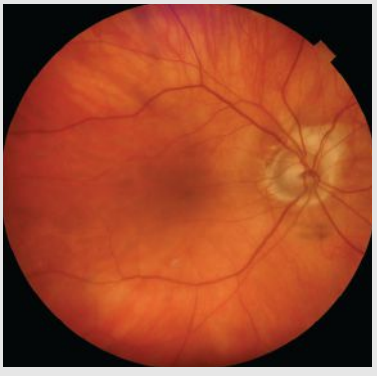
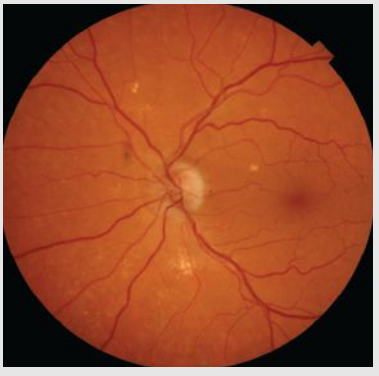


AMD: RPE Pigment Changes



Cataract, (ϕ)2mm Small Pupil



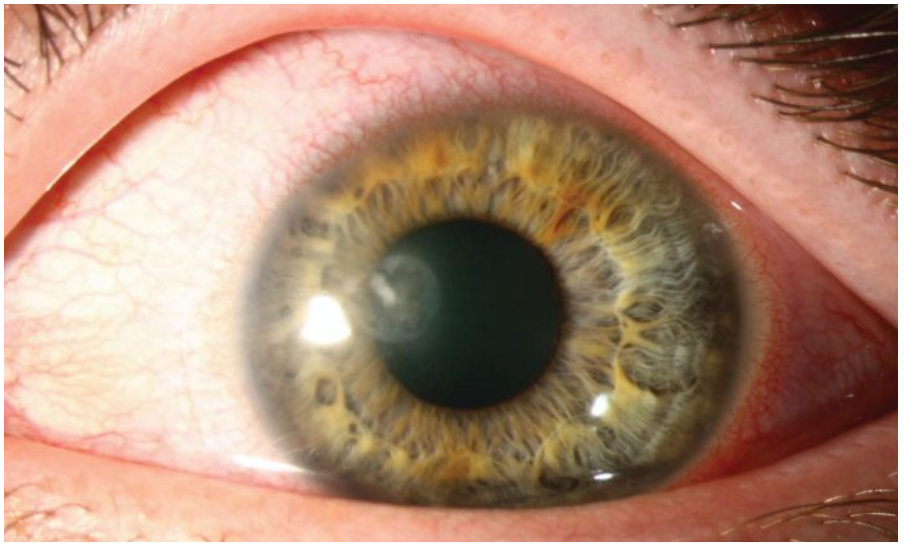
Cataract, Peripheral Drusen

Images courtesy of Silicon Valley Eyecare Optometry and Contact Lenses in Santa Clara, CA.

1. Compared to Topcon non-mydriatic retinal camera TRC-NW400.
2. Actual image size is 7.1MP.
3. Confirmed with model eyes.

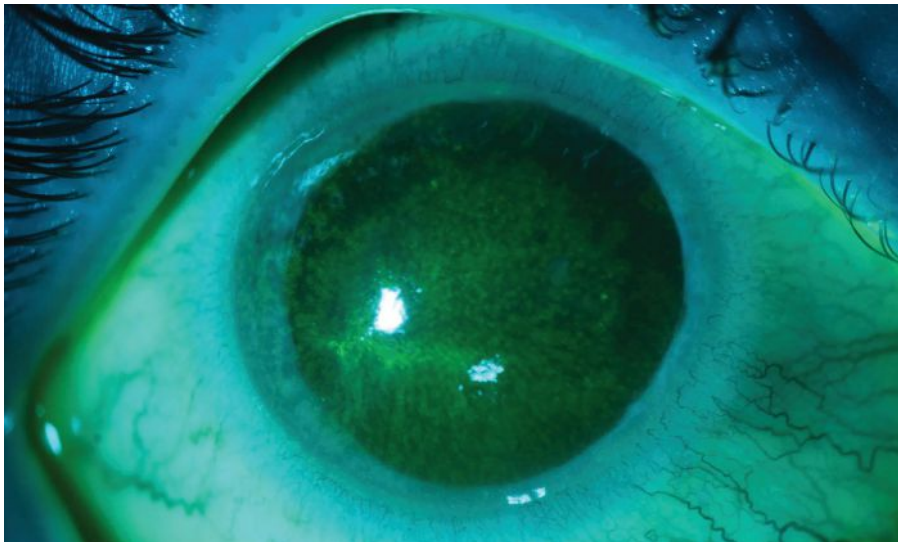
TOPCON Healthcare

Photo: Christine Sindt, OD



Natamycin, the mainstay treatment for fungal keratitis, is not readily available at most retail pharmacies. Instead, seek out a pharmacy at a local medical center.

Photo: Christine Sindt, OD



If diagnosis of *Acanthamoeba* keratitis is delayed, the amoeba will have already penetrated further into the corneal stroma, which causes therapy to be more difficult.

on the shelf of your local pharmacy, so consider reaching out to the pharmacy at a local medical center if it is needed. Often, they will have one or two bottles on hand, especially if they have an ophthalmology department. If you have a confirmed case of a yeast as the causative agent, compounded amphotericin B 0.15% may be the better drug of choice.[11]

If you think your patient is presenting with an *Acanthamoeba* infection, traditional antibiotics are ineffective. It is always recommended that you obtain appropriate cultures to confirm that you are dealing with AK. First line treatments include the topical antiseptic biguanides polyhexamethylene biguanide 0.02% and chlorhexidine 0.02%. Both agents disrupt cytoplasmic membranes and are cysticidal. The biguanides are synergistic with diamidines propamidine isethionate (Brolene) 0.1% and hexamidine 0.1%. Diamidines denature cytoplasmic proteins and enzymes, inhibiting DNA synthesis. They are effective again both the trophozoite and cyst form of *Acanthamoeba* but can be more toxic to the corneal epithelium over time than the biguanides.[12] Some corneal surgeons will opt to perform a superficial keratectomy prior to starting topical therapy to debulk as much of the organisms as possible. Topic treatment must be started hourly around the clock for the first 48 hours. The frequency of dosing is gradually reduced over days and weeks as resolution of the infection becomes apparent. Often patients are on topical treatment for four to six months and significant scarring is an end result, require a penetrating keratoplasty to restore functional vision.

Takeaways

Before implementing a treatment plan, you must be certain of your opponent. It is often said in health care that the treatment is easy, it's the diagnosis that is difficult. Use your clinical acumen to carefully assess the situation before initiating treatment. Having an assortment of game plans ready to implement once you've made your diagnosis is key to providing the best care possible for your patients. ■

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MANAGING EPISODES OF CORNEAL TRAUMA

Perform these steps to properly treat injuries, abrasions and foreign bodies.

BY RACHAEL LLOYD, OD
SAINT CLOUD, MN

Simply put, the cornea protects our eye. So, when the cornea experiences trauma, such as corneal injuries, abrasions and foreign bodies, it must not be taken lightly.

Globally, corneal injuries comprise the majority of ophthalmic cases in the emergency room.[1] The leading cause of blindness in children and young adults is ocular trauma that traditionally happens during recreational activities.[2]

Corneal abrasions are the number one form of ocular trauma and can arise from contact with a variety of materials, including dirt, wood, plants, metal, paper and fingernails.[3]

Corneal foreign bodies are another type of commonly seen corneal trauma, second only to abrasions. They are oftentimes superficial and consist of materials similar to what causes abrasions.

Additional forms of corneal trauma consist of injuries from chemical, thermal or radiation sources. Management varies depending on severity, but many conditions can be taken care of in-office. Here, we will discuss how to properly manage corneal trauma, along with etiologies of each to prepare you for when you see these types of cases come through your practice.

Corneal Injury Pathophysiology

This injury can be extremely painful due to the rich innervation of the corneal epithelium, which is four to six cell layers thick and can regenerate completely in about one week.[4] When the epithelial integrity is compromised, new cells rapidly proliferate to cover the wound.[4] The limbal stem cells regenerate corneal epithelium and remodel the basement membrane layer of the cornea.[4] This allows the cornea to heal by proliferating new cells that migrate to and fill in the corneal defect.

Healing time depends on the size and depth of the injury. Initially, the limbal stem cells will make a layer of epithelial cells to cover the wound. This "covering" will reduce pain significantly for the patient. Full healing requires the corneal epithelium to return to normal by proliferating cells and remaking cell adhesions to restore the strength of the cornea. Those with wounds where the cellular adhesions do not return to normal or those with certain corneal dystrophies are at risk for recurrent corneal erosions because the epithelium is in a constant weakened state.[4]

The corneal stroma is made up of keratocytes that are organized by collagen fibrils and proteoglycans. When corneal trauma creates deeper wounds into the stroma, healing time will be lengthened. Stromal wound healing involves proliferation of keratocytes which then migrate and differentiate into myofibroblasts. Myofibroblasts will then produce an extracellular matrix and proteinases which contract and close the wound. The proteinases then create an immune response which clears debris and helps prevent infections. This also allows the basement membrane to regenerate. When this cascade works as described, transparency of the cornea is reestablished. When the cascade is interrupted, a corneal opacity will result.[5]

Post-trauma Examination

After any corneal trauma, a full ocular health evaluation is warranted and careful examination of the anterior segment is essential.[6] Using ocular surface dye, such as sodium fluorescein, is helpful to identify the extent of injury. Sodium fluorescein can also assist in identifying a

About the author **Dr. Lloyd** practices at St. Cloud VA Health Care System in St. Cloud, MN. She received her doctorate in optometry from Salus University and completed her residency at the American Lake VA in Tacoma, WA. She specializes in low vision, traumatic brain injury and medical optometry. She has no financial disclosures.

penetrating corneal injury by a positive Seidel test. With any corneal trauma, it is recommended that the provider dilates the patient. This is especially important in injuries that arise from high-speed trauma, hot metal to the eye and grinding trauma in order to rule out intraocular foreign body with a self-sealed or cauterized corneal wound.

Corneal Abrasions

Despite the multitude of causes and presentations that abrasions may comprise, principles of care are fairly consistent.

Etiologies. Abrasions are scratches or injuries to the surface epithelium of the cornea and represent the most common form of ocular trauma. They may be caused by a variety of factors, such as trauma to the eye, foreign bodies, contact lens wear or underlying ocular disease. Patient symptoms can include pain, redness, tearing, photophobia, blurred vision and foreign body sensation.

In most cases, corneal abrasions heal within one to seven days; however, if the abrasion is very large or deep, the healing time can be longer.[1] Assisting in healing by use of medical treatment is necessary in almost all cases.

Recurrent corneal erosions are another type of corneal abrasion that occurs from a history of corneal trauma or corneal dystrophies where the epithelium was not able to restore the organization of cellular adhesions during the healing process. This puts the cornea at a higher risk of recurrent erosion and abrasions in the location of previous trauma. These commonly occur upon waking.

Management. Any corneal trauma should be evaluated with a slit lamp. Due to the pain that corneal epithelial damage causes, topical anesthetics can greatly increase ease of examination, but should never be dispensed to the patient. Firstly, after initial exam, instilling sodium fluorescein will help identify the extent of the corneal defect and make any corneal damage noticeable upon using the cobalt blue light, either from a slit lamp or handheld light source.

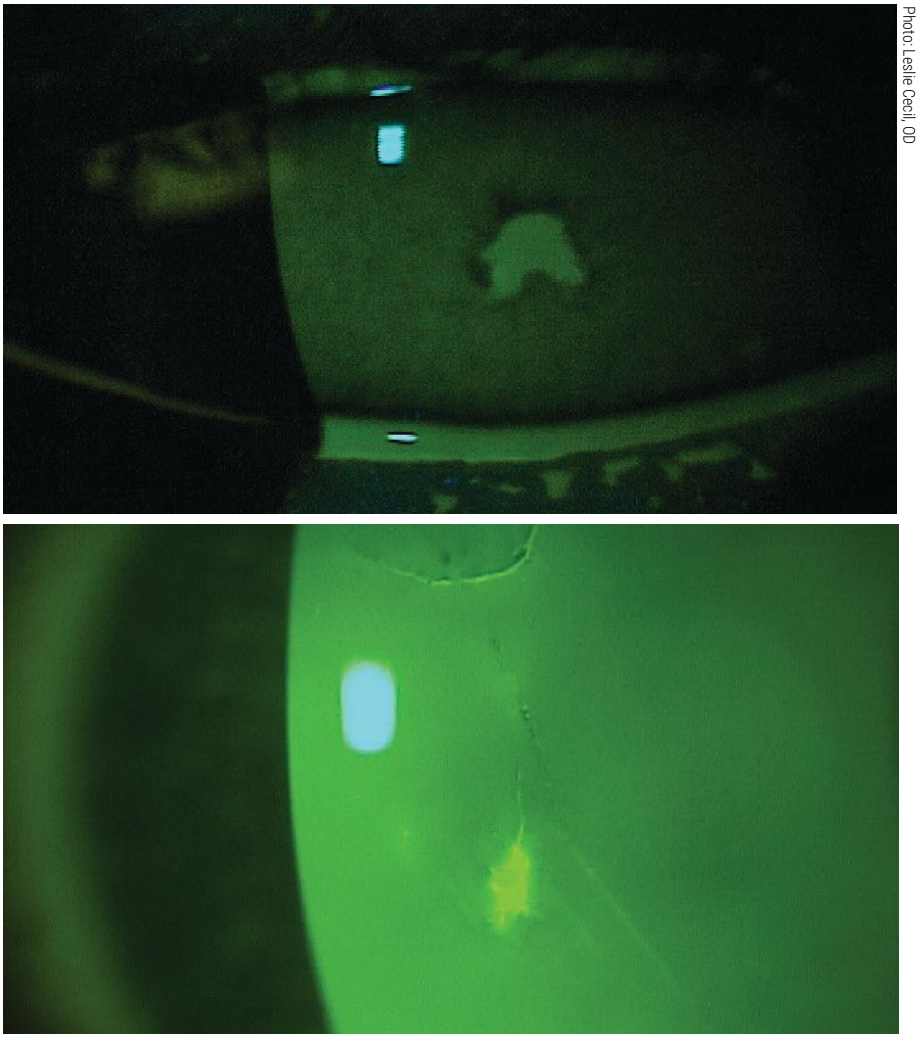

Photo: Leslie Cecil, OD

Fig. 1. Corneal abrasions stained with fluorescein and visualized using a cobalt blue light.

Abrasions have many different shapes and sizes, and it is important to photodocument or measure the size of the defect for management and follow-up purposes. Determining the cause of abrasion is necessary to establish a plan of treatment. Occasionally, the causative object is still present in the conjunctival sulcus. If the staining pattern is vertical, this may indicate a residual foreign body under the lid.[7] Everting the lid and irrigating the eye is critical here.

If there is any nonadherent or loosely adhered epithelium, debridement may enhance the healing process.[8] This procedure is done at the slit lamp using topical anesthesia. A foreign body spud or cellulose surgical sponge can be used to debride the loose tissue and provide a smooth basement membrane which allows for a better chance of epithelial re-adherence.[8]

Using topical antibiotics is the mainstay of treatment for corneal abrasions. For large abrasions greater than 4mm, topical cycloplegics, such as cyclopentolate, can also be used.[9] Patching for larger abrasions was previously recommended; however, it's no longer standard of care.[10] The Corneal Abrasion Patching Study Group found that traumatic, noninfected abrasions not arising from contact lens wear could safely be treated with antibiotics and cycloplegics without the need for a pressure patch.[10]

TABLE 1. TOPICAL OPHTHALMIC ANTIBIOTICS

Fluoroquinolones	Besivance (besifloxacin) Ciloxan (ciprofloxacin) Zymar (gatifloxacin) Quixin (levofloxacin) Vigamox (moxifloxacin) Ocuflox (ofloxacin)
Aminoglycosides	Tobrex (tobramycin) Genoptic (gentamicin)
Polymyxin B Combinations	Polytrim (polymyxin B/trimethoprim) Polysporin (polymyxin B/bacitracin) Neosporin (polymyxin B/neomycin/gramicidin)
Macrolides	Azasite (azithromycin) Ilotycin (erythromycin)

Topical treatment options include ophthalmic lubricants, cycloplegics and antibiotics, including fluoroquinolones, amnioglycosides, polymyxin B combinations and macrolides (*Table 1*). Many of these also come in ointment formulations that can be used to enhance comfort while healing and for overnight use. Many studies have been done regarding which antibiotic performs better, and the conclusions show that there is insufficient evidence to support whether one regimin outperforms another.[11]

If the corneal trauma is secondary to contact lens use, a fluoroquinolone or aminoglycoside is the drug of choice due to pseudomonas coverage. Antibiotic use is commonly dosed two to four times per day in the affected eye. Duration depends on size and depth of abrasion, and discontinuation is appropriate when the epithelium is healed.

For pain control, oral nonsteroidal anti-inflammatory drugs (NSAIDs) can be useful. Ophthalmic topical NSAIDs have not been shown to be beneficial in the same way oral NSAIDs can be.[9]

Cycloplegics can also be used for pain control due to discomfort from ciliary spasm. This is not as commonly used, but medication choices consist of cyclopentolate and homatropine.[9] These are more commonly used if there is a concurrent iridocyclitis along with the initial traumatic abrasion.

FDA-approved bandage contact lenses are sometimes used when the abrasion is large in order to increase patient comfort.

If the abrasion is non-healing, consideration can be made for an amniotic membrane.

CASE REPORT

A 25-year-old male presented to Urgent Care with new-onset eye pain, redness and decreased vision in his left eye after a walk through the woods with his dog the day prior. The Urgent Care provider referred the patient to us and he was evaluated in our office.

Entering visual acuities were 20/20 OD and 20/40 OS. Intraocular pressure (IOP) was 14mm Hg OD and 12mm Hg OS. Pupils were equal, round and reactive with no afferent pupillary defect detected. Extraocular motility was also normal in both eyes. Slit lamp examination revealed a 3mm by 2mm corneal abrasion with positive sodium fluorescein staining of the lesion on the left cornea. Anterior chamber was free from cells and flare. Dilated fundus examination of both eyes was unremarkable.

A corneal abrasion of the left eye was diagnosed. The patient was educated on healing time and given ofloxacin 0.3% to use TID OS for one week. A follow-up was scheduled for one week later.

At follow-up, the left eye corneal epithelium was completely healed without any sodium fluorescein uptake and vision returned to 20/20 OS. The ofloxacin was discontinued.

Corneal Foreign Bodies

Optometrists are increasingly called upon to not simply triage corneal foreign bodies but also remove them, as scope laws and optometric training are evolving to better meet the needs of the public.

Etiologies. Commonly occurring in the workplace, corneal foreign bodies are the second most common form of ocular trauma. The best protection against corneal foreign bodies is protective eyewear. Failure to consistently wear eye protection increases the risk of serious ocular harm. Foreign bodies are typically superficial and can cause significant ocular discomfort. Rarely, they can embed and even penetrate the cornea.[12]

Management. The origin of the foreign body must be determined and removal should happen as quickly as possible using one of many different techniques. Irrigation can remove superficial foreign bodies quite well and is less invasive than other methods. However, if the foreign body is deeply embedded, a 25- to 30-gauge beveled needle or a stainless steel spud can be used under slit lamp to assist in removal. An Alger Brush with burr or a Bovie burr can be used to eradicate a foreign body as well, but it is most frequently used to remove a rust ring leftover from metallic foreign bodies.[15]

Metallic foreign bodies can be removed with a low risk of infection; however, they have a higher risk of scarring after the procedure. Rust can remain after removal of the initial foreign body. It is sometimes appropriate to re-evaluate the patient a few days after the initial removal to eliminate remaining rust that has moved anteriorly. If the abrasion is large or central post-foreign body removal, it is common to issue topical prophylactic antibiotic coverage.

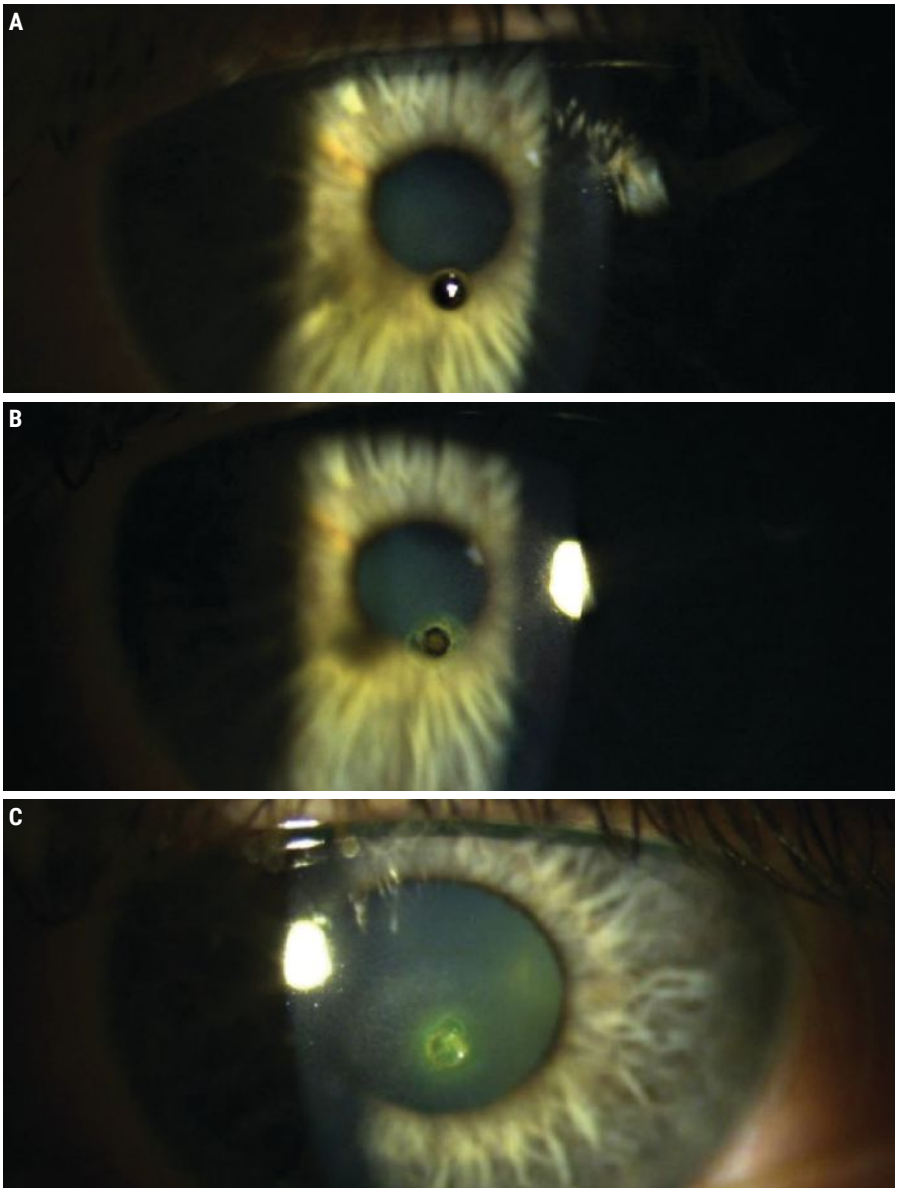

Fig. 2. (A) Metallic foreign body with early rust proliferation embedded in the central cornea. (B) Remaining metallic foreign body after the superficial metal was removed with a foreign body spud. (C) Corneal abrasion with sodium fluorescein uptake remaining after removal of a metallic foreign body.

If a foreign body is organic in nature, the risk of infection is higher, and the patient should be monitored closely for development of bacterial or fungal keratitis post-removal. It would also be appropriate to issue a topical broad-spectrum prophylactic antibiotic in this case.

If a foreign body is posterior to the posterior stroma or Descemet's membrane, it is recommended that the foreign body be surgically removed by an ophthalmologist emergently.[12] Rarely, there can be penetrating foreign bodies without an obvious outlet. In these cases, imaging, such as OCT, B-scan and CT, can be beneficial.

CASE REPORT

A 59-year-old male presented with a foreign body sensation and blur OS. He reported that he felt something in his eye a week ago and the blur hadn't subsided. No eye drops had been used.

Entering visual acuities were 20/20 OD and 20/200 OS. IOP was 10mm Hg OD and 16mm Hg OS. Pupils were equal, round and reactive with no afferent pupillary defect detected. Extraocular motility was also normal in both eyes. Slit lamp examination revealed a small metallic foreign body with rust beginning just inferior to the central visual axis (*Figure 2A*). The anterior chamber was free from cells and flare. Dilated fundus examination of both eyes was unremarkable.

Removal occurred using a stainless steel foreign body spud which removed the superficial metallic piece. A small, imbedded metallic foreign body remained, and a Bovie spud was needed to remove it completely (*Figure 2B*). After the entire foreign body was removed, a small superficial wound remained (*Figure 2C*).

The patient was given ofloxacin twice per day OS and scheduled for a follow-up two weeks later. Upon return, the corneal epithelium was healed completely with a small scar beginning to form.

Exposure-related Corneal Trauma

Corneal exposure to a chemical is an emergency and requires prompt evaluation and management.

Etiologies. The vast majority of these injuries are accidental.[13] There are two types of chemical burns: acid burns and alkali (basic) burns. Acids that are frequently contacted are from swimming pool cleaners and car batteries, and are generally milder than their base counterparts.[14] Acids with a pH less than four can impact the corneal epithelium and cause damage by denaturing the corneal epithelial cells.[14] Most acids will produce corneal proteins upon contact, which slows penetration and reduces destruction. Alkali chemicals are lipophilic, which allows them to penetrate cell membranes via membrane lipids permitting further chemical penetration of the cornea.[14] Common bases that are regularly available are found in cleaning products, such as lye or ammonia, and calcium hydroxide in cement or plaster.

Photo: Leslie Cecil, OD

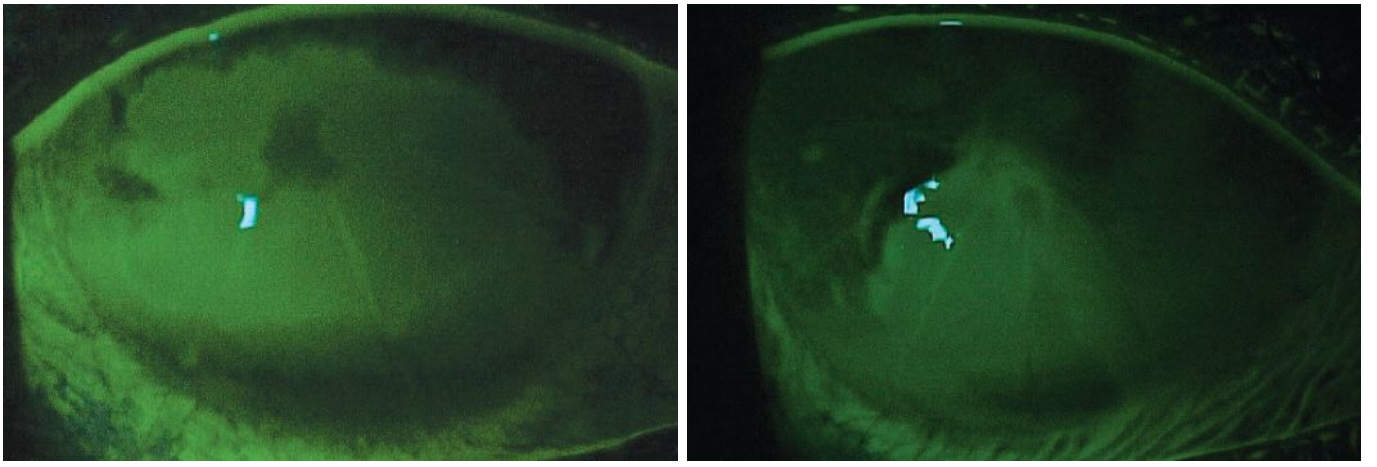

Fig. 3. Bilateral corneal injury from exposure to Simple Green household cleaner after instillation of sodium fluorescein dye. This patient previously had a radial keratotomy procedure.

There are numerous classification schemes available to grade ocular chemical injuries. The basis of these grading systems is to determine corneal, conjunctival and limbal damage at the initial assessment.[13] Though specific rationales differ, they are largely based on the degree of perilimbal ischemia and corneal haze. The prognosis is worse with a greater initial level of ischemia and haze.

Management. When a chemical corneal exposure case presents, time to dilution of the chemical is directly related to visual outcome. The most important step is copious irrigation to dilute and remove the offending agent. This irrigation can happen at the site of the incident or in office prior to a complete exam. After irrigation for five to 10 minutes, pH can be tested using litmus test strips, and when the goal of 7.0 to 7.4 pH is met, dilution is complete.[14]

Tap water has been shown to be an appropriate solution for irrigation due to its widespread availability in most settings. Balanced salt solution or saline solution are better options for irrigation in a clinical setting and also preferred options in an emergency settings if obtainable. Balanced salt solution has been shown to neutralize the pH faster than water.[14]

In mild chemical injuries, antibiotics such as erythromycin and bacitracin, usually in an ointment formulation, are typically used.[14] Use of a steroid, such as prednisolone acetate dosed four times per day, can be helpful to reduce inflammation during the healing process. Preservative-free artificial tears are also helpful for comfort while keeping the eye lubricated. If there is more discomfort and pain, a cycloplegic can be used.

Follow-up care should occur frequently until the entire cornea has healed.

More severe chemical injuries require an aggressive medication regimen for management. Cycloplegics for pain control, prednisolone acetate hourly while awake, antibiotic solutions four times daily and oral NSAIDs to help control pain are all parts of severe chemical injury treatment.

The use of an amniotic membrane graft is also found to be beneficial in certain cases; however, when to initiate this treatment is controversial. Nevertheless, follow-up should be daily until re-epithelialization is adequate. Careful monitoring of IOP is important; if it is elevated, alpha agonists should be avoided due to their vasoconstrictive properties.[14] Follow-up every other day to one week thereafter is acceptable until fully healed.

The goal of treatment is to keep the pain low while promoting epithelial healing.

Takeaways

Due to the cornea's role in protecting the eye, it is commonly injured in trauma, resulting from a multitude of etiologies as discussed. With prompt care and treatment, these conditions can be managed and visual acuity can be preserved. ■

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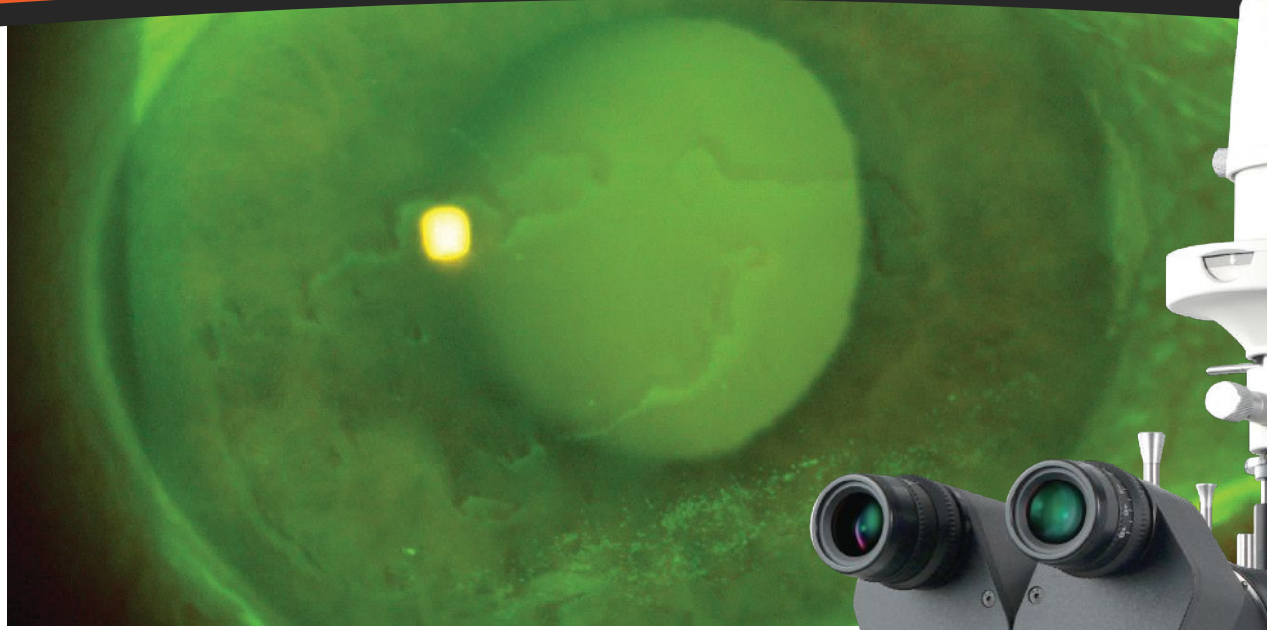

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KNOW YOUR OPTIONS FOR COMBATING RECURRENT EROSION

A wide range of medical and surgical interventions exist to help limit recurrence and improve the quality of these patients' lives.

BY SAM SAELI, OD
CINCINNATI

A relatively common condition, recurrent corneal erosion (RCE) is classically defined as a repeated detachment of the corneal epithelium in the presence of previous mechanical corneal trauma, dystrophy or degeneration.[1,2] Some of the most common causes of mechanical injury involve fingernails, pet scratches, paper cuts and tree branches. Following trauma, the rate of RCEs can range from 5% to 25%.[3]

The condition can be extremely painful and disruptive to a patient's life. Our job as clinicians is to treat them acutely and limit the number of recurrences.

Fortunately, today, there are many ways to treat an RCE depending on the severity of epithelial involvement and frequency of recurrence. Whichever method of treatment is chosen, the goal should always be patient comfort and reducing the likelihood of recurrent erosion. First-line therapies include topical and noninvasive options; however, surgery may be indicated for chronic episodes.

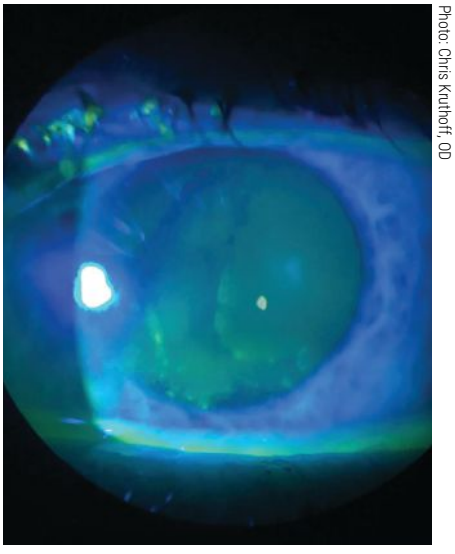

Photo: Chris Kruthoff, OD

Fig. 1. Slit lamp view of fluorescein staining in a patient with anterior basement membrane dystrophy.

In this article, I'll walk you through the pathophysiology, signs and symptoms, diagnosis and various treatment options for RCEs to equip you with the knowledge needed to best care for your patients dealing with this bothersome condition.

Pathophysiology

Mechanical injury to the cornea leads to changes in the cell-to-cell and cell-to-matrix adhesions of the epithelial basement membrane. Changes specifically at the hemidesmosomes are the most likely cause of RCEs. Hemidesmosomes act as anchoring filaments to the basal layer of the corneal epithelium. After an injury, the hemidesmosomes disassemble to allow the cornea to heal. In RCE patients, these structures are frequently found to be compromised or missing altogether. This healing process can be slower in patients with diabetes, putting these individuals at increased risk of RCE development.[4,5]

Epithelial basement membrane dystrophy (EBMD) is most commonly characterized by visible map-dot or fingerprint-like patterns shown on slit-lamp examination. These patterns are caused by an abnormal basement membrane protruding into the epithelium. Presence of intraepithelial pseudocysts and accumulation of intraepithelial material can also be found in varying degrees of EBMD. These redundancies and

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accumulation of irregular epithelial deposits lead to poor adhesion to the underlying structures when desquamating cells become trapped between the basement membrane and underlying structures. Up to 10% of patients with EBMD will experience RCEs.[6]

Signs and Symptoms

Patients with RCEs typically present in moderate to severe pain, which helps explain why this condition is a leading cause of eye-related emergency department visits. These episodes can be extremely debilitating and disrupt patients' daily living activities. Affected patients will likely present with one or more of the following symptoms: sudden pain upon awakening, redness, photophobia, blurred vision and increased tearing.[4,7] Any of these can last from hours to days depending on the severity of the erosion.

Upon examination, decreased best-corrected visual acuity may or not be present. A detailed slit-lamp examination will show variable degrees of disruption to the corneal epithelium. This can range from a small area of epithelial heaping to large areas of the epithelium being displaced or even missing. During the slit-lamp exam, an underlying corneal dystrophy or degeneration such as EBMD may be found and determined as an underlying cause of the RCE onset.

Fluorescein stain is essential in identifying and assessing the amount of epithelium involvement (*Figure 1*). Looking for areas of subtle epithelial movement when prodding with a cellulose sponge can reveal other areas of involvement as well. Conjunctival injection is also likely to be present.[4,6,8]

The recovery of the cornea from trauma involves a process of breaking down then repairing or rebuilding the damaged tissues. This process begins with inflammation with the increase in cytokines and an increase in matrix metalloproteinases (MMPs). While these factors are important in the inflammatory process, MMPs also play a role in the breakdown of the scaffold structured extracellular matrix. This matrix helps facilitate the rebuilding of the damaged tissues. Increased levels of MMPs can lead to the breakdown of this matrix too soon and inhibit proper repair of the epithelium and its underlying structures. Poor structuring in the repair process makes the epithelial cells prone to disconnect and could result in RCEs.[1,2]

The detachment of the corneal epithelium from the basement membrane during an RCE can have many causes, but the most common is the tear film drying out overnight. Combined with rapid eye movement cycles during sleep, this dryness can cause mechanical trauma to the cornea that results in an RCE and leads to an abnormally tight adherence of the eyelid to the corneal epithelium. The weak point of the junction with RCEs is typically the level of Bowman's layer. Adhesion to the eyelid can be problematic during the rapid-eye-movement stage of sleeping and when opening the eye upon awakening. This is the typical cause of the classic "pain upon awakening" symptom that patients most commonly present with.[4,8]

Diagnosis

Initial presentation of an RCE can be difficult to diagnose without a thorough case history. They occur spontaneously, so it can be difficult for patients to link an event to the cause outside of instant pain upon awakening. Probing case history is most likely to uncover a previous ocular trauma. The second most common underlying condition is EBMD. Less likely but notable underlying conditions to inquire about or search for during examination include other corneal dystrophies and degenerations, refractive surgery, meibomian gland dysfunction and previous ocular surgeries.[8]

RCEs can be difficult to manage and often tend to recur despite active treatment, causing patients repeated episodes of pain and discomfort. There are many treatments available today including both medical and surgical options. The ideal treatment for each patient should be based on the severity of symptoms and the number of recurrences.

Medical Treatments

Following an isolated incident of corneal trauma, a patient should be started on prophylactic treatment for three to six months to minimize the chances of an RCE.

Artificial tears are the first-line option for prevention and treatment of RCEs with few symptoms. Preservative-free artificial tears are recommended, but others can be used in their absence. The lubrication allows

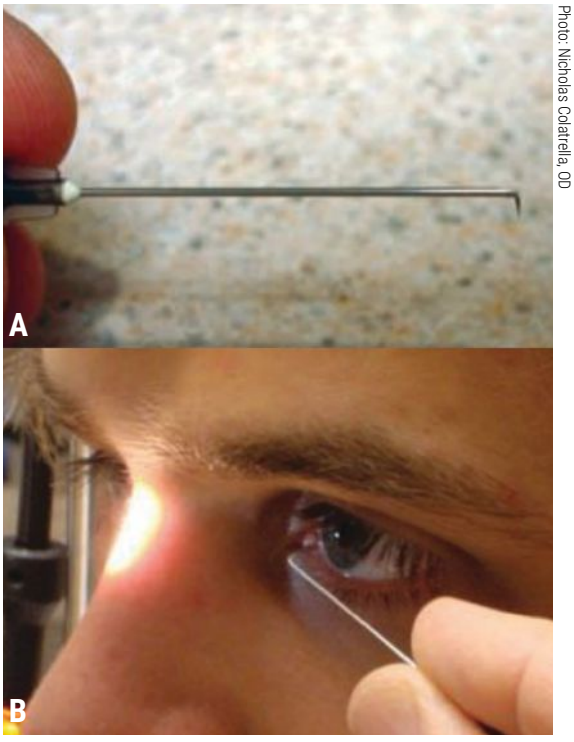

Photo: Nicholas Colatrella, OD

Fig. 2. (A) Properly bent needle to perform anterior stromal puncture in the treatment of RCE. (B) ASP being performed tangential to the corneal plane.

a buffer between the cornea and the eyelid that limits mechanical friction and adhesion of the cornea to the eyelid. This helps to promote healing for the cornea on its own accord without constant trauma from the lid. Failure with artificial tears and lubrication could indicate the need for punctal plugs to increase the tear lake and produce an equal or similar effect as drops.[4,9]

> **For RCEs with obvious epithelial defects, a topical antibiotic is indicated to help prevent infection from the compromised state of the cornea.**

For RCEs with obvious epithelial defects, a topical antibiotic is indicated to help prevent infection from the compromised state of the cornea. Antibiotics such as topical fluoroquinolones and macrolide ointment are both appropriate forms of treatment. An oral non-steroidal anti-inflammatory drug (NSAID) and/or topical cycloplegic can be added if the patient is in significant pain. Acetaminophen or ibuprofen are appropriate oral NSAIDs while 1% cyclopentolate is an appropriate cycloplegic dosing every 12 hours. Patients should never be allowed to self-administer topical corneal anesthetics for their pain.[4,9]

Painful RCEs may also indicate the installation of a soft bandage contact lens. This is to improve comfort for the patient by separating the damaged cornea from the constantly blinking eyelid. An extended-wear contact lens— silicone hydrogel being the most appropriate choice— should stay in the eye overnight and even for multiple days until the appropriate follow-up appointment. In severe cases, a cryopreserved amniotic membrane such as a Prokera can be another treatment option depending on need and availability. The main downside to Prokera lenses is that they are often not readily available and are usually expensive. Insurance coverage is not always guaranteed for Prokera, while a silicone hydrogel is likely available at most practices.[4,9]

Recurrent erosions with multiple recurrences can be treated more aggressively with autologous serum tears, MMP inhibitors and topical corticosteroids during the acute phase. Prophylactic antibiotic treatment is always recommended when using topical corticosteroids. These treatments help to decrease inflammation and promote proper healing of the cornea, which is essential to help limit recurrences.

Autologous serum tears can be an alternative lubrication option. Studies have shown that patients resistant to previous therapies have success with serum tears and fewer recurrences of RCEs. Allogeneic serum eye drops can even be an option for patients with poor venous access or severe anemia. These drops have a higher incidence of irritation and intolerance due to their allogeneic nature but remain an effective option when artificial tears are insufficient.[4,8,9]

MMP inhibitors such as oral tetracycline have been shown to be effective as a next-line therapy. MMPs promote the breakdown of hemidesmosomes and collagen so that MMP inhibitors can help promote strength in those connections and corneal structures.[1,4,9]

Corticosteroid drops such as loteprednol, fluorometholone or prednisolone acetate work to decrease inflammation and promote healing. They are best indicated after failed attempts at lubrication and punctal occlusion.[1,4]

Corticosteroid drops used in combination with MMP inhibitors can effectively inhibit MMPs as well as down-regulate the production of lipase. There is evidence to suggest that meibomian gland dysfunction is a risk factor for RCE, and this drug combination can help improve gland dysfunction symptoms.[1,4]

After resolution of an acute RCE, a hypertonic solution or ointment is often recommended for long-term therapy. Once the corneal epithelial defect is closed, these agents can help remove edema from the cornea through osmosis. The removal of this swelling allows the structures in the cornea to regrow closer to each other and promotes tighter adhesion. These hypertonic agents can be used for six to 12 months after the initial onset of RCE.[4,5]

Surgical Options

Medical management is often not sufficient to treat persistent RCE. In these more severe cases, surgical intervention may be necessary to help accelerate recovery of poorly healing lesions.

A common first-line surgery to manage stubborn RCE is anterior stromal puncture (ASP) (*Figure 2*). The most common practice of ASP involves anesthetization of the cornea followed by puncturing Bowman's layer with a bent 25- or 27-gauge needle, roughly 0.5mm apart. This process helps to promote stronger adhesion of the epithelium to Bowman's layer.[4,9-11]

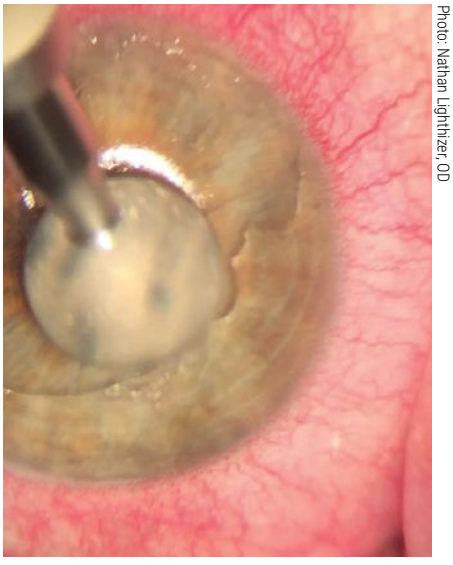

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Fig. 3. Slit lamp view of a debridement of the corneal epithelium under topical anesthesia using a foreign body spud. This procedure is effective for treating active acute RCE.

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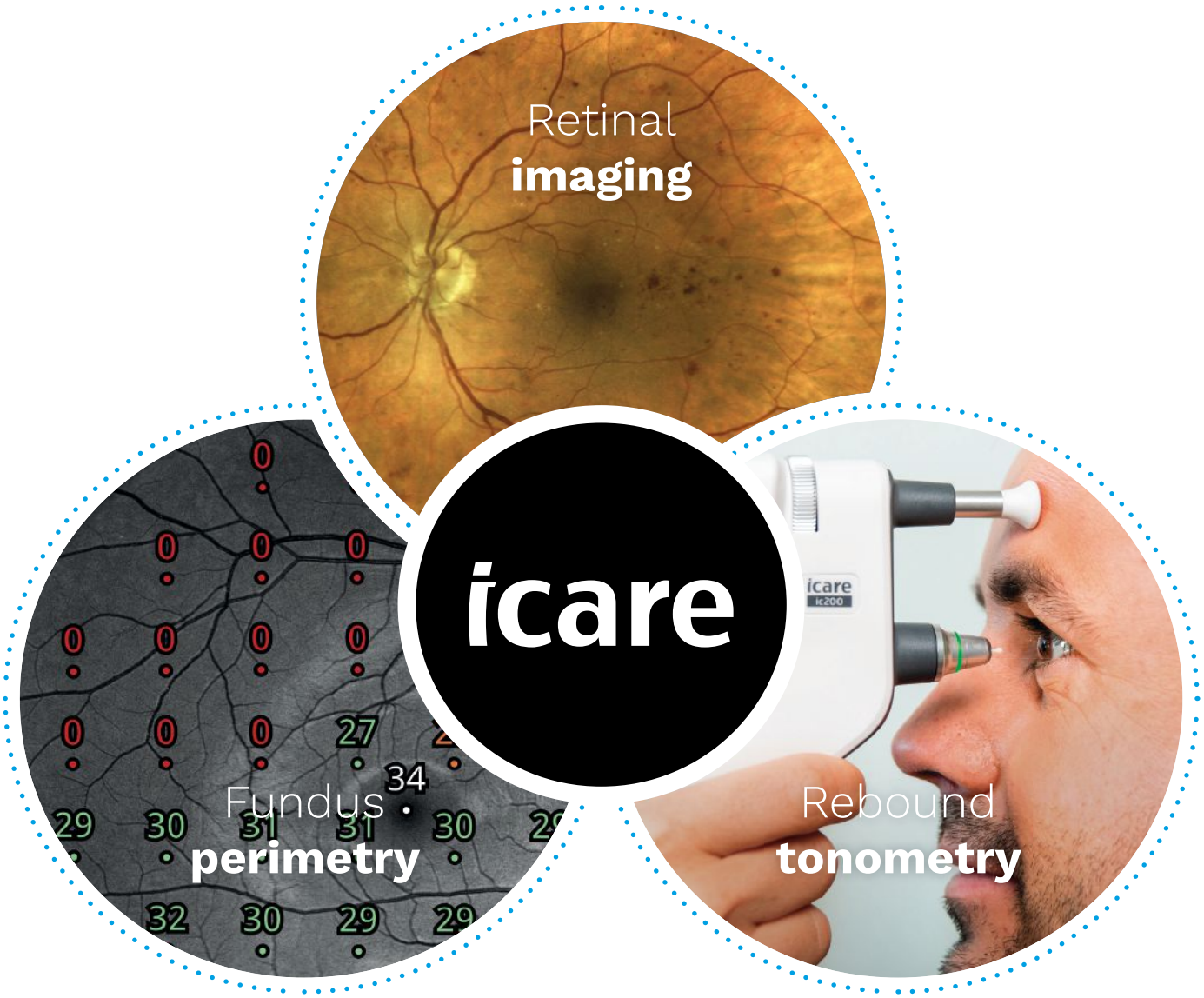

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A similar method of ASP uses a Nd:YAG laser instead of a needle to make the punctures in Bowman's layer. The benefit of the Nd:YAG laser is that the puncture's are shallower and more consistent, which, in theory, should lead to less corneal scarring.

It's important to note that these two methods of ASP only work for peripheral RCE lesions due to the high risk of scarring. Scarring on the peripheral cornea should not affect best-corrected visual acuity; however, there is a risk for the patient to have increased glare. Developments in ASP using OCT to map the anterior segment can provide a more detailed image of the injured area and enable more precise treatment, allowing for fewer punctures and, in turn, less scarring.[4,9-11]

Note that ASP and Nd:YAG laser are not usually indicated for central RCEs but rather are typically reserved for off-axis injuries. There are other surgical options that are more effective for central corneal epithelial defects, including diamond burr superficial keratectomy and phototherapeutic keratectomy (PTK).

Epithelial debridement is an effective and common treatment for active RCEs (*Figure 3*). The damaged tissue is mechanically removed with a cellulose sponge or blunt spatula. This clears the area for proper regeneration of epithelial tissue. Afterwards, a bandage contact lens should be placed, and the patient should be prescribed corticosteroid drops and a topical antibiotic while they recover. This treatment is extremely effective at managing acute RCEs but not at limiting the chance of recurrence.[4,9-11]

Diamond burr superficial keratectomy is an alternative treatment that has been shown to be the most effective method of reducing RCE recurrence (*Figure 4*). It is a variation of epithelial debridement that uses a diamond burr to remove the damaged tissue without puncturing Bowman's layer and thus can be used safely on central RCE lesions with limited risk of scarring. The diamond burr helps to create an extremely smooth surface on Bowman's that allows for proper regrowth while also possibly stimulating extracellular matrix proteins. This stimulation promotes stronger adhesions and connections to Bowman's layer and may help reduce recurrence rates.

While diamond burr superficial keratectomy is very effective at preventing recurrence, one of its downsides is the long recovery time for the patient. The process also can cause corneal haze during healing which may frustrate patients with blurry vision. The technique also often increases the amount of pain in recovery. Topical corticosteroids can be used in combination to limit corneal haze and accelerate patient recovery and discomfort.[4,9-11]

PTK has also shown effectiveness in treating RCEs and limiting their recurrence rates. This laser treatment ablates the superficial layers of the corneal past Bowman's layer and slightly into the anterior stroma. Due to the effect of the laser, there is no trauma response from the cornea, decreasing the risk of scarring. This makes the treated

RCE TREATMENT PROTOCOL RECOMMENDATIONS

Acute RCE without epithelial defect:
- Preservative-free artificial tears QID
- Sodium chloride hypertonicity ointment BID

First-time acute RCE with epithelial defect treatment options:
- Moxifloxacin QID (always)
- Cyclopentolate BID (for pain if needed)
- Ibuprofen 200mg to 400mg PO QID (for pain if needed)
- Bandage contact lens (for large/painful epithelial defects)
- Loteprednol QID (if large or central lesion, only use with prophylactic antibiotic)
- Debridement (if large area of loose epithelium is present)

Recurrent acute RCE with epithelial defect options (can use any or all in addition to the first-time acute RCE treatment options above):
- Punctal plugs (especially in cases of chronic dry eye)
- Autologous serum artificial tears QID
- Loteprednol QID (only use with prophylactic antibiotic)
- Doxycycline 50mg PO BID (typically used in conjunction with topical steroid)

Potential surgical options in cases of repeated recurrent episodes:
- Anterior stromal micropuncture (for non-visual axis lesions)
- Diamond burr superficial keratectomy (long recovery; good for lesions on visual axis)
- Phototherapeutic keratectomy (used with non-dystrophic corneas; requires surgical suite)
- Alcohol delamination (long recovery)

After resolution of RCE (healed epithelium):
- Preservative-free artificial tears QID (three to six months)
- Sodium chloride lubricating ointment QHS-BID (three to six months)
- Loteprednol QID (if concerned about the number of recurrences, use for two to three weeks)
- Doxycycline 50mg PO BID (use for two to three weeks if using loteprednol)

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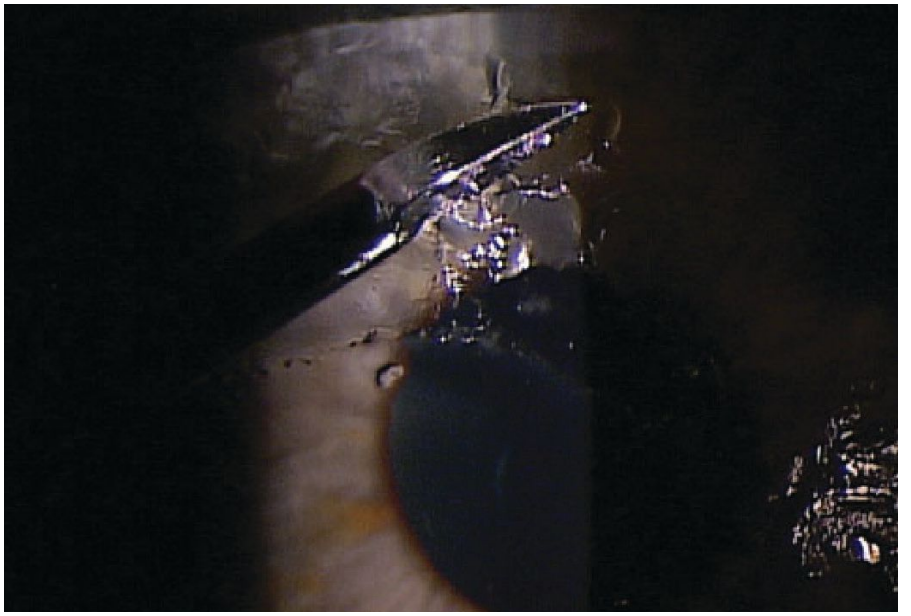

Photo: Aaron McNulty, OD

Fig. 4. Diamond burr superficial keratectomy is a variation of epithelial debridement that uses a diamond burr to remove the damaged tissue, creating a smooth surface at the level of Bowman's layer. Note that while this method is highly effective at limiting recurrences, it does have a longer recovery time for the patient than other procedures. Patients may also experience corneal haze and increased pain during healing, which topical corticosteroids can help to alleviate.

surface exceptionally smooth and, in turn, helps promote proper healing. A smooth surface for the epithelial basement membrane to bond to promotes stronger adhesions, specifically at the level of the hemidesmosomes. As with diamond burr polishing, the smooth surface is key to improving long-term results for RCE patients.

The biggest downfall of PTK is the cost and requirement of a surgical suite. It can also cause changes to refractive error, specifically increased astigmatism due to the depth of the therapy.[4,9-11]

A more recent treatment option called alcohol delamination has shown great promise in reducing recurrence rates. This process involves applying small amounts of diluted alcohol to an anesthetized cornea. After the alcohol is removed with a sponge, the damaged epithelium peels off easily. This process minimizes haze due to the removal of only the superficial corneal epithelium, an advantage that alcohol delamination has over diamond burr superficial keratectomy. Postoperatively, patients should use preservative-free artificial tears, take a topical antibiotic and wear a bandage contact lens for around one week.[4,9]

The goal of all these surgical treatments is to remove the compromised corneal tissue and allow new tissue to grow with stronger adhesive complexes. A smooth surface allows for cellular matrix structures to form tighter junctions and adhesions, ultimately leading to fewer recurrences.

To see a flowchart that outlines the various therapeutic options for managing RCE with or without epithelial defect, refer to the protocol outlined on the previous page.

Patient Reassurance

To help manage expectations of pain and discomfort for patients with RCEs, it's essential to educate them about the condition and various management options throughout follow-up. The anxiety of not knowing when an RCE will occur can be one of patients' biggest concerns. When managing these patients, especially those with numerous recurrences, exhibiting empathy and taking time to discuss the range of treatment options can be reassuring and help to establish patient trust and confidence. For patients that have struggled with RCEs for years, knowing that there are other interventions to try if one fails can help them feel more optimistic about treatment.

Takeaways

Topical and surgical treatments give physicians many options when treating RCEs. Guiding your treatment towards the unique situation that presents is the best way to ensure positive long-term results. Escalating our aggressiveness with treatment options depends on factors such as severity and frequency of recurrence.

Becoming familiar with the numerous treatment options you have at your disposal can help reduce recurrent episodes and improve your patients' quality of life. RCEs can be frustrating for patients and physicians alike, but limiting recurrence is key. ■

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KERATOCONUS: WHAT SURPRISES THE EXPERTS?

In this wide-ranging discussion, 15 pros reveal what perplexes even them about the course and management of this condition.

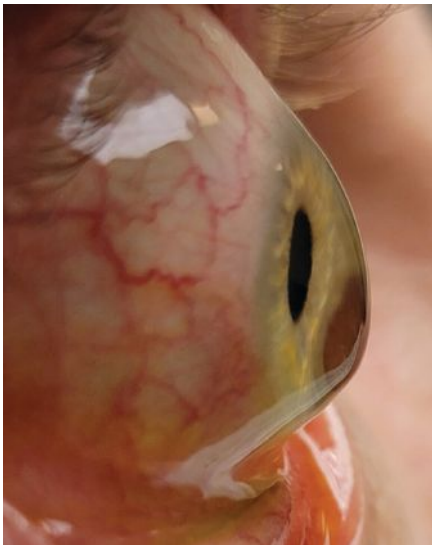
BY JULIE SONG, OD, AND CHRISTINE SINDT, OD
NEW YORK CITY AND IOWA CITY

Despite being one of the more prevalent corneal conditions we encounter, keratoconus still holds many mysteries for clinicians and patients alike. During one festive evening at the 2023 Global Specialty Lens Symposium in Las Vegas, various experts were asked, "What surprises you about keratoconus?" Below, you will find their responses followed by a literature review that lends context and background information to their experiences and insights.

Responses from the experts have been edited for brevity and clarity. Also note that their replies were meant to be off-the-cuff and thought-provoking rather than carefully considered, evidence-based commentaries, so there is an element of levity to some of the thoughts shared here.

Diagnosis and Initial Encounter

The consistent theme emerging during our discussion with experts was the critical importance of early identification of keratoconus patients and suspects, given the lifelong impact of the condition.



Dramatic presentations like this may be unambiguous cases of keratoconus, but experts agree that our emphasis should be on gaining a more nuanced understanding of the condition's subtle early signs to allow for swift intervention and a better long-term prognosis.

▶ *"The number of times keratoconus has not been detected."—**Tom Quinn, OD***

In a recent systematic review and meta-analysis, keratoconus prevalence was reported to occur in around 1.38 per 1000 people as an average across the globe.[1] This differs from an oft-cited study done by Godefrooij et al., which reports that the prevalence is much higher and measured at 1:375 in their study done in the Netherlands.[2] While prevalence varies depending on the population analyzed in each study, the simple truth remains: keratoconus cannot be reported if it is not detected.

The diagnosis can elude doctors who don't perform proper imaging and can be misdiagnosed as anisometropic or refractive amblyopia, high astigmatism, vernal keratoconjunctivitis and more. Keratoconus onset has traditionally been reported to be towards the middle of the second decade of life, but self-reported onset for patients is often not until a few years later.[3,4] For patients diagnosed after that, there are many years of missed opportunities for treatment.

About the authors

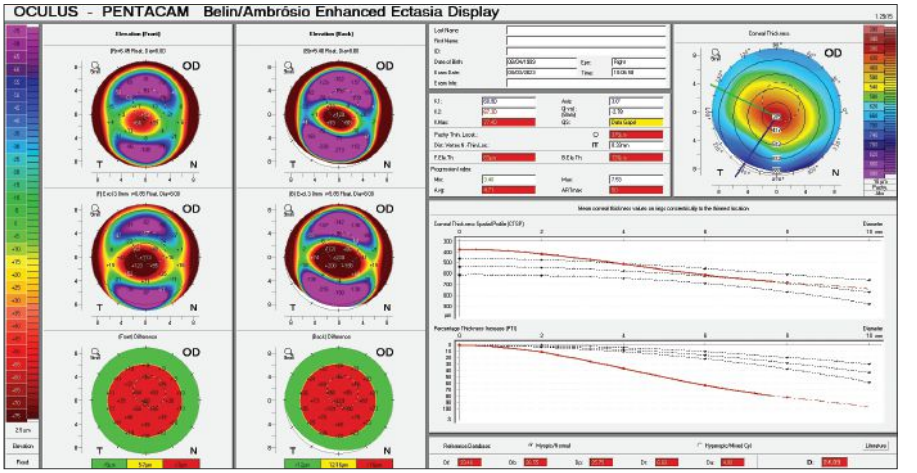
Dr. Song received her OD degree at the SUNY College of Optometry and graduated with numerous awards, including the Chancellor's Award for Student Excellence. She is currently completing a cornea and contact lens residency at the college. She has presented multiple posters at contact lens–focused conferences in eye care. Dr. Song has no financial disclosures. **Dr. Sindt** is a clinical professor of ophthalmology and visual sciences and director of the Contact Lens Service at the University of Iowa Carver College of Medicine. An internationally known expert in corneal disease and specialty lens design techniques, she is also Associate Clinical Editor of *Review of Optometry* and *Review of Cornea & Contact Lenses*. Dr. Sindt is the inventor and founder of EyePrintPro custom scleral contact lens manufacturing.

While the diagnosis can be simple when patients present with more advanced cases and evidence of clinical signs, it can be more difficult in very early or forme fruste keratoconus. Detecting these more difficult cases that do not have obvious corneal slit lamp findings requires additional testing, including corneal topography, and potentially corneal hysteresis, corneal tomography and aberrometry. Through corneal biomechanics testing, key markers to watch out for include deflection amplitude of highest concavity and stiffness parameter at first applanation.[5]

With corneal tomography, clinicians should direct their attention to the front elevation thickness at the cornea's thinnest location as an indicator for keratoconus.[5] Patients with keratoconus, and other non-inflammatory thinning disorders such as Pellucid's marginal degeneration, also have a higher incidence of higher-order aberrations, especially coma-like aberrations, which can be detected with an aberrometer.[6]

▶ *"It's possible that some cases are being missed and masked by the surge in practitioners launching their pediatric myopes into orthokeratology lenses without ruling out early ectatic disease with a simple Pentacam image. Pediatric optometrists and ophthalmologists should be the front line of early keratoconus detection—but they are not. In an ideal world, Pentacam imaging would be a mandatory part of a comprehensive annual pediatric eye exam."—**Andrew Morgenstern, OD***

Corneal topography and tomography scans remain a standardized method of diagnosing keratoconus. However, when eyecare practitioners do not have access to these devices, corneal ectatic disease can be misdiagnosed in the earlier stages. While taking and having pediatric patients sit for imaging can be difficult, the lack of standardized care to screen for keratoconus can prove to be detrimental to patients who fall through the cracks. Even though the age of onset is postulated to be around 15 years of age, kids can start to manifest early signs even before that. These early-onset patients tend to be battling more aggressive forms of the disease and need treatment as soon as possible.



Corneal tomographic data from the Belin/Ambrósio report of a 24-year-old keratoconus patient. The pacymetry progression index calculates the change in corneal thickness from the thinnest point to the periphery. A rapid change in thickness indicates ectasia.

For those practicing in settings where corneal tomography scans are accessible, there are a few key areas to evaluate closely.[7] In borderline diagnosis cases, your suspicion for keratoconus should be elevated when seeing Belin/Ambrósio values ≥1.54, 5th-order vertical coma aberration of the front cornea ≥0.023, Index of Surface Variance values ≥22 and Index of Vertical Asymmetry values ≥0.14.[7]

See *Table 1* for generally accepted diagnostic parameters of definite keratoconus.

▶ *"It always starts on the back of the cornea. If you only did topography, you messed up."—**Buddy Russell, FCLSA***

One of the earliest signs of keratoconus is steepening of the posterior elevation, which can be adequately measured with corneal tomography, but not topography, scans. While topography can be adequate to initially detect mild/severe keratoconus, its use alone will not be enough to confirm corneal ectasia in early cases.

For early and forme fruste keratoconus eyes, a cut-off level between 20.0µm and 26.5µm of posterior elevation can differentiate definite keratoconus when compared to normal eyes.[8]

In order to diagnose these patients with pre-topographical keratoconus, additional data that can be gained from corneal tomography scans are critical. For eyecare practitioners who do not have access to corneal tomography, there is always the opportunity to refer these patients to other doctors who do, so that they can perform the scan.

▶ *"HOAs suck! We need good aberrometers to measure them."*
—Tiffany Andrzejewski, OD

The introduction of wavefront-sensing aberrometers into optometric and ophthalmic clinical practice has greatly helped us quantify the cornea's optical/refractive performance. Various studies have reported an increase in the number of higher-order aberrations (HOAs) that patients with keratoconus experience, particular coma induced by superior-inferior asymmetry of keratoconic corneas; these can significantly impact visual impairment.[9] Several researchers have explored using wavefront sensing to detect early and forme fruste keratoconus—in other words, pre-topographic keratoconus—where increased corneal total HOAs and corneal coma can manifest themselves.[9-11]

Combining videokeratography and wavefront analysis can improve the specificity and sensitivity for early detection of the disease.[12] The magnitude and type of HOA changes

TABLE 1. GUIDELINES FOR DIAGNOSING KERATOCONUS FROM QUANTIFIABLE METRICS[7]

Diagnostic Indices	Values Indicating Definite Keratoconus
Mean Keratometry	>46.1
Maximum Anterior Elevation in 5mm Zone	>26.95
Maximum Posterior Elevation in 5mm Zone	>48.72
Index of Vertical Asymmetry	>0.69
Index of Surface Variance	>62
Keratoconus Index	>1.15
Central Keratoconus Index	>1.03
Index of Height Asymmetry	>20.90
Index of Height Decentration	>0.051
Minimal Sagittal Curvature	<6.59
Minimum Corneal Thickness	<473
Average Pachymetric Progression Index	>1.80
Maximum Pachymetric Progression Index	>2.55
Maximum Ambrósio Relational Thickness	<282
Average Ambrósio Relational Thickness	<202
Belin/Ambrósio Enhanced Ectasia Total Deviation Value	>6.94
Root Mean Square Total	>6.64
Root Mean Square Higher-Order Aberration	>1.70
3rd-Order Vertical Coma Aberration of Cornea Front	>-4.68
5th-Order Vertical Coma Aberration of Cornea Front	>0.535

as keratoconus progresses, but also potentially after procedures such as CXL are performed. A study done by Greenstein et al. examined the effect of crosslinking and Intacs on HOAs and found that total HOAs and vertical and horizontal coma of the anterior cornea decreased, while spherical anterior corneal HOAs increased and trefoil was not affected.[13] This becomes important when monitoring patients for progression in their disease process, as well as for designing wavefront-guided contact lenses for patients pre- and post-surgery.

▶ *"I'm surprised by the number of keratoconus patients who are happy with the vision they're entering with."*
—Jonathan King, OD

While there is not a lot of literature on uncorrected visual acuity in keratoconus patients who first present to clinic, most practitioners can relate to the surprise felt when examining a patient for first-time glasses or contact lenses who has never worn any correction before. In one study done in Tel Aviv, investigators found entering uncorrected acuity for patients with mild/moderate keratoconus and no corneal scarring to be 1.10±0.68 logMAR, which is about 20/250 for its Snellen equivalent.[14]

Depending on the asymmetric nature of the keratoconus as well, patients who are essentially functioning monocularly may not come in for visual distortion as early as patients whose keratoconus is more symmetric. No matter the reason or timeframe of the patient presenting in your chair, herein lies an opportunity to offer them a chance to achieve functional vision. The early referral for corneal collagen crosslinking (CXL) not only could help slow or halt disease progression but could also even help patients stay successful in spectacle lens wear for adequate visual correction.

Management and Prognosis

Clearly, the introduction of CXL has been a game-changer for keratoconus, and the recent renaissance in scleral lens fitting has given optometrists even more capabilities to provide the best possible vision.

▶ *"When you're managing keratoconus, you're not just managing their corneal ectasia—you're always taking care of a whole person. We need to spend more time correlating keratoconus with systemic diseases the patients may have."*
—Jennifer Harthan, OD

While we typically use clinical signs and clinical tests to diagnose keratoconus, there may be additional comorbidities the patient is battling that are either early clues or diseases that worsen the disease.

For keratoconus suspects, asking pertinent questions about a history of eczema, asthma, allergy, and eye rubbing should be a part of the entering case history.[1] In those already diagnosed with keratoconus, the aforementioned conditions still need to be managed, as well as sleep apnea, connective tissue disorders, inflammatory bowel disease, allergic rhinitis, diabetes and atopy.[15]

Eyecare practitioners have the ability to communicate with other healthcare providers to make recommendations and follow up on our guidance so that our keratoconic patients have an adequate team of experts to support them for all aspects of their well-being.

▶ *"Crosslinking has been proven effective for decades and yet not enough patients today do it. Get CXL first and then we'll talk about contact lens fitting."*
—Shalu Pal, OD

Since its introduction internationally in the late 1990s and its US FDA

approval in 2016, CXL has revolutionized the way practitioners manage and treat keratoconus. The potential reduction in the need for penetrating keratoplasty, the reduction in disease progression and the biochemical stiffening of the ectatic cornea are all made possible by the formation of strong covalent bonds from riboflavin drops and ultraviolet A light interactions with stromal collagen fibrils.[16]

Currently, the standard CXL procedure is still the Dresden or "epithelium off" protocol.[17] Epithelium-on procedures and other variants are being studied to try to reduce the incidence of infection and improve comfort for patients post-procedure to allow more patients to be able to undergo the procedure. However, current research has shown the Dresden protocol is still the most effective in mitigating disease progression.[18]

The most common potential adverse event from CXL is corneal haze, while the least common are microbial keratitis and stromal melt. Depending on severity, all complications may affect postoperative visual acuity.[19]

The ideal timing of referral can be tricky. While practitioners may wait to refer adult patients for CXL until progression is noted, pediatric keratoconus usually indicates a more aggressive phenotype that requires earlier intervention. Timing can also depend on visual demands and whether or not the patient is able to wait until after CXL to be able to achieve adequate acuity for their activities of daily living.

Anterior or posterior corneal surface steepening and a change in corneal thickness or rate of thickness change from the thinnest point to the periphery are all considered signs of progression. The presence of two out of three of these is considered progression, according to some; however, there is no uniformly accepted definition of the phenomenon.[20] Ultimately, corneal crosslinking is a relatively safe and effective intervention to reduce and potentially halt progression for the majority of keratoconic eyes.[21]

▶ *"I am surprised by how few solutions these patients have been given and how hard they struggle."—**Daniel Neal, PhD***

Visual impairment in general can significantly impact quality of life and is considered a common cause of psychological distress.[22] A general decline in acuity also has a positive association with depressive symptoms.[23-24] In a study done to compare the frequency and intensity of depression in keratoconic patients with their non-keratoconic age- and gender-matched counterparts, the former experienced more depression, and at higher intensity, than healthy control subjects.[25] It may be postulated that it is actually the subjective visual deterioration as opposed to lower best-corrected visual acuity that is actually correlated with developing depression.[23-24]

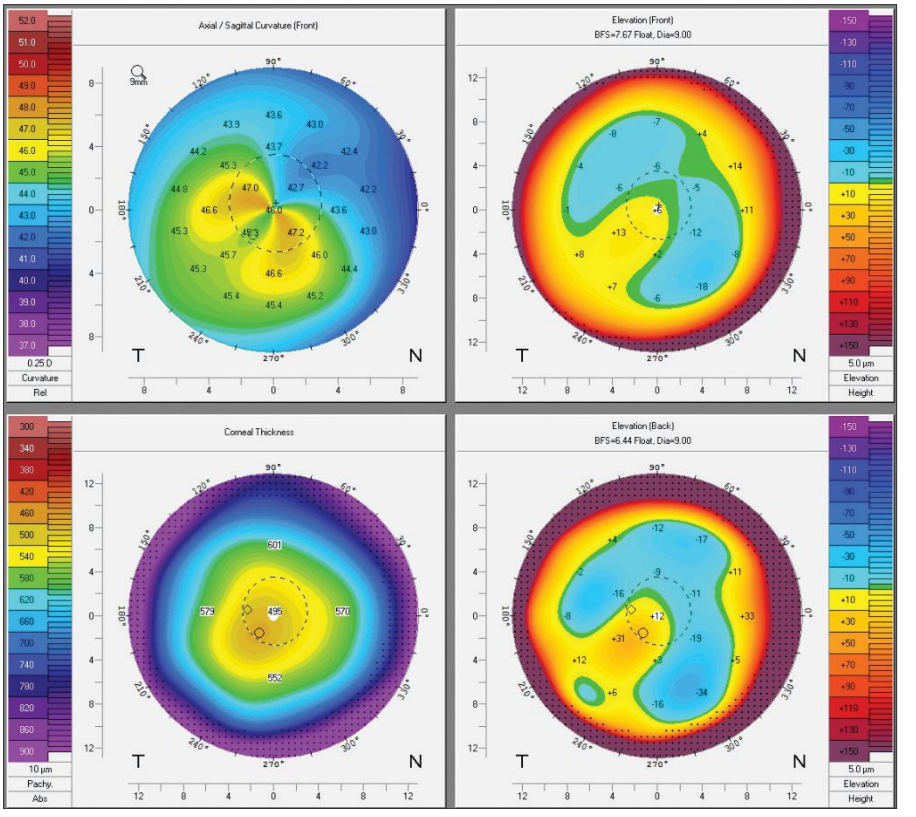
There are multiple ways to measure depression through screening questionnaires such as the following:[26-32]

- Hospital Anxiety and Depression Scale
- Hamilton Rating Scale for Depression
- Geriatric Depression Scale
- Zung Depression Inventory-Self Rating Depression Scale (Zung SDS)
- 36-item Short Form Health Survey
- 9-item Patient Health Questionnaire (PHQ-9)
- Beck Depression Inventory

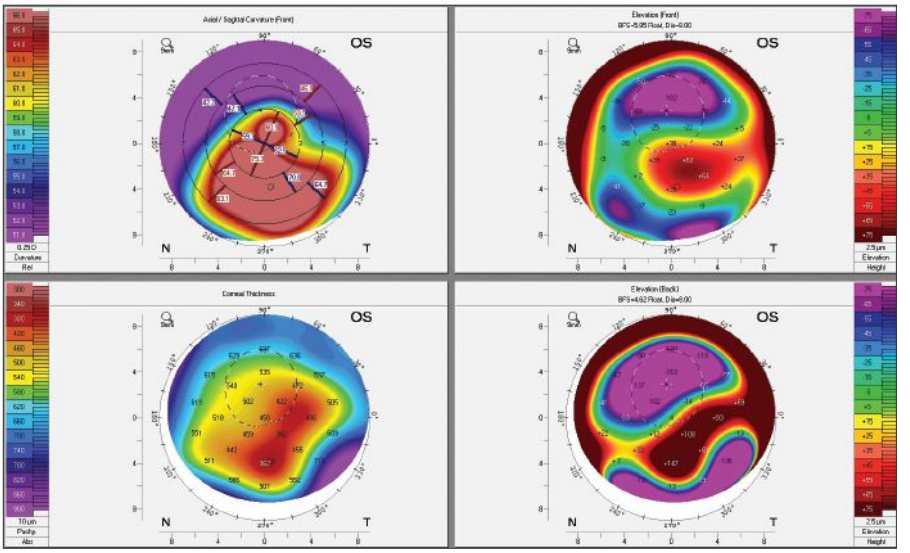
The PHQ-9 and Zung SDS are particularly useful questionnaires that could potentially be incorporated into practice, since they are strongly and positively intercorrelated with keratoconic patients.[25]

▶ *"I wish both doctors and patients would not believe and persist in suggesting that a diagnosis of keratoconus will either lead to blindness or corneal transplants."—**Barry Eiden, OD***

While keratoconus is a relatively rare condition, it generally has an onset during young adulthood, with 94% of patients diagnosed between the ages



Topographies of an early keratoconus patient post-CXL. Crosslinking binds collagen fibers to adjacent ones using riboflavin drops and UV light. While some Kmax flattening occurs, patients should be told that CXL is done to reduce progression, not improve vision.



Corneal topography of an advanced keratoconus patient with an Intacs implant and corneal scarring. Note the extreme elevation differences of the back surface of the cornea, corresponding to the thinnest pachymetry areas. For additional diagnostic imaging on this patient, see page 66.

of 12 and 39, and can be an emotional and devastating diagnosis.[33] Many patients mistakenly believe they will go blind from keratoconus and do not adequately understand the potential outcomes of the condition.

According to a 2005 study, the general population rates fear of blindness second only to fear of cancer and AIDS (a more consequential diagnosis at the time, prior to the introduction of life-saving therapies), and therefore keratoconic patients may develop irrational fear of incipient blindness if they are not properly informed about their visual prognosis.[34]

Especially with the availability of CXL and scleral lenses, more and more patients are now able to slow or even halt the progression of keratoconus and completely avoid the need for corneal transplantation.[35] It is therefore imperative to carefully monitor these patients for progression and offer them the appropriate protocols for CXL where indicated.[36] Patients diagnosed at younger ages (less than 17 years old) and with a steeper Kmax (greater than 55D) at initial presentation are at increased risk of progression and should be monitored more closely.[36]

Additionally, there are many different contact lens modalities available to the eyecare practitioner to correct keratoconus, such as custom soft, gas permeable, hybrid and scleral lenses. The latter can now provide visual correction for even the steepest of corneas.

Pathophysiology

While there are a few well-known factors concerning how keratoconus develops, they are less concrete than you may think, our experts shared.

▶ *"At the risk of oversimplifying: no rub, no cone."—**Eef van der Worp, PhD***

A history of atopy, eczema, allergies, UV-light exposure and eye rubbing have long been implicated as environmental factors that play a role in the pathogenesis of keratoconus.[37-39]

While the overall findings have been inconclusive between studies of eye rubbing's influence on keratoconus, it is widely accepted that there is a positive association between the two.[40] The exact mechanism is still elusive. The rubbing must be prolonged and repetitive to sufficiently alter the biomechanics of the cornea—findings suggest the greater the force of rubbing, the more likely it is for progression and increase in severity—however, the timeframe and force required is not known at this point. The part of the body used to rub (knuckle or fingertip) can also potentially affect the amount of force applied.

Keratoconic patients tend to rub their eyes with their knuckles, thereby generating more force than non-keratoconic individuals who rub their eyes with their fingertips.[41] There's even perhaps a significant relationship between the dominant hand of the patient and the more severe keratoconic eye due to the hand itself being stronger.[42]

Further, there are other possible mechanical factors that can induce rubbing besides use of the hands, such as sleeping on your side and participating in sports such as wrestling that put patients at risk for mechanical friction.[41] Keratoconic patients not only tend to rub more often than their non-keratoconic counterparts, they also tend to use more force when doing so.[43] Patient age can also play a role in differences in frequency and force of rubbing; even with similar amounts of ocular allergies, adults were measured to rub less than teenagers.[42]

While there is still incomplete data proving direct causation of keratoconus from eye rubbing, the literature points to a correlation between the two.

▶ *"You just can't predict hydrops."—**Renee Reeder, OD***

Acute corneal hydrops is a relatively rare complication of keratoconus to which there are currently no anatomic predictive risk factors.[44] However, there are a number of associations and theories. Occurring in around 3% of cases, hydrops has correlations with eye rubbing, young age at onset, vernal keratoconjunctivitis, atopy, male sex and Down syndrome.[45-47] Additional studies have found associations with steeper keratometry, poorer Snellen visual acuity at time of diagnosis and earlier age of diagnosis as having strong associations with subsequent acute corneal hydrops development.[48] There is even a study that evaluated ethnic associations and found that Pacific ancestry has a strong positive association

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Habitual eye rubbing, particularly when performed with the knuckles, has long been associated with increased likelihood of keratoconus development. However, numerous other factors—including age, genetic profile, history of atopic dermatitis, UV light exposure and more—also play a part and should be teased out during a careful patient history.

while New Zealand European heritage has a negative association.[49]

In the literature right now, anterior segment OCT, *in vivo* confocal microscopy and ultrasound biomicroscopy are all being used to monitor and manage the condition. In a study done by Fuentes, et al., the investigators noted that the presence of hyperreflective anomalies at Bowman's layer with marked stromal and epithelial thinning as measured on OCT were all findings that their keratoconic patients had prior to developing acute corneal hydrops.[50] These are seen in patients who do not yet have stromal scarring, which is considered to be protective against development of acute corneal hydrops due to the increase in rigidity.[50]

While corneal hydrops can be difficult to predict in certain patients, the literature suggests that the presence of advanced keratoconus is at least associated with its development.

Patient Psychology

Given its early onset in life, keratoconus is a formative experience for most patients. What does that do to their psychological make-up? Our experts share their observations.

▶ *"I am surprised by their personality."*
—Abigael Chocron, OD

While the postulation that there's a link between keratoconus and certain atypical personality traits has been suggested since the 1980s, there is at this time no concrete evidence of a unique "keratoconic personality" relative to high myopes.[51] However, it's possible that the perception of this unique personality is due to the specific interactions that patients have with their healthcare providers.

One study finds that these individuals tend to have maladaptive coping mechanisms, where they are less cooperative, less conforming and less respectful when interacting with their healthcare providers.[52] Another suggested a "two-hit hypothesis" for developing the "perceived keratoconus personality."[51] The first concept is that the onset of visual deterioration occurs during a vulnerable period in the patient's psychosocial development, when pathological coping mechanisms are poorly developed. The second is the disparate perceptions of what kind of burden keratoconus will have on the patient's vision and livelihood.

These two experiences occurring in succession during this vulnerable and critical developmental timeframe for patients can potentially develop into a "perceived keratoconus personality."

In another study, keratoconic patients were compared to a group of moderate to high myopes who also need contact lenses for visual correction. Results showed that the personality traits assessed—such as social introversion, paranoia and depression—were not significantly different between the two groups studied.[53]

▶ *"Patients will put up with anything to see."*—***Priscilla Sotomayor, OD***

Since keratoconus is typically diagnosed during income-earning, peak education and child-rearing years, the condition has the potential to decrease vision-related quality of life.[54] Keratoconic patients tend to experience significant ocular surface discomfort, perhaps exacerbated by contact lens wear, alterations in tear film, inflammation or corneal thinning with resultant nerve exposure.[55,56] These patients can also experience ocular

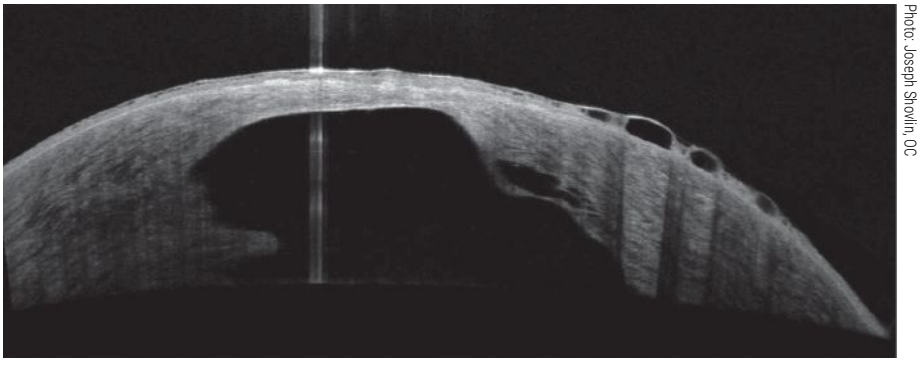

Photo: Joseph Shovlin, OC

About 3% of patients will develop hydrops. The condition is correlated with eye rubbing, young age at onset, vernal keratoconjunctivitis, atopy, male sex and Down syndrome.

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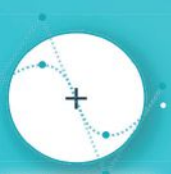

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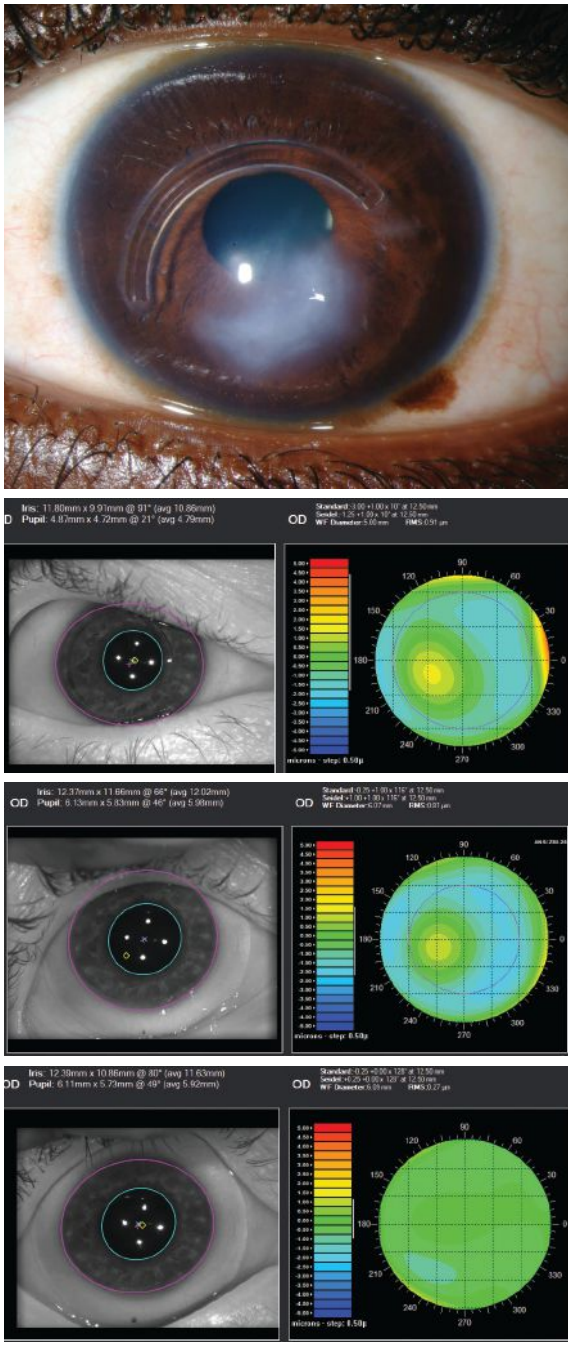

This series shows an advanced keratoconus patient with Intacs ring implantation and significant scarring. *First image:* slit lamp appearance. *Second image:* the impact of higher-order aberrations without correction (0.91µm@5mm pupil). *Third image:* aberrations remain with scleral lens wear (0.81µm@6mm pupil). *Fourth image:* aberration profile has been improved with use of an HOA-corrected scleral lens (0.27µm@6.09mm pupil).

pain from stromal and epithelial damage and contact lens intolerance.[56]

Patients with keratoconus may develop various coping mechanisms for their condition, such as introversion, which can lead patients to become more withdrawn and passive as their keratoconus becomes more visually debilitating.[52] In a study by Giedd et al., keratoconic patients were postulated to not be exacerbated by psychological stress when compared to the normative population of both physically ill and healthy adults due to the presence of low percentage of scores on measured psychogenic attitude scales.[52]

▶ *"There are people who meet these patients and think they're crazy. There is sometimes a lack of empathy from practitioners to care for patients who have keratoconus."—**John Gelles, OD***

The Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Observational Study showed that patient quality of life is low on all scales when using the National Eye Institute Visual Function Questionnaire (NEI-VFQ).[57] In the follow-up study from the CLEK Observational Study group, quality of life scores continued to decline for patients whose visual acuity worsened and corneal curvature steepened.[58]

Although more recent advancements in scleral contact lenses and the introduction of CXL have emerged since the study concluded, there are still barriers to accessibility for patients who cannot afford or do not have access to eyecare providers who can offer those treatment options. Additionally, healthcare providers can potentially underestimate how the condition affects patients' quality of life, especially if the keratoconus is clinically mild and the patient can achieve excellent Snellen visual acuity.[51]

In studies performed on clinical empathy, patients who perceive their doctors to be empathetic can potentially have better control of their treatment regimens, are less likely to sue for malpractice complaints and show objective changes in their immune system and significant reduction in duration and severity of symptoms.[59-61] Empathetic concern itself is associated with a neural response in the brain's striatum and ventromedial prefrontal cortex.[62] When confronted with images of painful situations, physicians showed activation in their superior frontal gyrus, medial prefrontal cortex and temporoparietal junction, all of which contribute to activating executive attention and mental state understanding.[62] Even though it can be perceived as blunting the instinct for empathy, expertise and learned experience play a role in how healthcare providers perceive others in pain by showing a downregulation in regions of the pain matrix when examining others' suffering.[63]

▶ *"You need to have patient communication skills. Be that genius for them."—**Louise Sclafani, OD***

In a study investigating how keratoconic patients receive prognostic and diagnostic information from their healthcare providers, results showed they were generally dissatisfied by the transmission of information from their doctors. This dissatisfaction can perhaps influence their perception of keratoconus and how it impacts their life.[51]

In order to improve the doctor-patient relationship, changing to a more patient-centered communication style by creating a sustainable relationship, verbalizing emotional experiences, exploring patients' perspectives and developing strategies jointly can be beneficial.[64-67] These skills can be further developed with training in conversation techniques. A couple examples

of effective techniques include the NURSE model for handling emotions (naming, understanding, respecting, supporting, exploring) and the WEMS technique (waiting, echoing, mirroring, summarizing).[68-70] It is possible for these patient-centered skills to be learned and improved by practitioners.[71] ■

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HOW TO HANDLE NON-OCULAR EMERGENCIES IN YOUR PRACTICE

Preparation is paramount. Here's how to gear up for these unexpected events so that you can react appropriately in your clinic.

BY CATLIN NALLEY
CONTRIBUTING EDITOR

As primary eyecare providers, optometrists regularly encounter ocular emergencies that they are well-equipped to handle. While not as frequent, other urgent, non-ocular medical situations can also occur while caring for patients in their clinical practice and it is crucial that ODs are prepared to manage these events properly when they arise.

"As optometric practice has evolved, so has the role of the optometrists," notes Tad Buckingham, OD, of Pacific University College of Optometry, who recently retired from Forest Grove Fire and Rescue. "We are physicians, and, as such, it is our responsibility to be able to identify and handle medical emergencies when they occur in our clinical practice."

While optometrists should be prepared to manage or triage numerous medical emergencies, such as anaphylaxis, stroke and seizure to name a few, it can be a step outside of their comfort zone, particularly since these events don't happen on a daily basis. However, with the right preparation, ODs can feel confident in their ability to contend with non-ocular crises, no matter the situation, says Dr. Buckingham, who uses his experience in emergency services to help educate ODs and other physicians.

Photo: Getty Images

An office emergency preparedness kit may include items such as blood pressure cuffs, first-aid kit and an AED. Place these items in a well-marked location that is easy to access.

This article will discuss common non-ocular emergencies that optometrists may observe in their clinic as well as how to respond appropriately—and quickly—to ensure the best possible care and outcomes for their patients.

Identify Common Emergencies

Managing in-office medical dilemmas begins with identification. Optometrists must have the knowledge and skills to recognize these events and take the necessary steps to provide appropriate care.

A medical emergency, Dr. Buckingham explained, can be defined as an intrinsic or extrinsic influence that has acute durational (and not transient) effects on the patient's:

- ***Level of consciousness***—confusion to unconsciousness
- ***Respiratory system***—airway and breathing
- ***Cardiovascular system***—abnormal/absent pulse and blood pressure
- ***Disability***—body paresis/paralysis, extreme hypo/hyper blood glucose levels

One of the most common non-ocular emergencies optometrists will face is vasovagal response, or fainting, according to Bascom Palmer's Alison Bozung, OD, who notes that

the likelihood of this happening is especially high among patients who need a procedure completed.

"I have seen this occur in patients with corneal foreign bodies, those requiring a corneal culture and even some patients who are extremely squeamish about everting their upper eyelids," she explains.

Dr. Bozung also emphasizes the importance of recognizing the initial red flags of a syncopal episode. These include the patient getting lightheaded, diaphoretic, dizzy or beginning to slouch back.

"Most times, if we can recognize the signs immediately, we can quickly recline the patient to lower their head and provide something cooling on their forehead," she continues. "Once in this position and steadied, I will offer a cool glass of water to sip when they can sit more upright again."

The frequency and type of non-ocular emergencies will vary depending on the size and type of the optometric practice. For Joseph Shovlin, OD, of Scranton, PA, whose main office has 10 providers at one time with over 40 exam rooms, rarely a week goes by without a non-ocular emergency.

"Fortunately, our ambulatory surgical center (ASC) is attached next door, and we have the benefit of a full-time anesthesiologist and nurse anesthetist on hand," he notes. "Nevertheless, every provider regardless of the size of their practice will at some point in their career be faced with a potentially life-threatening encounter.

"Some life-threatening events encountered in our main facility and surrounding offices included cardiac arrest, drug overdose, seizure, hypoglycemia and anaphylaxis (following fluorescein angiography)," adds Dr. Shovlin. "Other emergencies on a somewhat less troubling order included psychiatric events and asthmatic exacerbations."

No matter how often optometrists are faced with medical emergencies, it's critical to be familiar with the specific signs and symptoms of each situation. Proper recognition can allow the OD to act in the most effective way possible, Dr. Bozung emphasizes.

"For example, in patients with anaphylactic reaction, symptoms usually occur within minutes of exposure to an allergen, though they may be delayed up to an hour," she explains. "The patient may begin to experience difficulty breathing, tightness of the throat, flushed skin or hives, swelling of the face/lips/tongue, a rapid and weak pulse with hypotension."

Photo: Matthew Krein, OD, Sarah Krein, OD, and Richard Mangan, OD

This is the inside of an emergency kit used at Northeastern State University Oklahoma College of Optometry.

In the vast majority of states, according to Dr. Bozung, ODs are legally allowed to administer life-saving anaphylaxis treatment, "and it is certainly something we should be prepared for."

• ***Hypoglycemia***—a common and serious side effect of diabetic treatment—can present with a number of symptoms, including trembling, sweating, anxiety, hunger, nausea or tingling as well as neuroglycopenic changes such as confusion, difficulty concentrating, drowsiness, vision changes, dizziness and headache.[1]

Photo: Matthew Krein, OD, Sarah Krein, OD, and Richard Mangan, OD

A convenient medical kit should include an epinephrine pen for anaphylaxis emergencies.

If the patient is conscious, the American Diabetes Association recommends the "15-15" rule—have them consume 15g of a carbohydrate, such as glucose tablets, four ounces (1/2 cup) of juice or regular soda, or one tablespoon of sugar or honey. Then, blood sugar should be checked after 15 minutes. If blood sugar remains below 70mg/dL, this step should be repeated.[2] Adjust this for children, as they typically need less than 15g of carbs to fix a low blood glucose level.

Note that no substances should be given to a patient by mouth if they cannot control their airway. These patients will have altered consciousness and not be able to follow directions, Dr. Buckingham notes. "We do not want to make the situation worse by causing aspiration pneumonia."

"Those who are unconscious require urgent care, and emergency response should be contacted immediately," according to Chris Kruthoff, OD, who discussed emergency preparedness in a previous *Review of Optometry* article.

"In these cases, avoid injection of insulin, as it would further reduce blood sugar levels," he adds. "Do not attempt to provide food, drink or other oral therapies, as these are choking hazards."[1]

• ***Heart attack***—Chest pain or discomfort, jaw or neck pain, arm or shoulder pain and shortness of breath are some of the symptoms that could indicate a patient is experiencing a heart attack.[1] "One of the most important steps in managing heart attack is getting these patients to a hospital for emergency cardiac care," says Dr. Kruthoff.

"For patients who are symptomatic for heart attack, call 911 immediately. Give the patient a dose of 325mg aspirin (without enteric coating) to chew for faster systemic absorption and provide water for them to swallow. Monitor the patient until EMTs arrive for transfer to an emergency room with cardiac care."[1]

Many medical emergencies may present with ocular symptoms, notes Mohammad Rafieetary, OD, of Germantown, TN. "For example, a patient presenting with sudden-onset vision loss secondary to a retinal artery occlusion may be at risk of cerebrovascular accident or myocardial infarction," he notes. "This has to be treated as a medical emergency."

"Consider that a patient with a recent-onset cerebrovascular accident may present with complaints of peripheral vision loss" he adds. "While the patient may have a normal ocular examination, their complaint is neurogenic and has to be managed as a medical emergency."

Some emergencies may be the result of bodily injury. For instance, an elderly patient, particularly one with some vision loss, may have fallen and hit their head on a hard surface. These patients could present to the OD's office with concerns about their eyes, but they may have medical issues due to a concussion or cerebral venous sinus thrombosis with or without ocular signs, suggests Dr. Rafieetary, while noting that these situations must be treated as emergencies.

Prepare for the Unexpected

A key component of emergency preparedness is having the right tools on hand—and knowing how to use them. This includes items such as blood pressure cuffs (two sizes), glucose meter, pulse oximeter and universal precautions (latex free gloves, mask, eye protection), according to Dr. Shovlin.

"Having an ASC attached to our main office, we stock bag mask ventilators, intravenous catheter/butterfly needles, intravenous extension tubes, nasal airways, nasogastric tubes, oxygen masks and tanks, portable suction devices, resuscitation tape, resuscitation drugs and more," he notes. "For ODs who perform multiple surgical procedures (lid procedures included), carrying many of the supplies listed above are essential."

Danica Marrelli, OD, of the University of Houston College of Optometry, recommends also having these supplies on hand; however, she notes that ODs should check state laws/regulations to see what is and isn't allowed:

- Glucose tablets or another source of rapidly absorbed glucose (e.g., honey, juice, candy such as Life Savers) to administer if hypoglycemic.
- Non-enteric coated aspirin in case of chest pain.
- Epi-pen in case of anaphylaxis.
- Basic first-aid supplies such as bandages and cold packs in case of orthopedic injury or burn.

Another valuable tool for preparedness is an automatic external defibrillators (AED). The cost is reasonable and the device is easy to use, he says, so all staff should be educated on how to use the device. Supplies and

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equipment should be portable and kept in one common location.

Depending on where an OD's practice is located and what state regulations allow, it can be useful to also have Narcan (naloxone hydrochloride, Emergent BioSolutions) on hand for drug overdoses and accidental exposures, suggests Dr. Buckingham.

While only some states require it, all optometrists as well as members of their staff should be CPR and BLS certified. The American Red Cross, for example, offers group training courses. This could be beneficial for a small office looking to have more employees certified, suggests Dr. Bozung.

Response times for most emergency agencies are between four and six minutes, notes Dr. Buckingham. "And even with good CPR, people can start losing brain function permanently in about five or six minutes. And so, we can't depend on the emergency services to be there first," he says. "We need to be the first ones to identify and start treatment at our training level.

"We're not trying to be advanced cardiac life support, but we can definitely start CPR and get AED on the patient to help mitigate further harm," Dr. Buckingham continues. "We have a responsibility to provide care and intervention that is within our skillset and scope of practice."

Basic first aid and emergency preparedness courses can be valuable, notes Dr. Marrelli. Good recommendations for office preparedness, including staff training and drills, are often found in family medicine, pediatric and dental literature.

A clear action plan is critical for responding to urgent situations, and these plans and policies should be revisited periodically. You never know when it might strike, so you must be prepared at all times, advises Dr. Shovlin, while noting that the OD is responsible for the appropriate handling of any emergency that arises.

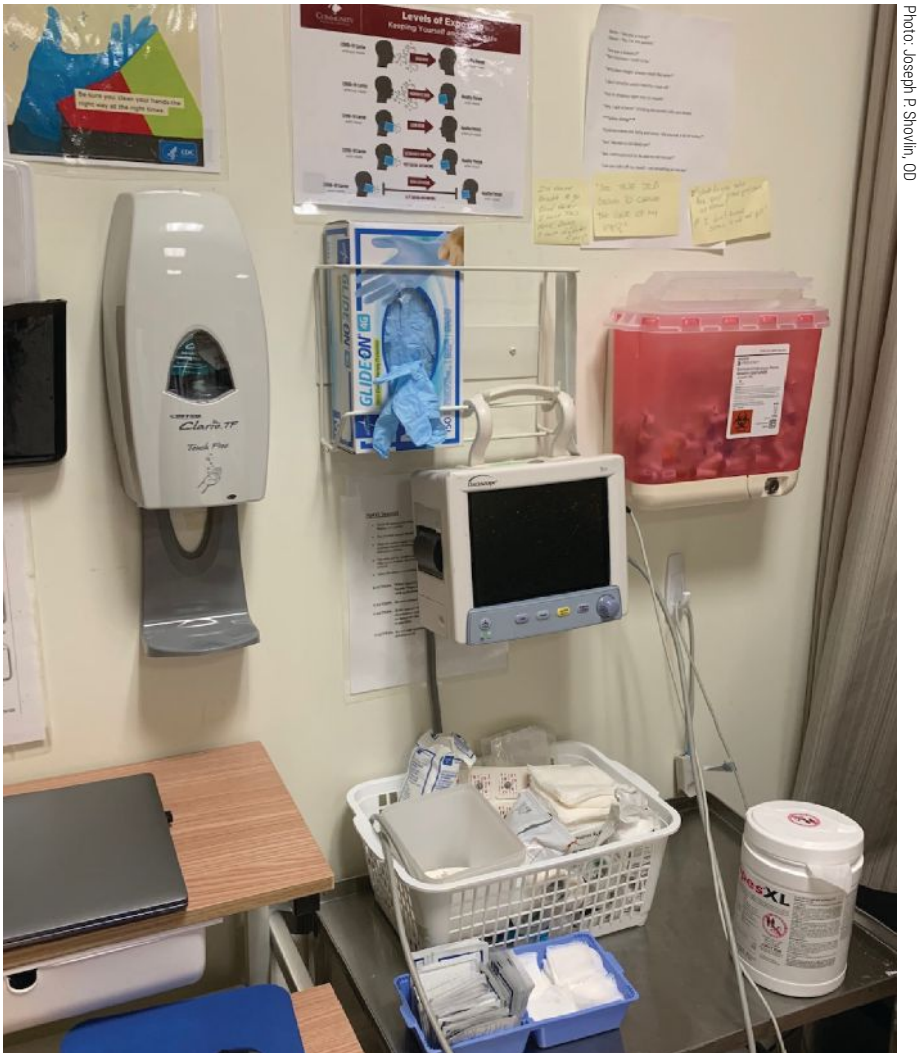

Photo: Joseph P. Shovlin, OD

A crash cart can store life-saving equipment in the event of a crisis.

"Having your staff ready for action is essential," he says. "It starts at the front desk, alerting the OD if a patient is ill when they arrive and monitoring any waiting room activity. When an emergency arises, task someone with making the initial 911 call and directing medical personnel to the location in the office when they arrive."

The size of the practice's staff will likely determine your exact plan of action. "Depending on staff size, you may be the only renderer of care," says Dr. Shovlin. "Your only staff member is calling 911. Act quickly and remember: the ABCs: 'airway, breathing and circulation.'"

"Staff response to these situations makes a great topic for periodic staff meetings," Dr. Marrelli adds. All staff should be prepared to recognize emergencies and react appropriately. Emergency situations can happen even when there is no doctor present, and they should at least be prepared to identify and activate EMS, she notes.

Role-playing various emergency situations can ensure both you and your staff are prepared and understand their role. Questions to ask include:

- Who's calling 911?
- Who starts CPR?
- Who continues if CPR is necessary for an extended period of time?
- Who can use the AED?
- Who, if anyone, is capable of providing medication and/or injections?

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Mock drills for different emergencies are essential, says Dr. Shovlin.

"Remember, it might be a staff member or even the OD who is experiencing an event, so is there a back-up plan in place for these scenarios?"

Teach the staff not to panic and to act professionally, says Dr. Rafieetary. "Often, people—even professionals—don't know how to behave in these types of extraordinary circumstances," he adds. "Making inappropriate nervous comments or immature acting can exacerbate an intense situation."

Protecting Your Patients and Practice

Preparation and a clear understanding of how to handle non-ocular emergencies not only protects your patients but also yourself and your practice. Dr. Shovlin advises ODs to carefully document any training with devices (*e.g.*, CPR, AED) and role play. It is also important to make sure that your certifications are up to date and valid. He also recommends creating a written emergency protocol that includes the skills and training of each current employee.

When a medical emergency occurs, thoroughly document the situation, which actions were taken and the outcome. While these emergency situations often fall under Good Samaritan laws to a certain extent (check your local regulations so you know the specifics for your area), ODs must understand the nuances of informed and implied consent and how to approach their patients, notes Dr. Buckingham.

For example, your patient has a vasovagal response. They briefly pass out and when they come to, they are often embarrassed. "A lot of times the patient may want to leave after this," says Dr. Buckingham. "However, it is your responsibility to make sure they are alert and oriented to person, place, time and event. If they are not, they are legally confused and if anything happened after they left your office the liability comes back to you as the medical provider."

Photo: Joseph P. Shovlin, OD

Emergency oxygen kits could help patients in need.

To determine if a patient can safely leave, Dr. Buckingham asks the following questions: What's your full name? Where are you? What month is it? What are you doing here? Then, clearly document this interaction and your findings. If the patient answers all of these questions correctly, they can leave, or finish the exam and then leave.

In cases where you believe a patient needs immediate medical care and yet they decline treatment, it is up to you to determine their competence. This is important to protect them as well as your practice.

For instance, when a diabetic patient with dangerously high sugar levels refused to go to the hospital, Dr. Buckingham outlined the urgency and then asked the four questions above before allowing the patient to leave against his medical advice. While patients have medical autonomy and can refuse treatment—barring any special circumstances—it is up to you to take the lead.

In emergency situations, it can be easy to let your flight-or-fight response take over, Dr. Buckingham acknowledges. "Stay with your patient and remember that you are their advocate. You're not there to magically fix a medical emergency that you're not trained for, but you can handle basic first aid while also providing comfort and support."

It is the optomerist's job to identify the situation and mitigate it until first responders get there. "Don't hesitate to call 911, even if you're not sure if it is necessary," Dr. Buckingham encourages. "Even if the patient doesn't want to go and ultimately refuses care, EMTs can evaluate the patient. There are no bills generated unless the patient is transported; when there are, those bills are sent to them, not the caller."

"Don't take anything lightly," adds Dr. Shovlin. "Know the signs and symptoms of cardiac arrest, stroke or any other life-threatening event. Things can worsen quickly, so don't hesitate and be decisive."

Remember that your role in an emergency situation is to always protect the patients from any further injury, says Dr. Shovlin. For instance, when seizures occur, removing any surrounding potential harm is important without making excessive moves.

"Overall, prepare for medical emergencies by having the right equipment and medications, educating staff with basic and advanced certifications and rehearsing protocols," he concludes. "Doing so significantly decreases any chance of experiencing an unfavorable outcome when an emergency arises." ■

1. Kruthoff C. 911 In the exam lane. Rev Optom. 2020;157(8):56-61.

2. Hypoglycemia (low blood glucose). American Diabetes Association. diabetes.org/healthy-living/medication-treatments/blood-glucose-testing-and-control/hypoglycemia. Accessed March 6, 2023.

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On December 6, 2022, FDA issued a final guidance, Homeopathic Drug Products, that describes the agency's approach to prioritizing regulatory actions for homeopathic products posing the greatest risk to patients. The FDA is prioritizing specific categories of drugs, such as those intended for populations at greater risk for adverse reactions. ***There are currently no FDA-approved products labeled as homeopathic, and the agency cannot ensure these drugs meet standards for safety, effectiveness, and quality.*** *Previously, the FDA warned the public about homeopathic products, including those containing a toxic substance and ones recalled due to contamination.*

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SHOULD YOU PRESCRIBE A GLAUCOMA DRUG FOR OCULAR HYPERTENSION?

Knowing when intervention is and isn't warranted is a key component of comprehensive care.

BY BRIAN D. FISHER, OD, ANNE MENJIVAR, OD, DANIELLE HOWARD, OD, MICHELLE NGUYEN, OD, AND ELYSE BANISTER, OD
NEW YORK CITY

Glaucoma is one of the leading causes of irreversible blindness in the United States—and worldwide. There are 80 million people globally with glaucoma, and this number is expected to increase to over 111 million by 2040.[1] In the United States, more than three million Americans are living with glaucoma, and 2.7 million aged 40 and older are affected by primary open-angle glaucoma (POAG).

Ocular hypertension (OHT) is another common condition clinicians can encounter and is considered a risk factor for conversion to POAG. While OHT's diagnosis can be forthright with intraocular pressures (IOPs) greater than 21mm Hg, normal optic discs and normal visual fields, management can become quite complex and variable depending on the experience level of the clinician.[2] These management challenges occur in OHT patients due to glaucoma's long latency phase, in which glaucomatous optic nerve damage has started, but the disease can remain undetectable on ancillary testing and the patient, asymptomatic.[3]

As optometrists, we should consider the following viewpoints to optimize our clinical decisions in treating our patients: (1) detecting early to prevent functional vision impairment and disability, (2) maintaining visual abilities for our patients to live independently and stay physically active, (3) reducing psychological stress and (4) negating the medication and medical costs.

The decision to treat depends on a variety of ocular, systemic, medical and psychosocial factors. Additional factors such as life expectancy, general health status and perceptions and/or expectations about treatment should also be considered.[3] There is less universal agreement about treating OHT in its earlier stages or suspects without clear structural or functional damage.[4]

The OHTS clinical trial—one of the largest (1,696 patients) and longest (20 years) studies to date—aimed to address this issue in phases I through III. Here, we will discuss all three and how the results of each can help guide our clinical decision-making in OHT.

OHTS-I

Each of the three OHTS phases has provided significant evidence about early treatment and observation of OHT, delayed treatment of OHT, incidence and severity of OHT, conversion to POAG and conversion prediction models.

OHTS-I randomized 1,636 OHT participants into a medication group

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and close observation group. Data collection started in 1994 and finished in June 2002. The clinicians in OHTS-I could use any topical OHT medication approved for use in the United States. Of note, topical beta-blockers were considered first-line topical treatment when the study began, and prostaglandin analogues were not introduced commercially until 1996. Twenty-five percent of the participants self-identified as African American.[5] The main goals of OHTS-I were to achieve an IOP of 24mm Hg or less and a minimum reduction of 20%. Others included identifying the safety and efficacy profiles of using topical OHT medication and predicting which patients would convert to POAG.

After 60 months, the cumulative frequency of developing POAG was 4.4% in the medication group and 9.5% in the observation group. These results indicated a positive therapeutic effect that was statistically significant for both optic disc and visual field protection. The absolute risk reduction of 5.1% indicated having to treat 20 OHT patients to prevent one from converting to glaucoma. No evidence of ocular- or systemic-associated risk was found. Notably, most of the early glaucomatous change was seen on optic disc photographs, while one-third of participants had their initial glaucomatous change represented on visual fields.[6]

Optic disc damage was classified as a change in the position of the vessels greater than would be expected from a shift in the position of the eye, development of a notch, development of an acquired pit and/or overall thinning of the rim. Though disc hemorrhages, localized RNFL dropout or changes in the depth of the cup were not considered evidence of optic disc change in OHT, they should still be considered as risk factors for glaucoma in all patients. Visual fields were considered abnormal if the pattern standard deviation (PSD) was p <5% or if the glaucoma hemifield test (GHT) was outside normal limits.

OHTS-I also successfully identified the clinical risk factors that could predict conversion from OHT to POAG, which have been widely accepted as a predictive model in separating patients into high- and low-risk categories. Older age, higher baseline untreated IOP, greater PSD, thinner central corneal thickness (CCT) and larger vertical cup-to-disc ratio (VCDR) were identified as significant predictors of the development of POAG.

Several of these risk factors were further broken down into the following categories:

- IOP: ≤23.75mm Hg, >23.75≤25.75mm Hg and >25.75mm Hg.
- CCT: ≤555µm, >555µm≤588µm and >588µm.
- VCDR: ≤0.3, >0.3≤0.5 and >0.5.

A thin CCT (≤555µm) was associated with a threefold increase in POAG as compared with participants with a thick CCT (>588µm), and this was found to hold true regardless of which category the baseline IOP and VCDR fell under.[7] There was a linear relationship between CCT and conversion to POAG, and CCT was shown to be a strong predictor of POAG. A greater PSD was noted to be predictive of POAG and was calculated by averaging PSD from multiple Humphrey 30-2 visual field tests. These factors were confirmed in several other studies.[8,9]

African Americans enrolled in the study were also at higher risk of conversion to POAG, but race was dropped from the OHTS-I predictive model. Once multivariate analysis was used to adjust for thin CCT and large VCDR, race no longer showed any statistical significance.[10]

Should You Prescribe a Glaucoma Drug For Ocular Hypertension?

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

JOINTLY ACCREDITED PROVIDER™ INTERPROFESSIONAL CONTINUING EDUCATION

Release Date: April 15, 2023

Expiration Date: April 15, 2026

Estimated Time to Complete Activity: two hours

Target Audience: This activity is intended for optometrists engaged in ocular hypertension management.

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

- Determine when to prescribe a glaucoma drug for ocular hypertension.
- Evaluate an ocular hypertension patient's overall risk profile.
- Educate patients on their individual risks and needs.
- Manage patients with ocular hypertension.

Faculty: Brian D. Fisher, OD, Anne Menjivar, OD, Danielle Howard, OD, Michelle Nguyen, OD, and Elyse Banister, OD

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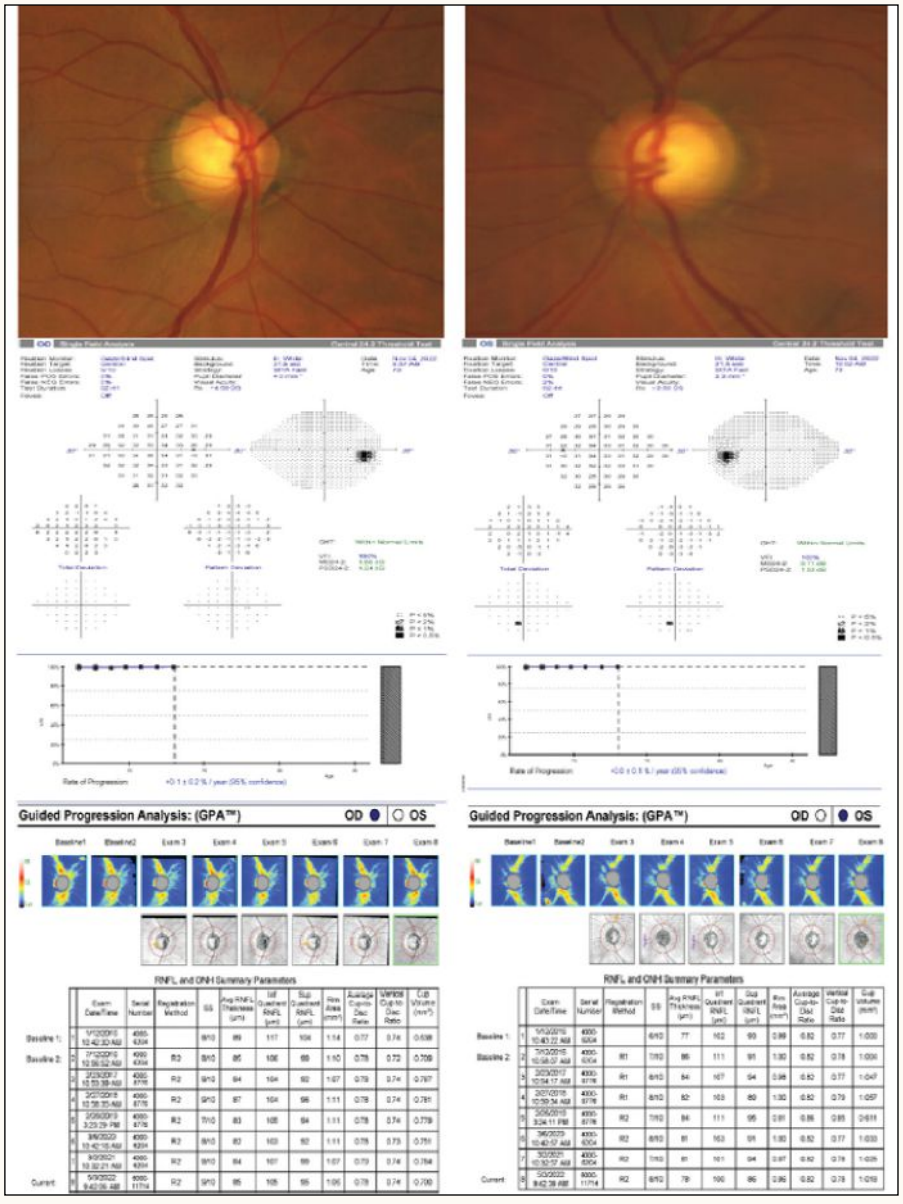


A 71-year-old Hispanic male with OHT, obstructive sleep apnea and a strong family history of glaucoma. His untreated IOP max was 26mm Hg in both eyes, pachymetry measured 576µm OD and 577µm OS, VCDR was 0.70 OD and 0.75 OS and PSD was 1.24 OD and 1.53 OS. Toward the end of the two years of observation, his untreated IOPs started to slowly rise. He was started on prostaglandin analogue treatment after year two due to moderate risk factors including rising untreated IOPs, VCDR, race, obstructive sleep apnea, positive family history, general health status and anticipated life expectancy. Early intervention in this case was effective in preserving structure and function as shown in the visual field and RNFL progression analyses.

OHTS-II

Results from OHTS-I showed early treatment was successful in decreasing the incidence of and conversion to POAG without adverse ocular or systemic effects. OHTS-II aimed to identify when treatment should be initiated.

There are several approaches and factors a clinician can face when determining the best course of treatment. These include: (1) treat every patient with elevated IOP, (2) defer treatment until there is detectable optic disc or visual field damage or (3) selectively treat patients identified as moderate to higher risk for conversion to POAG. Treating every patient in public health with OHT can be costly in both medications and office visits. The patient's quality of life can be affected due to medication burden and pressure to be compliant.

Though serious adverse reactions are atypical for prostaglandin analogues and other topical ocular hypotensive drug classes approved for use in the United States, we should remain aware of the systemic side effects of topical beta-blockers. Contraindications include patients with a history of asthma or a chronic obstructive pulmonary disease, bradycardia, heart block or uncontrolled heart failure. Side effects from the other topical medication classes include, but are not limited to, ocular surface disease, hyperemia, cosmetic and pigmentary changes from prostaglandin analogues and sulfa allergy from carbonic anhydrase inhibitors. The potential benefit of treatment resulting in a low POAG conversion rate should outweigh the alternatives, consequences and risks of no treatment.

In opposition, one can choose to delay treatment and wait for optic disc and/or visual field damage, but this could lead to accelerated retinal nerve fiber degeneration that is less responsive to treatment. This approach could cause visual impairment and result in a major public health issue if universally adopted. The best approach to treatment should address our viewpoints discussed earlier and, most importantly, ensure the prevention of functional vision impairment and disability and maintain our patients' visual abilities.[11]

OHTS-II aimed to identify if the cumulative incidence of POAG was greater in the delayed treatment group and to determine if the subsequent course of treatment after diagnosis was worse in this group. The same participants in the treatment and observation groups from OHTS-I were followed for an additional 7.5 years. The treatment group participants remained on treatment for an additional 5.5 years, and the observation group from OHTS-I

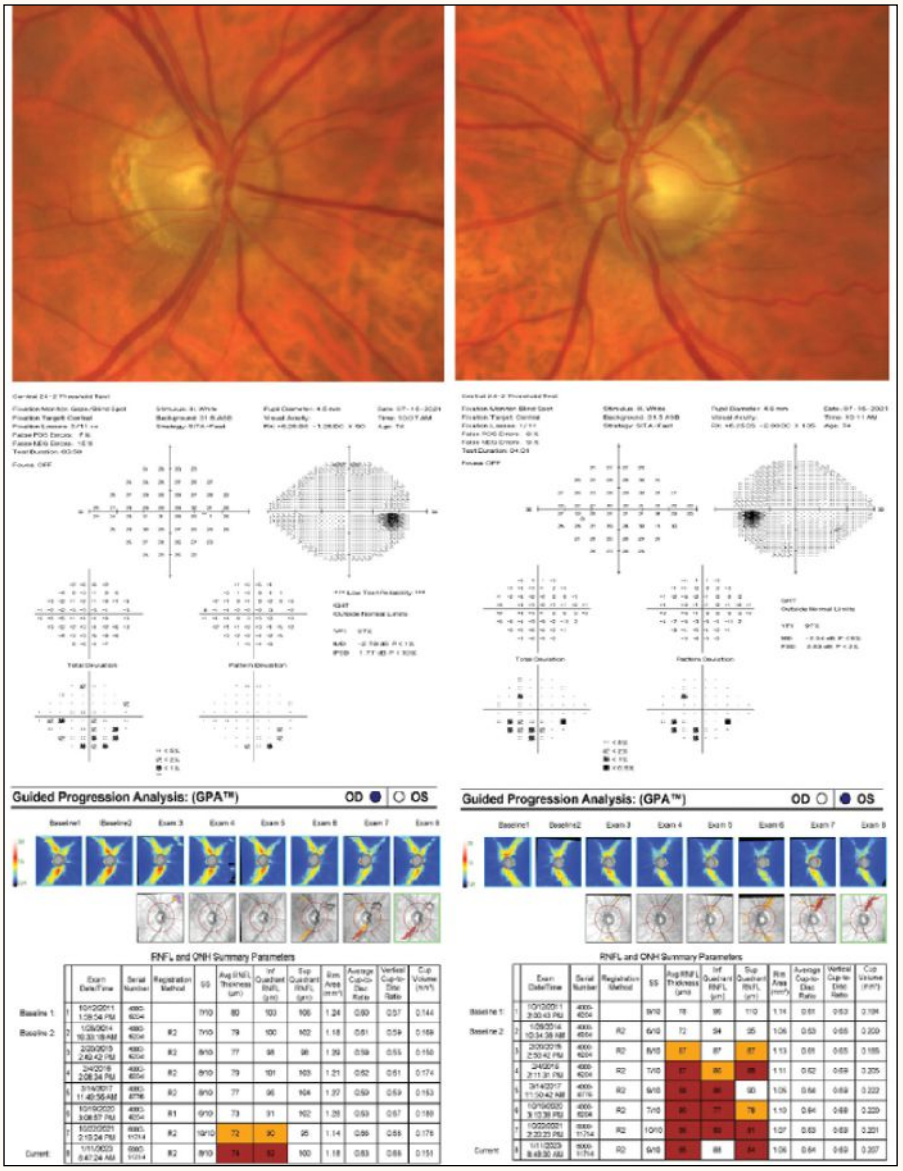
received topical OHT treatment for 5.5 years. This essentially created a treatment group (13 years) and a delayed treatment group (7.5 of observation and 5.5 years of treatment). Tests, measures and procedures remained consistent in both phases of the study.

Results from OHTS-II showed the median time to develop POAG was six years in the delayed treatment group and 8.7 years in the medication group, demonstrating a positive protective effect of early treatment.[12] After the study, participants were divided into equal distributed groups of high, medium and low risk using the predicative model from OHTS-I.

In determining the management effect of delayed treatment, the clinical course after diagnosis of POAG should be evaluated in both treatment groups. The data from these phases showed modest consequences for delaying treatment in OHT participants. Consequences were less tolerable in the high-risk group compared with the low-risk group, and we can conclude high-risk individuals benefit from earlier treatment and more frequent follow-up examinations.

The disease burden was also greater for the participants in the delayed treatment group compared with the early treatment group. Those in the delayed treatment group had both glaucomatous optic disc and visual field loss and had more glaucomatous structural and functional damage. The mean PSD slope of eyes that progressed to POAG was steeper in comparison to the early treatment group.

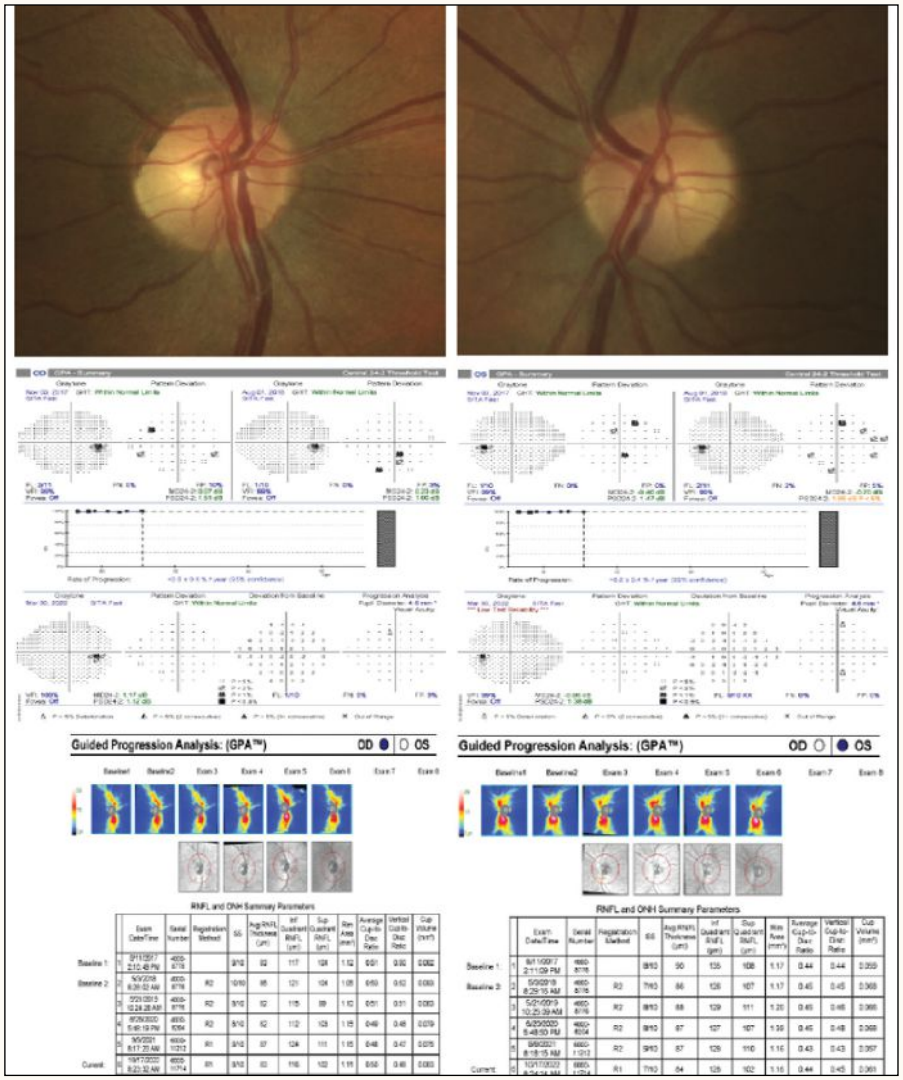
Treatment and management decisions should weigh the following factors: patient's age at diagnosis, general health status, life expectancy and personal preference to treatment. For example, patients of older age with slowly progressing glaucoma likely require less intense treatment or sometimes no additional treatment at all. In comparison, young glaucoma patients with fast progressing disease require quick action, an aggressive approach and possibly surgery depending on the circumstances.[13]



A 75-year-old white, non-Hispanic male presented with an initial history of OHT, but years of non-compliant follow-up and medication use resulted in accelerated loss of the RNFL and ultimate conversion to POAG. His untreated IOP max was 28mm Hg in both eyes, pachymetry measured 527µm OD and 529µm OS, VCDR was 0.60 OD and 0.70 OS and PSD was 1.77 OD and 2.53 OS. His visual fields were variable in both eyes. His RNFL showed accelerated and repeatable loss OS>OD. His deviation maps showed a widening wedge defect strongly correlated with glaucomatous RNFL loss. Based on these high-risk factors, medication and selective laser trabeculoplasty (SLT) were recommended at the time of diagnosis. The patient declined and experienced both structural and functional damage. Luckily, over the last three years with SLT and compliant topical prostaglandin analog use, his treated IOPs were lowered by 50%. This ultimately preserved his visual function without sustainable severe glaucomatous defects. Due to his general health status and anticipated life expectancy, he remains at risk for further visual damage if compliance and medication burden remain an issue.

OHTS-III

The final phase of the study is the 20-year observational follow-up to OHTS phases I and II.[14] The OHTS Study Group has done an impressive job following a large sample of people over 20 years, collecting a wealth of information along the way to help guide clinicians



A 53-year-old white, non-Hispanic healthy male with OHT. His untreated IOP max was 27mm Hg OD and 28mm Hg OS, pachymetry measured 636µm OD and 640µm OS, VCDR was 0.35 OD and 0.40 OS and PSD was 1.12 OD and 1.38 OS. Based on these risk factors, no treatment was elected due to patient preference. His visual field and RNFL progression analyses have been stable for five years. We remain conservative with this patient due to his general health status and young age but still do not recommend treatment. He had no family history of glaucoma, no vessel barring or bayonetting, no notches or acquired pitting, no thinning of the rim, no disc hemorrhages, no localized RNFL dropout and changes in the depth of the cup.

in their decision-making for the treatment of OHT.

An extensive effort was made by the OHTS Study Group to follow-up with as many subjects as possible, resulting in long-term data for 971 (59.4%) of the original 1,636 participants in OHTS-I.[15] Data on these subjects was collected from January 2016 to April 2019, or within two years of death, resulting in a median follow-up of 20.2 years. As of 2009 at the conclusion of OHTS-II, study participants were not treated under specific testing protocols. Treatment was left instead to the discretion of each subject's eyecare provider. Of the OHTS-III subjects, 696 (72%) remained on OHT medications, and 296 subjects (30.5%) underwent some form of glaucoma surgery.

OHTS-III aimed to investigate the following objectives:

1. Determine the 20-year incidence and severity of POAG.
2. Determine the frequency and timeframe of POAG progression.
3. Develop a 20-year prediction model for stratifying OHT patients by their risk for developing POAG. The risks considered include both the original predictive factors from OHTS-I as well as newly identified risk factors.
4. Develop a prediction model for glaucomatous visual field loss rates.
5. Determine the frequency and severity of self-reported functional limitations associated with POAG.

Assessment of visual function over 20 years was done through OHTS examination, interim clinical data or medical records within two years of death. Classification of POAG in OHTS-III used the same methodology as the first two OHTS phases. Use of OCT was not part of the original two phases, but OCT measurements of the retinal nerve fiber layer (RNFL) and macula were obtained during data collection for OHTS-III. However, in maintaining consistency with the first two phases, OCT was not used in POAG diagnosis.

Of the original 1,636 subjects, 483 (29.5%) developed POAG in one or both eyes after 20 years. Upon further analysis, 199 participants (12.2%) had only optic disc deterioration in one or both eyes, 70 (4.3%) had visual field loss without disc deterioration in one or both eyes, 204 (12.5%) had both visual field loss and disc deterioration and 10 (0.6%) had visual field loss in one eye and disc deterioration in the fellow eye.

Throughout the 20-year course of the OHTS study, 665 (40.6%) participants were lost to follow-up or declined to participate in phase III. Another 515 participants (31.5%) died, naturally reducing their risk of developing glaucoma to zero. To account for this statistically, the conversion rate to POAG was also calculated with an adjustment for person-years of exposure time (totaling 21,864 person-years). This resulted in a 45.6% incidence of glaucoma at 20 years for all participants, or a 49.3% incidence for participants in the original observation group and a 41.9% incidence for participants in the original medication group.

When broken down by race, African American participants were statistically more likely to develop glaucoma at 55.2% compared with participants of other races at 42.7%; however, African American participants were also more likely to have a thin CCT and a larger VCDR. As mentioned previously, race was not statistically significant in OHTS-I after adjusting for thin CCT and large VCDR.[10]

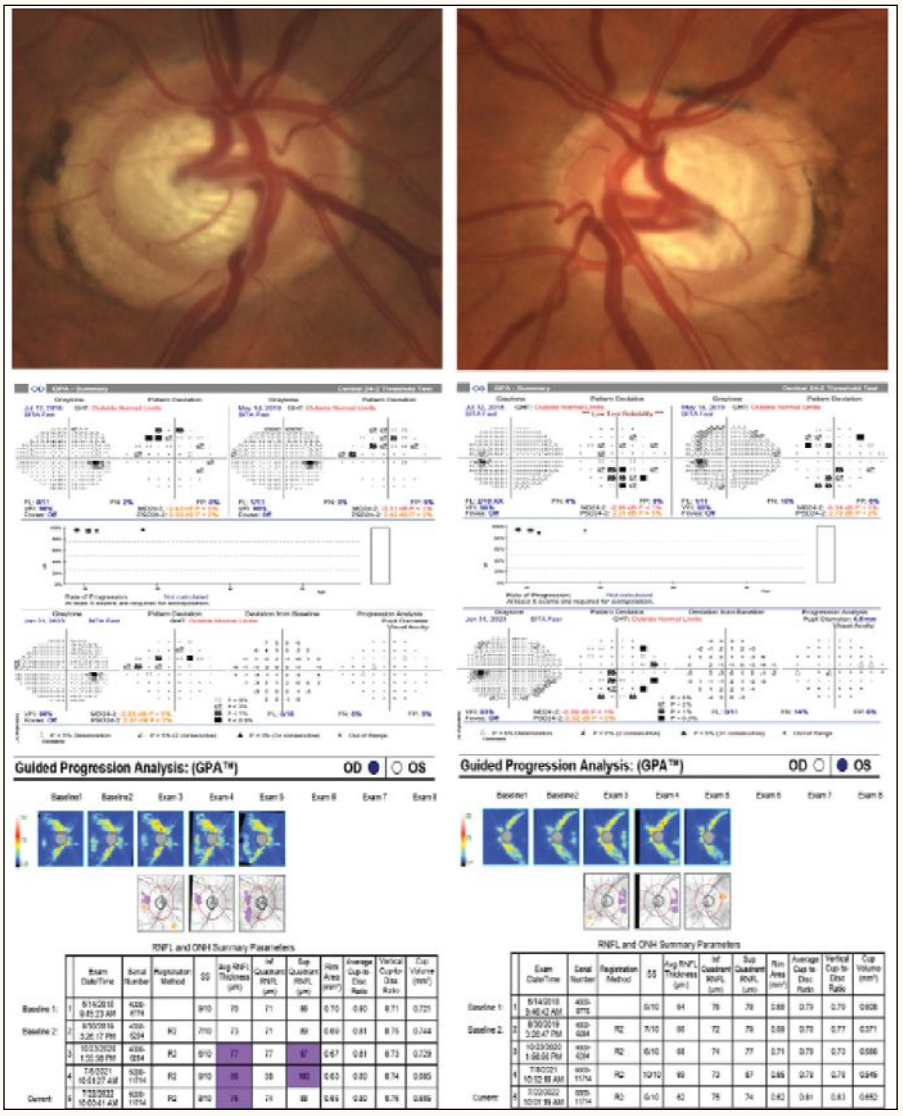
Of considerable usefulness in OHTS-III is the cumulative incidence of POAG when adjusted for person-years of exposure time as divided into low-, medium- and high-risk groups. Subjects in the low-risk tertile had a 1.3% incidence of POAG at five years and a 31.7% incidence at 20 years. The medium-risk tertile had a 4.3% incidence of POAG at five years and a 47.6% incidence at 20 years, and the high-risk tertile had an 11.9% incidence of POAG at five years and a 59.8% incidence at 20 years. The 20-year cumulative incidence of visual field loss was found to be 25.2%.

Treatment of OHT Patients

When you look at a 45.6% overall adjusted incidence of glaucoma at 20 years and the results from OHTS-I showing early topical medical therapy can reduce the risk of glaucoma by almost 60%, it seems straightforward to think all patients with OHT would benefit from treatment. OHTS phases I through III work together to demonstrate that while treatment is in fact effective at delaying or preventing POAG onset, medication is not something that is immediately necessary for all patients with OHT. This provides the clinician with evidence-based support on clinical decision-making. Low-risk patients can be followed less conservatively, with longer intervals of follow-up and delayed treatment, while medium- to high-risk patients should be followed at shorter intervals and started on treatment earlier.

While data from OHTS is very useful in everyday practice, it is also important to understand its limitations. The aforementioned risk predictions and incidences of glaucoma should only be applied to patients who meet similar characteristics of the OHTS cohort. For example, this data applies to generally healthy patients with IOP between 24mm Hg and 32mm Hg but not necessarily to patients suspected of normal-tension glaucoma, previous intraocular surgery, a life-threatening or debilitating disease, secondary causes of elevated IOP, angle-closure glaucoma or anatomically narrow angles, diabetic retinopathy and/or congenital or acquired optic disc abnormalities that can produce visual field loss.

The overall 20-year incidence of glaucoma may be higher in the OHTS cohort than in the general population for several reasons. The study intentionally over-represented African



A 51-year-old white, non-Hispanic male with OHT, type 2 diabetes and a positive family history of blindness related to glaucoma. His untreated IOP max was 32mm Hg in both eyes, pachymetry measured 580µm OD and 582µm OS, VCDR was 0.80 OD and 0.85 OS and PSD was 2.37 OD and 2.52 OS. The extent of visual field and structural damage presumably occurred prior to establishing care at our clinic. He was immediately started on prostaglandin analog treatment and underwent cataract surgery due to a diabetic cataract. He had endoscopic cyclophotocoagulation and an iStent placed in both eyes. His post-surgical and medicated IOPs were lowered by 50%. His visual field and RNFL progression analyses have remained stable for the past five years. Early and aggressive intervention in this case was effective in preserving structure and function.

Americans at 25%, which may have biased the calculated higher incidence of glaucoma as compared with other races. Additionally, goals of IOP reduction of 20% or less than 24mm Hg were set in OHTS-I, and this may not have been adequate for all subjects.

Conversely, one could argue that the incidence of glaucoma may have been under-represented in the OHTS trial due to advances in diagnostic testing. OCT is now used to determine optic disc deterioration in combination with disc photos, rather than disc photos alone. This allows for earlier detection and diagnosis of glaucoma and could mean OHTS trial patients who were considered to have OHT based on enrollment criteria likely would have had detectable early POAG if OCT methods had been available at the origination of OHTS-I.

It has been shown that RNFL loss occurs before visual field defects, so it is surprising that OHTS-III found that 4.3% of subjects developed visual field defects without optic disc damage.[16] It is possible that optic disc photos were not as sensitive in detecting early structural damage. This evidence illustrates the importance of using a combination of OCT, photos and visual fields to maximize sensitivity in detecting both structural and functional damage.

Even though the OHTS data has limitations, it can still serve as an excellent general guide when deciding whether to treat OHT. In a patient newly diagnosed with OHT, consider if they would fall under the low-, medium- or high-risk tertile based on the five baseline risks detailed earlier. While treatment in OHTS showed a 60% reduced risk of developing glaucoma, it is important to consider that the overall conversion rate to POAG (<10%) was still relatively low at five years, and this percentage would be even lower for someone categorized as low risk. There is an obvious burden to treatment in terms of cost, inconvenience and side effects. If a patient is considered lower risk, knowing that their risk of developing POAG in five years is approximately 1.3%, it would be reasonable just to observe without treatment and extend follow-up visits out longer than you would for someone in a higher risk category. This is also supported by data from OHTS-II which demonstrated that when comparing early treatment and delayed treatment groups, there was little difference in the cumulative number of patients who developed glaucoma.[17]

The clinical implications to initiate glaucoma treatment should incorporate an evidence-based approach from the results of these studies and include an assessment of the risk profile for each patient. The decision should consider the risks for functional vision impairment and decreased vision-related quality of life, ocular and systemic comorbidities, life expectancy, general health status and patient reservation about treatment.[18] Considering that by year 20 of the OHTS trial there was an overall adjusted incidence of POAG at 45.6% and only 25.2% had visual field loss, we can conclude that initiation of treatment should be reserved for medium- to high-risk patients. This study offers reassurance that it is reasonable to monitor without treatment in the earlier years of OHT diagnosis. Treatment is indicated when the risks of progressive disease outweigh the risks and potential side effects of therapy.

Another major consideration is the rate of progressive disease. The rate of decline in progressing OHT and POAG patients can be highly variable.[4,19,20] Some may progress slowly over the course of many years and decades, whereas others with aggressive disease may progress rapidly and eventually suffer from blindness or substantial impairment unless immediate interventions occur. Thus, evaluation in rates of change is a critical and fundamental factor in management of OHT and POAG, and treatment is generally indicated when such loss has been determined to be at a progressive, measurable rate. Optic disc changes and/or localized RNFL defects can predict functional loss in glaucoma. Those with detected structural loss and progressive damage should generally be treated.

Other specific risk factors to consider include baseline untreated IOPs, age, family history, worse disease severity at the time of diagnosis, optic disc hemorrhages, thinner corneas and pseudoexfoliation. Though OHTS phases I through III have shown progress in the identification of risk factors, more needs to be done to refine risk progression models. All these factors can affect the risk of progression and therefore help us pinpoint the expected prognosis of the patient's untreated disease. Frequency of follow-up and aggressiveness of therapy can then be decided.[4]

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OPTOMETRIC STUDY CENTER QUIZ

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1. How many people worldwide have a diagnosis of glaucoma, and how many are anticipated to have glaucoma by the year 2040?
a. 70 million and 100 million.
b. 80 million and 111 million.
c. 75 million and 120 million.
d. 85 million and 111 million.

2. Which is not a high risk factor for conversion to POAG classified by OHTS-I?
a. Large horizontal cup-to-disc ratio.
b. Older age.
c. Higher visual field PSD.
d. Higher baseline IOP.

3. The OHTS phases used which ancillary tests to detect structural and functional damage in participants?
a. Fundus photos and Humphrey 30-2 visual fields.
b. Fundus photos, OCT and Humphrey 30-2 visual fields.
c. OCT and Humphrey 30-2 visual fields.
d. OCT and gross visual fields by finger counting.

4. In OHTS-I, which treatment was used?
a. Prostaglandin analogues.
b. Beta-blockers.
c. Any commercially available topical ocular hypotensive medication.
d. Carbonic anhydrase inhibitors.

5. After 60 months of OHTS-I, the cumulative frequency of developing POAG was which in the medication group?
a. 2.5%.
b. 4.4%.
c. 5.5%.
d. 9.5%.

6. After 60 months of OHTS-I, the cumulative frequency of developing POAG was which in the observation group?
a. 2.5%.
b. 4.4%.
c. 5.5%.
d. 9.5%.

7. After 60 months of OHTS-I, which demographic was shown to be at highest risk for conversion to POAG?
a. African Americans.
b. Asian Americans.
c. White, non-Hispanic Americans.
d. None of the above after multivariate analysis to adjust for thin CCT and large VCDR.

8. OHTS-II had participants in medication and delayed treatment groups for how long?
a. 12 years, six years.
b. 13 years, 5.5 years.
c. 12.5 years, 5.5 years.
d. 13 years, six years.

9. Results from OHTS-II showed the median time to develop POAG in the delayed treatment and medication groups was how long?
a. Six years, 8.7 years.
b. Five years, 8.5 years.
c. Six years, eight years.
d. Six years, 8.3 years.

10. At the conclusion of OHTS-II, participants were divided into three equally distributed groups based on which?
a. Risk (high, medium, low) using the predictive model from OHTS-I.
b. Baseline IOP from OHTS-I inclusion criteria.
c. Visual field PSD values.
d. CCT (thick, normal, thin).

11. The aim of OHTS-III was to investigate all the following objectives except?
a. Determine the 20-year incidence and severity of POAG in the OHTS cohort.
b. Determine the frequency and timeframe of POAG progression in the OHTS cohort.
c. Develop a 20-year prediction model for stratifying OHT patients by their risk for developing POAG.
d. Develop a prediction model for the rate of OCT RNFL loss.

12. What was the 20-year adjusted incidence of POAG in the OHTS participants?
a. 40%.
b. 45.6%.
c. 50%.
d. 60%.

13. OCT was not used in the diagnosis of glaucoma in the OHTS trial, but at which phase(s) were OCT measurements recorded?
a. Phase I only.
b. Phases I and III.
c. Phase III.
d. Phases II and III.

14. The decision to treat OHT patients should consider which factor(s)?
a. Risk for developing functional vision impairment.
b. Ocular and systemic comorbities.
c. Life expectancy and general health status.
d. All the above.

15. Topical beta-blockers have all the following systemic contraindications except?
a. Bradycardia.
b. Migraines.
c. Asthma.
d. Heart block.

16. Which viewpoints should't be considered in the treatment of OHT and POAG?
a. Ability of our patients to live independently and stay physically active.
b. Psychological stress of treatment.
c. Medication and medical cost.
d. All the above should be considered.

17. In OHTS-II, outcome measures of delaying treatment were which in the original observation group, with participants showing what vs. the early treatment group?
a. Inferior; more structural and functional damage.
b. Inferior; less structural and functional damage.
c. Superior; less structural and functional damage.
d. Superior; more structural and functional damage.

18. Under which conditions is it most appropriate to apply the results from OHTS-III to our own OHT patient base?
a. Previous intraocular surgery in at least one eye.
b. IOP greater than or equal to 24mm Hg but less than or equal to 32mm Hg in at least one eye.
c. Presence of optic disc hypoplasia in at least one eye.
d. Severe nonproliferative diabetic retinopathy.

19. Optic disc structural damage was classified in the OHTS clinical trial as which?
a. Presence of a drance hemorrhage.
b. Development of a notch.
c. Localized RNFL dropout.
d. All the above.

20. What criteria was used in classifying functional visual field damage in the OHTS clinical trial?
a. p <5% for the PSD or if the GHT is within normal limits.
b. p <5% for the PSD or if the visual field index is 60%.
c. p <5% for the PSD or if the visual field index is 70%.
d. p <5% for the PSD or if the GHT is outside normal limits.

Examination Answer Sheet

Should You Prescribe a Glaucoma Drug For Ocular Hypertension?

Valid for credit through April 15, 2026

Online: This exam can be taken online at revieweducationgroup.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.

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

Credit: This course is COPE-approved for two hours of CE credit. Course ID 83915-GL.

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

Jointly provided by PIM and the Review Education Group.

Answers to CE exam:

1. Ⓐ Ⓑ Ⓒ Ⓓ
2. Ⓐ Ⓑ Ⓒ Ⓓ
3. Ⓐ Ⓑ Ⓒ Ⓓ
4. Ⓐ Ⓑ Ⓒ Ⓓ
5. Ⓐ Ⓑ Ⓒ Ⓓ
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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. Determine when to prescribe a glaucoma drug for ocular hypertension. ① ② ③ ④ ⑤
22. Evaluate an ocular hypertension patient's overall risk profile. ① ② ③ ④ ⑤
23. Educate patients on their individual risks and needs. ① ② ③ ④ ⑤
24. Manage patients with ocular hypertension. ① ② ③ ④ ⑤

25. 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.

26. 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): ☐

27. 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 diagnostic methods
Ⓒ Choice of management approach
Ⓓ Change in current practice for referral
Ⓔ Change in vision correction offerings
Ⓕ Change in differential diagnosis
Ⓖ More active monitoring and counseling
Ⓗ Other, please specify: _____

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

Ⓐ Very confident Ⓑ Somewhat confident Ⓒ Unsure Ⓓ Not confident

29. 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: _____

30. 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 # - -
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OE Tracker Number

Rate the quality of the material provided:

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

31. The content was evidence-based. ① ② ③ ④ ⑤
32. The content was balanced and free of bias. ① ② ③ ④ ⑤
33. 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 123773 RO-OSC-0423

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What's Bugging You?

This easy method for microbial identification can assist management.

BY JESSICA STEEN, OD, AND JOSEPH SOWKA, OD
FORT LAUDERDALE, FL; SARASOTA, FL

A 49-year-old woman presented with a red, mildly painful left eye. She wore daily contact lenses, and her acuity was 20/20 OU. She manifested a small area of corneal infiltration, with overlying epithelial excavation and a mild anterior chamber reaction. The infiltrative lesion was well away from her visual axis. She was diagnosed clinically with a presumptive bacterial keratitis and empirically treated with moxifloxacin every two hours while awake. Over the next 10 days, she slowly healed, and the medication was discontinued.

Three weeks later, she came back with similar symptoms. At this time, her left eye had an area of infiltration and overlying excavation in a different area on her cornea. The original lesion had left a faint stromal scar; thus, this was a new infectious event. To aid in the diagnosis, polymerase chain reaction (PCR) testing, or molecular diagnostic testing, was performed. This test rapidly searches for microbial DNA and doesn't involve culturing for growth.

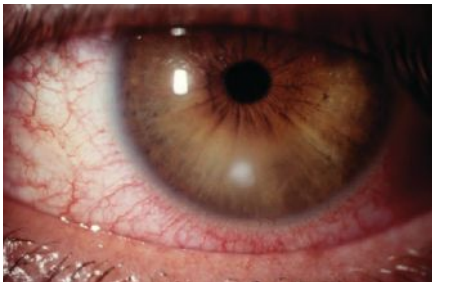
Molecular diagnostics have changed the way we think about diagnosis of infectious disease. Aiding in diagnosis and therapeutic selection in bacterial keratitis management, it has made its way into clinical practice due to improved accessibility of commercially available test kits.

Infectious keratitis encompasses microbial causes (bacterial, fungal or parasitic) and viral keratitis.[1] Of all microbial keratitis cases, 90% are bacterial in nature.[1] While most cases of bacterial keratitis are diagnosed and successfully treated empirically with commercial broad-spectrum topical ophthalmic antibiotics, corneal culture is recommended for corneal infiltrates that are: (1) greater than 2mm, centrally located and/or associated with significant stromal involvement; (2) unresponsive to broad spectrum antibiotic treatment; (3) present in a patient with a history of corneal surgery; (4) atypical in clinical appearance; or (5) present with multiple infiltrates.[2,3]

Corneal culture and a corneal smear have long been considered the gold standard in identifying pathogenic organisms in bacterial keratitis and form the basis for antimicrobial sensitivity testing. However, its associated practical challenges mean that access is primarily limited to academic subspecialty settings.[4]

The Basics

PCR technology used in molecular diagnostic testing requires a DNA template that contains the known target sequence, the sample DNA, heat-stable DNA polymerase, which synthesizes complementary DNA to the target sequence, and a primer sequence made of synthetic DNA fragments that bounds the sequence of interest.[5] During repetitive cycling of temperature in the system, the primer binds to a specific sequence in the sample each cycle, DNA is amplified and the newly produced strand of DNA is dissociated from the primer sequence. PCR allows for up to billions of copies of DNA to be produced from a single molecule of DNA rapidly.[5] Detection of bacterial 16S ribosomal DNA and fungal 18S ribosomal DNA in ocular samples are excellent broad-range targets for pathogen detection due to their commonality across bacterial and fungal species, respectively.[5,6]



Bacterial keratitis in another patient. Molecular diagnostic testing has illuminated that most of these clinically suspicious lesions are in fact infectious.

The Ins and Outs

Only approximately half of corneal cultures in clinically diagnosed infectious keratitis cases detect potential pathogenic growth.[7] While false negatives occur in molecular testing as well, there may be improved detection of bacterial presence. Also, unexpected or atypical organisms may be more likely to be detected through molecular testing due to difficulties of certain organisms of *in vitro* growth.[3,4,7]

More than one causative organism may be responsible for pathogenesis in infectious keratitis. In an analysis of positive cultures among infectious keratitis patients, 43% of positive cultures yielded at least two bacterial species, and while broad-spectrum antibiotics may be effective against many common corneal pathogens, identifying all

About Dr. Steen

Dr. Steen is an assistant professor at Nova Southeastern University College of Optometry where she serves as director of the Glaucoma Service, coordinator of the Primary Care with Emphasis in Ocular Disease Residency and teaches courses in glaucoma and ocular pharmacology. Her financial disclosures include Bausch + Lomb, Santen, Ocuphire and Carl Zeiss Meditec.

causative bacteria and determining individual susceptibility patterns can best inform and individualize treatment.[2,8] Isolating bacteria of different genera and species by culture from a single sample requires plating on specific agar media suited to the bacteria's nutritional and environmental needs, which is a cumbersome task.[2] Molecular testing of biologic samples can identify a variety of causative organisms from a single sample, without plating or incubation requirements, increasing the likelihood of detection of all present organisms.

The potential downside to detecting and amplifying trace amounts of microbial DNA is that naturally occurring, non-pathogenic conjunctival and eyelid flora found in low numbers may be inadvertently included in the sample along with the pathogenic organism of the infectious condition, leading to potential false positives.[4,9,10] In a sample where multiple organisms have been identified, determining which organisms are most likely to represent the pathogenic bacteria presents yet another clinical diagnostic challenge.[4,9,10] In a molecular diagnostic report where multiple microbes have been detected, those with the greatest number of detectable copies are more likely to be the cause of the underlying pathology.

While sensitivity and specificity of molecular testing and corneal culture cannot be described or directly compared due to lack of an error-free reference standard, it is possible to compare pathogen detection from the same sample by each method.[3] Of 272 eyes of individuals with clinically diagnosed infectious keratitis in a study, the diagnostic efficacy measured by area under the curve (AUC) was similar between culture and detection of bacterial DNA at 0.65 and 0.67, respectively.[6] The ability to detect a bacterial pathogen was improved when both were performed on a sample, with the AUC increasing to 0.72, demonstrating the adjunctive effect improving diagnostic accuracy.[6]

Despite the practical challenges associated with corneal culture and the convenience of commercially available molecular test kits for ophthalmic indications, molecular testing should not be considered a replacement for corneal culture when indicated by current clinical practice guidelines but as adjunctive analysis instead.[2,3,11] With a laboratory turnaround time of approximately 24 hours, the results of molecular testing, including pathogen detection and susceptibility findings, should be used to alter therapy if needed or to determine if current therapy is sufficient.[3]

> **Diagnostic testing platforms that are accessible, precise and affordable can provide the basis for formulating individualized treatment.**

In the case presented, two days after corneal scraping for molecular testing, the patient's results were returned. Her lesion revealed three isolates: the anaerobic bacteria *Pepostreptococcus anaeorbius* (moderate load at 320,000 copies/mL) and *Cutibacterium acnes* (moderate load at 170,000 copies/mL), as well as coagulase-negative *Staphylococcus epidermidis* (moderate load at 600,000 copies/mL). Included susceptibility testing identified *Pepostreptococcus* and *Staphylococcus*, which were both readily susceptible to the prescribed topical moxifloxacin, but *Cutibacterium* was only variably sensitive to that agent.

According to the report, *Cutibacterium* was very sensitive to oral doxycycline, and this was added at 100mg twice daily by mouth to her topical regimen. With this addition to topical ophthalmic moxifloxacin, her infiltrate resolved rapidly and completely. The organism resistant to moxifloxacin was likely the reason the patient previously healed comparatively slowly and rebounded shortly after initial treatment.

Takeaways

There are several lessons learned from molecular diagnostic testing evaluation. First, the majority of these suspicious infiltrates that are typically diagnosed and effectively managed empirically may actually represent true microbial infection. Second, there are often multiple microbes responsible for pathogenesis, with differing resistance profiles to commonly-used, broad-spectrum topical antibiotics. Finally, when treating presumed bacterial keratitis empirically, choosing more than one topical ophthalmic agent, each with variation in known susceptibility patterns for common ocular isolates, can increase the likelihood of optimal coverage in cases of polymicrobial infection.

As we shift toward true personalized care, the incorporation of diagnostic testing platforms that are accessible, precise and affordable in an acute care community environment can aid our diagnostic abilities and provide the basis for formulating a truly individualized treatment plan for individuals with corneal infectious disease. ■

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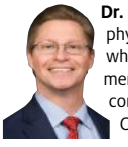
ABOUT THE CO-AUTHOR



Dr. Sowka is an attending optometric physician at Center for Sight in Sarasota, FL, where he focuses on glaucoma management and neuro-ophthalmic disease. He is a consultant and advisory board member for Carl Zeiss Meditec and Bausch Health.

BY JAMES L. FANELLI, OD

Bad, Worse, Worst

Proceed with caution in cases of progressing advanced glaucoma.

This is the second of two columns dedicated to managing advanced open-angle glaucoma. The previous column (February 2023) dealt with a case that so far has had a good outcome; this one details a case of worsening and how to proceed.

As previously mentioned, approximately 10% of glaucoma cases are considered advanced, whereas the majority of cases (80%) are mild to moderate. Not considering the refractory cases of glaucoma that progress despite intervention (10%), the 10% of patients with advanced open-angle glaucoma can successfully be managed by a well-trained, knowledgeable OD.

However, given that these individuals have advanced disease, there is less margin of error, and extremely close monitoring needs to occur to preserve vision. But even with well-intentioned and regular surveillance, sometimes these individuals do still progress. Identifying progression and intervening early is critical. With advanced disease comes less healthy structural neural tissue and more advanced visual field loss. Significant progression can have significant effects on quality of life.

Case

A now 84-year-old African American male initially presented in 2009 for a wellness evaluation. He had noted some changes in his vision and was interested in updating his glasses. It had been four years since his previous visit.

Two significant findings were observed at the initial visit: moderate cataracts and significant neuroretinal rim loss consistent with glaucoma. Cataract surgery was put on hold until firm baselines were established for the glaucoma and it had adequately stabilized. While the diagnosis was pretty straightforward following the initial testing, the reality of a visual field defect involving fixation also played a role in the patient's subjectively decreased vision.

Essentially, the patient had thin central corneal thickness readings (511µm OD and 501µm OS) and untreated intraocular pressures (IOPs) oscillating in the low 20s. The neuroretinal rims were essentially characterized by 0.80 x 0.90 cupping symmetrically with eroded rims OD in the inferotemporal sector and OS in the superotemporal sector. These structural defects were confirmed on both HRT3 and OCT scanning and were consistent with the initial visual field defects seen on formal perimetric studies.

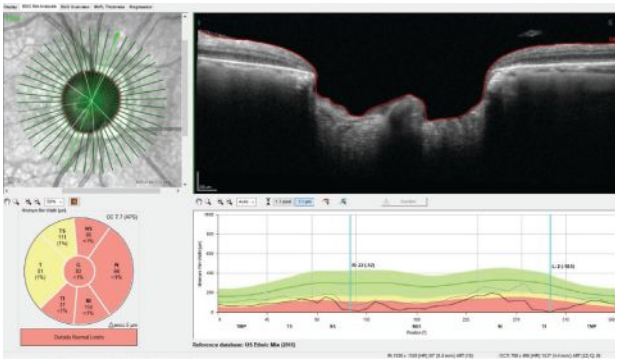
Ultimately, the patient's glaucoma was stabilized with a regimen of Lumigan HS OU as well as Azopt BID OU. Post-treatment IOPs hovered in the 10mm Hg to 14mm Hg range OD and 11mm Hg to 14mm Hg range OS over several treatment visits.

Initially, the glaucoma stabilized over a 12-month period, during which time the cataracts had further progressed to the point of affecting the clarity of the patient's remaining vision and his quality of life. Cataract surgery ultimately occurred in 2011 with excellent results.

Best-corrected visual acuities following intraocular lens extractions were 20/30- OD and 20/25+ OS. While the anterior chamber angles were open prior to cataract surgery, they were fully open following surgery. Gonioscopy never revealed any angle abnormalities other than moderate trabecular pigmentation. IOPs essentially remained stable compared with treated preoperative IOPs. The anterior segment was unremarkable, except for occasional superficial punctate keratopathy and the concurrent complaints associated with ocular surface issues.

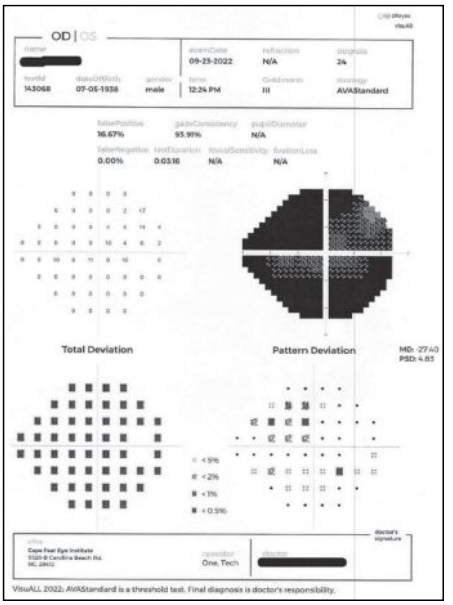
The patient's macular evaluations have remained stable with mild RPE granulation consistent with his age. The retinal vascular evaluation also remained stable with mild arteriolarsclerotic retinopathy consistent with the long-standing history of hypertension and elevated triglycerides. His systemic medications aiming to treat the hypertension, hyperlipidemia, gout and acid reflux were also stable throughout our time together. The peripheral retinal evaluations were essentially normal, and bilateral posterior vitreous detachments were noted.

Unsurprisingly, the patient's Medicare Part D coverage changed, precipitating a need to find alternative IOP-lowering agents. In 2016 we settled

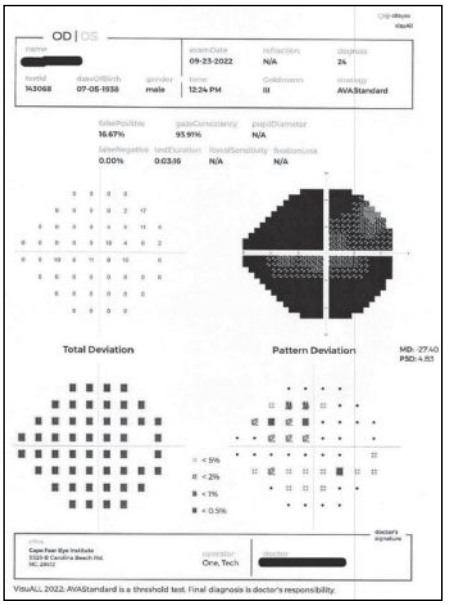


A significant loss of neuroretinal rim tissue inferotemporally, with loss of 185µm shown in the selected radial scan.

About Dr. Fanelli **Dr. Fanelli** is the founder and director of the Cape Fear Eye Institute in Wilmington, NC. He is chairman of the EyeSki Optometric Conference and the CE in Italy/Europe Conference. He is an adjunct faculty member of PCO, Western U. and UAB School of Optometry. He is on advisory boards for Heidelberg Engineering and Glaukos.



A 30-2 threshold field following loss of control of the right eye in June 2022. This was the second VF since re-evaluation.



A 24-2 threshold field three months later. This is the third VF since re-stabilization of the right eye. Note the stability.

on Xelpros HS OU and 0.5% timolol QDam. Structurally and functionally, he remained stable on this regimen.

While COVID interfered with regular follow-up care, we were able to refill his medications during the majority of 2020 and through late 2021. The patient was reluctant to come into the office because of COVID, and due to his mature age and higher risk of COVID complications, it wasn't until early 2022 that he made it back into the office.

He reported that ever since he had taken a bad fall a few months earlier, his right eye hadn't felt entirely normal, and his vision OD seemed to have gotten worse. Unfortunately, IOPs were 28mm Hg OD and 12mm Hg OS. His anterior chamber in the right eye was characterized by grade 1 cells and trace flare. There was mild limbal episcleral inflammation consistent with the anterior chamber reaction OD. Visual acuities were 20/50- OD and 20/30 OS. OCT showed marked neuroretinal rim loss OD. He was dilated with three drops of 5% homatropine and given an Rx of Pred Forte QID OD to use until follow-up to quiet the anterior uveitis OD.

The patient ultimately returned a week later, at which time his IOPs were 25mm Hg OD and 13mm Hg OS. The anterior chamber had no flare, and trace cells were seen; the episcleral injection was cleared.

Visual fields demonstrated significant progression OD with further involvement of fixation, and the left visual field remained stable from previous visits. Gonioscopy was essentially stable as well, with no evidence of abnormalities OU or angle recession OD.

While the anterior chamber reaction may certainly have played a role in the elevated IOP OD, it became a secondary issue once it was clear that the IOP was still elevated even though the chamber was quieter. Consider the possibility that IOP could now be elevated because of the introduction of the steroid. At this point, it became critical to lower IOP and ultimately titrate off the topical steroid as soon as possible. Accordingly, the Pred Forte was scheduled for a slow taper, and the right eye was dilated with 1% atropine given the clear angle findings. The Xelpros was stopped, and Vyzulta was substituted HS OU.

The patient followed up a week later as scheduled, and ultimately after a couple of weeks, the steroid was discontinued, and his glaucoma regimen was Vyzulta HS OU and Cosopt BID OU. IOP OD was reduced to the 10mm Hg to 13mm Hg range and OS to the 10mm Hg to 12mm Hg range.

At this point, it was clear that the patient had progressed, but the bigger question now became one of stabilization. It can be argued that he should have been sent to a glaucoma specialist at the first visit in 2022 when it was clear that he had progressed structurally and functionally and that his IOP was high. However, a good glaucoma specialist would have also realized that the inflamed anterior chamber was playing a role and that inflammation needed to be brought under control, requiring a balance between steroid inflammatory control and IOP control. A well-trained OD would come to the same conclusion.

I felt confident that we could bring the anterior chamber inflammation under control, but I initially was not certain that the glaucoma would remain stable. But once the IOP was brought under control and the chamber reaction was quieted, perhaps he would remain stable. If not, off to glaucoma surgery he'd go. But if he did remain stable moving forward, then no surgery would be warranted given the fragility of his nerves.

While the patient reported decreased visual acuity, and the visual field loss worsened during the absence of in-office care, it appeared as though he had stabilized. Overall, he did experience progression, but with consistent follow-up and appropriate management, we were able to control his glaucoma.

The patient was watched closely in 2022, with the most recent field study conducted in September. Structural indices have remained stable since early 2022, and so have the visual fields. IOPs have remained under 13mm Hg OD and OS since being brought under control, which means he is stable for the time being. Is he going to remain stable? The OD in me, as well as the OD in you, will see over time if that remains the case. If not, we've got a plan that involves surgery. But for now, the regimen is continued care in my office. ■

A Sight for Sore Eyes

Retinal whitening led to this patient's condition.

BY RAMI ABOUMOURAD, OD
MIAMI

An 18-year-old Hispanic male presented with acute onset pain, redness, photophobia and loss of vision in the left eye. His medical, ocular and family histories were all unremarkable, and he was not taking any over-the-counter, prescription or illicit medications.

Entering visual acuity (VA) was 20/60 OD with pinhole improvement to 20/40 and 20/200 with pinhole improvement to 20/100 OS. Extraocular motilities were full, confrontation visual fields were full and there was no relative afferent pupillary defect. IOP was 21mm Hg OD and 16mm Hg OS by applanation. Anterior segment exam was unremarkable OD. Regarding the left eye, there was 2+ diffuse conjunctival injection, the anterior chamber was deep, there were 4+ mixed pigment, red blood cells and white blood cells circulating in the anterior chamber, and there was a 1.6mm hyphema settled inferiorly. Posterior segment imaging is included here for review.

Take the Retina Quiz

1. How would you interpret the OCT of the left eye?
a. There is full-thickness retinal hyperreflectivity.
b. There is hyperreflectivity and disruption of the photoreceptor and retinal pigment epithelial (RPE) layers.
c. There is inner retinal thickening and hyperreflectivity.
d. All of the above are applicable.

2. What is the most likely diagnosis for this patient?
a. Commotio retinae.
b. Purtscher retinopathy.
c. Susac syndrome.
d. Viral retinitis.

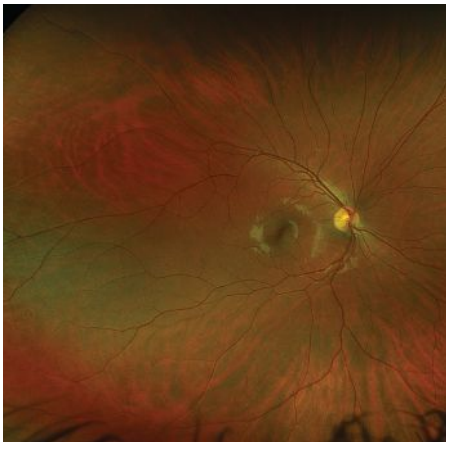


Fig. 1. Optos ultra-widefield fundus photo of the right eye.

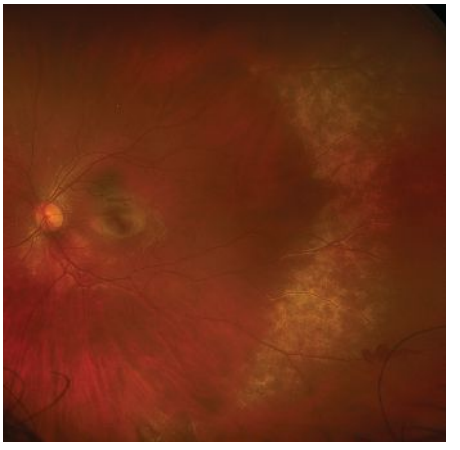


Fig. 2. Optos ultra-widefield fundus photo of the left eye.

3. Which of the following is the most appropriate management of this patient's posterior segment findings?
a. Emergent stroke work-up.
b. Intravitreal anti-VEGF injection.
c. Intravitreal tap with combined ganciclovir and foscarnet injections.
d. Serial dilated fundus examinations with scleral depression.

4. Which of the following best describes the pathophysiology of this patient's retinopathy?
a. It is infectious in nature.
b. It is inflammatory in nature.
c. It is ischemic in nature.
d. It is traumatic in nature.

5. All of the following regarding the posterior segment findings are true, except:
a. The disease is self-limiting.
b. Vision may recover to, or near, baseline levels.
c. In the absence of systemic treatment, there will likely be fellow eye involvement within a few days.
d. All of the above are true.

For answers to the quiz, see page 98.

Diagnosis

The patient was Shafer negative without vitreous hemorrhage OU. The fundus was normal OD, but there was a large area of retinal whitening temporally with adjacent pre-retinal hemorrhage, as well as peripapillary and subtle macular whitening OS (*Figures 1 and 2*). There were no retinal breaks seen with careful peripheral examination or B-scan ultrasound.

Differential diagnoses for retinal whitening should include commotio retinae, retinal ischemia, Purtscher or Purtscher-like retinopathy, chronic retinal detachment and retinitis. Further questioning revealed he

About Dr. Dunbar **Dr. Dunbar** is the director of optometric services and optometry residency supervisor at the Bascom Palmer Eye Institute at the University of Miami. He is a founding member of the Optometric Glaucoma Society and the Optometric Retina Society. Dr. Dunbar is a consultant for Carl Zeiss Meditec, Allergan, Regeneron and Genentech.

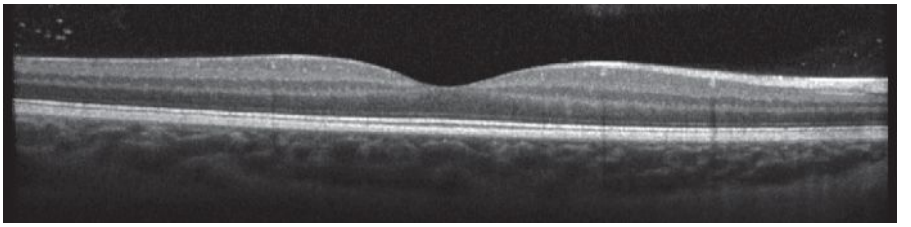


Fig. 3. Heidelberg OCT of the right macula.

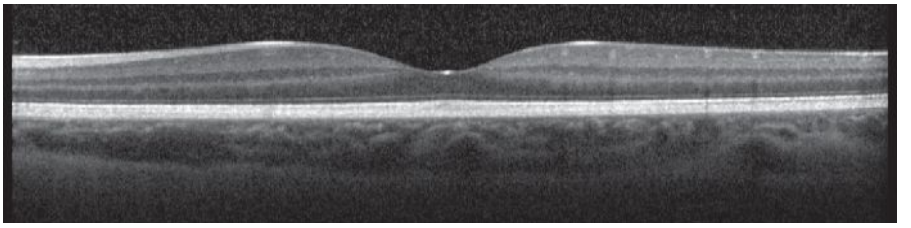


Fig. 4. Heidelberg OCT of the left macula.

suffered trauma while working at a gym from an elastic band that struck his left eye two and a half hours prior to examination.

The patient was diagnosed with a traumatic grade I hyphema, iritis, commotio retinae and preretinal hemorrhage OS. He was started on topical prednisolone acetate 1% six times daily and cyclopentolate 1% three times daily in the left eye. He was initially monitored every one to two days during the rebleed period to ensure that any secondary ocular hypertension could be identified and treated promptly if present. Additional recommendations included bed rest, sleeping with the head of his bed elevated, avoiding oral nonsteroidal anti-inflammatory drugs/blood thinners, ice packs as needed for comfort and acetaminophen as needed for pain.

Discussion

Commotio retinae is a common posttraumatic fundus finding secondary to closed-globe blunt trauma that was first described by Berlin in 1873.[1,2] The term "Berlin edema" is also used to describe commotio retinae, but typically refers to involvement of the posterior pole. Closed-globe blunt trauma often produces a coup-contrecoup force that can produce commotio retinae at the site of direct scleral impact (coup trauma) or opposite the site of direct impact (contrecoup trauma).[3]

The retinal opacification can take hours to develop and may involve both the posterior pole and peripheral retina.[1,3] The study used animal models to illustrate that the fundus changes represented injury at the level of the photoreceptor outer segments and RPE, which has also been confirmed by histopathological analysis of enucleated human eyes within 24 hours of trauma.[3-5] Over the course of up to one week, photoreceptor cells may either recover or undergo degeneration, depending on severity of injury. Photoreceptors that undergo degeneration are then phagocytosed by RPE cells, resulting in secondary RPE migration into the retina.[3] Interestingly, animal models have suggested evidence of a transient breach in the blood-retinal barrier in the immediate period following trauma for up to seven days, but this has not been validated clinically.[6]

Advances in OCT technology allow us to noninvasively image and visualize the retinal tissue response to trauma *in vivo* at any time interval.[1,4,7] Acutely, there is hyperreflectivity and disruption of the photoreceptor inner segment and outer segment (IS-OS) junction and the RPE; chronically, there can be focal IS-OS loss and RPE migration into the retina.[4,7] The sequelae related to commotio retinae have been compared with that of photic retinopathy.

While there is no histopathological distinction regarding severity of commotio retinae, there is a clinical description made to distinguish mild vs. severe disease states.[1] A milder grayish-white appearance to the retina with presenting VA better than 20/200 is felt to be a retinal concussion, while a more intense whitening of the retina with worse presenting VA is a retinal contusion.[7] In either case, commotio retinae is a transient and self-limiting disease with no supported interventional options in the literature.[1,4,8] With observation, retinal concussions tend to demonstrate more favorable outcomes, with restoration of vision to, or near, baseline levels; retinal contusions often result in poorer visual outcomes.[1,4]

At most recent follow-up, the patient's uncorrected VA measured 20/40 and he is being followed with serial dilated fundus exams with scleral depression. The hyphema resolved without complications, and manifest refraction and gonioscopy are planned for his next visit. ■

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BY MARC B. TAUB, OD, MS, EdD, AND PAMELA H. SCHNELL, OD

A Day in the Life

Getting to know who your patient is outside the clinic could make a world of difference in crafting an effective treatment strategy.

The most crucial aspect of any examination is the history. A comprehensive history includes talking with the patient and getting to know them. Not only do you foster a relationship that will hopefully last for years to come, but you can also better serve the patient's needs as well. You might learn that a patient is struggling in school and suggest a referral to a learning specialist or neuropsychologist or run a few extra binocular vision tests. You may learn that a patient recently lost a family member and extend condolences and a listening ear; if needed, you can provide a referral to a counselor. You could learn that a patient has not had a physical in many years and suggest visiting their primary care physician.

The list of things is literally endless and can ultimately help you decide on the best course of action for each of your patient's visual needs. We will use the following three cases to help illustrate and drive home this crucial point:

Case 1

A 19-year-old male presented for a routine exam complaining of intermittent blur at distance. His VA was 20/25 OD, 20/20- OS and 20/20 OU at distance and 20/25 OD, OS and OU at near. His stereo was 70 seconds, cover testing was ortho at distance and near, NPC was reduced at 14cm break and 17cm recovery and the rest of the chair skills were normal. His dynamic retinoscopy and refraction showed values of -0.50 -0.25x090 OD and -0.25 -0.25x090 OS. The NRA/PRA was +2.25/-1.75.

The student quickly realized that this was an accommodative issue due to the data and the answers to questions about his current visual needs. Simply inquiring about what he was doing for work and school opened up a treasure trove of helpful information. He was in ministry and spent significant time reading the Bible on his phone and using the computer. Plus at near (+0.75 OU) was trial-framed at near. His stereo and NPC both improved with the plus in place. He was prescribed near vision-only glasses to be used with reading and computer work.

Case 2

A 21-year-old female presented with a history of wearing +0.75 reading glasses prescribed two years prior. The glasses worked for a short period of time, but then the patient saw double. Her VA was 20/25 OD, OS and OU at distance and 20/25 OD, OS and OU at near without the glasses, which improved to 20/20 at distance and 20/20- at near with the glasses. The stereo was 25 seconds, cover testing was ortho at distance and 8pd exophoria at near, NPC was reduced at 14cm break and 19cm recovery and the rest of the chair skills were normal. The near vergence ranges were 10/18/7 base-in and 12/20/4 base-out.

It was clear that the patient needed to continue using the plus at near, but vision therapy was needed for true relief. The path to the ultimate treatment came from the history and questioning about work and school. She was a full-time daycare worker, and she was doing online schooling. Coming in for vision therapy was not in the cards due to her limited free time during the day. The remaining tool on our belt was prism at near, so we trialed 3pd base-in. The patient noticed the change immediately, reporting that "things seemed so much clearer." She was once again prescribed near vision-only glasses, but this time we added 1.5pd base-in to each eye. For this patient, knowing about her work/school balance and what would work best for her helped direct our treatment path.

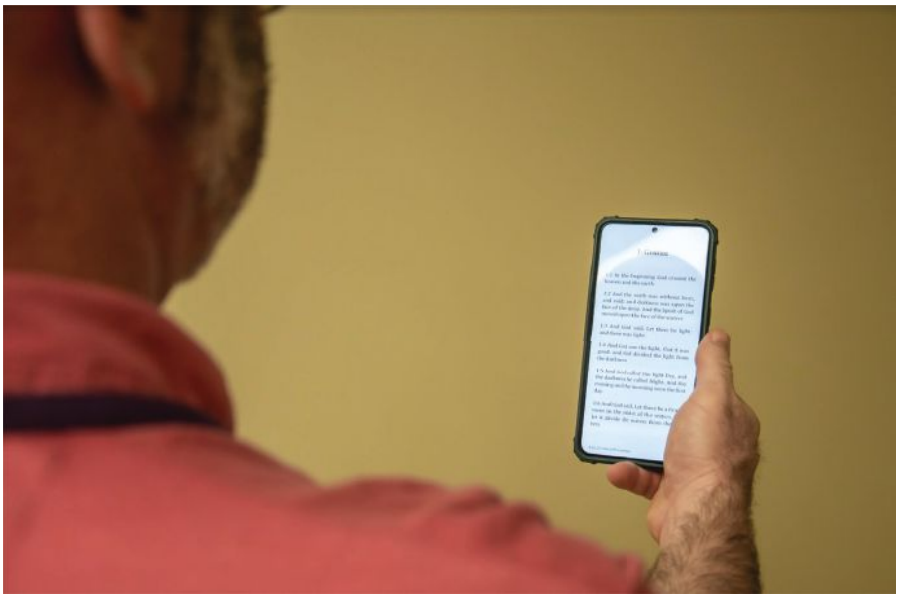
Case 3

A 52-year-old male presented four months post-stroke, complaining of constant double vision. Another clinician originally saw him in a rehab facility. His cover test showed 30pd exophoria and 4pd left hyperphoria, but prism neutralization proved unsuccessful. He was prescribed spot occlusion, as the double vision could not be resolved. Several months later, the cover test now showed 15pd exophoria and 4pd left hyperphoria, but once again, the double vision was not correctable, returning after one to two minutes.

At the current visit, VA with his flat-top bifocal was 20/20 OD, OS and OU at distance and 20/30 OD, OS and OU at near. His eye movements were atrocious: pursuits were jerky and labored, and saccades were inaccurate, with under- and over-shooting. The cover test now showed 8pd exophoria and 4pd left hyperphoria. We again attempted to neutralize the double vision but were thwarted; after several minutes, it returned at distance.

About Drs. Taub and Schnell

Dr. Taub is a professor, chief of the Vision Therapy and Rehabilitation service and co-supervisor of the Vision Therapy and Pediatrics residency at Southern College of Optometry (SCO) in Memphis. He specializes in vision therapy, pediatrics and brain injury. **Dr. Schnell** is an associate professor at SCO and teaches courses on ocular motility and vision therapy. She works in the pediatric and vision therapy clinics and is co-supervisor of the Vision Therapy and Pediatrics residency. Her clinical interests include infant and toddler eye care, vision therapy, visual development and the treatment and management of special populations. They have no financial interests to disclose.



Near-point issues occur with or without the use of technology such as the smartphone.

Typically, if there is significant fluctuation in the stability of the visual system, we refrain from grinding in prism. Still, we took into account that the patient was a lawyer who typically performed a significant amount of near work. He desired to read again but was hampered by double vision. Reading was not only needed for work; it represented normalcy and freedom for him.

Since we typically take brain-injured patients out of their multifocal lenses, we prescribed near vision–only glasses with horizontal and vertical prism ground in. We showed caution by trial-framing the potential prescription with 2pd base-in OD and OS and 2pd base-down OS and having the patient read for 10 to 15 minutes. Luckily, the double vision did not return.

Discussion

A good history includes more than just a rundown of visual symptoms. We ask about medical and visual history, developmental history, academics, sports, hobbies and work. These do not just check boxes on the screen; we use the info we gather to help make important care-related decisions.

As you can see in the three included cases, the fact that the patients were students, how much they worked at near, whether they could attend vision therapy and what kind of work they did all made a difference in our treatment approach. Even though we are all rushed to see more patients in a given timeframe, we have to stop and smell the roses and actually talk to them. Doing so will not only help us as doctors but will also help our patients achieve a higher quality of life in whatever they choose to pursue. ■

PRODUCT REVIEW

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▶ EXAM EQUIPMENT

Haag-Streit Exam Lane Features New Slit Lamp Model

If you're looking to expand your practice by adding more patient care capacity or just want to update an exam room or two, you can buy a new exam lane suite (phoropter excluded) from Haag-Streit that features some diagnostic equipment mainstays plus a brand new slit lamp known as the Reliance SL3. The device features LED illumination, 10x, 16x and 25x magnification settings, three filters (gray, red-free and blue) and a 6° stereo angle, according to the product brochure. Its microscope also includes a yellow filter. Haag-Streit says the SL3 is exclusively available as part of the exam lane.

The overall package, called the Reliance Optometry Workplace, includes the Reliance SL3, the company's AT 870 Goldmann tonometer (a part of the company's product line since 1957), the Reliance 7900 instrument stand and the Reliance 520 examination chair, paired with the Reliance 4246 exam stool. The chair and stool are available in black or charcoal upholstery.

The price of the five-part exam lane is $20,500, representing a discount over what the total would be if each equipment piece was purchased separately, according to the company. Add a phoropter of your choice and you're ready to go!

▶ CONTACT LENSES

CooperVision Debuts Lens for Digital Eye Strain

The average American spends almost half their day—about 11 hours, according to Nielsen—gazing at a screen, which for some can result in symptoms of eye strain such as ocular dryness and discomfort. For your contact lens wearers who complain of this problem, CooperVision says that a new daily disposable lens in its lineup—MyDay Energys—may be able to offer some relief through a combination of hydrating and strain-reducing properties.

Like the company's existing MyDay daily lenses, the Energys lens is made with a material of nearly 50% water that's designed to help it maintain wettability. This moisturizing feature, known as "Aquaform" by the company, works by linking hydrogen bonds to hydrophilic molecules in the lens to help it maintain up to twice its weight in water, which CooperVision says can improve comfort.

What sets Energys apart from other MyDay lenses is the inclusion of a design feature intended to reduce eye strain, which CooperVision calls "DigitalBoost." The company says that the aspheric design of the lens delivers a +0.3D add power (even for a single vision Rx) to help ease strain on eye muscles when shifting focus from near to far (like from digital devices to offline activities). CooperVision notes on its website that patients in a company-led study who wore lenses using this design reported that their eyes felt less tired, heavy and painful after a work day with heavy computer use than those wearing lenses without the power add.

As with other lenses in the product lineup, MyDay Energys includes a UV blocker, which developers say can protect eyes against 86% of UVA and 97% of UVB rays. The new lens is available now in sphere powers of +8.00D to -12.00D (0.50D steps after +5.00D and -6.00D), with no plano option.

▶ PHARMACEUTICALS

Vuity Gets Increased Dosing Nod

Presbyopes who manage their near vision needs with AbbVie's presbyopia drop Vuity (pilocarpine HCl 1.25%) but find themselves frustrated when results wear off mid-day will be glad to hear that the FDA just approved a twice-daily dosing option for the drug. According to the new labeling, a second dose (one more drop in each eye) may be administered three to six hours after the first one. The company says this can extend the effect of Vuity to up to a total of nine hours between the two doses in some patients.

The approval is based on results from the double-masked Phase III VIRGO trial in which 230 participants aged 40 to 55 years old with presbyopia were randomized to Vuity (n=114) or placebo (vehicle alone, n=116). Just over one-third of subjects (35.1%) experienced a three-line gain in near vision at hour nine without losing more than one line of distance acuity, AbbVie said in a press release.

The most common adverse reactions reported in >5% of participants were headache and eye irritation. Ocular adverse reactions reported in 1% to 5% of participants were visual impairment, eye pain, blurred vision and vitreous floaters. ■

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BY ANDREW S. GURWOOD, OD

DIAGNOSTIC QUIZ

Skin in the Game

It's wise to evaluate areas beyond the eyes and ocular adnexa, as they may reveal definitive clues to diagnosis.

A 58-year-old woman presented to the ophthalmology department on referral from the emergency department with a red right eye of seven days' duration. She denied trauma or use of contact lenses. She was COVID negative. Her systemic history was positive for well-controlled hypertension. She was not diabetic.

She denied trauma or the use of contact lenses. She denied allergies of any kind.

Clinical Findings

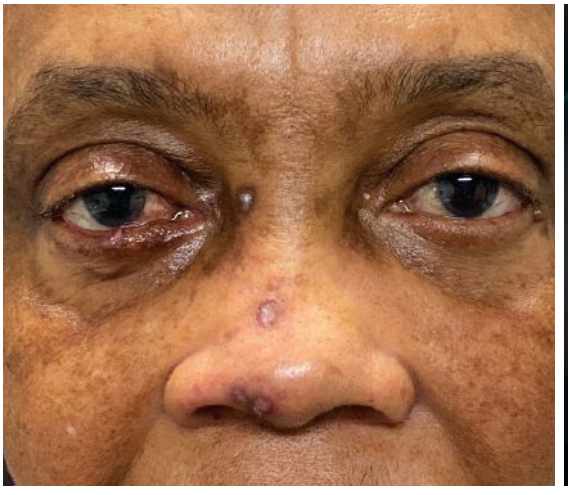
Her best uncorrected entering visual acuities were 20/30 OD, OS, OU at distance and near. A refraction of +0.50/+2.50 improved acuity to 20/25 OD and 20/20 OS at distance and near. Her external examination was normal and there was no afferent defect.

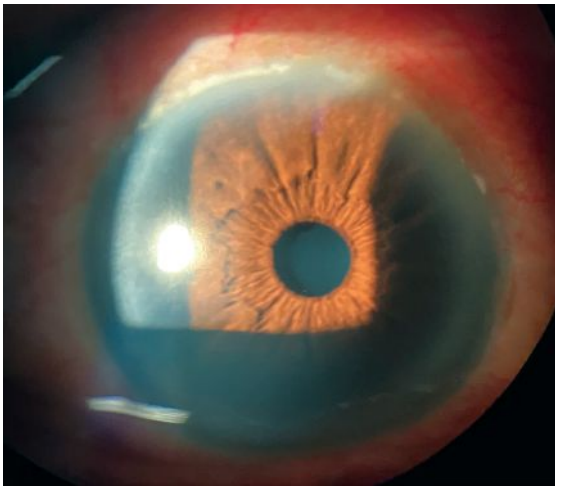
The important biomicroscopic findings OD are demonstrated in the photographs. Her intraocular pressures measured 12mm Hg OD and 16mm Hg OS, using Goldmann applanation tonometry. The dilated examination found cup/disc ratios of 0.2 round, with distinct margins and normal grounds.

Additional Testing

The patient's corneal sensitivity was measured and found to be normal in both eyes. Sodium fluorescein staining demonstrated mild punctate epitheliopathy, greater in the right eye than the left, with no frank pooling. Anterior segment photography was completed.

The eyelids were everted to rule out the presence of large papillae or follicles. In addition, the preauricular, submandibular and sublingual lymph nodes were palpated.





Is there anything in the patient's ocular or non-ocular presentation that suggests the nature of her condition?

Your Diagnosis

What would be your diagnosis in this case based on the findings presented? What's the likely prognosis? Which interventions, if any, would you recommend? To find out, read the online version of this article at www.reviewofoptometry.com. ■

About Dr. Gurwood Dr. Gurwood is a professor of clinical sciences at The Eye Institute of the Pennsylvania College of Optometry at Salus University. He is a co-chief of Primary Care Suite 3. He is attending medical staff in the department of ophthalmology at Albert Einstein Medical Center, Philadelphia. He has no financial interests to disclose.

Retina Quiz Answers (from page 90)—Q1: b, Q2: a, Q3: d, Q4: d, Q5: c

NEXT MONTH IN THE MAG

In May, we present our annual issue devoted to dry eye care. Articles will include:

- How the Eyelids Contribute to Dry Eye
- Keeping Contact Lens Wearers Protected from Dry Eye
- What We Can Learn from the TFOS Lifestyle Report on Dry Eye
- A Refresher on Lacrimal Gland Disorders

Also in this issue:

- Pediatric Eye Exams Made Easy—Advice from a Pro
- What to Do When Psych Issues Manifest in Your Patient

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[2]Based on a laboratory study.
[3]Antioxidant protects hyaluronan against free radicals.
[4]For 12 hours compared to Biotrue Multi-Purpose Solution, based on a laboratory study.
[5]Data on file. Bausch & Lomb Incorporated. Rochester, NY.
[6]Standardized Testing (ISO 14729) against *S. aureus, P. aeruginosa, S. marcescens, C. albicans, F. solani.*

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