NEW DEPT.—You Be the Judge: A Tragic Headache, *P. 30* • Retina Quiz: A Serous Problem, *P. 82*

REVIEW of OPTOMETRY®

ANNUAL DIAGNOSTIC SKILLS AND TECHNIQUES ISSUE

February 15, 2023 • reviewofoptometry.com

Leadership in clinical care

REVIEW OF OPTOMETRY • VOL. 160, NO. 2 • FEBRUARY 15, 2023 • Effective Case History Documentation • Tips for Better Examination Techniques • Adding Labs and Neuroimaging to Your Practice • Challenges in Keratoconus Care • Diagnosis of Pupil Disorders

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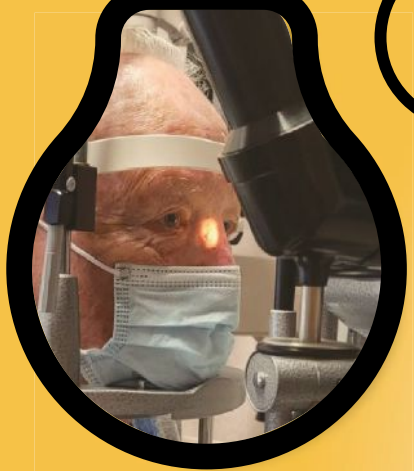

27 Bright Ideas for Better Exams

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ALSO INSIDE

For the treatment of all stages of neurotrophic keratitis (NK)

NOT JUST ANY SOLUTION

A RESOLUTION

Complete and long-lasting resolution of NK for most patients*[1-4]

- **Up to 72% of patients** achieved complete corneal healing in clinical trials*†[1-3]
- **80% of these patients** remained healed at 1 year (REPARO trial)*[4]

oxervate® (cenegermin-bkbj ophthalmic solution) 0.002% (20 mcg/mL)

* Resolution was evaluated in clinical trials as complete corneal healing, defined as the absence of staining in the lesion area and no persistent staining in the rest of the cornea after 8 weeks of treatment and as <0.5-mm lesion staining at 48-week follow-up.[1-3]

† Key study findings were after 8 weeks of treatment, 6 times daily. REPARO (Study NGF0212): 52 European patients with neurotrophic keratitis (NK) in 1 eye per group; 72% of patients completely healed; vehicle response rate 33.3%. Study NGF0214: 24 US patients with NK in 1 or both eyes per group; 65.2% completely healed; vehicle response rate 16.7%.[2,3]

Important Safety Information

WARNINGS AND PRECAUTIONS

Use with Contact Lens

Contact lenses should be removed before applying OXERVATE because the presence of a contact lens (either therapeutic or corrective) could theoretically limit the distribution of cenegermin-bkbj onto the area of the corneal lesion. Lenses may be reinserted 15 minutes after administration.

Eye Discomfort

OXERVATE may cause mild to moderate eye discomfort such as eye pain during treatment. The patient should be advised to contact their doctor if a more serious eye reaction occurs.

ADVERSE REACTIONS

In clinical trials, the most common adverse reaction was eye pain following instillation which was reported in approximately 16% of patients. Other adverse reactions occurring in 1% to 10% of OXERVATE patients and more frequently than in the vehicle-treated patients included corneal deposits, foreign body sensation, ocular hyperemia, ocular inflammation and tearing.

USE IN SPECIFIC POPULATIONS

Pregnancy

There are no data from the use of OXERVATE in pregnant women to inform any drug associated risks.

Lactation

The developmental and health benefits of breastfeeding should be considered, along with the mother's clinical need for OXERVATE, and any potential adverse effects on the breastfed infant from OXERVATE.

Pediatric Use

The safety and effectiveness of OXERVATE have been established in the pediatric population. Use of OXERVATE in pediatric patients 2 years of age and older is supported by evidence from adequate and well-controlled trials of OXERVATE in adults with additional safety data in children.

INDICATION

OXERVATE® (cenegermin-bkbj) ophthalmic solution 0.002% (20 mcg/mL) is indicated for the treatment of neurotrophic keratitis.

DOSAGE AND ADMINISTRATION

Instill one drop of OXERVATE in the affected eye(s), 6 times a day at 2-hour intervals for eight weeks.

To report ADVERSE REACTIONS, contact Dompé U.S. Inc. at 1-833-366-7387 or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

Please see the Brief Summary of full Prescribing Information for OXERVATE on the following page.

References: 1. OXERVATE® (cenegermin-bkbj) ophthalmic solution 0.002% (20 mcg/mL) [US package insert]. Boston, MA; Dompé U.S. Inc.; 2019. **2.** Bonini S, et al. *Ophthalmology*. 2018;125:1332-1343. **3.** Pflugfelder SC, et al. *Ophthalmology*. 2020;127:14-26. **4.** Data on File. Clinical Study Report (NGF0212). Dompé U.S. Inc., 2016.

See more clinical data
OXERVATE.com/hcp

Dompé

oxervate®
(cenegermin-bkbj ophthalmic solution) 0.002% (20 mcg/mL)

Brief Summary of full Prescribing Information

Consult the full Prescribing Information for complete product information, available at www.oxervate.com/prescribing-information.

INDICATIONS AND USAGE

OXERVATE® (cenegermin-bkbj) ophthalmic solution 0.002% is indicated for the treatment of neurotrophic keratitis.

DOSAGE AND ADMINISTRATION

General Dosing Information

Contact lenses should be removed before applying OXERVATE and may be reinserted 15 minutes after administration.

If a dose is missed, treatment should be continued as normal, at the next scheduled administration.

If more than one topical ophthalmic product is being used, administer the eye drops at least 15 minutes apart to avoid diluting products. Administer OXERVATE 15 minutes prior to using any eye ointment, gel or other viscous eye drops.

Recommended Dosage and Dose Administration

Instill one drop of OXERVATE in the affected eye(s), 6 times a day at 2-hour intervals for eight weeks.

WARNINGS AND PRECAUTIONS

Use with Contact Lens

Contact lenses should be removed before applying OXERVATE because the presence of a contact lens (either therapeutic or corrective) could theoretically limit the distribution of cenegermin-bkbj onto the area of the corneal lesion. Lenses may be reinserted 15 minutes after administration.

Eye Discomfort

OXERVATE may cause mild to moderate eye discomfort such as eye pain during treatment. The patient should be advised to contact their doctor if a more serious eye reaction occurs.

ADVERSE REACTIONS

Clinical Studies Experience

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

In two clinical trials of patients with neurotrophic keratitis, a total of 101 patients received cenegermin-bkbj eye drops at 20 mcg/mL at a frequency of 6 times daily in the affected eye(s) for a duration of 8 weeks. The mean age of the population was 61 to 65 years of age (18 to 95). The majority of the treated patients were female (61%). The most common adverse reaction was eye pain following instillation which was reported in approximately 16% of patients. Other adverse reactions occurring in 1-10% of OXERVATE patients and more frequently than in the vehicle-treated patients included corneal deposits, foreign body sensation, ocular hyperemia, ocular inflammation and tearing.

USE IN SPECIFIC POPULATIONS

Pregnancy

Risk Summary

There are no data from the use of OXERVATE in pregnant women to inform any drug associated risks.

Administration of cenegermin-bkbj to pregnant rats or rabbits during the period of organogenesis did not produce adverse fetal effects at clinically relevant doses. In a pre- and postnatal development study, administration of cenegermin-bkbj to pregnant rats throughout gestation and lactation did not produce adverse effects in offspring at clinically relevant doses.

Lactation

Risk Summary

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

Pediatric Use

The safety and effectiveness of OXERVATE have been established in the pediatric population. Use of OXERVATE in this population is supported by evidence from adequate and well-controlled trials of OXERVATE in adults with additional safety data in pediatric patients from 2 years of age and older.

Geriatric Use

Of the total number of subjects in clinical studies of OXERVATE, 43.5 % were 65 years old and over. No overall differences in safety or effectiveness were observed between elderly and younger adult patients.

NONCLINICAL TOXICOLOGY

Carcinogenesis, Mutagenesis, Impairment of Fertility

Carcinogenesis and Mutagenesis

Animal studies have not been conducted to determine the carcinogenic and mutagenic potential of cenegermin-bkbj.

Impairment of fertility

Daily subcutaneous administration of cenegermin-bkbj to male and female rats for at least 14 days prior to mating, and at least 18 days post-coitum had no effect on fertility parameters in male or female rats at doses up to 267 mcg/kg/day (1709 times the MRHOD).

In general toxicology studies, subcutaneous and ocular administration of cenegermin-bkbj in females was associated with ovarian findings including persistent estrus, ovarian follicular cysts, atrophy/reduction of corpora lutea, and changes in ovarian weight at doses greater than or equal to 19 mcg/kg/day (119 times the MRHOD).

Dompé

C/D Ratio Associated with Optic Nerve, Brain Aging

Enlarged cupping in women without glaucoma could possibly provide a surrogate measure of pathologic changes and cognitive function.

In the clinical setting, a large cup-to-disc ratio is generally associated with glaucoma patients. In addition to the normal aging process, pathologic neurodegenerative conditions of the optic nerve and the brain could lead to increased optic nerve cupping. Therefore, many believe that increased optic nerve cupping could represent physiologic aging of the optic nerve or serve as an indicator of the pathologic neurodegeneration of the optic nerve and/or the brain. A recent study, whose findings were published in the *American Journal of Ophthalmology*, determined that, in women age 65 and over without glaucoma, a large cup-to-disc ratio was associated with lower relative total brain volume and absolute regional volume in the frontal and occipital lobes. Brain volume loss is associated with advanced aging and neurodegenerative conditions, including Alzheimer's and dementia-related diseases. This finding further adds to the growing evidence supporting the use of retinal imaging as a biomarker for brain health.

Retrospective data was collected from cup-to-disc ratio measurements from the Women's Health Initiative Sight Examination study, as well as MRI-based total and regional brain volumes from the Women's Health Initiative Memory Study MRI-1. The final analysis included 471 women without glaucoma between ages 65 and 79. The majority of subjects (92.8%) were Caucasian.

A large cup-to-disc ratio, defined in the study as 0.6 or greater in either eye, was found in 7.2% of women.

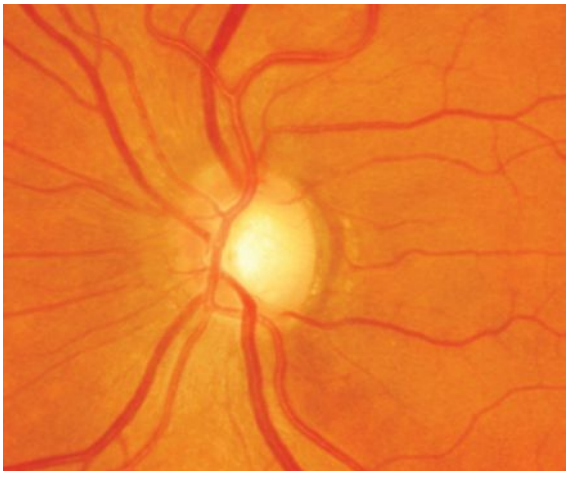


Photo: Sarah B. Klein, OD

In women without glaucoma, cup-to-disc ratio was linked to lower absolute brain volume, as well as lower regional volumes in the frontal and occipital lobes.

After controlling for total brain volume and demographic and clinical characteristics, lateral ventricle volume was found to be 3.01cc larger, frontal lobe volume was 4.78cc lower and occipital lobe volume was 1.86cc lower for those with large ratios compared with those without. The researchers point out in their *AJO* paper that "while the decrease in the occipital lobe volume in patients with large CDR aligns with the conventional understanding of glaucomatous disease, both the frontal lobe volume reduction and lower total brain volume emphasize the neurodegenerative aspect of glaucoma."

The authors then continue by speculating, "Our analysis suggests there is an association between large optic nerve cupping in individuals without glaucoma and decreased brain volume. Enlarged optic nerve cupping in individuals without a glaucomatous diagnosis could represent a sign of optic nerve aging or be used as a surrogate measure of natural brain aging, pathologic changes and cognitive function."

The researchers suggest that subsequent studies should examine these optic disc and brain findings in larger, more racially and ethnically diverse sample sizes with other-gendered patients. Further research examining the changes in ratios in conjunction with MRI brain findings in patients with and without glaucoma is also warranted.

"It is important to note that lower global cognitive function or, specifically lower executive function could hinder a patient's abilities to perform clinical testing such as visual fields, causing them to be incorrectly labeled as glaucoma suspect or a suspect for normal-tension glaucoma," the team concluded in their paper.

Wang C, Kravets S, Sethi A, et al. An association between large optic cupping and total and regional brain volume: the Women's Health Initiative. Am J Ophthalmol. January 10, 2023. [Epub ahead of print].

Nebraska Introduces Bill to Allow ODs to Perform SLT

Advocates point to the successful track record of optometrists in other states to buttress their case.

Though the year is young, states have already set efforts in motion to push scope expansion legislation for optometrists. Advocates in one trailblazing state, Nebraska, are actively working to pass a bill (LB 216) this year that would allow the state's ODs to perform selective laser trabeculoplasty (SLT), a non-invasive IOP-lowering procedure that's becoming recognized as a first-line treatment for glaucoma. The bill was introduced on January 10th and since has been voted on by the state's Board of Health and heard by Nebraska Legislature's Health and Human Services Committee, where it now awaits committee member votes.

When the legislation was initially presented to the Nebraska Board of Health in October and again in November 2022, both votes resulted in a tie. Janet Seelhoff, executive director of the Nebraska Optometric Association (NOA), explains, "Indication from the Nebraska Department of Health and Human Services legal counsel was that the Board of Health was required to submit a report to the interim chief medical officer that could not include a vote resulting in a tie." Thankfully, the third time's a charm. Late last month, the Board voted 7-6 in favor of the bill, and the proposal was sent to the state's acting chief medical officer, Matthew Donahue, MD, for his review.

During the latest hearing, on January 26th, before the Health and Human Services Committee, multiple testimonies were given by doctors, advocacy leaders and community members both in support and in opposition of LB 216.

First to the stand was bill sponsor Senator Jana Hughes, who explained to committee members the legislation's purpose to improve access to eyecare for Nebraskans. "The number of people in the US suffering from glaucoma is expected to reach 6.3 million by 2050," she pointed out. "This bill is relevant for a significant number of people in our state who need medical help in managing this disease over the course of their lifetime. Treatment for glaucoma often depends on an ongoing regimen of eye drops. For many patients, SLT is a better and more cost-effective option." Yet, Senator Hughes noted that although SLT is an in-office procedure, "there are only seven cities in our entire state beyond the Omaha metro area where patients can get SLT."

While concerns about safety and insufficient training are often cited by opponents of the bill, Amy Devries, OD, who practices in Freemont, NE, presented data during her testimony from existing laser states to serve as evidence of the procedure's safety when performed by an optometrist. She pointed out, "Optometrists are already licensed to perform SLT in 10 states: Colorado, Wyoming, Oklahoma, Arkansas, Louisiana, Mississippi, Indiana, Kentucky, Virginia and Alaska. Despite what you will likely hear from the opposition, there has been no evidence of harm to the public in any of these states. Agencies charged with protecting public safety in those states have officially validated that there has been no increase in regulatory actions taken against optometrists," said Dr. Devries. Notably, Oklahoma, which currently has the broadest scope of practice in the country, has allowed ODs laser privileges for more than two decades with no proof of public safety risk.

How to Support LB 216

The NOA says that it plans to keep its members informed on the status of the bill and what ODs in the state can do to help. It also encourages optometrists in Nebraska to reach out to their state senators to express their support of LB 216.

Contact the NOA to learn how you can stay informed and advocate for the bill. Call 402-474-7716 or email noa@assocoffice.net.

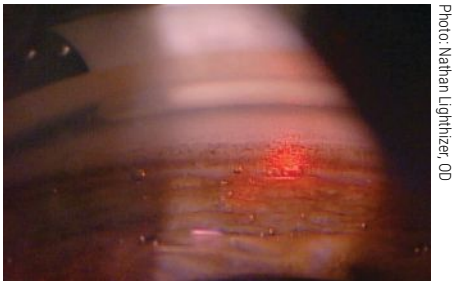


Photo: Nathan Lighthizer, OD

If LB 216 is passed, Nebraska will be the 11th state to allow optometrists to perform SLT.

The chair of Nebraska's State Board of Optometry, Robert Vandervort, OD, who practices in Omaha, NE, also took the stand to challenge the concerns of the opposition regarding the safety of optometrists performing SLT. "Over the last 40 years, ophthalmology has strongly opposed every single enhancement to optometry's scope of practice, arguing the implementation of that scope is unsafe for the public," he said. "Yet, we have submitted copies of letters from other state boards of optometry in states that authorize optometrists to perform SLT documenting that there have been no complaints against optometrists relative to their performance of SLT." Dr. Vandervort then assured the committee, "You do not need to speculate what will happen in Nebraska if LB 216 is passed."

Andrew Bateman, OD, from Lincoln, NE, pointed out in his testimony that administering SLT requires a skill set that optometrists already use on a daily basis. "The laser is mounted to a slit lamp, and to align the laser, you must understand how to focus a slit lamp, which we have to do every day," he explained. "The second part is utilizing a gonio lens to view the angle of the eye where the laser is applied. We use a gonio lens on glaucoma patients already to examine and monitor the angle of the eye where the drainage occurs." Dr. Bateman concluded, "Once you can

(Continued on page 12)

Mask Wear Doesn't Effect Endophthalmitis Post-Injection

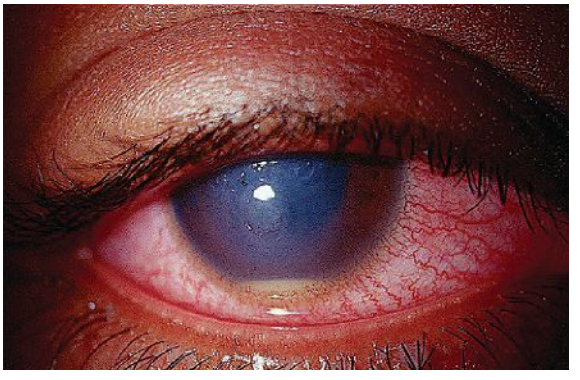
Large study investigating intravitreal injections before and during the pandemic showed no increased risk.

Although it's advisable in most high-risk settings to wear a face mask to reduce chances of airborne pathogen transmission, eyecare specialists learned during the pandemic that it can also have deleterious effects on the ocular surface due to the redirecting of oral bacteria toward the eye. Still, the jury is out in some settings, including during intravitreal injection. Previous studies have not demonstrated an increased rate of endophthalmitis. The hypothesis was that contaminated masks could affect the flora in the periocular region, and/or the altered airflow could be associated with increased bacterial exposure in the sterile field.

Researchers at a university near Stuttgart, Germany recently investigated whether the introduction of universal compulsory face masking in public life leads to increased rates of post-injection endophthalmitis, finding no clear increased risk in their patient population. Six months after the mandate was enforced, no difference in visual acuity was detectable.

All injections of bevacizumab, ranibizumab, aflibercept, dexamethasone or triamcinolone between Jan. 2015 and Dec. 2021 were included in the retrospective analysis. The two study periods were defined by the introduction of the compulsory face masking rule in public life during the COVID-19 pandemic (Jan. 1, 2015 until April 27, 2020 vs. April 28, 2020 until Dec. 31, 2021). The injection procedure included the use of a sterile drape covering the head up to the shoulders which prevents air flow toward the eye.

A total of 83,543 injections were performed in a tertiary eye clinic, associated with a total of 20 post-injection endophthalmitis episodes (0.024%, one in 4,177 injections). Of these, thirteen were documented during the pre-pandemic period (0.021%, one in 4,773 injections) and seven during the pandemic period (0.033%, one in 3,071 injections).



Good news: prolonged use of a face mask during intravitreal injections did not lead to an increased rate of endophthalmitis post-injection.

The researchers observed no significant difference in post-injection endophthalmitis risk, and there was no case of oral flora-associated post-injection endophthalmitis.

The median age of patients with endophthalmitis was 76. In the pre-pandemic group, the median age was 76 and 80 in the pandemic group. On median, patients had previously received 29 injections in the first group and 20 injections in the second. In the pre-pandemic group, endophthalmitis was associated with neovascular AMD in six patients, veno-occlusive disease in another six and diabetic macular edema in one. In contrast, in the pandemic group, endophthalmitis occurred in six patients with neovascular AMD and one with diabetic macular edema.

"Nevertheless, patients should continue to be educated about the importance of hygiene after intravitreal injections to minimize risk," the researchers concluded in their paper. "In addition, consistent use of artificial tears should be advised during prolonged face mask wear to counteract the development of dry eye disease."

Neubauer J, Gklavas K, Kortüm F, et al. Legal obligation in the general population: face mask influence on endophthalmitis after intravitreal injection. Graefes Arch Clin Exp Ophthalmol. 2023;261(1):97-102.

IN BRIEF

Pediatric Cataract Extraction Increases Risk of Strabismus Surgery. About **10% of patients who have pediatric cataract extraction will need strabismus surgery within five years,** according to a paper recently published in *Ophthalmology Science* that examined a large cohort using claims data to evaluate associations and risk factors.

The researchers retrospectively analyzed claims from two US insurance databases of patients ≤18 years old who underwent cataract surgery and had no history of strabismus (*n*=5,822). They found that 4.7% of children included in the study had strabismus surgery, with a 9.6% cumulative incidence of strabismus surgery within five years.

Undergoing strabismus surgery was significantly associated with the following characteristics:

- **Younger age at the time of cataract surgery**
- **Female sex**
- **History of persistent fetal vasculature**
- **History of nystagmus**
- **Pre-existing strabismus diagnosis**
- **Less risk of IOL placement**

Though the estimated cumulative incidence for strabismus surgery after cataract surgery was lower than estimates previously described, the researchers noted that their numbers were comparable when the data was stratified by age and pre-existing strabismus diagnosis. They concluded in their paper that **"future efforts toward screening would be particularly beneficial in these patients."**

Hwang B, Oke I, Lambert SR. Risk factors for strabismus surgery after pediatric cataract surgery in the United States. Ophthalmol Sci. January 5, 2023. [Epub ahead of print].

We're willing to bet most eye care professionals don't realize just how prevalent *Demodex* blepharitis is.[1]

In fact, ~**25 million eye care** patients in the US may have *Demodex* blepharitis (DB).[2]

DON'T BELIEVE US?
LEARN HOW DB CAN FLY UNDER THE RADAR AT

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References: 1. Data on file, Tarsus Pharmaceuticals, Inc. June 2022. **2.** O'Dell L et al. *Clin Ophthalmol*. 2022;16:2979-2987.

US--2200006 12/22

Over 25% of Elderly Americans Are Visually Impaired

Experts characterize the rise in cases and differences based on socioeconomic status, education and ethnicity as evidence of failure of policymakers to expand access to care.

A new study published in *JAMA Ophthalmology* offers a sobering look at the extent of vision problems among Medicare beneficiaries, finding that 27.8% of those 71 years old or older experience some form of visual impairment (VI).

The researchers explained that these new, national epidemiological estimates were much needed, as existing ones outlining the prevalence in the US were at least 14 years old. Also updated were the methods of measurement, as prior estimates were based on self-reported data and measures of visual function.

The report included tablet-based test of distance and near visual acuity and contrast sensitivity with habitual correction. Out of 3,026 patients included, distance visual acuity impairments were seen in 10.3%, near acuity impairments in 22.3% and contrast sensitivity impairments in 10.0%. The finding that more than one quarter of those 71 years or older had some form of visual impairment was higher than previous estimates, the authors noted in their paper. All VI types were additionally linked to older age and lower education and income.

Being of any non-white ethnicity was also correlated with near VI and contrast sensitivity impairments; this was especially greater in non-Hispanic Black and Hispanic populations. Despite this observation, race and ethnicity were not associated with visual function measures, suggesting that "the observed differences between racial and ethnic groups may be driven by socioeconomic factors like education and income," the authors of the study relate.[1]

The authors draw attention to the finding that most near VI observed in this older population can be treated with reading glasses, an inexpensive and readily available option. Most distance VI can similarly be treated with glasses. And despite these relatively easy fixes, Medicare—the primary insurer of older adults—does not provide eyeglass benefit except after cataract surgery.

Photo: Anthony Metcalfe on Unsplash

An alarming number of visual impairment cases arise from elderly patients failing to get proper corrective eyewear. To combat the problem, researchers suggest health education campaigns and public policies or programs to help inexpensive reading glasses become more accessible.

The authors of the study urge others to keep in mind that "understanding the epidemiology of VI and blindness in this population is critical because adults 85 years and older are the fastest growing age group in the United States and may also be at high risk for such downstream sequelae of VI as injurious falls, depression, cognitive decline and early mortality."[1]

In an invited commentary on the study by the same journal, one author further highlights the importance of the original study's updated estimations. The author relates that without surveillance data, it is not possible to tell if improving access has worked or if there are other adverse trends at play.

They do make sure to note of the limitations of the tablet-based tests used to determine data, such as the lighting conditions and lack of standardization for near vision testing distance. But, even with these considered, the author finds the data startling because "there is such a high prevalence of near visual acuity impairment."[2]

In a similar vein, the commentary notes that this shouldn't happen when reading glasses are inexpensive. From this, they bring up potential reasons for this trend, such as the cost being a hurdle for this population, failing on educating the population of visual needs for the elderly, resulting in lack of usage and smartphones and other screens' ability to increase font size somewhat masking the extent of the impairment.

The author of the commentary agrees with the authors of the study—suggesting as an action plan that "if income and education are the main drivers behind the greater prevalence of visual impairment in older individuals, then public policies or outreach programs aimed at providing access to inexpensive reading glasses […] and increased health education campaigns focused on the importance of reading glasses or other portable optical magnifiers in improving near vision may be effective and should be studied."[2]

1. Killeen OJ, De Lott LB, Zhou Y, et al. Population prevalence of vision impairment in US adults 71 years and older. JAMA Ophthalmol. January 12, 2023. [Epub ahead of print].

2. Coleman AL. The importance of public health surveillance for vision impairment in older adults. JAMA Ophthalmol. January 12, 2023. [Epub ahead of print].

Research Details Influence of Systemic Meds on Cataract

Some of the strongest associations were with tricyclic antidepressants, antiarrhythmics and insulin.

Speeding up cataract development is just one well-known ocular complication of many systemic drugs, and a new study in *AJO* aimed to identify the biggest culprits. The retrospective, cross-sectional design included people ages 40 and older and analyzed data from the 1999 to 2008 National Health and Nutrition Examination Survey.

Of the total 14,931 participants, 9.6% displayed a prevalence of surgically treated cataract. The researchers identified 20 drug categories with significant association to surgically treated cataract, with eight of those remaining significantly associated after adjusting for comorbidities.

Highest in association were the drug categories of tricyclic antidepressants, insulin and group III antiarrhythmic agents. Other categories included SSRI antidepressants, calcium channel blocking agents and loop diuretics. Providing some protection against risk of surgical cataract intervention was the use of sex hormone combinations in women. For all eight drug categories, dose-response relationships were present.

The study authors highlight that "our comprehensive evaluation provides new knowledge on the complex relationships between systemic medications and surgically treated cataract." They provide a few potential explanations for the observed associations.

As for antidepressants, mixed results from previous research suggests other mechanisms may be causing increased cataract risk in those taking this drug. That includes indirect effects of high IOP or glaucoma related to antidepressants, resulting photosensitivity or the cataractogenic potential of serotonin.

With diabetes medications, mainly insulin, one suggested mechanism may be an increased photosensitivity of the lens as a result, thus leading to accelerated formation of cataract. Also, insulin use may cause proteins to unfold and subsequently epithelial cell death.

Related to diabetes, hyperglycemia could have a pathogenic role in formation and progression of cataract through the aldose reductase pathway causing hyperosmotic conditions, increased oxidative stress and inflammation.

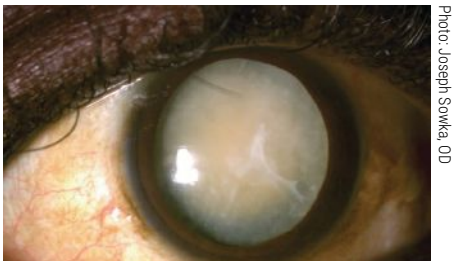

Photo: Joseph Sowka, OD

Beware of the potential for increased risk of cataract in patients on systemic drugs.

One explanation for the protective effect seen in sex hormone combinations against needing cataract surgery is the direct interaction of estrogen receptors with lens epithelial cells.

The study authors say their findings "could provide valuable insights into the biological mechanisms underlying the formation and progression of cataract and facilitate the future development of more effective prevention and treatment methods for cataract."

Deng R, Zhu Z, Han X, et al. Evaluation of systemic medications associated with surgically treated cataract among US adults. Am J Ophthalmol. January 13, 2023. [Epub ahead of print].

Repeated Anti-VEGF Has Protective Effect on Ocular Surface

Suffice to say that no one wants to have a needle stuck into their eye. But for the AMD patients who routinely have to undergo this, the silver lining seems to be an improvement in dry eye symptoms. A recent study in *Ophthalmology* reported that repeated intravitreal anti-VEGF injections with pre-op povidone-iodine application was associated with decreased meibomian gland (MG) loss, increased tear volume and reduced inflammation.

This retrospective controlled, observational study included 90 neovascular AMD patients (mean age: 77.5). The fellow eye of each was used as a control. Tear film and ocular surface exams were performed at least four weeks post-injection. A pre-intravitreal injection asepsis protocol with povidone-iodine was applied.

The median number of anti-VEGF injections in treated eyes was 19.5 total and eight within the last 12 months. Mean MG loss in the upper eyelid was 19.1% in treated eyes and 25.5% in untreated fellow eyes. For the lower eyelid, median gland loss was 17.4% in treated eyes and 24.5% in fellow eyes. Mean bulbar redness score was 1.32 in treated eyes vs. 1.44 in fellow eyes. Median tear meniscus height was 0.36mm in treated eyes and 0.32mm in fellow eyes. There was no difference in treated vs. fellow eyes regarding non-invasive TBUT, tear film osmolarity, Schirmer test, corneal staining, fluorescein TBUT or MG expressibility or quality.

"Lid hygiene is a recommended treatment for chronic lid margin inflammation and a possible mechanism for a beneficial effect on MG and ocular surface health could be that repeated [povidone-iodine] applications limit commensals through its potent antimicrobial properties," the team wrote.

Malmin A, Thomseth VM, Forland PT, et al. Associations between serial intravitreal injections and dry eye. Ophthalmology. January 21, 2023. [Epub ahead of print].

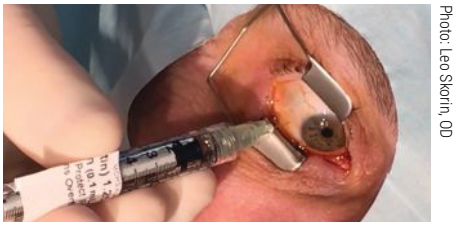

Photo: Leo Skorin, OD

Frequent preinjection antisepsis of the eyelids reduces microbial load, staving off MGD.

'Low Vision Mode' Coming to Smart TV

Samsung recently previewed technology for easier viewing of screen displays.

Last month in Las Vegas at the annual Consumer Electronics Show—the gargantuan meeting where tech companies show off their next-gen products—Samsung previewed a new TV mode that is purported to help people with low or limited vision. The concept uses filtering algorithms that strengthen object outlines, sharpen contrast and enhance colors on the television display expressly for low vision patients.[1] The company calls it "Relumino Mode" and showed a clip simulating how it could help a retinitis pigmentosa patient.

The new accessibility feature enhances images to help those with vision impairment. The above image was demoed at CES in January, showing how an RP patient sees the world normally on the left and with the new low vision mode on the right.

According to low vision expert Erin Kenny, OD, of Salus University, many individuals with reduced vision benefit from management plans that focus on enhanced contrast. Some examples include using accessibility features on devices that provide bold colors, doing tasks under good lighting and employing video magnification. "Samsung's claims of its Relumino Mode would be very beneficial for individuals who have a reduction in their contrast sensitivity," she notes.

Samsung reported that Relumino has been available to the public as an app since 2017, involving a phone connected to a VR device. The app records what's in front of the person wearing the VR using the phone's camera, enhances the image in a clear way to someone with vision impairment and then shows it to that person.[1,2] In its app form, there are various features such as zoom in/out, screenshot and a color invert mode that also displays in high contrast.

Dr. Kenny believes the VR emulation setup works for some individuals and not so much others. "Technology absolutely has its role in low vision rehabilitation, but I do not believe there is one device that solves all problems," she says.

As the innovative TV mode is in its initial stage, Samsung said it will continue to improve with further research and development to include features such as screen magnification. According to Dr. Kenny, magnification can provide a higher level of detail and a better TV/digital device experience for someone with reduced central visual acuities and central scotomas. Achieving this can be as simple as relative size magnification (using a larger screen) or relative distance magnification (moving closer to the TV).

"Currently, spectacle-mounted telescopes can provide angular magnification without having to alter the size of the TV or the distance to the TV," Dr. Kenny adds.

1. Mauran C. CES 2023: Samsung previews a new V mode for people with low vision. Mashable. Published January 4, 2023. mashable.com/article/samsung-event-relumino-mode-smart-tvs-ces-2023. Accessed January 11, 2022.

2. Relumino: light up again. Samsung Relumino. www.samsungrelumino.com/home. Accessed January 11, 2022.

IN BRIEF

Geographic Atrophy Manifests Differently in Asians than Europeans. A study recently published in *Ophthalmology Retina* evaluated differences in geographic atrophy (GA) characteristics in Asian (mainly East Asian) and non-Asian individuals. "As potential therapies for GA are being investigated mostly in subjects of European descent, understanding of the phenotypes, natural history and risk associated with fast progression are crucial if these therapies are to be considered in Asian populations," the researchers explained in their study. They reported that **GA lesions in Asian subjects had smaller baseline size and slower growth rates than those of non-Asian subjects.**

The retrospective, multicenter case series included 169 eyes of 144 subjects ≥50 years of age with GA secondary to AMD (no neovascularization) and follow-up data spanning at least two years. The researchers characterized GA lesions using multimodal imaging (fundus autofluorescence, near infrared and SD-OCT). Roughly half of the study population was Asian (50.9%).

The researchers reported in their paper that Asians had significantly thicker choroids (167µm vs. 134µm) and a lower prevalence of drusen (40.7% vs. 66.3%). **They also demonstrated significantly smaller GA area at baseline and fewer foci in Asians than non-Asians** (3.7mm^2 vs. 6.3mm^2 on near-infrared imaging, 2.4mm^2 vs. 8.4mm^2 on fundus autofluorescence, 1.7 vs. 2.7 foci). **GA lesion growth rate was slower among Asians than non-Asians** (0.7mm^2 vs. 1.9mm^2 per year on near-infrared imaging, 0.3mm^2 vs. 0.2mm^2 per year on fundus autofluorescence). Notably, **when baseline lesion size was ≥5mm^2, ethnic differences were no longer significant.**

The team concluded that ethnicity, junctional zone fundus autofluorescence pattern, baseline GA area and number of GA foci were all associated with lesion growth rate. Additionally, they identified subgroups of Asian eyes with fast progression. **"Despite the relatively slow growth rate in the Asian cohort of 0.7mm^2/year, our sensitivity analyses showed faster GA growth among Asians with drusen (1.8mm^2/year) and those with large baseline GA lesions (2.6mm^2/year),"** they wrote in their paper. "Asian patients who are fast progressors may show greater benefit from new GA therapies."

Teo KYC, Fujimoto S, Sadda SR, et al. Geographic atrophy phenotypes in subjects of different ethnicity: Asia-Pacific Ocular Imaging Society Workgroup Report 3. Ophthalmol Retina. December 28, 2022. [Epub ahead of print].

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Green Space Lowers Myopia Risk

Study shows this is associated with a reduced prevalence among adolescents and in schools.

It goes without saying that myopia is a public health issue, particularly in high school-aged adolescents in Beijing who are affected by an alarming prevalence of myopia. As green space has a certain association with factors that can protect against myopia, researchers recently examined its effects and found that a 500m buffer around schools was associated with a lower myopia risk among adolescents and a lower prevalence of myopia in schools.

Green space was measured using the normalized difference vegetation index (NDVI). A total of 13,380 samples from 51 high schools were selected for analysis. Adolescent myopia was defined as an SE of ≤-1.00D in the worse eye.

In addition to the 500m buffer associated with a lower myopia risk and prevalence, prior studies have highlighted the greenness of the buffer surrounding the school for the role it plays in students' social and health benefits.

"We considered that students probably tended to live close to their school to minimize time costs or benefit from opportunities offered by the school," the authors explained in their paper. "Thus, the 500m buffer may also cover students' outside-school environments, providing day-long exposure to greener space and reducing myopia risk."

They added that a greener environment may lead to more outside activities after school, encouraging students to enhance social connections with peers instead of playing alone on electronic devices. "In addition, with more green space outside schools, students may have greener routes between school and home. Walking home along an avenue with a tree canopy can be highly inspirational," they suggested.

It should also be noted that the marked variation in the prevalence of myopia between suburban and urban schools did not occur when the effects of the NDVI of the buffers were considered, which suggests that the greenness level around schools rather than the urbanization of the location could better determine myopia prevalence.

Lastly, the effects of green space within the 500m buffer on myopia prevalence varied between demographic subgroups. Females had a higher myopia prevalence and were slightly more sensitive to the buffer NDVI than males. "This shows marginalization, which is usually reported in gender variation; that is, females are marginalized with poor health outcomes but gain more than males from green space exposure," the authors noted.

Photo: Robert Collins on Unsplash

Green space within 500m of schools may be protective against pediatric myopia.

"Green space around schools is an independent protective factor for adolescents' myopia, and we suggest the importance of the appropriate distribution of within-campus trees for myopia prevention," they concluded.

Zhang C, Wang C, Guo X, et al. Effects of greenness on myopia risk and school-level myopia prevalence among high school-aged adolescents. JMIR Health Surveill. 2023;9:e42694.

(Continued from p. 5)

Nebraska SLT Bill Introduced

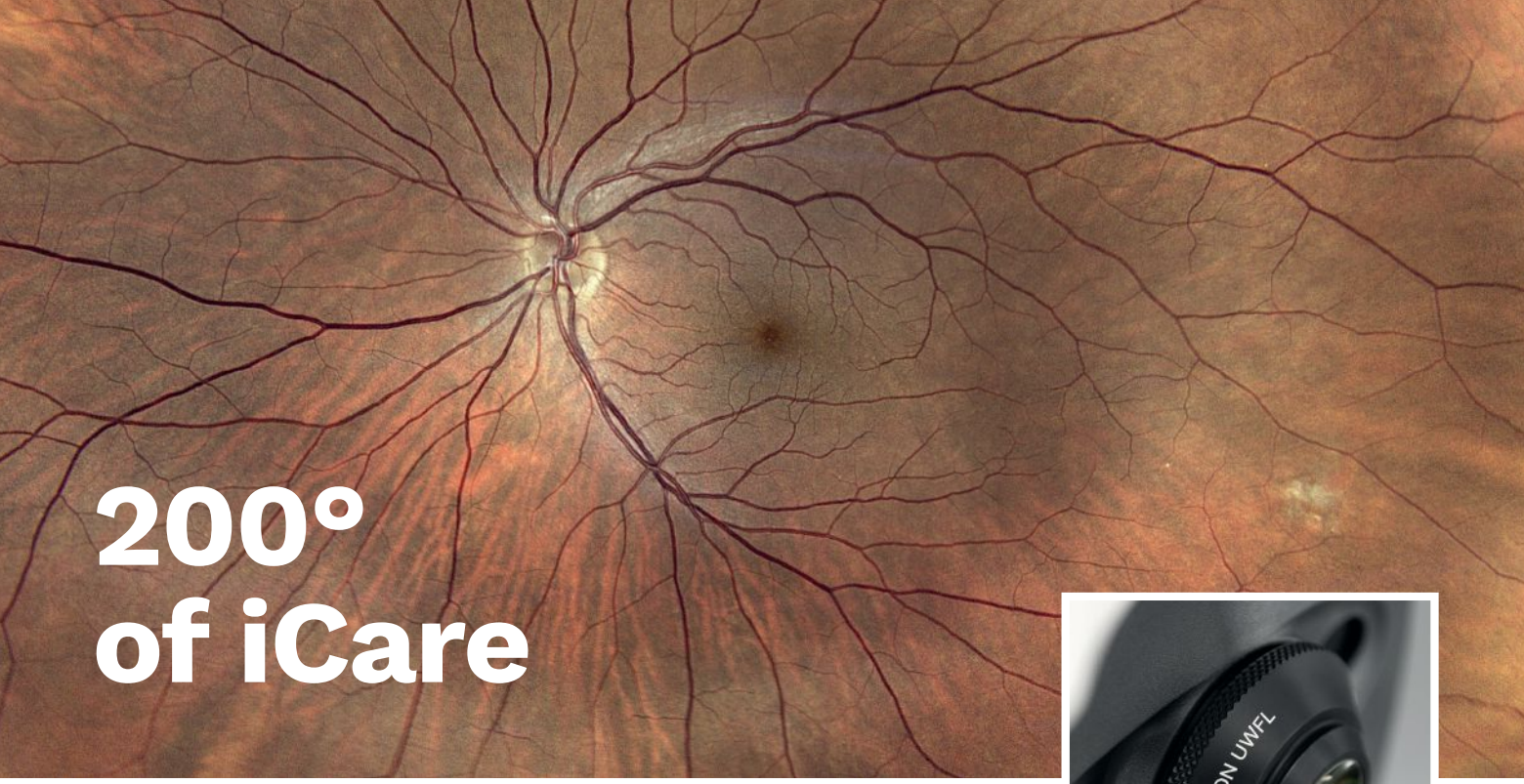
perform these two skills, the last step is applying the laser to the tissue by using the appropriate setting and pressing a button."

Christopher Wolfe, OD, who practices in Omaha, NE, but received training on SLT in Oklahoma 15 years ago, expressed to committee members the patient benefit of making the procedure more accessible. "SLT lowers IOP in 80% of patients by about 20%," he said, adding that topical medication shows similar efficacy but may disrupt the ocular surface over time, not to mention the expense or compliance issues that accompany drop therapy. Dr. Wolfe also cited data from the LiGHT trial, which concluded "there is a lower need for incisional glaucoma surgery or cutting surgery when patients are treated with SLT than with drops."

The first testimony opposing LB 216 was given by Daniel Rosenquist, a family medicine physician in Columbus, NE, and president of the Nebraska Medical Association. Dr. Rosenquist and several other testifiers cited concerns regarding education and training standards for ODs vs. MDs. "The education and training standards in the current optometric proposal are not sufficient to provide assurance of safe and effective use of the surgical services in question," he argued before the committee. Dr. Vandervort countered these concerns during his earlier testimony, stating that "Under the provisions of this bill, the Nebraska Board of Optometry will act to ensure that the educational institutions comply with the statutory standards and all doctors are certified to meet those standards." LB 216 states that ODs who weren't trained on SLT in school must attend courses and gain proper certification before performing the procedure.

After nearly two hours, the hearing adjourned, and what happens next with LB 216 relies partly on the efforts of scope expansion advocates in the state. "Our next step is outreach to the committee members to ask for their support to vote the bill out of committee," says Ms. Seelhoff.

To track the status of LB 216, visit www.nebraskalegislature.gov/bills/view_bill.php?DocumentID=50267.



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FEATURES

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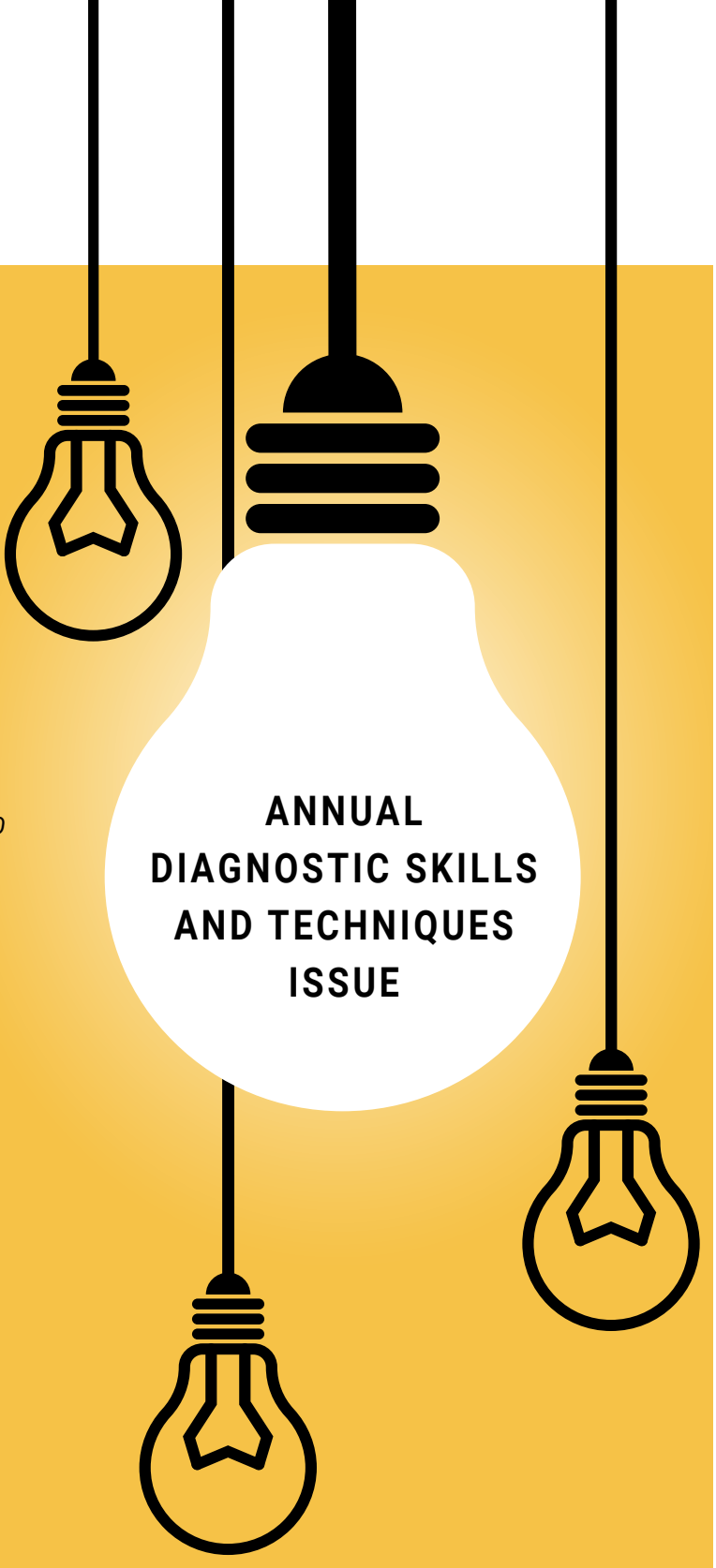

ANNUAL DIAGNOSTIC SKILLS AND TECHNIQUES ISSUE

#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

1.88
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.

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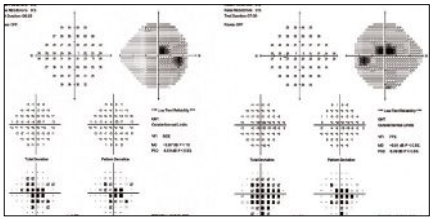

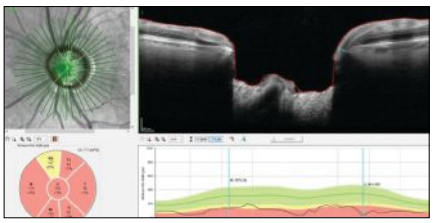

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BY JACK PERSICO
EDITOR-IN-CHIEF
OUTLOOK

Completing the Picture

The process of diagnosis is fraught with trouble, as ODs must piece together an idea from just a few glimpses of the issue. Here's help.

When I first met Jerry Sherman, back in 1991 at the start of my career, he was already a legendary diagnostician and a role model for the next generation of ODs. A prolific writer, his contributions were a staple of this publication. For a time, he actually wrote three monthly columns for *Review* simultaneously: Retina Quiz, Malpractice Quiz and Visual Field Quiz. Only Retina Quiz remains (more on that in a minute), while the other two eventually ran their course and were discontinued.

More than anything else, the responsibility at the heart of all three of those columns was the crucial skill of disease diagnosis. So, I'm excited to use our annual Diagnostic Skills & Techniques issue to announce the launch of a new column to be written by Dr. Sherman along with another SUNY faculty superstar, Sherry Bass. These two esteemed educators will be unpacking the arguments for malpractice claims—whether spurious, warranted or somewhere in between—in a new monthly department called You Be The Judge. The goal is to put the reader into the exam room while a tricky case unfolds and ask each of you whether you believe the proper course of action was followed by the doctor(s).

Drs. Sherman and Bass have a combined 94 years—yes, you read that right—of experience on the faculty at SUNY and as fixtures in wider world of optometry. Their insights into vulnerabilities in the care a doctor provides that might expose someone to a malpractice claim are simply invaluable. The cases they'll use as teaching examples will naturally tend toward situations with high stakes, sometimes with catastrophic outcomes, as with the debut column this month.

Fortunately, most day-to-day optometric care isn't such a high-wire act as all that, but still the mandate to nail the diagnosis remains. To help readers brush up on simple workaday exam techniques, our cover story provides a grab-bag of ideas and tips to help you make the most out of a relatively brief visit that needs to cover a lot of ground efficiently. In a similar vein, the first feature in the series digs deep into the nuances of eliciting good, actionable information in the case history.

The remaining features in the diagnostic theme cover the frustrating logistics of adding bloodwork and neuroimaging to your practice, challenges inherent in keratoconus diagnosis and related topics, and a CE course on the panoply of pupil disorders. We hope you enjoy this year's line-up.

Back to the long-running Retina Quiz column Dr. Sherman launched decades ago: his successor, the brilliant Mark Dunbar of Bascom Palmer, will be transitioning the column this year to a protege of his, Rami Aboumourad. Just a few years into his career, Dr. Aboumourad has distinguished himself at Bascom Palmer for his deep understanding of retinal pathophysiology.

This month also sees Jessica Steen's debut in writing the Therapeutic Review column, as her former mentor Joseph Sowka also begins to pass the baton. It's heartening to see several generations of keen intellects—the stewards of optometry's past, present and future place in the world—come together under one roof to help the profession fill in its gaps and move forward, one diagnosis at a time. ■

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By Paul M. Karpecki, OD
Chief Clinical Editor

THROUGH MY EYES

In With the New

Consider these latest technologies to improve your diagnostics.

The old adage holds true for clinical practice—an accurate diagnosis is key to a successful outcome. The latest innovative diagnostic technologies are becoming mainstream either because they replace testing that patients don't look forward to, replace those that are difficult to perform or simply provide critical clinical insights you can't get elsewhere. Let's review them.

Despised Tests

Let's admit it—there are tests patients complain about, from manual refraction and binocular vision assessments to visual field testing.

Phoria testing is one such example, as most find it impossible to determine the misalignment endpoint. One might argue that this test belongs in the "difficult for the doctor to perform" category as well. The Neurolens Measurement Device, Gen 2, makes the task simple with an objective, repeatable test that takes less than two minutes. It acquires 10,000 data points and all misalignments are determined to an accuracy of 0.01µm. Contoured prism is prescribed, which has had a dramatic effect on my patient population in relieving asthenopia, headaches, neck stiffness, dizziness and/or dry eye sensation.

Another task patients (and techs) loathe is visual field testing. Patients get tired and frustrated with the button-pushing and insecurity of correct answers with standard automated perimeters (SAP). Because of this, it's not uncommon for patients to fail to return to the office for follow-up testing. If you are looking for a VR headset, make sure it has active tracking—meaning the testing automatically halts if the patient loses fixation—and options such as neighborhood cluster testing to ensure a quick test that typically is less than three minutes (M&S Technologies is one example).

> **Replacing these technologies with something easier will increase your patient volume.**

ObjectiveField (Konan Medical), or the OFA, is a binocular, objective field analyzer that uses neurological pupil response to precisely map the visual field, with no button to push. Further setting OFA apart from SAP, both eyes are tested at once and novel diagnostic information such as mapped hypersensitivities and latencies, fellow-eye asymmetries and their respective progression analysis are captured.

Difficult to Perform Tests

There are assessments that we know are important but difficult for doctors or staff to perform consistently well, or lack the sensitivity to provide useful information. For example, many patients with early glaucoma have a subtle relative afferent pupillary defect (RAPD), but I doubt many of us could pick up that level of asymmetry with the swinging flashlight test. Pupil testing with EyeKinetix (Konan Medical) provides a detailed neurological pupil testing assessment in about 90 seconds accurately and objectively. Early glaucoma is a common cause of these subtle RAPDs.

Ultrasound and other biometry measurements are difficult to obtain but helpful for myopia management. New devices such as Lenstar Myopia (Haag-Streit) or Myopia Master (Oculus) make testing more accurate and provide easy to follow patient reports with long-term tracking data.

Uncovering Clinical Insights

Diagnostics that provide insights beyond standard testing can add a level of sensitivity that increases our accuracy and prevents us from treating a patient who may not require it. One example is measuring hysteresis with the Ocular Response Analyzer (Reichert). While IOP gives us an idea of risk, hysteresis provides a more accurate IOP, and it alone is the most accurate marker for determining who is likely to have a progression to glaucoma and risk of visual field loss.

Osmolarity is a key differentiator of DED. Far too many conditions such as eye misalignment, exposure keratitis, epithelial basement membrane dystrophy and blepharitis have symptoms similiar to dry eye. Putting such patients on dry eye treatments fails, is costly and is frustrating for doctors and patients. Osmolarity above 308mOsmol/L in either eye confirms a diagnosis. The new ScoutPro (Trukera Medical) is a single, portable handheld system that provides a precise tear osmolarity measurement in seconds.

Good diagnostics are the key to success in clinical practice. Consider new innovations that uncover essential clinical data or replace difficult tests—that's essentially what innovation is meant to achieve. ■

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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BY MONTGOMERY VICKERS, OD

CHAIRSIDE

Presence is the Greatest Present

Live in the moment; life is constantly giving and taking.

He was very sad. His eyes were watery and soft, lids loose and sagging. As this 60-year-old patient I had never met admitted his life had been dissolving ever since he lost his mother a year ago, it was as if his whole face was slowly melting away. Having been there multiple times as my wife and I went through the losses of our parents through the years, I understood all too well.

I especially felt this lovely fellow's journey in the shadow of the recent loss of several notable optometrists, all of whom I respected so very much.

Dr. Art Epstein was, to me, a courageous genius. He never shied away from his brilliant decisions. He exemplified what we each could be if we never stopped learning and growing in optometry.

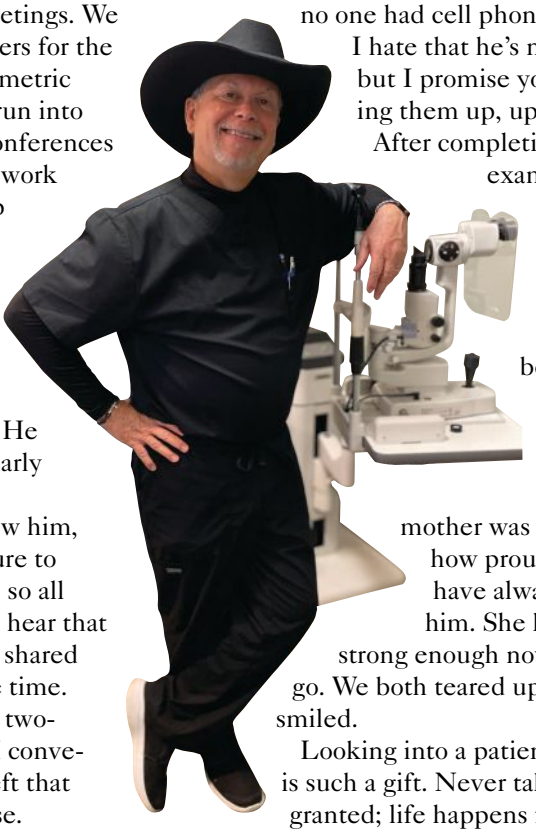
I would communicate with Art, mostly through emails, whenever I had a question about nearly every topic in our profession. Art was eternally kind to me no matter how stupid I must have sounded to him sometimes. He guided me, not for any reward, but because he was a giver. I'll bet there are doctors reading this who never took the time to learn that about Art but, if you did take the time to listen, Art's gentle truth would poke holes in any preconception you may have had about him.

He was funny, too. One time he interrupted one of my dumb dry eye questions and said, "Monty, will you please retire?" I thought he was serious—he could have that aura at times—and then he just laughed, "Nah! What else could you do anyway?"

I miss Dr. Epstein. The profession was better because he was part of it.

Then, we lost Dr. Stuart Richer. I met Stuart many, many years ago when I spent a few years traveling around the country doing what I called "optometric stand-up comedy" at optometry meetings. We were both speakers for the Minnesota Optometric Association. I'd run into him at various conferences where he would work very hard to help us learn about nutrition and the eye, a topic that was often ignored in optometry school curricula. He changed that, nearly single-handedly.

Whenever I saw him, I always made sure to loudly announce so all around us would hear that Dr. Richer and I shared a hotel room one time. Okay, so it was a two-room suite, but I conveniently always left that part out, of course.



What I forgot to tell Stuart was this: ever since I met him, I've mentioned his name almost every day as I make nutritional recommendations based on what I learned from him, whether through CE classes or his wonderful articles in our various journals. No joke, my techs will tell you that I say the words "Dr. Stuart Richer" on a regular basis. That won't change with his passing. I really wish I had told him that while I still could.

Dr. Al Angle, "Big Al," was famous to anyone who met him. He was the first person I met as a freshman at PCO. He was my roommate and CEO of good times. He was big and strong and hilarious. I don't have the space to tell you of our adventures, and even if I did, this may not be the most appropriate platform to share them. Let's just say thank goodness no one had cell phones back then.

I hate that he's no longer here, but I promise you he's cracking them up, up there.

After completing an eye exam on the gentle fellow mentioned at the start of this column, I asked for both his hands and reminded him of what a wonderful gift his mother was to him and how proud she must have always been of him. She knew he was strong enough now for her to go. We both teared up, nodded and smiled.

Looking into a patient's eyes is such a gift. Never take that for granted; life happens fast. ■

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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Detective Work

Deeper questions can uncover underlying systemic conditions.

Q A 39-year-old male presented with uveitis and rather "sudden" loss of vision but no obvious fundus findings. Where should I begin?

A The first question I often ask patients is, "When was the last time you had a complete physical with bloodwork?" says Cynthia Noorani, OD, of the Roswell Eye Clinic in Atlanta. This patient in particular reported he hadn't been to any doctor since he was a child. Best-corrected vision was 20/50 OD and 20/100 OS, which had deteriorated over the previous week. Confrontation fields and pupils were normal. His color vision was abnormal in both eyes.

Slit lamp examination revealed an anterior and posterior uveitis, with no symptoms of light sensitivity. The retina was grossly normal, as were the optic nerves. The macular OCT showed very subtle retinal pigmented epithelium (RPE) thickening (*Figure 1*). His visual field showed bilateral central scotomas, confirming some variant of optic neuropathy.

During the initial exam, the patient became emotional and asked if his general health could affect his eyes. "It was at this point that I had to ask some blunt questions related to sexual activity and any presenting signs, such as pain on urination or rashes," says Dr. Noorani. He remained awkwardly silent during this line of questioning. A blood panel was ordered including testing for sexually transmitted infections, specifically an rapid plasma reagin (RPR), fluorescent treponemal antibody absorption (FTA-ABS) and venereal disease research lab (VDRL) for syphilis, NAT for HIV and IgM and IgG for herpes simplex. The patient agreed to the tests and started using a topical steroid drop for the uveitis.

A few days later, Dr. Noorani received a phone call from an infectious disease physician from the department of health. The patient tested positive for not only an active case of syphilis but also HIV with a CD4 count of 284—very close to reaching AIDS. He was started on intramuscular penicillin, and the infectious disease physician monitored him to see if his reaction to intramuscular would be enough before starting intravenous and HIV treatment. A retina specialist was consulted and confirmed that the findings on his OCT correlated with his syphilis diagnosis, known as placoid chorioretinitis.

Counting on Blood Count

Syphilis cases have been steadily rising in the United States, with an average of 12 million new cases per year in developing countries.[1] The infectious disease is primarily caused by *Treponema pallidum* and is generally transmitted during sexual contact or congenitally *in utero*.[1,2] Consider serological testing including RPR, VDRL and FTA-ABS in cases of vision loss and subtle neuro-ophthalmic findings as in this case.[1,3]

Syphilis is the third leading cause of an active interstitial keratitis, with herpes being the first.[1] The most common ophthalmic finding—and maybe the only systemic sign—in syphilis is uveitis, which typically occurs six weeks after the primary infection.[1] Another possible finding is Argyll Robertson pupils, which typically occurs late in the disease and may explain our patient's small, sluggish pupils at his exam. The optic disc may be swollen either unilaterally or bilaterally and can be subdivided anteriorly or retrobulbar.[1] Our patient had a subtle retrobulbar neuritis which explained his vision loss and abnormal color vision.

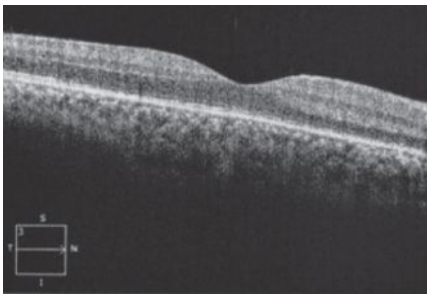

Fig. 1. OCT imaging with subtle areas of RPE thickening, or placoid chorioretinitis.

Syphilis is a very challenging clinical diagnosis because its presentation overlaps with many other etiologies. Dr. Noorani says she urges doctors to have a deeper conversation with patients in order to arrive at the correct diagnosis. Discussing the importance of getting updated blood work as part of a complete physical exam is something all practitioners should encourage.

"This patient had no idea he was also HIV-positive with a risky CD4 count that may have progressed to AIDS if he waited longer to be seen or get tested," she notes. The patient returned about a month later with a best-corrected visual acuity of 20/20 OU and expressed immense gratitude for the care he received. ■

1. Lee AG, Bindiganavile SH, Wiley Z, Al-Zubidi N, Bhat N, Belushi FA. Ophthalmologic manifestations of syphilis. EyeWiki. eyewiki.aao.org/ophthalmologic_manifestations_of_syphilis. Published July 29, 2022. Accessed December 27, 2022.

2. Singh AE, Romanowski B. Syphilis: Review with emphasis on clinical, epidemiologic and some biologic features. Clin Microbiol Rev. 1999;12(2):187-209.

3. MedLine Plus. Syphilis tests. MedlinePlus. medlineplus.gov/lab-tests/syphilis-tests/. Accessed December 27, 2022.

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.

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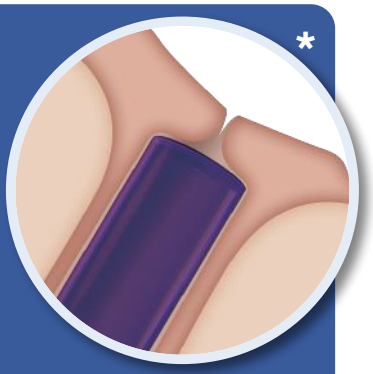

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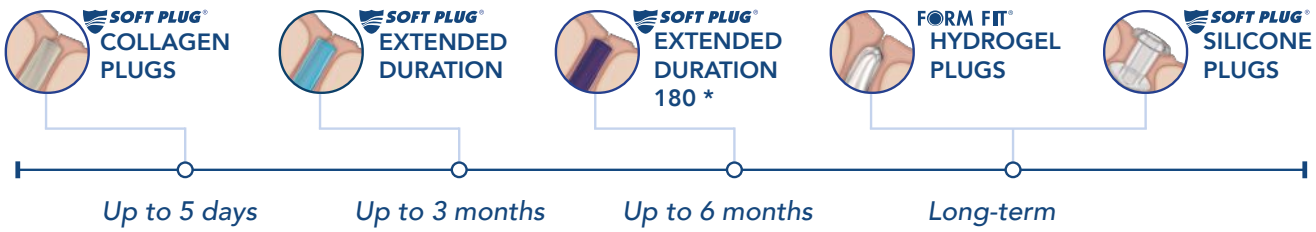

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BY MARC B. TAUB, OD, MS, EdD, AND PAMELA H. SCHNELL, OD

Looking Through Rose-Colored Glasses

Let's take a look at how tints play an important role in treating brain injury.

Acquired brain injury (ABI) can have severe visual consequences that can impact patients both in the short- and long-term. Under the umbrella heading of ABI, we include traumatic injury from car accidents and other blows to the head, often resulting in concussion, and nontraumatic injuries from stroke, surgery and neurological diseases such as ALS and MS. Depending on the severity of the injury, the patient's symptoms and optometric findings may be variable. These symptoms can include blurred, doubled or lost vision, photophobia, reading difficulty, headache, balance issues and visual neglect/inattention. One study found an increased occurrence of exo deviations, oculomotor dysfunctions, vertical deviations, dry eye, blepharitis, optic nerve pathologies and visual field deficits in a population of adults who had sustained a brain injury.[1]

Photophobia is common following an ABI. It is not rare for patients to wear sunglasses both indoors and outside following their injury. We have even seen some patients present with sunglasses, a hat and a hoodie pulled over their heads. As with other symptoms related to ABI, the level of photophobia varies with the severity of the injury.

We can help these patients quite quickly and easily through the use of tints. This intervention can be added to a standard pair of glasses or prescribed as a fit-over on top of glasses or contact lenses. Researchers studied 51 concussed patients, 76% of whom complained of photophobia. Of those patients with photophobia, 85% were successfully treated with tints.[2] In our experience at Southern College of Optometry (SCO) in the Vision Therapy & Rehabilitation Service, we can boast of similar treatment results. Here, we will present a case of successful treatment of ABI-related photophobia.

Case

A 19-year-old female college student presented with complaints of visual fatigue when reading, intermittent headaches and photophobia and increased blinking and refocusing with watering since her concussion 15 days prior. She also reported that her comprehension was worse and that she felt foggy since the event. While she was a college athlete, the concussion was sustained when a light fixture fell on her during a party.

The patient did not have a history of glasses wear, as was evident from her 20/20 acuities OD, OS and OU. Her confrontation fields, EOMs and pupils were all normal. Her BIVSS score was 65; a score above 31 is a

A variety of tints from the Chadwick Optical ABI flipper set and the Bowan grating card.

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.

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References: 1. Medeiros FA, Meira-Freitas D, Lisboa R, Kuang TM, Zangwill LM, Weinreb RN. Corneal hysteresis as a risk factor for glaucoma progression: a prospective longitudinal study. Ophthalmology. 2013 Aug;120(8):1533-40. 2. De Moraes CV, Hill V, Tello C, Liebmann JM, Ritch R. Lower corneal hysteresis is associated with more rapid glaucomatous visual field progression. J Glaucoma. 2012 Apr-May;21(4):209-13. 3. Susanna CN, Diniz-Filho A, Daga FB, Susanna BN, Zhu F, Ogata NG, Medeiros FA. Am J Ophthalmol. A Prospective Longitudinal Study to Investigate Corneal Hysteresis as a Risk Factor for Predicting Development of Glaucoma. 2018 Mar;187:148-152. doi: 10.1016/j.ajo.2017.12.018. 4. Felipe A. Medeiros, MD and Robert N. Weinreb, MD. Evaluation of the Influence of Corneal Biomechanical Properties on Intraocular Pressure Measurements Using the Ocular Response Analyzer. J Glaucoma 2006;15:364–370.

The patient wearing her FL-41 lenses.

red flag. Her cover test showed four exophoria at distance and 10 exophoria at near. A Maddox rod, along with a Thorington card at near, showed nine exophoria with a 0.5 left hyperphoria. Her NPC was receded at 7/9, 9/12 and 10/12 for break/recovery x three. Her near base-out vergence range was x/18/2, and her accommodative amplitudes were 5.00D OD and OS.

In working with concussion patients, the first goal is to make them more comfortable. Since small vertical misalignment can be a huge issue for ABI patients, we trialed a 0.5 base-down prism in front of the left eye, and the patient reported immediate improvement in the form of better clarity and focus.

Then, using the Bowan grating card—an alternating black and white card—we showed her five or six different tints from a premade, commercially available set from Chadwick Optical. Usually the response to a specific tint is immediately positive or negative, and this was indeed the case for this patient. She liked the most popular tint, the FL-41. The set has three saturation levels: 27%, 50% and 75%, and she appreciated the lightest tint. The prism and tint were made onto a base of plano lenses, and the patient was scheduled for a follow-up in four to six weeks to recheck her binocular status.

At the follow-up, the patient reported that her symptoms were significantly reduced and that she was wearing her glasses less and less. She was still visually fatigued, had occasional headaches and was having trouble focusing, but her fogginess and photophobia had abated. Her BIVSS score was now 42. Her binocular and accommodative testing continued to show a convergence insufficiency, and eye movement testing from RightEye showed poor fixation and saccades.

She was told to continue wearing her glasses full-time, and she was enrolled in vision therapy. While convergence insufficiency is a relatively easy condition to treat with therapy, the fact that it was secondary to a concussion in this case added an extra layer of complication. Even so, we expect her to make a full recovery.

Discussion

At SCO, we are lucky in that we have an amazing optical staff, and they have the most common tint formulas, including times for different saturations, down pat. Speak to your local optical and see if they can do the most common FL-41 as a starting point. The other option is to use an optical like Chadwick, which produces the ABI flipper set that we use most often to help patients select their preferred tint and saturation. There are six flippers in the set, with 12 different color/saturation combinations to choose from. Chadwick can make a pair of glasses with a specific prescription and tint in the frame of your choice. Fit-overs are the quickest way to get the tint on the patient. There are many commercial avenues to get FL-41 fit-overs in various saturations, and Chadwick has recently introduced fit-overs in several other colors as well.

Adding specialty tints for ABI to your practice not only sets you apart from other practitioners but also helps your patients recover from their injuries quicker. For young patients who play sports, concussions are unfortunately part of the game. Don't assume that only football players are affected, as we have actually seen more concussions from soccer, basketball and volleyball. We have also not seen a gender or age preference with ABI. We have cared for stroke patients in their 30s; neurological disease can impact anyone. Consider adding a question about brain injury in your history evaluation. You will be shocked at how many people have ABI-related symptoms, especially photophobia, and how much of a difference you can make in their quality of life with even simple management methods. ■

1. Suchoff IB, Kapoor N, Waxman R, Ference W. The occurrence of ocular and visual dysfunctions in an acquired brain-injured patient sample. J Am Optom Assoc. 1999;70(5):301-8.

2. Clark J, Hasselfeld K, Bigsby K, Divine J. Colored glasses to mitigate photophobia symptoms post-traumatic brain injury. J Athl Train. 2017;52(8):725-9.

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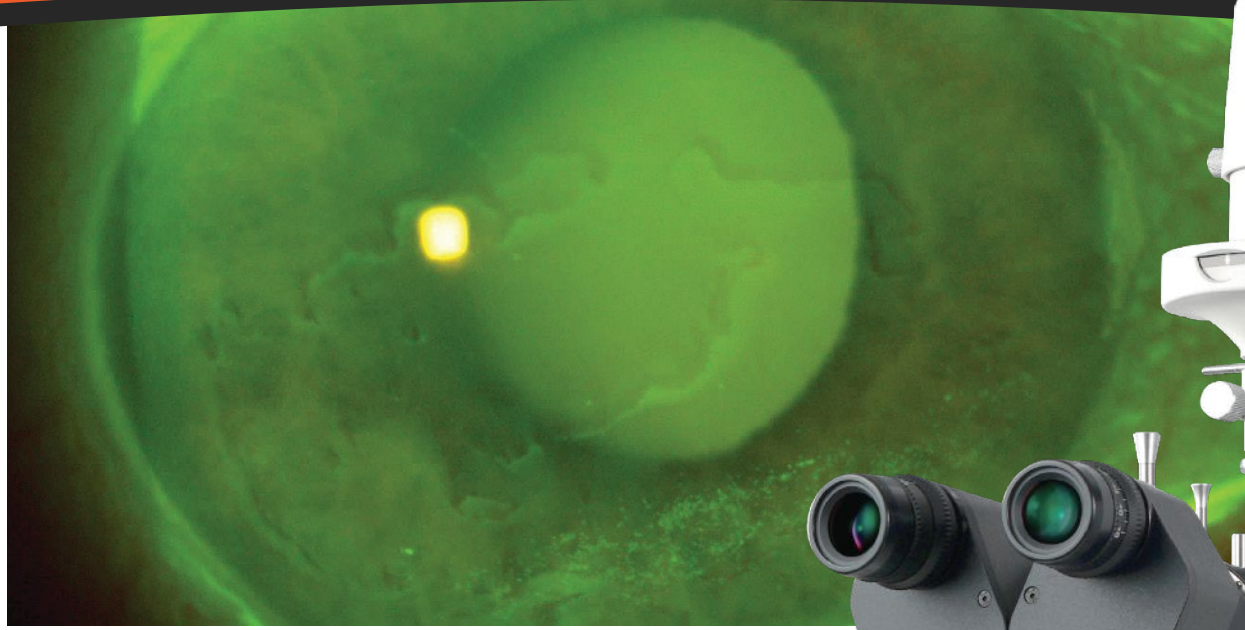

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BY JEROME SHERMAN, OD, AND SHERRY BASS, OD

A Tragic Headache

Those who examine a pregnant patient before you do may be wrong. It's your opportunity to get it right.

A 33-year-old in her 33rd week of pregnancy presented to the emergency department (ED) of a small rural hospital. Her chief complaint was severe headaches on her left side. She reported no history of trauma. Several ER doctors evaluated her and obtained a CT scan, which was read as normal. This small rural hospital did not have an MRI, and the nearest facility with one was about 25 miles away. No contusions on the face were noted.

The diagnosis that was then arrived upon was migraines, and she was treated with Imitrex (sumatriptan, GlaxoSmithKline) for the headaches and improved hydration. No neurologist was available in the ED at that time to evaluate the patient. Her OB-GYN was not contacted and the ED doctors did not attempt to obtain an OB-GYN consult at that time.

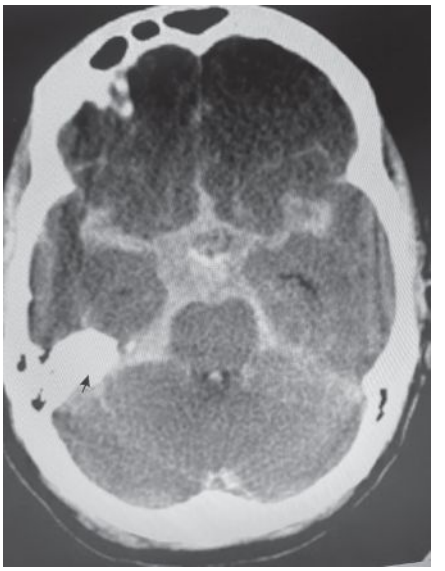
She was not hospitalized but was evaluated the next day by her ear, nose and throat doctor, who was affiliated with the small rural hospital and hence had access to the records from the ED. He reviewed the CT scan from a day earlier and diagnosed sinus involvement and treated her with oral antibiotics.

Presentation

Three days later, she was examined by her optometrist, who obtained a history, then recorded normal VA in both eyes and a normal fundus evaluation. The OD noted that both pupils reacted to light. He observed anisocoria, and occasional diplopia in extreme positions of gaze was identified, which were not present on previous exams by the same optometrist. The patient reported to the OD the normal CT scan several days earlier, as well as the diagnoses of migraine headaches, dehydration and a sinus infection and the treatments prescribed. When asked, she stated that she was taking the meds as prescribed. The optometrist concluded that the very pregnant woman should have a neurological evaluation ASAP, but he could not obtain one directly because of the patient's health insurance rules.

However, he was able to arrange for the patient to be seen by her primary care physician (PCP) early the next morning. He faxed over all his records and stressed in his note that he observed anisocoria for the first time and highly recommended a referral to neurology ASAP. The PCP evaluated the patient the next morning, was aware that the patient was referred by her optometrist based upon an exam the previous day, reviewed the history, performed an exam and arranged for the next available neuro consult several days later.

Tragically, the patient died two days before the scheduled appointment with the neurologist. The cause of death was determined to be a subarachnoid bleed. All attempts to save the near-term baby were unsuccessful. The woman and her unborn daughter were buried together.



On CT scans, blood appears white. Depicted here is a subarachnoid hemorrhage (black arrow) on the right side of the brain from a different patient. There was no such obvious bleed in this tragic case.

Not surprisingly, everyone involved in the care of this patient in the last week of her life was sued for malpractice, including the hospital and the personnel in the ED and the radiologist, who concluded that the CT scan was within normal limits. As anticipated, the ENT MD, OD and patient's PCP were all included in the lawsuit.

You Be the Judge

What caused the subarachnoid bleed? A pre-existing aneurysm that burst because of the physiological and/or psychological stress of pregnancy? Unreported head trauma secondary to spousal abuse? Is anisocoria nearly

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.

always caused by serious disorders in the brain?

Let's blame the EMR? OK, but why? Is this a case of bad disease and not bad doctors?

If you were the OD, what would you have done?

Our Opinion

One of us (Dr. Sherman) reviewed all the available information and concluded that the optometrist met the existing standard of care. It is important to note that migraine headaches are considered one of the more common causes of anisocoria, but rare etiologies, such as subarachnoid hemorrhages, are occasionally encountered. In malpractice allegations, the legal system often considers what "a like practitioner would do under like circumstances." In this case, a like practitioner would likely have done the same.

The OD was aware that the patient was dismissed by the MDs at the local hospital but still was quite concerned and reasoned that a neurologist may be able to determine the cause of the patient's symptoms and clinical findings. If the patient's health care plan would have allowed for a direct referral to a neurologist, at least one day would have been saved and it is possible that the tragic outcome would have been avoided.

Plaintiff's experts for the surviving family members argued that a lumbar puncture should have been performed and may have been diagnostic of a bleed. The nearest MRI was 25 miles away at a larger hospital, but a lumbar puncture could have been performed in the ED during the same visit.

Outcome

The case against all the defendants was settled prior to a jury trial. The insurance companies for all the defendants contributed to the final global award, which was under a million dollars. The insurance company for the OD contributed a very small fraction of this amount.

Generally Accepted Standard of Care for Emergency Room Physicians

- If the CT is interpreted as negative but a ruptured aneurysm is still suspected (recent onset of significant headache with no prior migraine history), a lumbar puncture should be performed to detect blood in the cerebrospinal fluid.
- If blood is detected in cerebrospinal fluid, obtain a cerebral angiography or tomographic angiography to determine the location, size and shape of a probable aneurysm.

Comments

Hormonal changes and hemodynamic stress during pregnancy may cause an increase in the risk of aneurysm development and rupture (especially during the last trimester). The incidence of subarachnoid hemorrhage during pregnancy is one in every 10,000 patients, a rate five times higher than in nonpregnant woman.[1]

The emergency department MDs may or may not have been culpable in this case, but this can be best argued by dueling expert witnesses on both sides in the same specialty. Did the radiologist miss the bleed? Should the radiologist have recommended an MRI? Experts in neuroradiology for the plaintiff and for the defense can render their opinions after reviewing the CTs.

A female neurologist friend/colleague who learned about this case opined that OB-GYN should have been consulted in the ED before dismissing the patient. An MD/PhD neuroradiologist friend who frequently testifies in malpractice cases opined that "CT scans can be normal in some patients with subarachnoid hemorrhage, and especially if the headaches commenced greater than 48 hours prior to the scan."

A review of the PCP's deposition revealed several problems in the existing health system and in EMRs. The PCP testified that she could not order an MRI, but it could be ordered by the neurologist who never had the opportunity to examine the patient because of the death several days before the scheduled exam.

The PCP also testified that she never saw the faxed records from the optometrist but recognized that the patient was referred by her optometrist. She went on to explain in her deposition that the faxed records went into the "tank or holding tank" of their EMR system, and she was never educated about how to obtain the fax or how long the fax would remain in the holding tank before being transferred to the patient's records. The technician who typically performed this task was not present for the 8am appointment.

During the deposition, the PCP was not asked the obvious question: If she had reviewed the referring optometrist's records and report during her evaluation, would she have done anything differently such as immediately have the patient transferred to an ED of a major medical center? We will never know.

If this case went to trial, a sympathetic jury may have found some or even all of the defendants culpable of malpractice, and the jury award could have perhaps been in the many millions.

Although the OD met the standard of care, this case demonstrates in general that multiple MDs who examine a patient before you do may be wrong and you have the opportunity, if not the responsibility, to get it right. An immediate referral by the OD to the ED of a major hospital may just have altered the outcome in this tragic case. ■

1. Fox MW, Harms RW, Davis DH. Selected neurologic complications of pregnancy. Mayo Clin Proc. 1990;65(12):1595-618.

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.

DEVELOPING A CONSTRUCTIVE APPROACH TO CASE HISTORY

From pre- to post-exam, learn how to retrieve, document and use this information to optimize patient care.

BY JULIE TYLER, OD, AND MELISSA TAWA, OD
ANAHEIM, CA

For many optometrists, the most valuable resource we can save is our time. In some situations, clinicians may choose to buy themselves time between exams by performing a more brief, less refined medical history, despite its critical role in patient care. However, by implementing tools to streamline patient intake and case history gathering, doctors can execute a more focused approach to patient management and develop fuller potential diagnoses. In addition, giving case history the proper attention helps show the patient in your chair that you value and care for them as more than just a number on your schedule.

Knowing which questions to ask and information to obtain from the patient in your chair throughout the examination and beyond can crucially guide care and influence patient outcomes.[1] Here, we offer practical recommendations to enhance the experience of your patients and refine your overall case history skills, recognizing that this process continues throughout the exam.

Fig. 1. Dr. Tyler taking a patient's case history.

As you're reading through these suggestions, keep in mind the words of Oliver Sacks: "There is only one cardinal rule: one must always listen to the patient."[2]

Intake Forms

To gather a more efficient and comprehensive case history, clinicians should first consider the type of intake forms given to their patients. These documents are available in a wide variety of styles depending on the practitioner's preferences and goals. Often, offices incorporate a generic intake form, whether on paper or within an automated system, that does not reflect the clinic's environment or demographics. On the other hand, when these forms do reflect the type of practice, doctor's specialty and common patient populations seen within the office, the information collected will enhance the quality and efficiency of the case history and exam. An example of this customization could be adding keratoconus as a pertinent part of an ocular history intake form at a specialty contact lens practice.

We provided an example of an intake form on pages 35-36, and throughout this article we'll highlight different sections that can be modified to better

About the authors

Dr. Tyler is an associate professor at Southern California College of Optometry at Marshall B. Ketchum University. **Dr. Tawa** is currently on faculty at Southern California College of Optometry at Marshall B. Ketchum University. They have no financial interests to disclose.

Example of Eye History Including Section for Elective Procedures

Condition	Self (Indicate X if Yes)	Family
Eye turn/strabismus/lazy eye		☐ Y ☐ N Relation:_____
Childhood cataracts		☐ Y ☐ N Relation:_____
Glaucoma/suspect		☐ Y ☐ N Relation:_____
Macular degeneration		☐ Y ☐ N Relation:_____
Previous eye injection(s)		Eye and type of injection if known:
Retinal tear/detachment		Eye and type of management if known:
Dry eye		
LASIK/refractive surgery		
Other eye condition(s)		☐ Y ☐ N Relation:_____
Previous eye injury		
Previous eye surgery		Type of surgery:
Elective or other facial procedures		Type of surgery/procedure:

suit the needs of your patients. This involves taking into consideration factors such as demographics and commonly treated conditions at your clinic, as well as your practice modality. Taking the time to customize these tools for your office will guide the case history interview and allow you to recognize earlier in the exam the types of conditions you may be looking for. Consider tearing out the example intake form to use at your practice or reference when contriving your own.

Ensure inclusivity. Intake forms with inclusive language can set the tone for a patient's experience in the office and help establish trust even prior to being seen by a technician or the doctor. Options for pronouns with checkboxes and a "fill-in-the-blank" line allow patients to easily select how they identify themselves. While we often use "other" in various portions of our intake forms (*e.g.*, "other medications"), the use of "other" in the setting of pronouns can alienate patients who don't fit into the listed categories.[3] By including an option to write in pronouns that aren't listed, the practice indirectly supports inclusivity (see the following example).

Example of demographic collection with attention to inclusivity:

Chosen Name (Last, First): _____

_____

Legal Name (if different from chosen):

_____

Date of Birth: _____ Birth sex: ____

Pronouns: ☐ he/him ☐ she/her

☐ they/them ☐ _____

Address:

_____

City: _____

State: ____ Zip: _____

Home Phone: _____

Cell Phone: _____

Ask patients directly about past cosmetic procedures. When completing an intake form or during case history, many patients may not think to disclose past facial cosmetic procedures such as Botox or blepharoplasty. Some might be hesitant to admit it and others may not realize it's germane to eye health. Here's why they're mistaken.

Botulinum toxin belongs to a class of medications described as neurotoxins and is used for the management and treatment of both therapeutic and aesthetic applications. Therapeutic uses for botulinum toxin (Botox) include chronic migraines, musculo-spasmodic disorders (such as blepharospasm and hemifacial spasm), occipital or trigeminal neuralgia and numerous other systemic spasmodic and pain associated conditions—in addition to use for cosmetic purposes.[4]

While patients may not think to associate recent Botox injections or other cosmetic procedures with visual symptoms such as new-onset diplopia, facial paresis or symptoms of dry eye, aesthetic procedures have been shown to result in ocular complications.[5-7] Some examples of specific complications from elective cosmetic surgery include periocular botulinum toxin injection that may result in decreased tear expression due to infiltration of the lacrimal gland and dermal fillers that have been associated with retinal arterial occlusions, causing temporary or even permanent vision loss.[5,6]

Additionally, even if an outcome is cosmetically "successful," the procedure may result in restrictions to lid-closure strength associated with Botox or overcorrection on blepharoplasty that can cause exposure-related dry eye.

For all these reasons, creating space on the intake form—or including questions within your verbal case history—to ask patients specifically about elective/cosmetic procedures may be invaluable to identifying potential etiologies and addressing their visual symptoms while helping streamline the exam (see example above left).

Be mindful of patients using high-risk medications. In addition to the medications prescribed by optometrists, there are a wide variety of drugs that can have ocular side effects or adverse reactions (*Table 1*).[8,9] Ideally, the risks should be identified early in an exam to guide the practitioner's attention during the ocular health evaluation and to identify necessary ancillary testing. Ocular risks from pharmaceutical agents may result from any formulation of a medication (*e.g.*, topical, oral, inhaled) although some presentations may have higher risk of side effects. Specifically inquiring within the intake and/or early in the verbal case history about the use of OTC medications, topical agents (*e.g.*, creams, gels, ointments) and inhalers may allow practitioners to identify potential complications and ocular impacts of these less commonly reported methods of medication distribution.

TABLE 1. MEDICATIONS WITH HIGH RISK FOR OCULAR MANIFESTATIONS[8,9]

Drug Name/Class	Systemic Usage	Ocular Manifestations
Chloroquine, Hydroxychloroquine	Rheumatoid arthritis, lupus, other autoimmune conditions	Retinal toxicity (maculopathy)
Tamsulosin (Flomax)	Benign prostatic hyperplasia	Intraoperative floppy iris syndrome
Alpha-1 adrenoceptor antagonists (e.g., doxazosin, prazosin)	Hypertension	Intraoperative floppy iris syndrome
Corticosteroids (oral, topical, inhaler, injected)	Inflammation management, autoimmune diseases	Increased IOP, central serous chorioretinopathy, early cataract formation
Digoxin	Congestive heart failure, atrial fibrillation	Optic neuropathy, dyschromatopsia
Ethambutol	Tuberculosis	Optic neuropathy
Isoniazid	Tuberculosis	Optic neuropathy
Amiodarone	Arrhythmias	Optic neuropathy, corneal verticillata
Isotretinoin	Acne	Night blindness, pseudotumor cerebri, optic neuritis
Topiramate (Topamax)	Epilepsy, migraine	Myopic shift, acute angle closure
Vigabatrin	Seizures	Visual field constriction
Phosphodiesterase-5 inhibitors	Erectile dysfunction, pulmonary hypertension	Non-arteritic anterior ischemic optic neuropathy

In an observational case series comparing self-reported medication use from patients at follow-up visits in a primary care clinic with their EMR prescription orders, upon reconciliation almost 75% of patients had at least one discrepancy in medication, dosing or frequency. The most common type of discrepancy was an incorrect medication documented in the chart, and most were related to OTC use.[10]

When ocular complications/side effects occur, they range from mild to severe, asymptomatic to symptomatic, including risks for significant vision loss. *Table 1* lists medications with ocular risks, including those more commonly encountered medications with potentially serious ocular adverse events and ones to be attentive to when reviewing your patients' medication history.

Two medications that are commonly prescribed and associated with significant ocular risks in which we play a role in decreasing potential complications are tamsulosin (Flomax) and hydroxychloroquine (Plaquenil). These may warrant specific inquiry on an intake form or within a case history interview to ensure proper additional testing is completed and risks are communicated to the patient's providers for best interprofessional collaborative care and prevention (see example below).

Example of specific medication inquiry for ocular risk management:

Are you currently on or have you previously taken either of the following medications:
Tamsulosin (Flomax) ☐
☐YES ☐NO
Hydroxychloroquine (Plaquenil)
☐YES ☐NO
If Yes, current dose: _____
current weight: _____

A known history of tamsulosin use is critical for patients planning to have cataract extraction, as any prior use can lead to intraoperative floppy iris syndrome.[11] Discontinuation of tamsulosin prior to surgery may decrease but not eliminate the risk for the condition, partially due to the drug's long half-life. Tamsulosin can also irreversibly block a-1 adrenoceptors, potentially resulting in permanent iris atrophy. While some risks during cataract surgery may persist, noting other patient-related risk factors (including other risk-associated medications) and taking the appropriate pre- and intraoperative measures can address and/or prepare for potential cataract extraction complications and decrease overall risk for the patient.[12]

While the mechanism of hydroxychloroquine toxicity is not fully understood (or, for that matter, the medication's ability to support patients with a variety of autoimmune disorders), its potential for retinopathy is well-established and may be a reason that patients are referred to your practice for baseline examinations and ongoing monitoring of ocular risks. The guidelines for monitoring patients using hydroxychloroquine have been updated several times, with the most recent (as of this writing) being from 2016.[13] Management guidelines rely on additional personal information about the patient, including their dosing of mg/kg/day and medication use duration. If your practice frequently sees patients with rheumatologic conditions using hydroxychloroquine, a dedicated space for additional patient information—such as current dosage, length of use and body weight—on an intake form is ideal for making risk assessment easier to calculate.

Ask about past COVID-19 infection. Although COVID symptom screenings have very much been on the forefront of our intake processes since 2020, inquiring about date(s) of infection and symptoms of "long COVID" may be a less customary practice. Beyond follicular conjunctivitis, COVID-19 infections can result in ocular manifestations such as cotton wool spots and retinal hemorrhages, retinal vascular occlusions, optic

WELCOME TO THE EYE CENTER! Today's Date: _____ / _____/ _____

PLEASE COMPLETE THE FOLLOWING:

Chosen Name (last, first): _____ Date of Birth: _____ / _____/ _____

Legal Name (if different than chosen): _____ Height: _____ ft _____ in Weight:_____ lbs

Pronouns: ☐ he/him ☐ she/her ☐ they/them ☐ _____

Last EYE Doctor/Location: _____ Date of last EYE exam: _____

Primary Care Physician/Location: _____ Date of last PHYSICAL Exam: _____

Pharmacy/Location_____ Occupation: _____

SPECTACLE/CONTACT LENSES

Do you wear glasses? ☐ Yes ☐ No ☐ Full Time ☐ Part Time ☐ Distance Only ☐ Reading Only ☐ Multifocal

How old are your current glasses? _____

Do you wear contact lenses? ☐Yes ☐No Are you interested in a new contact lens design? ☐ Yes ☐ No

COMPUTER USE How many total hours per day do you use a computer, cell phone, tablet or play video games?
☐ 0-2 hours ☐ 2-4 hours ☐ 4-6 hours ☐ more than 6 hours

Do you use computer glasses? ☐ Yes ☐ No Are you interested in special glasses to make computer work easier? ☐ Yes

SPORTS AND LEISURE : What sports/hobbies do you participate in? _____

Do you wear any special eyewear for your sport/hobby? _____

Do you currently wear prescription sunglasses? ☐ Yes ☐ No Are you sensitive to bright lights? ☐ Yes ☐ No

_____

What is the **MAIN reason** for your visit today? _____

Do you have any other visual/eye problems? _____

REVIEW OF SYSTEMS ***Are you currently experiencing any of the following symptoms?***

☐ **Please check here if ALL of review of systems is NO**

Category	Current Symptoms	Yes	Category	Current Symptoms	Yes	Category	Current Symptoms	Yes
Constitutional	Fever		***Genitourinary***	Burning while urinating		***Musculoskeletal***	Unexplained muscle pain	
	Unexplained Weight Loss			Difficulty urinating			Joint pain/restricted movement	
	Unexplained Fatigue			Blood in urine			Lower back pain	
Cardiovascular	Chest pain		***Head***	Sore throat		***Neurologic***	Muscle weakness	
	Difficulties with exertion			Hearing loss			Tingling in extremities	
	Irregular heart beat			Hoarse voice			Dizziness	
Endocrine	Increased urination			Loss of smell			Dimming of vision	
	Increased thirst			Sinus congestion		***Psychiatric***	Ongoing depression	
	Increased appetite		***Hematologic/ Lymphatic***	Swollen glands			Memory lapses	
Gastrointestinal	Constipation			Easy bruising			Disorientation	
	Diarrhea		***Integumentary (Skin)***	Unexplained skin rashes		***Respiratory***	Shortness of breath	
	Blood in stool			Itching of skin			Persistent cough	
				Pigmented areas			Wheezing sounds	

PLEASE TURN OVER →

MEDICATIONS

Please include all medications, including inhalers, contraceptives and over the counter

Medication Name	Purpose	Dose	Medication Name	Purpose	Dose
Over-the-counter/Topical			Eye drops		

Are you *currently* on or have *previously* taken either of the following medications:

Tamsulosin (Flomax) ☐ YES ☐ NO.

Hydroxychloroquine (Plaquenil) ☐ YES ☐ NO **If Yes** - current dose: _____

PLEASE CHECK ONLY THOSE BOXES THAT APPLY. UNCHECKED BOXES WILL MEAN "NO".

EYE HISTORY

Condition	Self	Family	
	Yes	Yes	Relation
Eye Turn/Strabismus/Lazy Eye			
Childhood cataracts			
Glaucoma/Suspect			
Macular Degeneration			
Retinal tear/detachment			
Dry Eye			
Previous Eye Injury			
Other Eye Conditions(s):			
Previous Eye Injection		Type of Injection:	
LASIK/Refractive Surgery		Type of surgery:	
Previous Eye Surgery		Type of surgery:	
Elective or other facial procedures		Type of surgery/procedure:	

SOCIAL HISTORY

	Yes
Drink alcohol	
Smoked in the past	
Currently smoke	Type
Recreational drug use	Type

REPRODUCTIVE HEALTH

	Yes
Pregnant - currently	
Nursing - currently	

ALLERGIES

	Yes
Seasonal	
Medication(s)	
Other	

MEDICAL HISTORY

Condition	Self	Family	
	Yes	Yes	Relation
Diabetes			
High blood pressure			
Elevated Cholesterol			
Heart disease/heart attack			
Sleep Apnea			
Migraine			
Thyroid disorder			
Stroke			
Cancer Type(s):			
Asthma/COPD			
Kidney disease			
Arthritis, Type(s):			
History of COVID-19 infection		Date of infection(s):	
Other:			

I verify that the information contained on this page is current.

_____

Patient Signature

_____

Date

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neuritis and paracentral acute middle maculopathy.[14,15] Additionally, the medical community does not understand the long-term ocular risks of COVID-19 infection. Specifically including past infection with COVID-19 within the medical history review may be beneficial in determining a potential etiology for ocular findings in a patient that does not fit a more established or other disease-related profile.

Now that we've discussed what to include and be mindful of on patient intake forms, let's review how to continue forming a sensible case history during the clinical examination.

EHR Systems and Record-Keeping

While there certainly are benefits to creating a readable template of data within an electronic health record (EHR) system, the EHR format may not be the most conducive to an efficient and personalized case history. The standard template design might make it challenging to understand each patient's needs and create a flow of questions that allows the clinician to fully appreciate the patient's health narrative. EHR templates are designed to fit within a screen and thus, often are not ideal for the actual nature of interviewing the patient in the exam chair.

In a study from 2015 regarding a qualitative assessment of EHR and "building the patient's story," the data revealed that EHR was obstructive to a clinician's ability to fully build the patient's story due to fragmentation of data and limits to the number and size of free-text spaces available for notes.[16] In short, the constraints of the EHR system "inhibited the clinicians' ability to read the why and how interpretations of clinical activities," especially if the care involved multiple team members. Varpio et al noted that EHR systems negatively impacted clinical reasoning and interprofessional collaborative practices, taking a longer time to "build the patient's story."[16]

For the reasons outlined, creating supplementary methods of assessment (*e.g.*, customized/localized intake forms, symptom surveys) and incorporating practices, like those listed below, may compensate for the limitations of an EHR case history template.

Whether you plan to record case history within an EHR or supplementary system, below are a few guidelines on best practices to optimize documentation of patient data.

Don't fall victim to "copy and paste." Now that most medical offices rely on electronic record-keeping, it can be tempting to cut corners for the sake of time, such as copy-forwarding the records of a patient's previous visit without edits. The practice of "copy and paste" is dangerous, as it discourages accurate updating of case histories, medications and potentially other exam components. When not edited, this shortcut omits patients' personal updates on their own health and well-being. Documenting how patients feel in their own words is an essential part of ongoing care, as it helps provide a fuller picture of the signs and symptoms, they experience from one visit to the next. As a reminder, *Table 2* lists best practices for EHR documentation as suggested by Weis and Levy.[17]

Be mindful of proper abbreviation use. The Institute for Safe Medicine Practices (ISMP) publishes the ISMP List of Error-Prone Abbreviations, Symbols and Dose Designations.[18] This list contains various abbreviations, symbols and dose designations that have been found in medical records and/or prescriptions and were reported through the ISMP National Medication Errors Reporting Program as associated with harmful or potentially harmful medication errors. It's recommended that these abbreviations/symbols never be used in medical communication. The list also identifies abbreviations/symbols that the Joint Commission recognizes on its own "do not use" list. Unfortunately, this list does contain the commonly used ocular abbreviations of OD and OS for right eye and left eye, respectively, as they can be confused with AD and AS (right ear, left ear). While unlikely to confuse eyecare providers, other healthcare practitioners may confuse the ocular and auditory abbreviations. Within an interdisciplinary setting, and when records may be seen by other types of healthcare providers, it is best to avoid the abbreviations OD and OS, as well as the other abbreviations/symbols on the ISMP list.

Asking Difficult Questions

Another area that can complicate taking patient histories during the exam involves discussing issues that may be perceived as sensitive topics from a patient perspective. Issues that are traditionally private—such as last menstrual period, sexual activity and mental health status—may be important to inquire about for the care of our patients. Not only may they be surprised that their eye doctor is interested in these areas of medical history, but patients may also not be forthright in disclosing information due to societal "norms" and expectations. Nevertheless, these personal history components may be crucial to determining differential diagnoses and related conditions, and what to prescribe for therapeutic management.

Let's discuss how to best communicate topics that may be sensitive to some patients.

TABLE 2. EHR BEST PRACTICE RECOMMENDATIONS[17]

The final author is responsible for all content of the signed document.
Review and update all copied or otherwise imported information meticulously.
Clearly identify all copied information.
Include attribution of source (date, time and original author) in copied text or data.
Data copied or imported should be essential and pertinent to the clinical encounter.
Invest in provider education to create high-quality documentation with EHR tools.

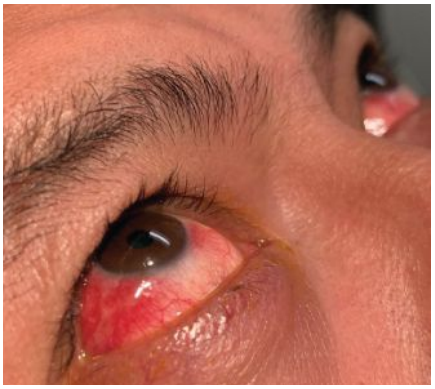

Fig. 2. This case of red eye in a patient presenting for a problem-focused exam may require fuller analysis of review of systems and questioning about STI.

Pronouns. While asking patients which pronouns they use might initially seem awkward, using the wrong ones is an even bigger blunder. Using correct pronouns throughout the examination and case history demonstrates respect and inclusivity, and consequently, it can help build patient rapport. Patients may not disclose pertinent information if they feel alienated at any point during the appointment.[19] On the other hand, some patients are unaccustomed to these types of questions and may react adversely to them. How do we balance this?

This is where intake forms and annual history updates can be beneficial, recognizing that gender identity may change over time. Normalizing gender identity throughout the office can be helpful to create a safe space. For example, using pronoun identification on staff and doctor nametags and introductions such as, "Hello, my name is Dr. Eye. My pronouns are she/her. How would you like to be addressed?" can reinforce positive attitudes and patient commitment to the practice.[20]

Substance use. Inclusion of social history questions regarding substance use on a patient response intake form may help break the ice for conversations regarding use of alcohol, tobacco, vaping and other legal and/or illegal drugs. Substances that are subject to abuse can affect the eye either directly (*e.g.*, alcohol-induced diseases such as optic neuropathy) or indirectly (*e.g.*, talc retinopathy associated with cocaine use).[21-22] Eloge et al has proposed incorporating questions regarding substance use into the history of present illness rather than only in the social history due to the fact that substance use disorders are pervasive in the US and permeate a variety of medical specialties.[23] Explaining the reasoning behind the case history questions can help reassure patients of your goals for inquiry and provide them with a more complete understanding of various factors that connect to ocular health.

In the current age of EHRs and patient portals, patients may want access to their exam records. While they may use colloquial language to describe

TABLE 3. STANDARDIZED HISTORY SURVEYS

Ocular Diseases	Accessible Links
MERSI: Ocular Inflammatory Disease Review of Systems[25]	uveitis.org/patient_articles/ocular-inflammatory-disease-review-systems-questionnaire
Dry eye	
Standard Patient Evaluation of Eye Dryness Questionnaire (SPEED)[26]	www.reviewofoptometry.com/cmsdocuments/2022/05/speed-questionnaire.pdf
Ocular Surface Disease Index (OSDI)[27]	www.reviewofoptometry.com/cmsdocuments/2022/05/osdi.pdf
Binocular Vision	
Convergence Insufficiency Symptoms Survey (CISS)[28]	wowvision.net/wp-content/uploads/2014/08/ci-screening-and-symptom-survey.pdf
Diplopia Questionnaire[29]	public.jaeb.org/pedig/view/diplopiaquest

their substance use, the use of person-first language by healthcare professionals is critical in reducing stigma around substance use disorders. For example, instead of documenting "patient is a substance abuser," an alternative would be, "patient has a history of substance use disorder" or "patient who uses IV drugs."[24]

Sexually transmitted infections (STIs). The CDC has excellent resources about STIs, including "A Guide to Taking a Sexual History."[24] Within the recommendations for taking STI history is a suggestion to follow what's known as the "5 Ps" approach, representing questioning of the patient regarding (1) Partners, (2) Practices, (3) Protection from STIs, (4) Past history of STIs and (5) Pregnancy intention. A deeper dive into case history, including STI inquiry, may be warranted in situations when patients come for an exam with an atypical red eye (*e.g.*, hyperacute conjunctivitis) or persistent red eye despite attempted management or when traditional questions regarding discharge and exposure to another person with a red eye are unclear (*Figure 2*). In such cases, careful review of the patient's review of systems in the areas of genitourinary symptoms, rashes and feelings of general fatigue and/or malaise may suggest or support questioning regarding recent sexual activity, understanding that the patient may require additional work-up including an assessment for STI.

The patient may be guarded in their response to these types of questions; however, educating them as to why you're performing a more complete case history may encourage understanding and openness on their part. Also, if STI testing is recommended based on history, having a list of patient resources in your area is essential.

Continuing History Post-Exam

Forming a complete case history for each patient takes place before an exam via intake documents, at the start of an exam with a formal history interview and during the exam as concerning clinical findings are identified and warrant questioning. Case history may also continue during down time (*e.g.*, dilation) or beyond the allotted exam time by utilizing various surveys and questionnaires. These ancillary tools are especially valuable for patients with findings that warrant timely follow-up, additional management/comanagement and those suffering from conditions that have been previously studied and assessed (*Table 3*). Examples of conditions with well-established and validated surveys and questionnaires include dry eye, convergence insufficiency and uveitis, to name a few.

Having printed copies of questionnaires for patients to fill out during downtime may be an effective use of in-office time. However, these surveys, especially those that are longer, can also be provided to patients to fill out at home prior to their next visit. This allows the patient to gather additional history and reflect about ongoing signs and symptoms prior to their follow-up visit, which may help further direct long-term care. This type of "continued" case history may also be used for patients who do not have a definitive diagnosis but have findings warranting additional workup such as in the case of a new, bilateral uveitis patient or patients who have variable symptoms (*Figure 3*).

As suggested for patient intake forms, it may also be helpful to find surveys and questionnaires that reflect the type of patients most frequently seen at your practice. For example, if you work at a low vision practice, you may want to include night blindness as a question on the patient history form.

A resource available to the public for various standardized tests in the areas of pediatric and binocular vision management—including surveys of symptoms related to atropine for myopia and nasal-lacrimal duct obstruction—may be found at: public.jaeb.org/pedig/view/reference (associated with the Pediatric Eye Disease Investigator Group). Dry eye questionnaires and surveys have

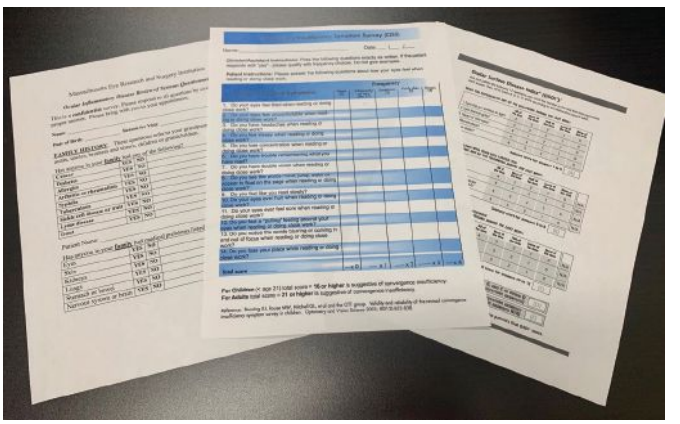

Fig. 3. Various standardized surveys, which may be printed out for patients with specific ocular findings to assist in more complex histories before or after an exam. (Left to right: MERSI, CISS, OSDI).

been curated by EyeWiki and can be downloaded at: eyewiki.aao.org/dry_eye_syndrome_questionnaires.

Final Thoughts

Case history information gathered by a variety of methods can guide and direct patient examinations. Efforts to adapt intake forms and history-taking techniques to reflect a practice's community may be invaluable to provide effective patient care.

We'll leave you with a few insightful words from Warner Slack, MD, an EHR pioneer: "The largest and least utilized healthcare resource is the patient him/herself."[31] ■

1. Halkett GKB, McKay J, Shaw T. Improving students' confidence levels in communicating with patients and introducing students to the importance of history taking. Radiography. 2011;17(1):55-60.

2. Oliver Sacks (2013). "Migraine", p.309, Vintage from Oliver Sacks. (n.d.). AZQuotes.com. www.azquotes.com/quote/827371. Accessed December 12, 2022.

3. Kronk CA, Everhart AR, Ashley F, et al. Transgender data collection in the electronic health record: current concepts and issues. J Am Med Info Assoc. 2011;29(2):271-84.

4. Busey B, Esparza MJ. The evidence for noncosmetic uses of botulinum toxin. J Fam Pract. 2020;69(9):447-53.

5. Coroneo MT, Rosenberg ML, Cheung LM. Ocular effects of cosmetic products and procedures. Ocul Surf. 2006;4(2):94-102.

6. Ricci LH, Navajas SV, Carneiro PR, Söderberg SA, Ferraz CA. Ocular adverse effects after facial cosmetic procedures: a review of case reports. J Cos Derm. 2015;14(2):145-51.

7. Langsdon PR, Schroeder RJ 2nd. Recognizing, managing, and guiding the patient through complications in facial plastic surgery. Facial Plast Surg Clin North Am. 2020;28(4):483-91.

8. Pula JH, Kao AM, Kattah JC. Neuro-ophthalmologic side-effects of systemic medications. Curr Opin Ophthalmol. 2013;24(6):540-9.

9. Syed MF, Rehmani A, Yang M. Ocular side effects of common systemic medications and systemic side effects of ocular medications. Med Clin North Am. 2021;105(3):425-44.

10. Stewart AL, Lynch KJ. Identifying discrepancies in electronic medical records through pharmacist medication reconciliation. J Am Pharm Assoc. 2012;52(1):59-68.

11. Christou CD, Tsinopoulos I, Ziakas N, Tzamalis A. Intraoperative floppy iris syndrome: updated perspectives. Clin Ophthalmol (Auckland, NZ). 2020;14:463.

12. Kumar A, Raj A. Intraoperative floppy iris syndrome: an updated review of literature. Int Ophthalmol. 2021;41:3539-46.

13. Marmor MF, Kellner U, Lai TY, Melles RB, Mieler WF. Recommendations on screening for chloroquine and hydroxychloroquine retinopathy (2016 rev). Ophthalmol. 2016;123(6):1386-94.

14. Sen M, Honavar SG, Sharma N, Sachdev MS. COVID-19 and eye: a review of ophthalmic manifestations of COVID-19. Indian J Ophthalmol. 2021;69(3):488.

15. Zhang Y, Stewart JM. Retinal and choroidal manifestations of COVID-19. Curr Opin Ophthalmol. 2021;32(6):536-40.

16. Varpio L, Rashotte J, Day K, King J, Kuziemsky C, Parush A. The EHR and building the patient's story: A qualitative investigation of how EHR use obstructs a vital clinical activity. Int J Med Inform. 2015;84(12):1019-28.

17. Weis JM, Levy PC. Copy, paste, and cloned notes in electronic health records. Chest. 2014;145(3):632-8.

18. Institute for Safe Medication Practices (ISMP). ISMP list of error-prone abbreviations, symbols, and dose designations. ISMP. 2021.

19. Bindman J, Ngo A, Zamudio-Haas S, Sevelius J. Health care experiences of patients with nonbinary gender identities. Transgender Health. 2022;7(5):423-9.

20. The Washington Post. The inclusivity trap. Published February 9, 2021. www.washingtonpost.com/outlook/2021/02/19/gender-pronouns-doctors-patients-medical. Accessed December 2022.

21. Karimi S, Arabi A, Shahraki T. Alcohol and the eye. J Ophthalmic Vis Res. 2021;29;16(2):260-70.

22. Shah VA, Cassell M, Poulose A, Sabates NR. Talc retinopathy. Ophthalmology. 2008;115(4):755.

23. Eloge J, Napier TC, Dantz B. Integrating substance use disorders or "use" into the medical history. Sub Abuse. 2018;39(4):505-8.

24. Chan C. Back to basics: a stigma-free history. The Curbsiders. thecurbsiders.com/addiction-medicine-podcast/8-back-to-basics-a-stigma-free-history. Accessed December 2022.

25. Centers for Disease Control and Prevention. A guide to taking a sexual history. 2021. www.cdc.gov/std/treatment/sexualhistory.htm. Accessed December 2022.

26. Foster CS, Vitale AT. Diagnosis and treatment of uveitis. 2nd ed. New Delhi: Jaypee Brothers Med Pub Ltd. 2013;20-32.

27. Ngo W, Situ P, Keir N, et al. Psychometric properties and validation of the standard patient evaluation of eye dryness questionnaire. Cornea. 2013;32(9):1204-10.

28. Schiffman RM, Christianson MD, Jacobsen G, Hirsch JD, Reis BL. Reliability and validity of the ocular surface disease index. Arch Ophthalmol. 2000;118(5):615-21.

29. Convergence Insufficiency Treatment Trial (CITT) Investigator Group. Validity of the convergence insufficiency symptom survey: a confirmatory study. Optom Vis Sci. 2009;86(4):357.

30. Holmes JM, Liebermann L, Hatt SR, Smith SJ, Leske DA. Quantifying diplopia with a questionnaire. Ophthalmology. 2013;120(7):1492-6.

31. deBronkhart D, Sands DZ. Warner Slack: patients are the most underused resource. BMJ. 2018;362:k3194.

CLINICAL SKILLS REFRESHER:
27 BRIGHT IDEAS FOR BETTER EXAMS

From gonioscopy to peripheral 3-mirror evaluation, we offer suggestions to improve core diagnostic elements without fancy equipment.

BY SARA WEIDMAYER, OD, WITH NANCY PETERSON-KLEIN, OD
ANN ARBOR, MI

No matter how long we've been in practice, we always have more to learn—the art of practicing optometry is just that. We can continue to pick up little nuggets as we go, and sometimes spending time talking to other ODs to glean these gems is all it takes.

The tips offered here will improve your exam techniques in the clinic with regular ol' equipment, and range from somewhat technical to ridiculously practical. While some may make you say "duh," hopefully at least one or two will be worthwhile and help you become a more savvy diagnostician.

Slit Lamp Tips

1. We all have patients who just can't quite lean into or stay in the slit lamp for very long. You know what I'm talking about—big bellies. I see a lot of these in my practice and have learned that the most effective positioning tip is this: ***ask the patient to spread their legs apart and bend forward at their hips.*** This way, they don't have to strain to bend forward over their belly; they can keep their back straight while hinging forward and you can put an end to labored breathing to stay in the slit lamp (*Figure 1*).

Fig. 1. Ask your patient to spread their legs apart and bend forward at their hips for a more comfortable fit into the slit lamp.

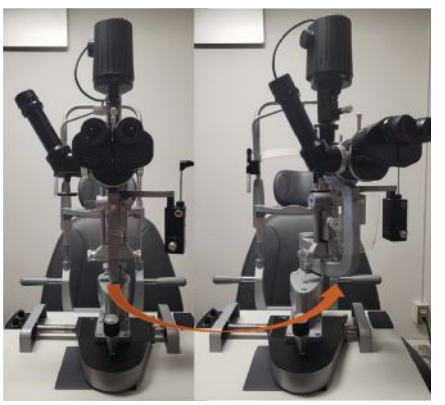

Fig. 2. The entire ocular-light source unit can be turned to adjust the orientation of the light source.

2. We share some responsibility with other healthcare providers for the whole patient. One simple and frequently encountered aspect of this is dermatologic lesions that are outside of the periorbital area. We should care about those, too.

Before jumping into the exam, take a few moments to look at the patient as a whole. I can't tell you how many cheeks, ears, noses, scalps and arms that have been biopsied or underwent micrographically oriented histographic

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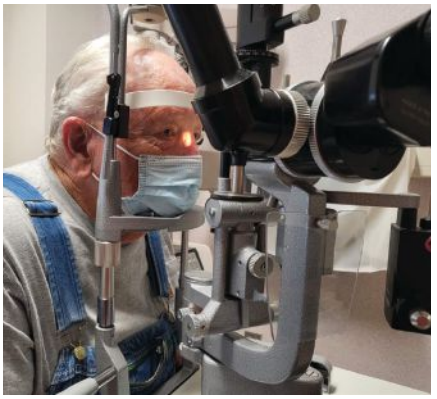

Fig. 3. Turning the ocular-light unit allows you to better visualize areas at the slit lamp that are otherwise hard to see if it is tangential to the area of interest. Here, we can more easily evaluate a nasal sidewall lesion.

Fig. 4. Use the calipers on your slit lamp beam to measure.

surgery (MOHS) because I have referred suspicious lesions. It's helpful to look at some of these under the slit lamp, but not all areas are easily viewed when the patient is in a typical position for an exam. The nasal sidewall in particular is difficult because it is more tangential to the direction of the light beam. For this, simply adjust the orientation of your entire ocular unit (*Figure 2*). My slit lamp can move 50° in either direction from center, and this allows me to look more directly at the sides of the nasal bridge and entire nasal sidewalls (*Figure 3*).

3. One major key to detecting change is to know exactly what it was like at baseline. Photographs (or other imaging modalities) are critical in many circumstances, but even without fancy technology, we can all do better with just our basic tools.

Use a ruler or your slit lamp calipers to take actual size measurements of everything that could change: eyelid lesions, conjunctival melanosis, iris nevi, choroidal nevi—the works. As we know, the slit lamp light beam height and width is adjustable, and when we adjust it we can conveniently read the beam size in millimeters and then change its orientation to get actual 360° measurements of anything we want (*Figure 4*).

Fundus Exam Tips

4. When taking measurements in the fundus using the slit beam caliper and a condensing lens, there are adjustment factors to calculate the actual measurement depending on which lens you're using (i.e., 90D lens vs 78D lens). But guess what? I don't have time for that. For example, ***it's OK to write "1.2x3.4xflat (with 78D lens)" so you can quickly compare*** without having to whip out your calculator.

5. You know that red-free (AKA green) filter on your slit lamp? How often do you use it? While it's sometimes helpful to make choroidal nevi disappear with it, the potential of the red-free filter is greater than just that magic trick. Recall that red light has longer wavelengths than green, so the red-free filter blocks longer wavelengths and transmits shorter ones. In layman's terms, in the fundus it essentially suppresses visualization posterior to the RPE where the green light is reflected to make it look generally darker. It highlights superficial layers and makes red things, like blood and blood vessels, look black.[1] This is tremendously helpful when picking up small microaneurysms and hemorrhages in the retina, since we can see these as black-on-dark background instead of the red-on-reddish background we see with white light on the fundus (*Figure 5*). This also can help you better appreciate the contour of the cup within the disc, as well as the areas of nerve fiber layer thinning, and makes epiretinal membranes shine.

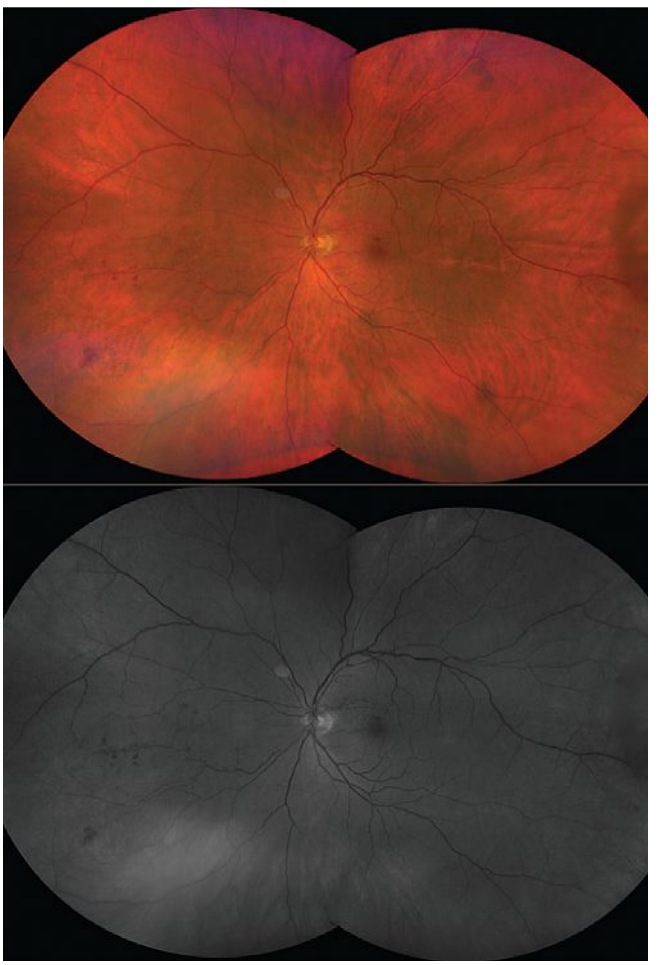

Fig. 5. White light (top) vs. red-free (bottom). Note the difference in contrast between the intraretinal hemorrhages and background color.

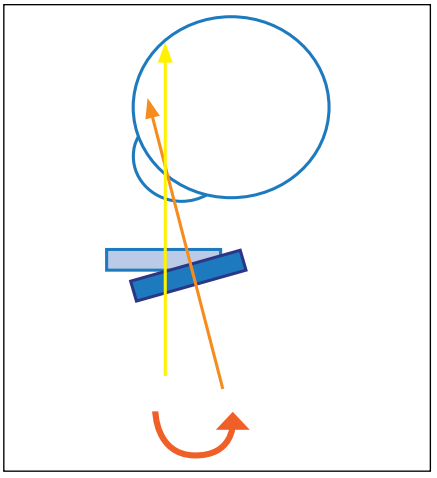

Fig. 6. A schematic of tilting the lens at the slit lamp. Tilting the condensing lens can direct the light more peripherally.

Fig. 7. Here is an example of tilting the condensing lens for peripheral view. Tilt toward the side of the face of the condensing lens that is opposite to the area you want to examine. For example, if the patient is looking left, tilt the left (your left) part of the lens laterally toward the face.

Peripheral Fundus Exam Tips

If you're performing a peripheral retinal exam at the slit lamp, these minor adjustments can help you see more peripherally:

6. First, put your condensing lens as close as you can to the patient's eye. The pupil, dilated or not, is like a keyhole; when you're further away from the hole, your field of view on the other side is much narrower. Pushing it close will broaden your view and allow more room to visually navigate without your view being cut-off by the pupil.

7. Next, tilting your condensing lens can make a huge difference. You don't have to remember too much of optics to know that tilting the lens will redirect the light going out of it, so use that to your advantage. For example, if the patient is looking right/temporally with their right eye, move the lens slightly medially and tilt your thumb posteriorly (toward their medial canthus) to direct light more lateral/peripherally (*Figure 6*). Likewise, but opposite for the patient looking left, tilt the bottom of the lens toward the patient for upgaze and the top of the lens toward the patient for downgaze (*Figure 7*). This all remains true when using your 20D or 30D lens with your BIO, as well.

8. Then, if you adjust the orientation of your light source (i.e., for OD looking left, moving the entire light/ocular unit somewhat laterally/to your left so it projects the light medially), ***this can help you capture just a bit more peripheral retinal landscape.***

9. Lastly, just plain do better. How many doctors have the patient look up, down, left and right for their peripheral exam? Boy, does that get my goat. Realizing that the eye is roughly a sphere, consider up/left, down/left, down/right, up/right. You're missing prime real estate and doing a suboptimal exam if you don't look at each sector of the retina, and this is amplified if you're not scrolling around when you look at each sector. You will be a lot more likely to find problems if you actually look in those areas (*Figure 8*).

Macula

12. Earlier we talked about moving the entire light/ocular unit for both the external ocular exam and for the peripheral retina. Guess what? We can do that for the macula, too. Subtle thickening in the macula is hard to pick up when you're looking straight on from a top-down

Tips for Specific Conditions

10. Vortex vein varix. Ampullae of vortex veins, also known as vortex vein varices, are often confused for more ominous lesions due to their grayish-brown color and elevation. Because they are simply a venous pocket, one trick can quickly tell you what they are and save you and the patient a lot of stress. ***Increasing intraocular pressure will overcome the choroidal venous pressure and cause the vortex varix to collapse***, so if you simply press on the patient's eye and see the elevated area completely flatten, you can rest assured that you're just dealing with a vortex varix.[2]

11. Retinoschisis. Differentiating this from a retinal detachment can be tricky, especially if the retinoschisis has inner leaf breaks, which can make it look like a rhegmatogenous detachment. While scleral depression, ultrasonography and OCT are going to be most telling, one clinical pearl is to ***remember pathophysiology and use that to your advantage. Recall that in retinoschisis there is a separation between the inner and outer retinal layers***. If there is no communication between inner and outer retina, there is no vision in that part of the retina. In a retinal detachment, on the other hand, the retinal layers are generally intact, albeit detached from the RPE, so the tissue can still send information about vision until the tissue dies. If you make a small block of light and direct it at normal, adjacent retina and ask the patient what they see, they will tell you that they see a block of light. If you then move the block into the area of schisis, they will tell you that they see nothing.

You can also modify this to have the light bridge the area of normal and schisis retina, and you can guess what they will say! This setup and concept is similar to using the Watzke-Allen test in the macula, but for this we will call it the "Weidmayer test."

view. For example, it's hard to tell how high a mountain is when you're looking down from above. Shifting the light source to the side is akin to how we use a parallelepiped for the cornea—it allows you to appreciate thickness and topography more easily. This can be used elsewhere in the fundus, too (*e.g.*, choroidal lesions).

Gonioscopy Tips

Our gonio lenses should be used regularly in our clinics. There are many conditions where we need to look at the iris and angle for glaucomas, ischemic eye diseases, iris tumors, trauma, etc., and this tool may be more versatile than you realize.

13. Tilt that lens. When a patient has steep or plateaued iris approaches, you really need to tilt your lens to see the angle structures. For example, if I'm looking at the temporal angle (anatomically), I use the medial mirror and can only see a bombéd iris; if I slide my lens slightly laterally on the cornea and tilt my lens laterally, I can see over the iris and down into the angle (*Figure 9*). This helps understand the actual angle anatomy.

14. Turn off all the lights. Doing this in your exam room, including items such as your computer monitor, promotes pupillary dilation that will more closely simulate the angle anatomy when it is at its "worst" (in regards to the narrowness of the angle) in scotopic conditions. Doing gonioscopy in brighter conditions can give you a false sense of safety or cause you to miss an occludable angle altogether.

15. Press that lens. When you're dealing with a narrow angle and wondering if a laser peripheral iridotomy (LPI) would be helpful, perform dynamic/compression gonioscopy by applying pressure to the eye with the non-flanged gonio lens. If the trabecular meshwork is not blocked (*i.e.*, if it is appositional, not synechial narrowing), aqueous will push into the angle, push the iris posteriorly and widen the angle with compression, suggesting that indeed, an LPI would be helpful.

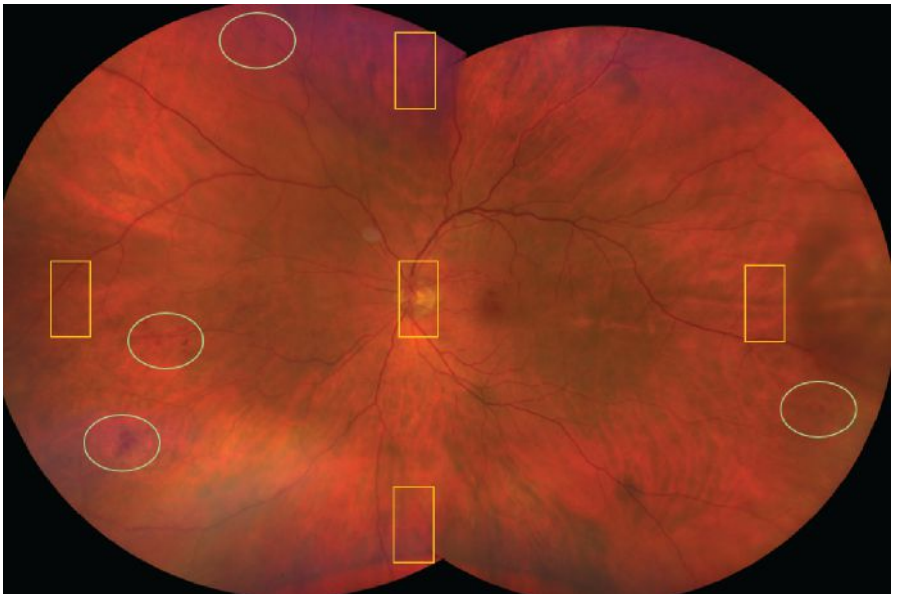

Fig. 8. The yellow rectangles are all you see if you have the patient look up, down, left and right for a peripheral exam. Notice what you'd be missing in the green ovals.

Even if the trabecular meshwork was visible to start with, if the angle does not widen with compression, do not waste your time with an LPI. Don't forget that you have to figure out and deal with why the angle is narrow or synechied (*e.*g., phacomorphism, neovascularization, choroidal effusion).

16. Use a 3-mirror gonioscope lens. While I reach for my 4- or 6 mirror most of the time, the image quality on a 3-mirror is higher. When looking for something more subtle, like neovascularization in the angle, pull out that 3-mirror and coupling solution to get a higher resolution view.

17. Remember, those three mirrors are at different angles for a reason. When you're struggling to see something in the far peripheral retina, or even on the pars plana or the peripupillary posterior iris (like a posterior iris cyst), dilate the eye and use the 3-mirror lens for a beautiful view of those hard-to-see areas.

18. I'm not quite done with 3-mirror gonio lenses yet. They also have the central contact lens, and ***the view into the posterior pole with a contact lens is gorgeous.*** Trying using it, especially for subtle macular pathology.

19. One more thing. ***Your 3-mirror gonio lens can also be helpful for patients who are somewhat difficult to examine***—they can try to squint all they want, but sometimes it's even hard for me to break the coupling solution seal to pop the lens off, so the big 3-mirror can help keep lids open and out of the way, too. You could feasibly do your entire posterior segment exam with a 3-mirror gonio lens. Sounds like fun, right?

Pupil Evaluation

20. Pupils—size, shape, afferent and efferent responses—tell us so much, yet are often hurried through on exam. This is a topic that deserves significant discussion; for now, my best tip is to actually make sure you check them and do it very carefully. *(Editor's note: see the article on page 62 for comprehensive advice.)*

21. Earlier we talked about actually measuring things; pupils are one of those. Don't forget that pupils should be evaluated in both bright and dim illumination. A super handy laminated paper with half-round pupil measurements on it gets quite a bit of love in my clinic, and other formats are available, too (*Figure 10*).

Ocular Alignment Evaluations

If you know me, you know I'm not a binocular vision guru. I'm sure pediatric ODs are going to bark at me for this, but these tips can help even the least binocular-vision-inclined OD.

22. Small heterophorias, vertical in particular, can sometimes be difficult to appreciate on cover tests. I find a Maddox rod to be really helpful. With the lines oriented vertically on the Maddox rod in front of one eye, have the patient look at a muscle light with both eyes and ask if the horizontal red line (produced by the rod) is above, below or straight through the light. If the line is lower than the light, the eye with the Maddox rod is hyper relative to the other eye. Then, you can use prism to measure the amount. With most patients, you'll be able to speed through all positions of gaze with this very quickly and easily.

23. Another way to detect small heterophorias is to just ask your patient. As you perform the alternating cover test, ask them, "Does the target look higher with your right eye or your left eye uncovered?" The object will appear lower to the hyper eye because if the eye was hyper-deviated while covered, as soon as you uncover it the target will be hitting the retina superior to the fovea, which will make it look like it jumped down as soon as the eye is uncovered. The same principle works for eso- and exo- deviations. For example, in esophoria, the object will appear to the patient to be jumping the opposite direction as your paddle on alternating cover test, and in exophoria, the target will jump the same direction your paddle is moving.

24. This also works for a small tropia. When you perform the unilateral cover test, ask the patient if the object looks like it jumps at all when you cover their eye. If so, the eye you didn't cover was not fixated on the target when both eyes were open—when you covered the fixating eye, the strabismic eye had to move to pick up fixation. Your patients will tell you exactly what you need to know, but only if you ask them.

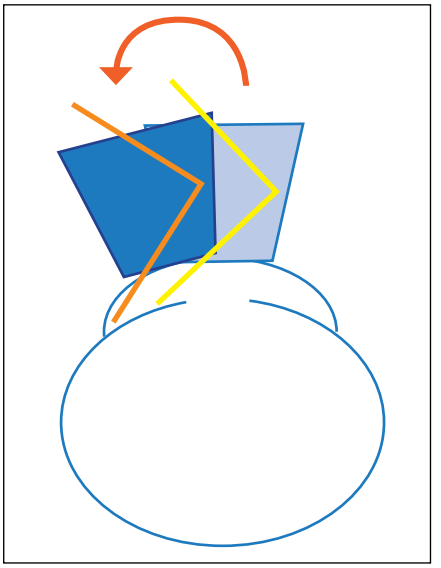

Fig. 9. Tilting the gonio lens on the cornea can adjust your view down into the angle.

Takeaways

These tips and pearls don't require any special equipment or skills, just the basic knowledge and tools we have in-office, to improve diagnostic elements of your exams. When I put this article together, I learned a bit myself about dry eye evaluations from one of my own optometric heroines, Nancy Peterson-Klein, OD (see box at right). Hopefully something discussed here will stick and help you do better across the board as well, while improving clinic life for you and your patients. ■

1. Leburg S. Rediscover Your Red Free. Rev Optom. Jan 2021;72-3.

2. Weidmayer SL, Demirci H. The spontaneous resolution of a vortex vein varix: case report. BMC Ophthalmol. 2021;21(1):101.

3. Pauk SV, Petriček I, Jukić T, Popović-Suić S, et al. Noninvasive tear film break-up time assessment using handheld lipid layer examination instrument. Acta Clin Croat. 2019;58(1):63-71.

For a Better Dry Eye Evaluation

By Nancy Peterson-Klein, OD

Typically, doctors instill preserved anesthetic drops, then the dilating drops prior to measuring a standard tear break-up time (TBUT). Those drops applied to a compromised cornea further degrade the tear film and give an additionally reduced TBUT.

Here are tips on the process of assessing dry eye patients and following them to determine the effectiveness of your treatment plan:

25. Use an Amsler Grid to check if lines are wavy and have them blink. If wavy lines disappear, the patient has poor tear quality. The grid can also be used to demonstrate to your patient the value and need for them to blink to clear their vision during the day.

26. Use the topographer to view the rings reflected from the cornea and time how long it takes in seconds for the rings to fall apart after a complete blink. This represents a type of tear thinning time or noninvasive (NI) TBUT that is fast to assess and not so irritating.

If you don't have a topographer, NIBUT can be measured using a handheld lipid layer exam instrument and the biomicroscope. NIBUT, measured by handheld lipid layer exam as compared with the standard TBUT, has been found to have better diagnostic ability to distinguish patients with dry eye symptoms from normal patients with vague symptoms in detecting dry eye. Measuring NIBUT is certainly less irritating and could be added to your external exam testing. Studies have found that the handheld instrument showed that NIBUT values were reproducible and consistent.[3] NIBUT can be used to follow-up with patients and assess whether the dry eye therapy is effective.

27. View the topographer rings and note which areas seem to break-up the fastest to determine if sleeping goggles would help reduce the effects of lagophthalmos.

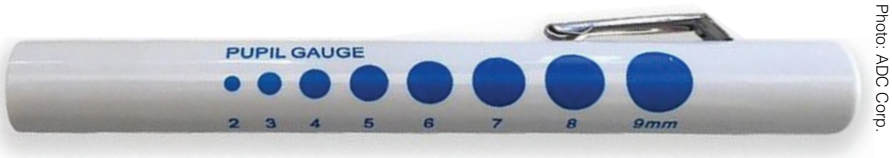

Photo: ADC Corp.

Fig. 10. A pupil gauge can help you quickly and more accurately measure pupil size. I keep a small laminated paper handy, but this one is printed directly on a penlight for convenience. Check and measure pupils very carefully in both bright and dim illumination.

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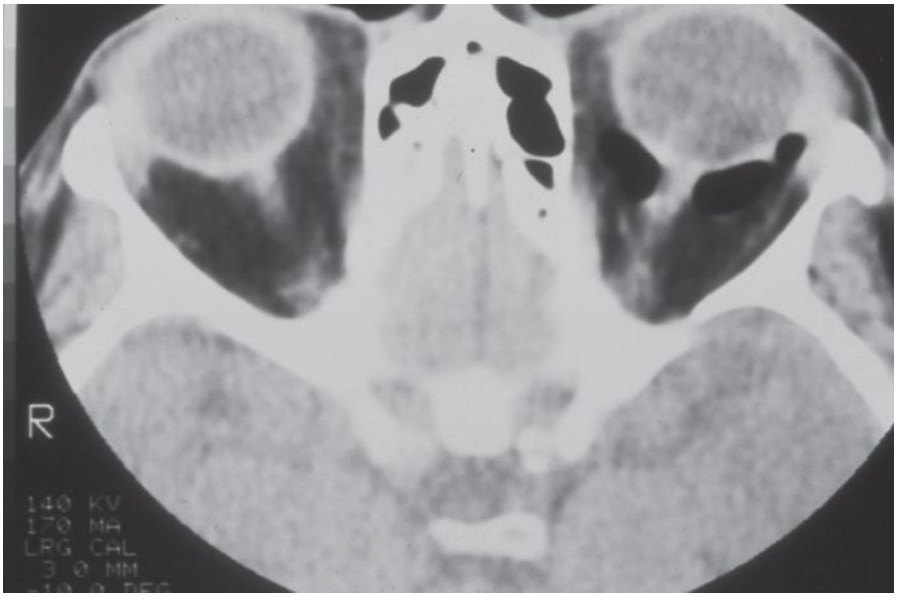
BRING LABORATORY STUDIES AND IMAGING INTO YOUR PRACTICE

Learn the logistics of getting these results into your hands—and how to overcome the common setbacks. *Part 1 of 2.*

BY JAMES L. FANELLI, OD
WILMINGTON, NC



A CT scan of a patient with a left orbital floor fracture. While the fracture is not seen in this particular scan image, the air seen behind the left eye surrounding the optic nerve is consistent with communication between the orbit and the maxillary sinus.

With an aging population and the number of patients needing ophthalmic care increasing, many individuals will need eye care that involves more than just routine wellness evaluations. Fitting with this need, optometrists occupy a strategic healthcare position, able to coordinate care with other specialty providers. Ultimately, this offers the patient an enhanced and more complete level of care, addressing any underlying problems they present with at the office.

The Institute of Medicine defines primary care as the following: the provision of integrated, accessible healthcare services by clinicians who are accountable for addressing a large majority of personal healthcare needs, developing a sustained partnership with patients and practicing in the context of family and community.[1]

The role of the optometrist in providing care for the eye and visual system is well established and, many times, these are affected by systemic diseases that may or may not already be diagnosed. In any event, we are all seeing patients who bring with them problems affecting the visual system. It is incumbent upon our profession to facilitate and coordinate care when the patient's problem requires the aid of expertise of other healthcare providers.

In many instances, laboratory and imaging studies are an integral part of the work-up for these patients,

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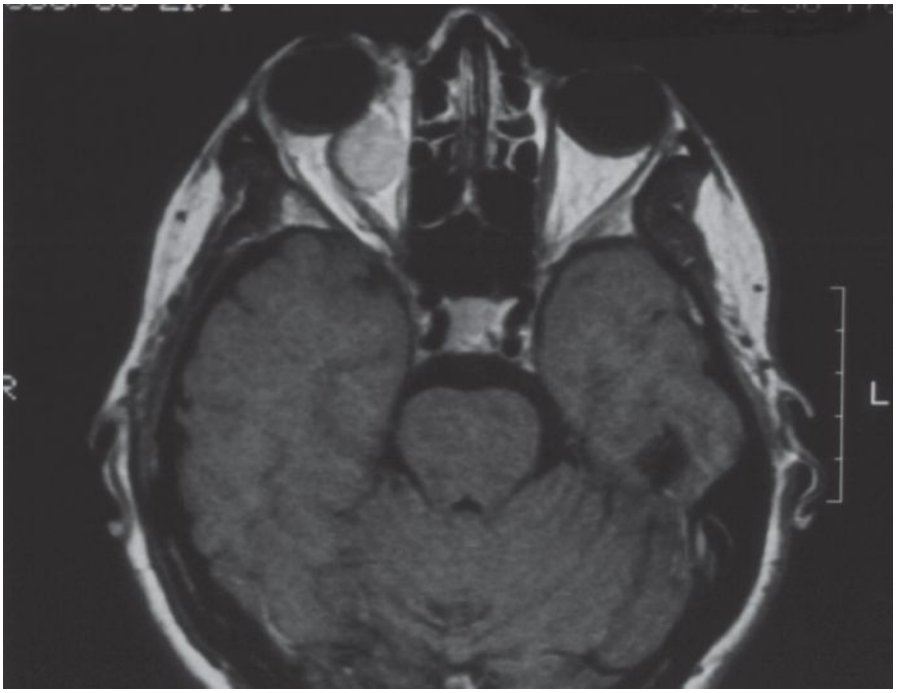
and there are several ways in which optometrists can play a role in coordinating care for these individuals. In this two-part article, we will first (this month) go through the practical challenges of adding these diagnostic capabilities and then (in part two) work through several specific clinical examples of how they can improve the care you provide.

Why Order Lab and Imaging Studies?

Frankly, there are many potential answers to this question, all of which are predicated upon the specific disease or clinical finding in question. Lab and imaging studies are important in the initial phases of examining a patient with suspicious findings to monitor said condition once a diagnosis has been made or proffered and continuing to follow these patients once firm diagnoses are solidified. For example, a patient who presents with unilateral proptosis (whether it is obvious or subtle) with extraocular movement abnormalities has a high suspicion of an orbital etiology. That pathology may be related to thyroid abnormalities, in which case both lab and imaging studies are helpful in developing a diagnosis. Better put, these studies are important for determining differential diagnoses or confirming a suspected diagnosis.

Once a diagnosis is made, further studies are often required to adequately monitor the response to treatment of the condition. In cases of diabetes, for example, HbA1c readings do just this; they allow the provider a good glimpse at how well their patient's diabetes is being controlled. Note that patients with acute afferent visual field abnormalities are in need of neuroimaging. This is not only to identify the location of the underlying problem but also to shed light onto the cause of this problem. Is this an acute infarct, is it the result of a demyelinating process or perhaps a space-occupying lesion?

The scenarios are endless and those who have been in practice long enough have seen their fair share of patients with problems who require lab and imaging studies. In general, lab studies are directed toward identifying abnormal physiologic processes while imaging studies are directed toward identifying structural abnormalities. Not surprisingly, many disease entities demonstrate both abnormal physiologic processes and structures, prompting the need for both lab and imaging studies.



An axial MRI image demonstrating the presence of an enhancing mass in the right orbit. Note also the presence of proptosis seen on the right side as compared with the left.

Who Should Order the Studies?

This is a more complex issue than it may initially seem and depends on several factors. There are two general routes an OD may take. The first would be that lab and imaging studies can be obtained when an optometrist sees a patient who needs further investigation and the patient can be referred out to another provider best-suited to evaluate the suspected condition. The second option is when the optometrist can orchestrate the initial lab and/or imaging studies. In both cases, subspecialty care will often be involved; the practical difference is at what point they are brought into the case. That will vary depending on the condition, the optometrist's comfort level with managing these situations and their relationship with the general medical community. Both options are correct. Ultimately, the patient's primary care provider (PCP) will be made aware of the situation once the patient is on the right track. But, in certain cases and with certain disease processes, such as acute neuro-ophthalmic situations, having the PCP drive the initial work-up and evaluation process may result in delayed care.

As with general medicine, where there may be several areas of interest and expertise of the provider, the same holds true for optometry. Some primary care practitioners see a generally younger and healthier population, whereas others see older patients who have several ongoing disease processes. In the same way, some optometrists may specialize in contact lenses, pediatrics or binocular vision, while others are more diversified in their emphasis of care. Some of us specialize in glaucoma and neuro-ophthalmic disorders while

others are strictly anterior segment specialists.

It's not feasible to expect a contact lens practitioner to be fluent in the nuances of neuro-ophthalmic disorders, just as it is not feasible to expect a posterior segment specialist to be cognizant of the nuances of specialty scleral lens designs. But what is a reasonable expectation is for every optometrist to be cognizant of a disease process occurring in an area of the eye and visual system outside their area of expertise.

Therefore, my suggestion would be that for those providers encountering a condition outside of the visual system they are not proficient in, referral to a fellow provider—OD, MD or other—is appropriate earlier on in this process. However, for those providers who practice in their area of expertise and encounter patients with problems in said areas of the visual system, then there is no harm in initiating the appropriate lab and imaging study orders themselves. That is, so long as two important things follow the ordering: the first is to understand specifically what to order and how to interpret those findings. The second is to act upon those findings in an appropriate manner.

A CT angiogram of the neck and intracerebral arterial vasculature. In this antero-posterior view, one can clearly visualize the internal carotid arteries, the vertebral arteries, a portion of the circle of Willis and the anterior and middle cerebral arteries on both the right and left sides.

Oftentimes in lab study ordering, the results are presented in a fashion where base values are obtained (for example in a CBC), but the interpretation of that information is left to the ordering physician. For most ordered neuroimaging, on the other hand, there is usually a radiology report sent to the ordering physician with the clinical findings outlined. In short, the OD has the benefit of receiving the radiologist's interpretation of the scans along with the scans themselves. While the radiology report summarizes the findings seen in the images, the OD does need to be able to interpret the clinical implications of the report. Whereas with reviewing lab results, the OD does need to possess the ability to interpret the specific findings and coordinate that with the clinical case presentation, since there is no interpretation report that comes with lab studies other than cursory comments from the lab regarding a specific index or test result.

Once the results of the test(s) are interpreted, it is then important that the OD knows what needs to be done with that information. Take the case of a patient who presents asymptomatically with a retrochiasmal visual field defect that is seen during an eyecare visit. The provider knows there is a structural defect resulting in the field loss. What the provider does not know is when that event occurred. It may have happened months or years ago, or it may have been recent. Nor does the provider know what caused the event.

Neuroimaging helps very much with determining the chronicity of an ictus. Does the patient need to be sent to a stroke unit immediately or are the MRI findings consistent with longstanding cerebral ischemia? Just because the clinician is seeing a new finding for the first time does not mean that the finding is of new onset. In other words, the currently asymptomatic patient may have had a chronic ischemic event months ago that caused the field defect, but if the MRI is not showing evidence of acute ischemia, an immediate referral to a stroke center is not necessary. What is appropriate in this situation is a referral to the appropriate healthcare provider to mitigate the risk of future events.

Being able to establish a management plan for patients after ordering lab or imaging studies and after the clinical evaluation that precipitated the testing is an important part in their care. It is the same with our glaucoma patients—once all the data is in, only then can you create a targeted, focused management plan.

Options for Ordering Labs and Imaging

Once the decision has been made that lab and/or imaging studies are warranted, what options do ODs have for obtaining these tests, if they choose to do the ordering? This answer depends on your location, mode of practice and what you are ordering, to a large degree.

Lab test ordering. Most ODs, independent of their practice setting, do not draw blood in their office. For those ODs in multidisciplinary and hospital settings, ordering lab testing is often straightforward: orders are sent to the in-house lab for the specific tests needed. For most other ODs in practices not part of a multidisciplinary setting, commercial labs are best-suited to obtain the necessary testing. There are many nationwide commercial laboratories where this can be done, such as Solstice Labs, LabCorp and Roche Diagnostics, to name a few. Do keep in mind that many of these labs supply offices with the items necessary to draw

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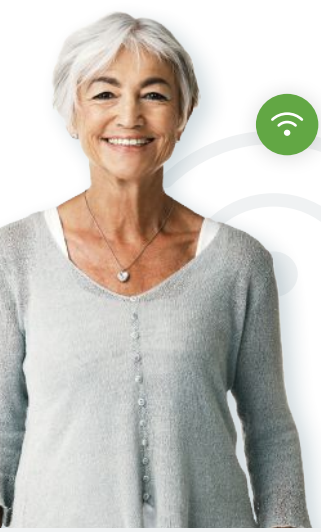

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References: 1. Rao P et al. *Ophthalmology*. 2018;125(4):522-528. **2.** Domalpally A, Clemons TE, Bressler SB, et al. *Ophthalmol Retina*. 2019;3(4):326-335.

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blood in the clinic. These specimens are ultimately transported to the lab facility for analysis. While that may not work for you, these same commercial labs do possess the capacity to have your patients instead go to their facility. From there, patients can have their blood drawn and analyzed, saving you the need to collect the specimens in your office.

Setting up an account with these facilities is straightforward. Simply contact your local lab and say that you have the occasional need for lab studies and that you'd like to set up an account with the company. When a patient needs labs, you can send them directly to the lab along with your orders. The lab will then send you back the results for you to interpret and act upon.

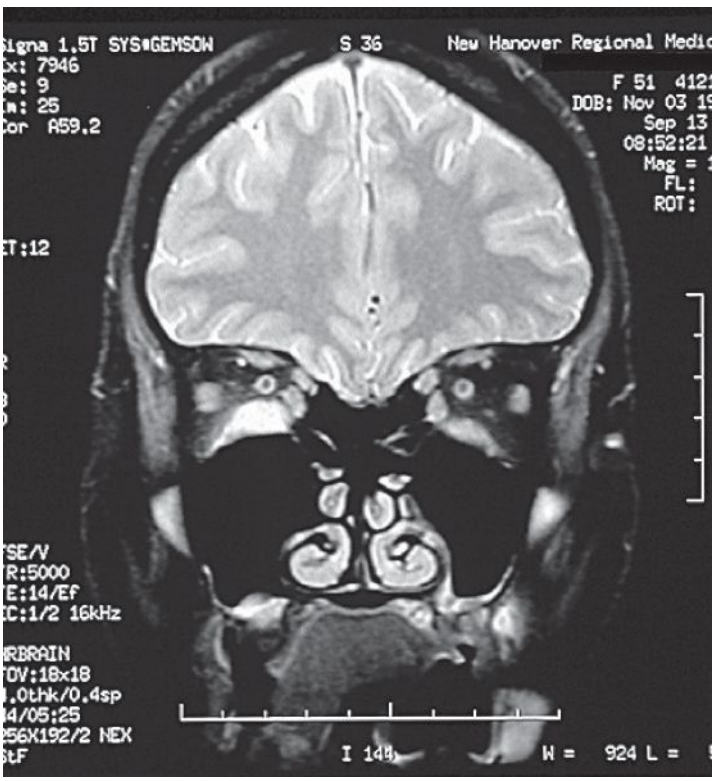
There is another nuance to lab studies that must be considered: should you send the patient to their PCP for the lab work? I think that much depends on your relationship with the PCP. If you already have a great relationship with the patient's PCP and they value your contribution to the health care of the patient, then certainly, have the patient go to their PCP's office for the bloodwork. They don't necessarily need to see their PCP at that point in the care of the patient, but the lab results will be automatically incorporated into the patient's medical record there with the results forwarded to you. Coordination of care with the PCP for that patient, if needed, can then easily take place.

But what if the patient's PCP is someone who does not value your opinion, or consistently refers mutual patients that you send to them to another provider, usually an ophthalmologist? Of course, the first question to ask is whether or not you believe that provider offers the patient the best possible care when they consistently refer your mutual patient to ophthalmological practice. It may not be in the patient's best overall interest, driving up healthcare costs. While the PCP will ultimately need to know the results of such bloodwork, consider sending this patient to a commercial lab for the specific tests you require. Then, after reviewing the results, inform the PCP of your diagnosis and plan.

This scenario plays out often enough when ODs send patients to their PCP because of retinal hemorrhages. There are many causes of this condition, some of which carry significant risk, while others may be innocuously due to a Valsalva maneuver in the presence of a patient who is also anticoagulated. You, as the primary provider for the patient's eye and visual system, know what your differentials are and, consequently, your level of concern. In contrast, the PCP usually does not know what the differentials are (in reference to the types and locations of retinal hemorrhages seen during funduscopy) and oftentimes reverts to thinking that since the patient's eye is bleeding, they need to be seen by a retina specialist ASAP. They also may not completely understand an OD's competence is in this area and may not know the finer nuances of retinal hemorrhage etiologies. To avoid this scenario, it's reasonable to order the appropriate bloodwork and subsequently inform the PCP of the findings and the plan you have generated for the patient. You can then inform them of when you plan to see the patient back, as one would in the case of an isolated Valsalva hemorrhage.

Image ordering. Through the same means, vascular ultrasonography, CTs and MRs can be obtained by the hospital or multidisciplinary setting in which you work. Other times, you can order the necessary imaging directly through a radiology-owned imaging center. Some hospitals require you to have hospital privileges to order the images, while others do not. In many cases, though, this will not necessarily be the barrier to obtaining scans. Instead, an issue may arise because of the need for prior approvals before imaging is obtained. Doppler imaging for carotid studies can be ordered from a vascular or cardiac surgeon's office directly, which is a great way to develop relationships with these specialty providers.

When ordering CT and MR imaging (included with these are specific subsets of CT and MR images, including CTA, MRA, MRV, etc.), it is imperative that you convey to the radiologist exactly what your tentative and/or differential diagnoses are, as well as to include any relevant clinical findings.



A coronal MRI of the orbits in a patient with Graves' disease, demonstrating enlargement of the inferior recti muscles, right > left.

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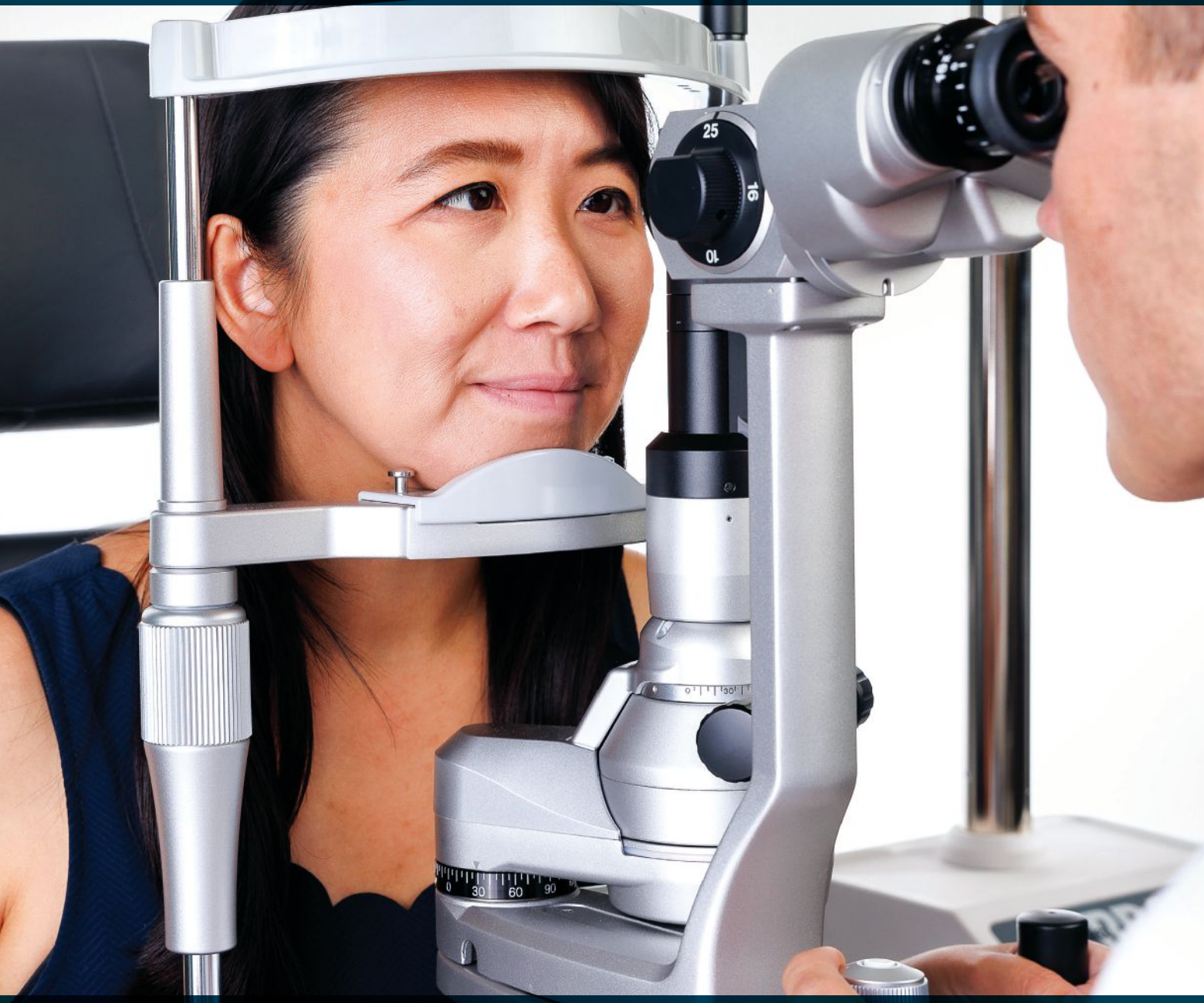

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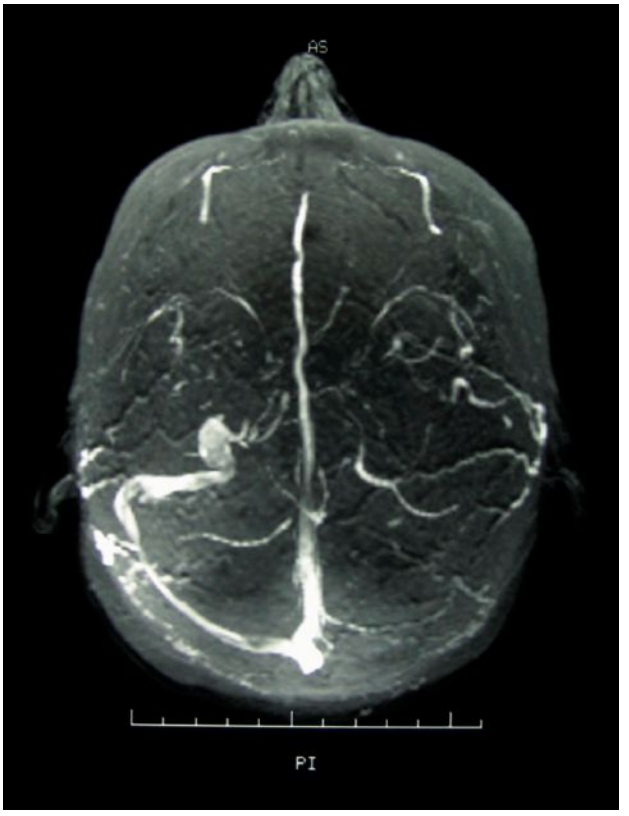
By relaying these specifics, the radiologist can then use their judgment as to what particular image techniques should be used during image acquisition. Doing so focuses their attention on the distinct problem areas that can facilitate a relevant interpretation of the imaging.

You don't necessarily need to specify the thickness of the slices of the CT, for example, nor whether to incorporate apparent diffusion coefficient mapping or diffusion-weighted imaging into the MRI protocol, since that is the job of the radiologist. However, you do need to give the radiologist precise information to focus on. For example, you might call attention to the pituitary region, visual cortex or the midbrain. Without this provided to the radiologist, there is a higher likelihood that the interpretation will not be as specific as needed for a firm diagnosis. Communication is key in ordering imaging, particularly for neuroimaging.



An MRV of a patient demonstrating stenosis of the left transverse sinus. MRV imaging is important in the workup of patients with papilledema, as abnormalities of the dural venous sinus system can affect CSF drainage and ultimately result in increased ICP.

This type of order may sometimes be needed on an emergent basis, whereas other times is only needed on an urgent basis. Your clinical decision-making dictates how urgent or emergent the imaging is needed on a situational basis. When following up long after a patient with a history of, for example, pituitary adenoma and who underwent surgery, these scans are often scheduled on a non-urgent basis.

Availability to obtain scans in a timely fashion can sometimes be challenging aside from the issue of prior authorization. In many areas, CT scanning is generally more available on short notice than are MR scans; the difficulty lies in that CT scanning is not appropriate for many cases of neuroimaging.

Occasionally, CT imaging will be urgently needed, as in the case of trauma or the need for CT angiography, and these orders can be processed readily. But what should you do when you need an urgent or emergent MRI and there is a lag time in available MR appointments? This will depend on whether the need is emergent or urgent and, if so, how soon the appointment can be made. Urgent cases that can be scanned within 12 to 24 hours via appointment is usually acceptable. Emergent scans simply cannot be delayed that long. In these cases, the hospital emergency department is often the most prudent way to proceed, but this too requires thorough communication with the attending physicians.

Hospital ED Imaging Referral

As previously discussed, clear communication is key to obtaining neuroimaging. When scans can be scheduled in a timely fashion, communication occurs between you and the interpreting radiologist by way of your orders and the information provided therein. However, when the emergency department (ED) is used for urgent and emergent scanning, you communicate with the emergency room attending physician. Keep in mind that the ED physician is dealing with a whole host of emergencies, whereas we are only dealing with urgent and emergent conditions of the eye and visual system. We know the nuances of the condition in consideration, but the emergency room physician may only have a superficial or rudimentary understanding of these conditions.

Without specific communication as to your concerns and desired imaging techniques, emergency room physicians typically default to using CT imaging because it is more readily available and part of their normal protocol. This is because patients who end up in the emergency room unconscious typically receive CT imaging. The ED physician is concerned about an intracranial bleed; subarachnoid and subdural hemorrhages readily show up on CT imaging.

Take the case, for example, of a symptomatic patient who presents to your office with profound bilateral disc edema and fits the profile for idiopathic intracranial hypertension (IIH). Though this may be your working diagnosis, there are certainly other conditions that can cause this clinical presentation. If you send the patient to the ED with only cursory information, such as something generic like 'papilledema', chances are the ED physician is going to order either a CT scan (being concerned about a mass or hemorrhage), or call in a neurologist (causing a time delay) who ultimately will confirm the bilateral disc edema and who may then order either a CT or MR series, significantly delaying the diagnosis. If in fact the patient

does have intracranial hypertension, a CT scan will not be useful and further delay proper care. MRI and MRV imaging are standard protocol in imaging patients with suspected IIH, which will be discussed later in part two.

In cases like these, I'd suggest your office call the imaging centers first to determine how urgently the patient can be scanned. If the time frame is not suitable, then you need to call the ED and speak with one of the emergency room physicians, making sure to educate and guide them to your required imaging technique.

The conversation may go something like this: "I am sending a patient to your emergency department for urgent neuroimaging. They presented today with headaches of one week duration and clinical findings consistent with papilledema (*education*). As you know, papilledema can be caused by a variety of conditions, but our findings are consistent with elevated intracranial pressure, and since the patient fits the profile for idiopathic intracranial hypertension, MRI and MRV are warranted, in lieu of CT imaging (*guidance*) with emphasis on the intraorbital optic nerve segments, the sella turcica and the transverse dural venous sinuses."

Conversations of this detail are genuinely appreciated by the ED physician and lead to more efficient neuroimaging. Of course, the conversations will be specific to each individual patient's problem, but the key is that these thorough conversations offer relevant clinical information and guidance, resulting in a more problem-oriented examination.

Takeaways

The indications for lab and imaging studies in eye care are numerous, system-wide and can be complex. Nevertheless, they highlight the eye's intimate relationship with multiple organ systems and physiological processes of the body. The eye may very well set off an evaluation that leads to a diagnosis of abnormality in a separate organ system. Or, the eyes may need to be evaluated because of a known, pre-existing systemic condition with ophthalmic manifestations. With both cases, lab and imaging studies are part and parcel of the management of patients with diseases of the eye and visual system.

Evaluation of these studies is not done in the absence of other healthcare providers; rather, they are done in tandem. Those other providers may be neurosurgeons, rheumatologists, vascular surgeons, internal medicine physicians, neurologists or others. Sometimes it is the other providers who initiate the specialty testing, and other times it is us who initiate the labwork and imaging. Either way, it is imperative that the clinician who sees the patient populations with higher disease rates be aware of the indications, uses and limitations of these studies. ■

1. Institute of Medicine (US) Committee on the Future of Primary Care. Defining primary care: an interim report. Donaldson M, Yordy K, Vanselow N, ed. Washington (DC):National Academies Press (US);1994.

TRENDS, CHALLENGES AND CONTROVERSIES IN KERATOCONUS

Get updated on the latest discourse on this increasingly relevant topic.

BY BRIAN CHOU, OD, AND JEROME LEGERTON, OD, MS, MBA
SAN DIEGO AND JUPITER, FL

As it stands, relatively few patients are diagnosed with keratoconus in the modal eyecare practice, even though we now know the disease is far more prevalent than previously thought. New technologies allow for earlier and more frequent diagnosis. Given there are now enhanced treatment alternatives, including modern scleral contact lenses and corneal crosslinking (CXL), early detection represents an imperative. With such advances come new trends, challenges and controversies. Here, we investigate five in particular.

CHALLENGE: Early Identification an Imperative

A prompt diagnosis during adolescence is more important than ever because this is the critical time when CXL has the strongest indication to prevent the most progression. In contrast, if a patient already displays Munson's sign with a spectacle-corrected visual acuity (VA) of count fingers, a surgeon may feel these eyes are beyond the time to benefit from CXL (*Figure 1*). This would be analogous to how, in myopia management, it is valuable to initiate low-dose atropine therapy or peripheral defocus optical correction for a child with -1.00D myopia yet perhaps not so much for an adult with -12.00D myopia.

Testing for genetic risk of keratoconus was commercially introduced in February of 2020 and marketed as an important method to gain early diagnostic certainty. Genetic testing has not yet achieved widespread clinical acceptance as a useful standalone predictive test.[1] Instead, tried-and-true clinical metrics continue as the basis for clinician keratoconus diagnoses.

There may be an emerging role for data analytics and artificial intelligence in improving a clinician's ability to diagnose keratoconus. In the past, various indices were proposed to aid in this capacity, including the KISA% index based on corneal topography.[2] Today with improved computational technologies, a neural network could be trained with databases of clinical metrics of those with and without keratoconus. The metrics could include best-spectacle corrected VA, intraocular pressure, corneal hysteresis, corneal thickness, corneal topography or tomography, aberrometry and pachymetry, as well as demographic data including age, race, family history of keratoconus, history of eye itching with severity and laterality, presence of allergy, asthma and eczema. A data-driven risk assessment of keratoconus may prove more sensitive and specific than that of an average clinician. Even so, the entry burden of multiple data fields may make real-time diagnosis using data analytics impractical. The greatest promise may require incorporation into electronic medical records or retrospective application to an existing patient electronic medical record database.

One of the most effective pathways for new keratoconus diagnosis is through LASIK consults. Since the approval of LASIK in 1999, screening for surgical candidacy has fueled diagnosis for many new cases of keratoconus. Studies found between 6.4% to 9.6% of prospective LASIK patients were ruled as non-candidates due to probable keratoconus, whereas an estimated

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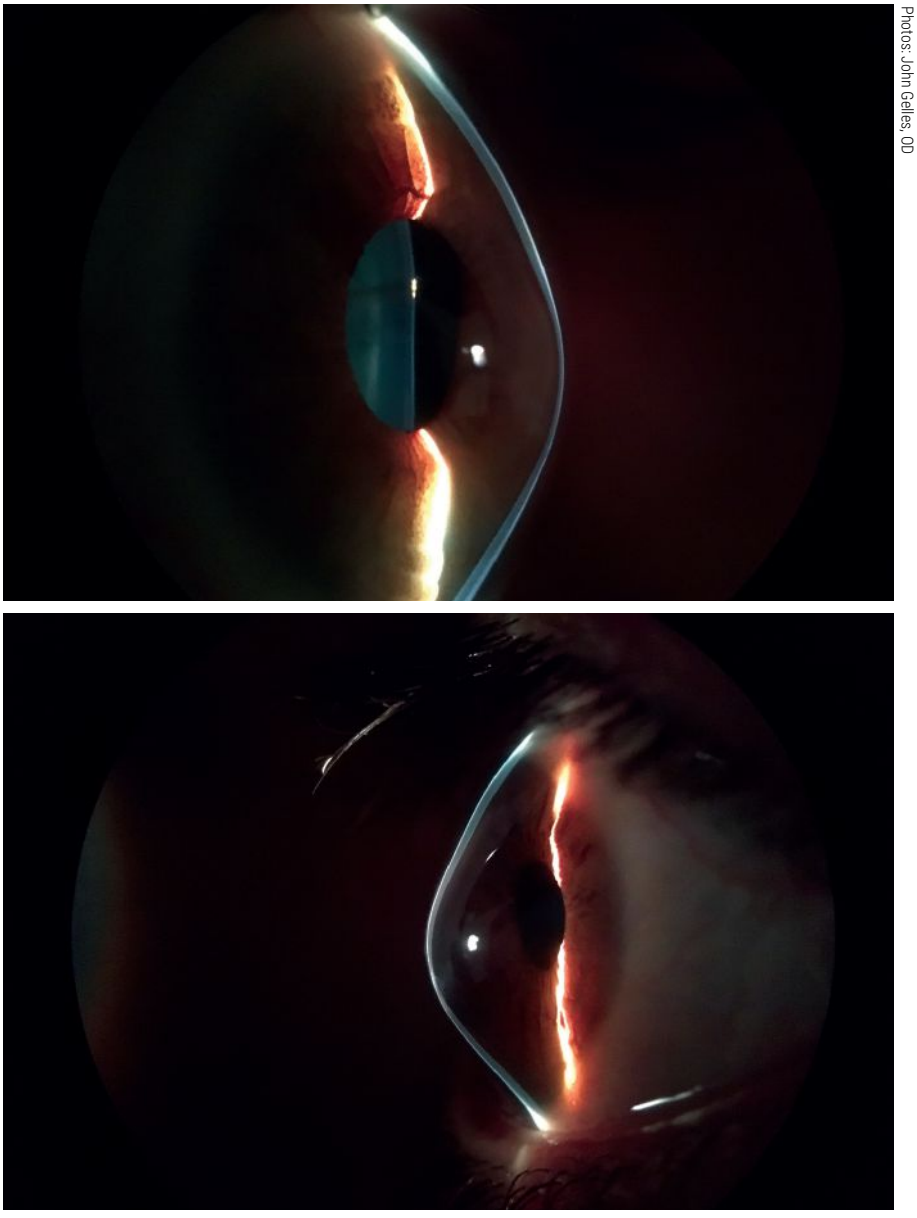
Dr. Chou practices at ReVision Optometry, a referral clinic for keratoconus and scleral lenses in San Diego. He reported the first US case of Intacs for keratoconus and is a past recipient of the National Keratoconus Foundation's Top Doctor award. He has no relevant financial interests to disclose. **Dr. Legerton** is the co-founder of SynergEyes, Innovega, Prolign Technologies and Ocular Surface Innovations. He is an inventor of more than 200 US and international patent cases and is honored with the American Optometric Association Outstanding Achievement Award, the American Academy of Optometry Founders' Award, the Contact Lens Manufacturers Association Trailblazers Award and the Orthokeratology Academy of America Achievement Award.

one in 375 in the general population are expected to have keratoconus.[3-6] Corneal topography or tomography, conducted across-the-board during LASIK consults, is arguably the single-most efficacious measurement to help a practitioner diagnose keratoconus. This unintended contribution to new keratoconus identification, however, is not optimized for early identification. Adolescents are non-candidates for LASIK, so they do not present for LASIK consultations.

This prompts the question, "Should corneal topography be part of a routine comprehensive eye examination?" For early diagnosis, standard inclusion of corneal topography may be a positive step for early detection of keratoconus; even so, it is not required now for a reasonably prudent practitioner. Furthermore, none of the major vision plans require a corneal topographer to join or stay on their panels. There are forces in play that may change this, creating new incentives that should lead to improved and widespread keratoconus screening. In the meantime, early identification of keratoconus in adolescents and young adults who may progress rapidly remains a challenge.

CHALLENGE AND TREND: Improving and Expanding Keratoconus Screening

The corneal topographer is a foundational instrument for early identification, diagnosis and monitoring keratoconus rapidly and accurately, in the same manner the blood pressure cuff serves in identification, diagnosing and monitoring hypertension. Even so, not all practitioners have incorporated corneal topographers in their practices. One dynamic that may inspire movement toward adopting topography as part of routine examination is that there is now liability exposure for not diagnosing keratoconus and referring progressing disease for CXL in a timely manner. Sometime after the April 2016 FDA approval of the first CXL system, timely referral for this procedure became the standard of care for progressing keratoconus.



Photos: John Gelles, OD

Fig. 1. Consider whether CXL has a compelling indication in a patient with Munson's sign.

Today, more than 95% of commercial medical insurers provide some coverage for CXL.[7] If damage to an eye or vision loss occurs proximate to failure to diagnose and/or refer in a timely manner, the practitioner has heightened exposure to claims of negligence. The mere fact that medicolegal claims of this nature already exist foreshadows increasing practitioner medicolegal liability when not diagnosing keratoconus in a timely manner. Incorporating corneal topography as part of routine examination can mitigate this risk by improving the practitioner's ability to diagnose and monitor keratoconus. One large vision provider network has already incorporated instrumentation, combining topography and wavefront aberrometry as a routine element of their comprehensive eye examination.[8] Combined corneal topography and aberrometry is expected to have greater power in diagnosing keratoconus than corneal topography alone.

Other factors driving increased keratoconus screening include heightened public awareness and patients' desire to be screened. Over the past decade,

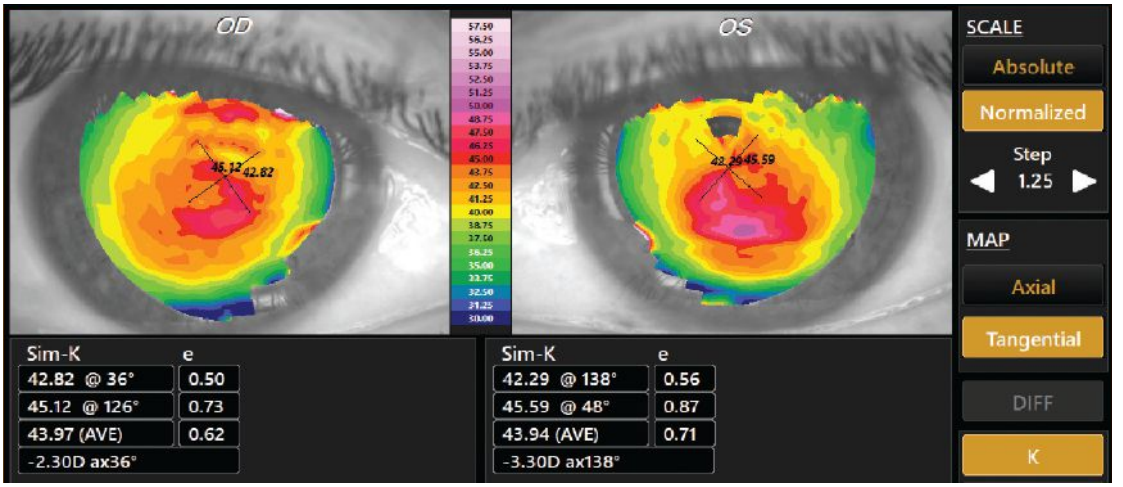


Fig. 2. Tangential topography of a 53-year-old male, which confirmed a first-time diagnosis of keratoconus. Best-spectacle corrected visual acuity was 20/20- in each eye with -0.50-2.00X038 OD and -0.50-2.50X137 OS. This was not "late onset" KCN but longstanding keratoconus that was not detected at any of his prior eye exams.

professional sports stars, including NBA great Steph Curry and MLB outfielder Tommy Pham, have openly discussed and raised public recognition of keratoconus.[9,10] Perhaps someday patients will commonly ask if their eye exam detects keratoconus in the same manner they ask if they have cataract, glaucoma or macular degeneration.

Finally, there is a possibility that a judicial ruling establishes topography as part of the comprehensive eye exam. This would be similar to the 1974 Helling v. Carey case, in which the Supreme Court of Washington held that tonometry was a necessary part of the routine eye exam not only for patients age 40 and older, but for all.[11] However, most practitioners might prefer that their industry generate clinical care guidelines rather than leaving it to a judge or legislative body without clinical understanding and experience.

CONTROVERSY: Is Concern about Progression Overstated?

It is well understood that keratoconus is expected to progress during adolescence to early twenties. This warrants the attention of all clinicians to ensure a timely referral for CXL to arrest disease progression. Yet for a keratoconus patient who has reached presbyopia and beyond, is concern for progression warranted and is there a concomitant over-referral for CXL?

Keratoconus is understood to stabilize and arrest on its own by the third to fourth decade of life.[12] Although keratoconus can have a later onset, the probability of late onset keratoconus is low. Cases of late onset keratoconus may in fact represent pre-existing disease that was not identified sooner (*Figure 2*). In some cases, corneal gas permeable (GP) contact lens wear may mask the diagnosis of keratoconus by confounding the topographical pattern through epithelial redistribution. If a corneal GP washout is not complete, the change in topographical appearance may masquerade as progressing keratoconus, whereas the cornea may, in fact, be returning to its natural shape.

Diagnosis of keratoconus later in life may correlate with milder and stable corneal distortion. Form fruste disease may escape detection due to the lack of suspicious findings. By the time classic clinical signs of keratoconus are detectable—Munson's sign, Vogt's striae and Fleischer rings—the keratoconus has existed for years. It is expected that a significant number of keratoconus patients diagnosed using these classic clinical signs may already have achieved stability.

With today's emphasis on carefully monitoring for progressive corneal distortion, it is reasonable to wonder if CXL is worthwhile when the keratoconus may have stabilized on its own. Unnecessary CXL may represent an alpha risk of increased health care cost and complications from the CXL vs. beta risk of progression by a failed prognostication of nonprogression.

Standard epi-off CXL is not without its risks, with one paper citing a complication rate of between 1% to 10%.[13] A large-scale review of 2,025 eyes undergoing accelerated CXL found haze formation in 9.1% in the early postoperative period and failure of treatment in 4.2% in the late period, with other common complications including loss of two or more Snellen lines in 2.4% and delayed epithelial healing in 1.8%.[14] There are also rare reports of corneal melting and perforation after CXL.[15]

Even with this understanding of complication risk, practitioners and patients with keratoconus may take comfort in knowing that the overall rate of corneal transplantation has already plummeted by fivefold with the success of scleral contact lenses.[16] Inducing fear during the counseling of keratoconus patients who are beyond their 40s to stimulate them to believe they may progress to corneal transplantation and that CXL prevents corneal transplantation may present an alpha risk for the patients that is not reasonable. A conservative approach for these seemingly late onset cases may include serial monitoring to confirm stability.

A standard of care is suggested for the intentional use of CXL that is moderated by age of onset and

clinical metrics to support progression or the lack thereof, rather than an across-the-board application of CXL for all that are newly diagnosed. The personalized recommendation for intentional CXL would strike a balance between alpha and beta risk.

CONTROVERSY: Corneal Crosslinking or Contact Lens Treatment First?

For a newly diagnosed patient with keratoconus and poor best spectacle-corrected VA, is the first order treatment CXL or contact lens prescribing? There is no practitioner consensus yet; rather, the treatment plan is managed on a case-by-case basis with differences from one practitioner to another. It is reasonable to pursue both concurrently for many keratoconus patients since CXL is not expected to normalize the shape of the cornea sufficiently to reduce the higher order aberrations that impact best spectacle-corrected VA.

It is worth noting that medical insurance coverage for CXL may take months to even over a year to obtain, depending on administrative burden and criteria needed to demonstrate to the third-party payer to establish progression. It is advantageous that during this time, the patient benefits from vision improvement via contact lens prescribing and gains proficiency with lens handling. These adolescent patients need vision correction to perform well in the classroom and on the sports field. In lieu of being held in limbo waiting for the CXL approval, the patient benefits from contact lens wearing and the restoration of their visual performance immediately. Practitioners report that most patients in sclerals prior to CXL can wear the same lenses following surgical recovery. This observation suggests that it is reasonable to expect that contact lens re-prescribing may not be required after CXL.

Keratoconus patients on some vision care plans should know that undergoing CXL can potentially reduce their corneal powers below the threshold for reimbursement.[17] One major plan sets a 53.00D steep keratometry criteria for the stepped-up necessary contact lens reimbursement for scleral prescribing. In the event of a reduced post-surgical steep keratometry meridian power, these patients may receive a surprise bill for out-of-pocket costs for subsequent scleral lens prescribing. At the same time, the same patient may enjoy peace of mind by minimizing the risk of disease progression. To avoid this coverage issue, initiating contact lens prescribing before CXL may be financially advantageous for the patient who may be teetering close to the third-party vision plan threshold for scleral lens reimbursement.

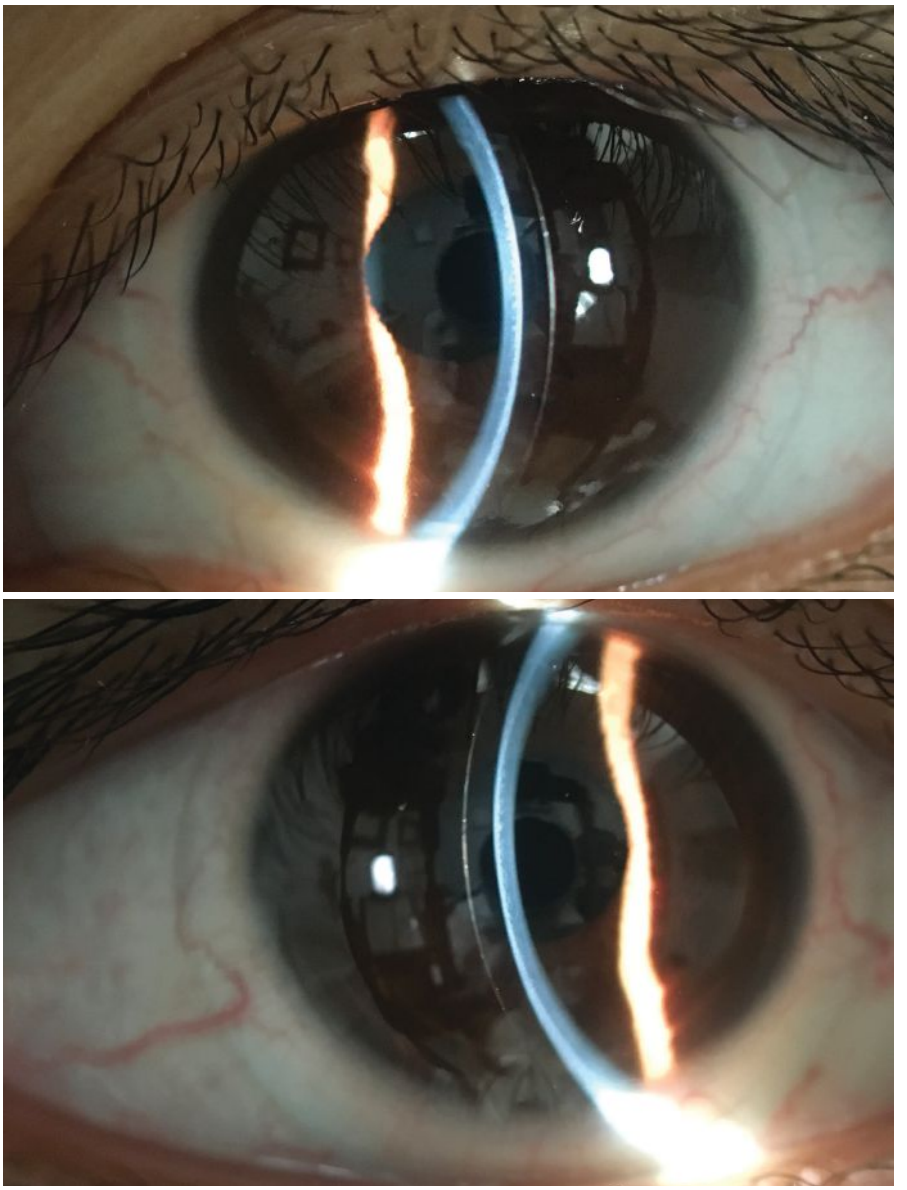


Fig. 3. Optic sections of ultrahigh Dk custom soft contact lenses for keratoconus.

A practitioner prescribing contact lenses before CXL should know that corneal gas permeable lenses or hybrid contact lenses may confound the surgeon's ability to assess the pre-treatment topography and the post treatment progression. Soft lenses and sclerals impact corneal shape less and are expected to cause less interference with topographical and tomographic evaluation for disease progression.

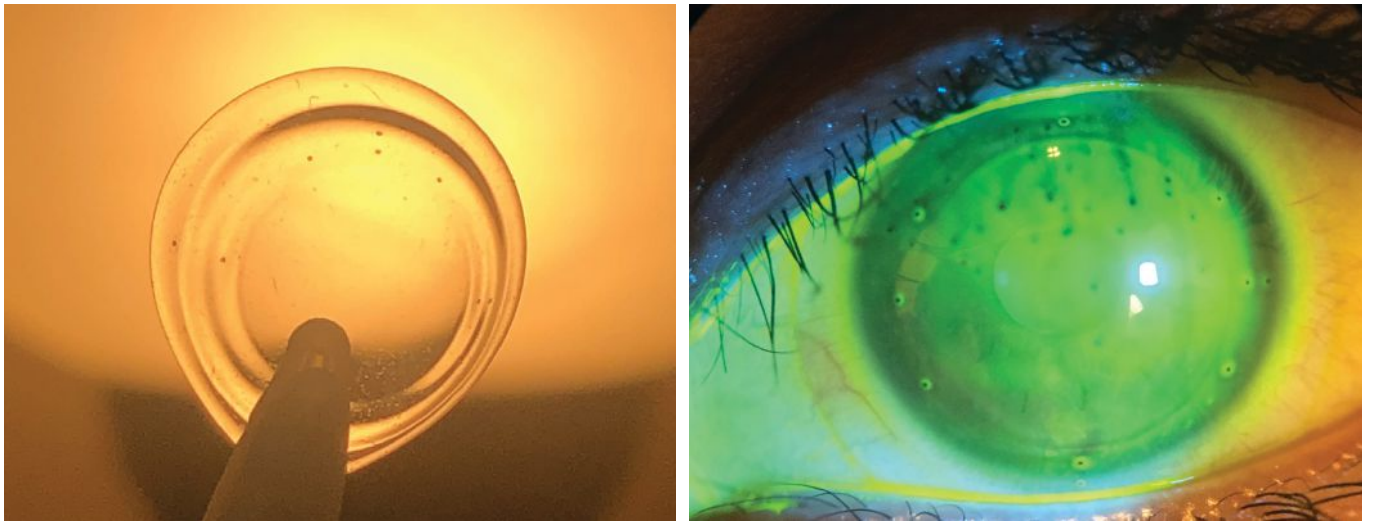


Fig. 4. Lens with registration marks at left. Same rotationally and translationally stabilized ultrahigh Dk soft lens on eye for wavefront-guided higher-order aberration correction for keratoconus.

CHALLENGE AND EMERGING TREND: Wavefront-Guided Contact Lenses

Retrospective medical records review and prospective predictions conclude that custom soft lenses may be the lens of choice for sizeable number with keratoconus.[18] Presently, custom soft contact lenses indicated for keratoconus have increased thickness and deliver oxygen transmissibility below the Holden-Mertz criteria for daily wear. They are lathe cut and have a high cost of goods, making disposability infeasible. New ultrahigh Dk lens materials and molding methods may deliver higher oxygen transmissibility along with reduced cost of goods that might allow a monthly disposable modality (*Figure 3*).

Also keep in mind that increased adoption of aberrometers by eyecare practitioners and software for converting simultaneous aberrometry and registration data to lens manufacturing is enabling wavefront-guided scleral contact lenses and custom soft lenses that manage the higher order aberrations that commonly reduce VA in keratoconus (*Figure 4*). The ultimate achievement of improved best corrected contact lens VA is anticipated.

Takeaways

Over the past 25 years, keratoconus treatment has advanced tremendously. While corneal gas permeable contact lenses and penetrating keratoplasty have ongoing roles for long-term keratoconus management, their frequency of use is muted today. This is largely due to the dramatic success of scleral lenses in restoring vision and collagen crosslinking in minimizing disease progression. New custom wavefront-guided soft lenses for keratoconus may emerge as a viable alternative for mild to moderate keratoconus.

Unfortunately, the greatest challenge from a public health perspective is that far too many adolescents and young adults with keratoconus remain undiagnosed, and there remains a cohort with known keratoconus who have not yet received the optimized treatment available today. ■

1. Cole J. KCN genetic testing: where does it fit in? RCCL. 2022;159(1):10-3.

2. Rabinowitz YS, Rasheed K. KISA% index: a quantitative videokeratography algorithm embodying minimal topographic criteria for diagnosing keratoconus. J Cataract Refract Surg. 1999;25(10):1327-35.

3. Xu K, McKee HD, Jhanji V. Changing perspective of reasons for not performing laser-assisted in situ keratomileusis among candidates in a university eye clinic. Clin Exp Optom. 2013;96(1):20-4.

4. Sharma N, Singhvi A, Sinha R, Vajpayee RB. Reasons for not performing LASIK in refractive surgery candidates. J Refract Surg. 2005;21(5):496-8.

5. Hori-Komai Y, Toda I, Asano-Kato N, Tsubota K. Reasons for not performing refractive surgery. J Cataract Refract Surg. 2002;28(5):795-7.

6. Godefrooij DA, de Wit GA, Uiterwaal CS, Imhof SM, Wisse RP. Age-specific incidence and prevalence of keratoconus: a nationwide registration study. Am J Ophthalmol. 2017;175:169-72.

7. Insurance coverage for iLink corneal crosslinking. Glaukos. www.glaukos.com/cornea/reimbursement. Accessed January 17, 2023.

8. Clarifye: the digital eye exam that gives more information. LensCrafters. www.lenscrafters.com/clarifye. Accessed January 17, 2023.

9. Horsting L. Steph Curry, the NBA's greatest shooter ever, has had vision problems his whole career. WarriorsWire. warriorswire.usatoday.com/2019/04/03/steph-curry-the-nbas-greatest-shooter-ever-has-had-vision-problems-his-whole-career. April 3, 2019. Accessed January 17, 2023.

10. Kolakowski R. Rays' Tommy Pham shares story of eye condition that threatened career. Tamba Bay Times. www.tampabay.com/sports/rays/2019/10/16/rays-tommy-pham-shares-story-of-eye-condition-that-threatened-career. October 16, 2019. Accessed January 17, 2023.

11. Ruskiewicz JP, Godio L, Myrowitz E, France L. Cost and quality implications of changes in tonometry use by optometrists. J Am Optom Assoc. 1983;54(4):339-44.

12. Gordon-Shaag A, Millodot M, Shneor E, Liu Y. The genetic and environmental factors for keratoconus. Biomed Res Int. 2015;2015:795738.

13. Seiler TG, Schmidinger G, Fischinger I, et al. Komplikationen der vernetzung der hornhaut [Complications of corneal cross-linking]. Ophthalmologe. 2013;110(7):639-44. German.

14. Çakmak S, Sucu ME, Yildirim Y, et al. Complications of accelerated corneal collagen crosslinking: review of 2,025 eyes. Int Ophthalmol. 2020;40(12):3269-77.

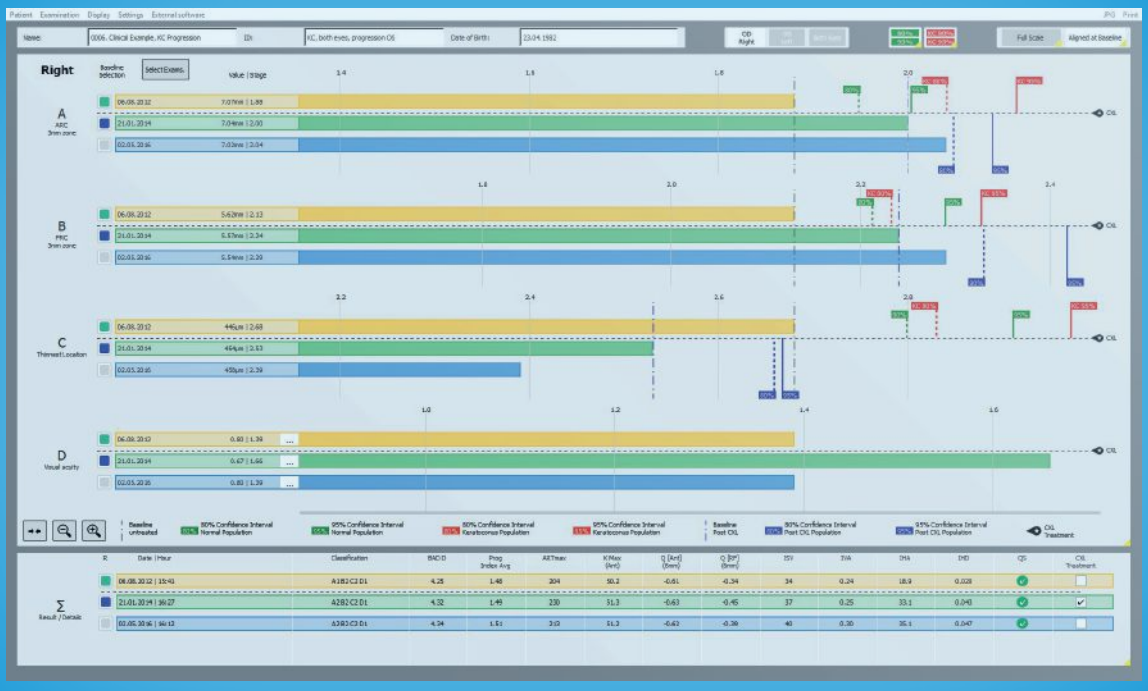
15. Tillmann A, Kampik D, Borrelli M, et al. Acute corneal melt and perforation—a possible complication after riboflavin/UV-A crosslinking (CXL) in keratoconus. Am J Ophthalmol Case Rep. 2022;28:101705.

16. Ling JJ, Mian SI, Stein JD, et al. Impact of scleral contact lens use on the rate of corneal transplantation for keratoconus. Cornea. 2021;40(1):39-42.

17. Chou B. New tools to tame keratoconus. RevOptom. 2019;156(4):42-9.

18. Gelles JD. Contact lenses for visual rehabilitation in keratoconus: characteristics and outcomes of contact lenses for keratoconus an evidence-based fitting algorithm. Presented at Global Specialty Lens Symposium 2020.

Keratoconus Progression at a Glance!



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BY DENISE GOODWIN, OD
FOREST GROVE, OR

Understanding pupil testing and disorders is critical. With one quick, objective test, the pupil evaluation provides information about the retina, optic nerve, chiasm, optic tract, midbrain, cranial nerves III and V and the orbit. In addition, almost all of the true emergent conditions we deal with in optometry can be picked up by a pupil examination.

The following article will cover how to evaluate the pupils and ways to identify and localize both afferent and efferent pupillary disorders. Most importantly, we will cover the characteristics of five pupil disorders that should be managed emergently.

Pupil Evaluation

Check pupil sizes and reactions with the room lights off in order to make the room as dark as possible. The contrast of the lack of room light compared with the brightness of the transilluminator

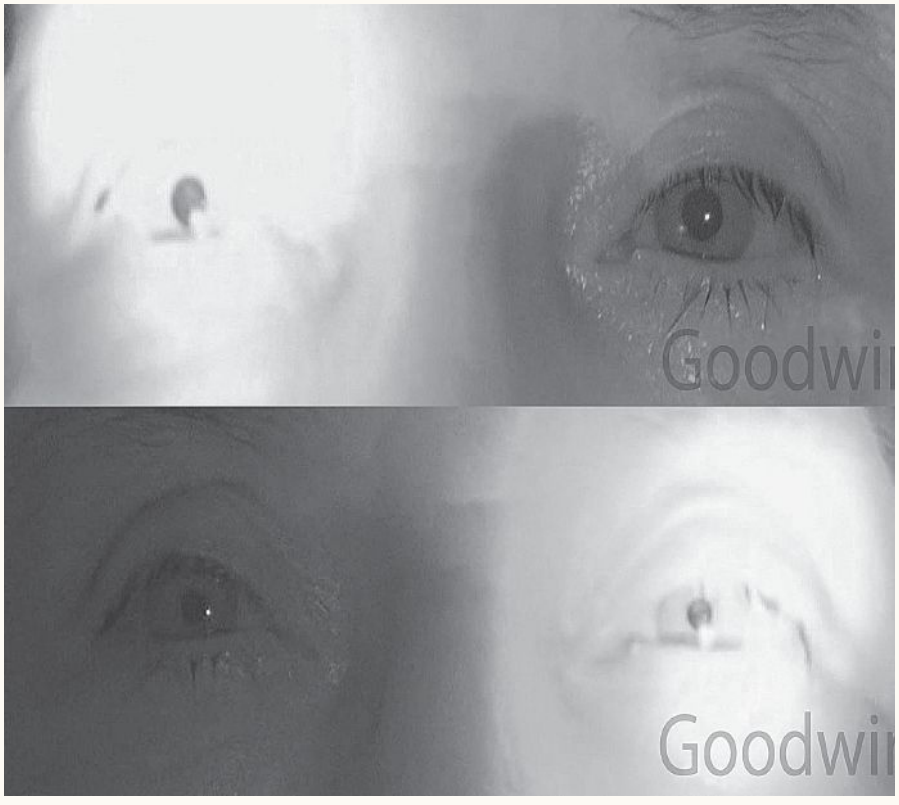

Fig. 1. A right RAPD in a patient with optic neuritis. Shining light in the left eye causes both pupils to constrict. Shining light in the right eye causes both pupils to dilate.[8]

About the author

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will accentuate a relative afferent pupillary defect. The patient should fixate on a distant target to prevent the pupil constriction that occurs with accommodation and convergence. Look for anisocoria in dim illumination by holding the light two to three inches below the chin and shining the transilluminator upward, tangential to the patient's face. This will allow you to see the pupils in dim illumination without getting too much light getting in the way. Then use the transilluminator to check pupillary light reactions. While doing this, look for anisocoria in bright illumination.

Finally, check for a relative afferent pupillary defect (RAPD) by moving the light back and forth between both eyes (swinging flashlight test). While alternating the light, count to three. Watch to see at which number the pupils start to dilate. If one pupil starts to dilate at two and the other pupil starts to dilate at three, this is an RAPD. Watching how quickly the pupils redilate during the swinging flashlight test helps to differentiate a subtle RAPD from hippus, which should be symmetric movement between the two eyes.

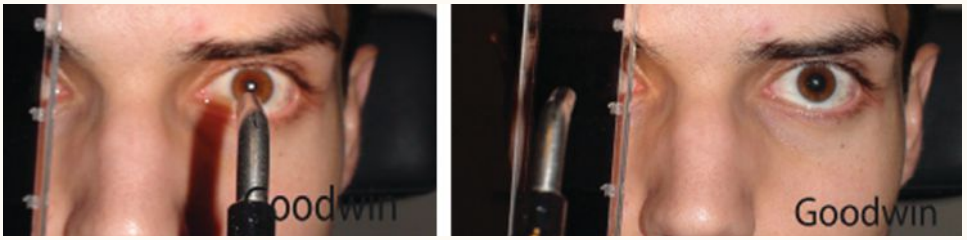

Fig. 2. A neutral density bar can be used to determine the severity of an RAPD.

RAPDs

This finding indicates that the signal going back to the midbrain is unequal between the two eyes. There is no anisocoria associated with an RAPD because both pupils dilate equally when light is shined in the abnormal eye. Shining light in the relatively normal eye causes both pupils to constrict. When counting to three for each eye during the swinging flashlight test, the relatively normal pupil may stay constricted for the entire count. If you have a fairly severe RAPD, both pupils will dilate almost immediately when moving the light into the relatively abnormal pupil (*Figure 1*). With a more subtle RAPD, the relatively abnormal pupil will stay constricted and then start to dilate between counts one and two compared with the relatively normal pupil which may stay constricted for the full count of three.

RAPDs can be graded on a scale of zero to four. A grade one RAPD indicates initial constriction followed by quicker dilation of the involved pupil, while a grade two RAPD has no initial movement followed by a quick dilation. Grade three is an immediate dilation of the pupil as you shine light from the normal to the involved eye. With a grade four RAPD, the pupil will stay dilated even with prolonged illumination.

Neutral density filters can be used to quantify an RAPD (*Figure 2*). Put the filter over the better eye while performing the swinging flashlight test. Continue increasing the density until there is no difference in pupillary dilation.

If one pupil is fixed due to neurologic disease, iris trauma or medication, check for an RAPD using the reverse Marcus Gunn test. Watch only the mobile pupil while alternating the light between the two eyes. If the mobile pupil constricts when light is shined directly in the eye and dilates when light is shined in the opposite eye, there is an RAPD in the nonmobile pupil. If the afferent signal is equal between the two eyes, the mobile pupil constricts when the light is shined directly in the eye and then stays constricted when light is shined in the opposite eye. Thus, there will be no movement of the mobile pupil as you move the light back and forth.

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

- Recognize the pathophysiology of pupil abnormalities.
- Create a work-up for the abnormal pupil patient.
- Identify when additional tests and/or monitoring are required.
- Manage patients with pupil abnormalities.

Target Audience: This activity is intended for optometrists engaged in pupil disorder management.

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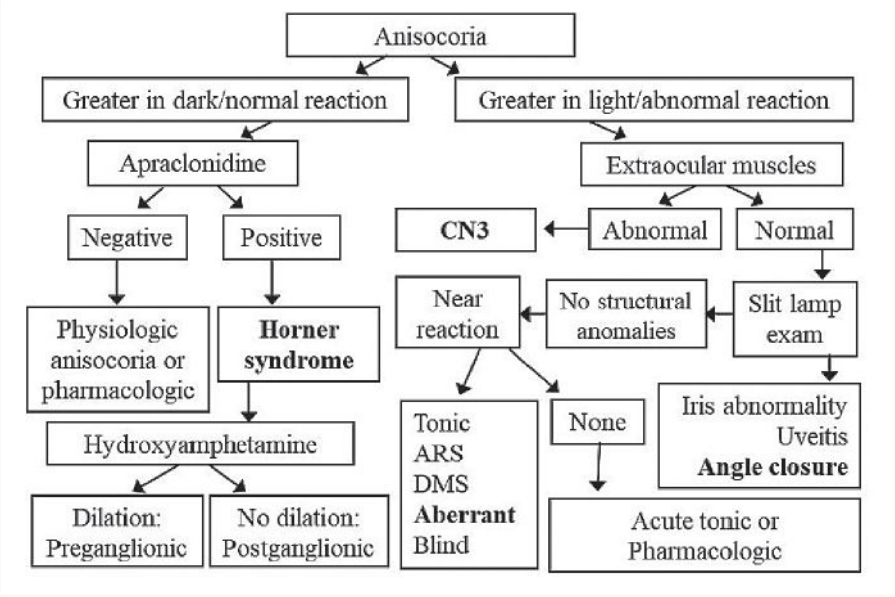

Fig. 3. Flowchart differentiating various causes of anisocoria. The bolded conditions indicate situations that need to be dealt with emergently.
CN3: cranial nerve III, ARS: Argyll Robertson syndrome, DMS: dorsal midbrain syndrome

The most common cause of an RAPD is unilateral or asymmetric optic nerve disease. You can also get an RAPD with a large retinal lesion. If there is subtle retinal disease, it will not cause an RAPD. Amblyopia and marked anisocoria can cause a very mild RAPD.[1,2] A lesion of the optic tract will cause an RAPD in the eye with the worse visual field. An optic tract lesion with a complete homonymous hemianopia will cause an RAPD in the eye contralateral to the lesion (*i.e.*, the eye with the temporal visual field).[3] This occurs in part because there are more intrinsically photosensitive retinal ganglion cells in the nasal vs. the temporal retina.

A brachium lesion of the superior colliculus can cause an RAPD with normal vision. Fibers leave the optic tract before getting to the lateral geniculate nucleus and travel to the pretectal nuclei. As these fibers do not go to the lateral geniculate nucleus, vision will be unaffected. It is otherwise fairly unusual that the visual system would be normal when an RAPD is present. Compressive optic neuropathy can cause normal vision and an RAPD because visual acuity loss can be very mild with compressive optic neuropathy despite a significant RAPD. Also, a previous episode of demyelinating optic neuritis can cause normal visual acuity and an RAPD since the acuity goes back to normal after about six weeks, but there is generally permanent loss of ganglion cell fibers.

It is important to know what does not cause an RAPD so it isn't attributed to an incorrect etiology, causing one to miss a potentially serious condition. An RAPD will not occur with a media opacity, such as corneal scarring or cataract. In fact, an RAPD often occurs in the eye with less severe cataract.[4] Subtle retinal lesions will not cause an RAPD. If the lesion is bilateral and symmetric or behind the lateral geniculate nucleus, you will not get an RAPD. No RAPD will be present despite even severe functional vision loss.

Efferent Pupillary Defects

The characteristic feature of an efferent defect, regardless of whether it is a sympathetic or parasympathetic issue, is anisocoria. *Figure 3* shows a flowchart that can help determine a diagnosis once anisocoria is detected. Note the four diagnoses that are bolded and need to be dealt with emergently.

If anisocoria is present, observe the pupils in dim and bright illumination. If the anisocoria is worse in bright light, consider a parasympathetic problem. This is verified by looking at the pupil's reaction to light. A parasympathetic problem causes poor constriction to light. That lack of constriction is what makes the anisocoria worse in bright light. If the anisocoria is worse in dim illumination, an issue with the sympathetic system is most likely present. With a sympathetic problem, the pupil will constrict normally to light, but it will dilate slowly.

Cranial nerve III palsy. If anisocoria is worse in bright light with abnormal reaction to light, look for associated features like ptosis or extraocular muscle palsies. If the muscles are involved, consider a cranial nerve III palsy (*Figure 4*). This is an emergent situation. A cranial nerve III palsy that involves the pupil should be considered due to an aneurysm until proven otherwise. This presents with a dilated pupil, ptosis, an inability to adduct the eye and an inability to move the eye up or down.

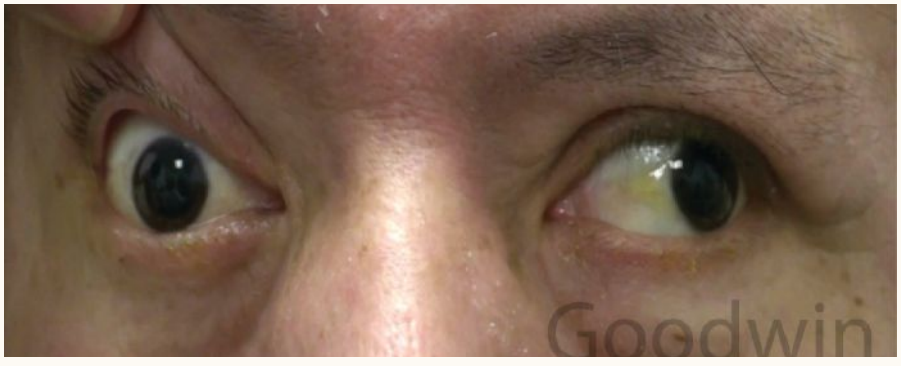

Fig. 4. A right cranial nerve III palsy. The right eyelid is manually raised due to ptosis. The eye is unable to adduct or move up or down.

Whether or not the pupil is involved indicates the likelihood that an aneurysm is the cause of the cranial nerve III palsy. A complete pupil-sparing cranial nerve III palsy (the pupil is normal) is most likely due to ischemia, as would occur with diabetes. It is possible that the pupil may not be involved yet but may become involve imminently. Don't dilate a patient with a cranial nerve III palsy, and watch the pupils carefully. If the pupils become involved, immediate computed tomography angiography or magnetic resonance angiography (MRA) is warranted. A pupil-sparing cranial nerve III palsy due to ischemia will generally improve with time and care of the vasculopathic risk factors.

If the pupil is involved in a cranial nerve III palsy, emergent magnetic resonance imaging (MRI) and MRA should be ordered looking for an aneurysm.[5] Pupillary fibers are located on the superficial surface of cranial nerve III as it exits the midbrain. The extraocular muscle fibers are deeper in the nerve. Because of this, an aneurysm that is pressing hard enough to cause an extraocular muscle deficit will also compress the pupillary fibers. An incomplete cranial nerve III palsy—for example, only the medial rectus and inferior rectus are involved—requires an MRI, regardless of pupil involvement.

Iris abnormalities. If extraocular muscle movements are normal, look for iris abnormalities. Iris defects may confound the pupillary evaluation. Additionally, there are important iris conditions that should not be missed. Congenital aniridia can be an indication of Wilms tumor—a cancer of the kidney. A coloboma or an ectopic pupil can complicate your pupil exam. Other conditions that can result in pupillary abnormalities include uveitis, iris tumors, trauma and ischemia, which occurs with ocular ischemic syndrome.

Ischemia of the iris occurs with angle-closure glaucoma. This is one of the five emergent causes of pupil abnormalities because of the potential to cause blindness quickly. This will produce a mid-dilated pupil that is not responsive to light or a near target.

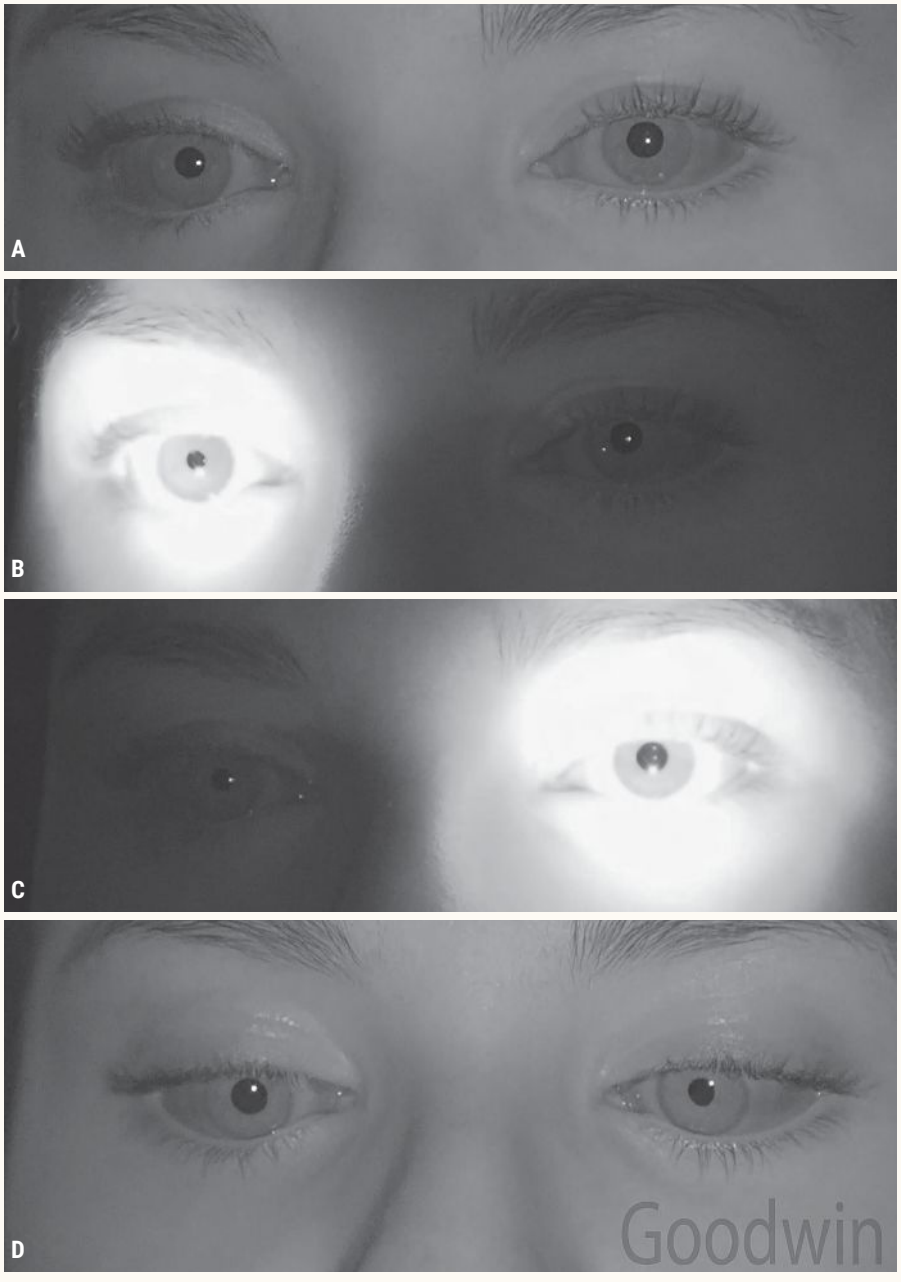

Fig. 5. A left tonic pupil: (A) There is slight anisocoria in dim illumination. (B) The normal right pupil is responsive to light. (C) The tonic left pupil is not responsive to light. When light is shined in the eye the amount of anisocoria is greater. (D) Both eyes constrict to a near target, although the left eye takes longer to constrict maximally.

These patients often have corneal edema, pain, redness and halos around lights. Ultimately, this diagnosis is made by taking intraocular pressure.

Light near dissociation. Any time a patient's light reflex is not normal, check near pupillary responses. Light near dissociation, where the pupil reacts better to a near target than to light, indicates one of the following five conditions: a tonic pupil, an Argyll Robertson pupil, dorsal midbrain syndrome, aberrant regeneration or a blind eye.

Blindness due to lesions anterior to the lateral geniculate nucleus will cause a lack of light reflex. Even if the patient is completely blind bilaterally, focusing on their own thumb will produce the pupillary constriction that comes with convergence and accommodation.

TABLE 1. COMMON CAUSES OF PHARMACOLOGICALLY INDUCED ANISOCORIA

Parasympatholytic Causes	Sympathomimetic Causes
· Scopolamine patch · Asthma inhalant · Botulinum toxin · Insecticides · Gentamicin	· Cocaine · Eye-whitening drops in conjunction with corneal abrasion or contact lens use · Phenylephrine nose spray · Adrenergic inhalers · Apraclonidine with autonomic problems

Fig. 6. A right tonic pupil. The pupil is not circular.

Aberrant regeneration may be congenital or due to a past trauma. It can also be due to a slow-growing mass, the most emergent of which is an aneurysm. With aberrant regeneration, damaged fibers grow to innervate structures they were not initially intended to innervate. If fibers from the medial rectus aberrantly grow to innervate the sphincter, the pupil will constrict when the patient converges to look at a near target despite not constricting to light due to direct damage. If you know that there was a previous injury or that the aberrant regeneration is congenital, no additional testing is necessary. If the patient has no previous history, the aberrant regeneration indicates a slow-growing mass. Consider an aneurysm until proven otherwise.

Another cause of light near dissociation is a lesion pushing on the posterior midbrain. A tumor of the pineal gland, which sits directly behind the midbrain, can damage the pupillary fibers that travel in the posterior midbrain. Typically, both eyes will become nonreactive to light because the signal does not get from the pretectal nuclei to the Edinger Westphal area. The fibers involved in the near pupillary response don't leave through the brachium of the superior colliculus; instead, they continue to the lateral geniculate nucleus, the occipital lobe and the frontal eye fields. The information goes directly from the frontal eye fields to the Edinger Westphal area without going through the pretectal nuclei. Because of this, a lesion affecting the dorsal midbrain will spare the near fibers, and both pupils will respond briskly to a near target despite having no light reaction. Other signs of dorsal midbrain syndrome include a superior gaze palsy and convergence retraction nystagmus.

Argyll Robertson syndrome, commonly associated with neurosyphilis, results in very small pinpoint pupils. Like dorsal midbrain syndrome, the pupils do not react to light but respond briskly to a near target. One difference between the two conditions is that dorsal midbrain syndrome has normal-sized pupils.

The last of the five conditions causing light near dissociation is tonic pupil. This is a parasympathetic post-ganglionic problem, so the lesion is in the ciliary ganglion or short ciliary nerves.[5] The pupil fibers have left the rest of cranial nerve III, so there are no other signs of a cranial nerve III palsy, such as ophthalmoplegia or ptosis. Tonic pupil exhibits greater anisocoria in bright illumination (*Figure 5*). Despite having no constriction to light, there is a slow constriction to a near target. That slow tonic reaction differentiates this from other causes of light near dissociation where the near pupillary reaction is brisk.

Another characteristic feature of tonic pupil is an irregular pupil border (*Figure 6*). Here, parts of the iris sphincter still

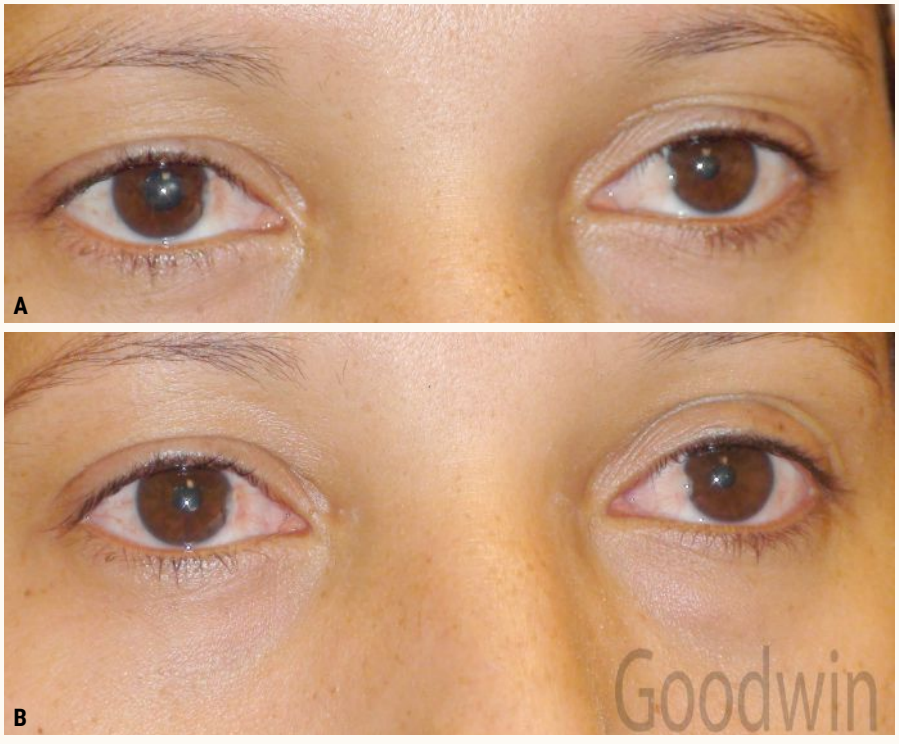

Fig. 7. A right tonic pupil: (A) Before 0.12% pilocarpine is instilled. (B) After 0.12% pilocarpine is instilled in both eyes. Note that the right pupil constricts following drop installation whereas the left does not.

function while other parts do not. A related feature is iris streaming, causing pupil constriction only in some areas. When light is shined in the eye, it looks like the pupil border bunches up in one area like a drawstring of a purse. These are the healthy segments of sphincter tightening up and pulling on the nonfunctioning areas.

A tonic pupil diagnosis is generally based on the clinical features alone, including the slow light near dissociation, irregular pupil border and segmental constriction; therefore, the use of dilute pilocarpine is usually not necessary. Dilute pilocarpine can help distinguish tonic pupil from a pharmacologically dilated pupil. This is made by combining one drop of 1% pilocarpine with eight drops saline to create a 0.12% concentration. A normal pupil will not constrict to 0.12% pilocarpine, but a tonic pupil will (*Figure 7*).

Often, patients with a tonic pupil come in due to either glare or reading problems (since it initially affects accommodation). After a few weeks, accommodation is at least partially restored. Generally, no other workup or treatment is needed for these patients. Plus lenses can be prescribed if accommodative problems are bothersome or persistent. Tinted glasses or low-dose pilocarpine can be helpful if the patient has light sensitivity due to the dilated pupil.

A number of both local and systemic causes can affect the ciliary ganglia or short ciliary nerves. The ganglion is located within the orbit so any orbital infection, inflammation, mass or trauma can cause a tonic pupil. Very commonly, tonic pupil will occur following ocular surgery, most notably damage to the ciliary ganglion during retinal detachment surgery or damage to the short ciliary nerves during retinal photocoagulation. Systemic diseases that affect the autonomic nervous system, such as diabetes, can cause a bilateral tonic pupil. Tonic pupil is commonly idiopathic, called Adie tonic pupil. Like other idiopathic diseases, all causes of tonic pupil should be ruled out prior to diagnosing Adie tonic pupil.

Fig. 8. A pharmacologically dilated pupil following the use of a sympathomimetic agent.

Pharmacologically dilated pupil. If there is poor light reaction, extraocular muscle movements are normal, slit lamp exam is normal and there is no near reaction, consider a pharmacologically dilated pupil or an acute tonic pupil that hasn't had time to develop aberrant regeneration or hypersensitivity. If due to a parasympatholytic agent, a pharmacologically dilated pupil will not react to light or accommodation. There will be no ptosis or extraocular muscle restriction.

To confirm a pupil is pharmacologically dilated with a parasympatholytic agent, instill a drop of 1% to 2% pilocarpine in the eye. A normal pupil, as well as a tonic pupil or pupil involving cranial nerve III palsy, will constrict with 1% to 2% pilocarpine. A parasympatholytic ally pharmacologically dilated pupil will not constrict. Common causes of pharmacologically dilated pupils are listed in Table 1.

Figure 8 shows a patient with blurry vision in the right eye. He was 20/20 in each eye, but right eye vision wasn't quite as good as it used to be or as good as the left eye. A careful ocular health exam was normal other than the right pupil being larger than the left. He was using Opcon-A six times per day. A worse depth of focus in the right eye due to the enlarged

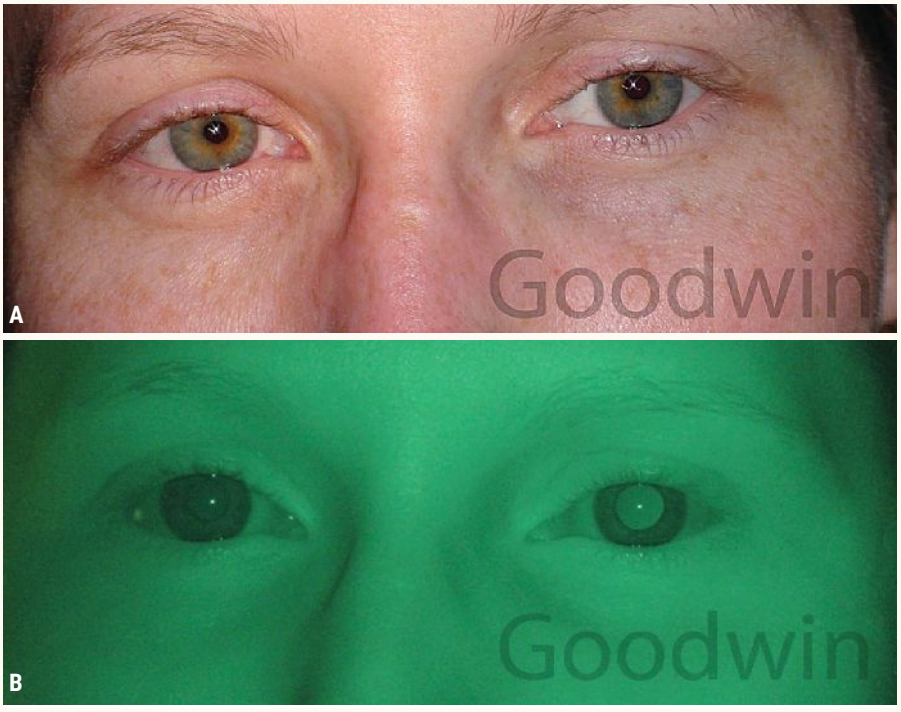

Fig. 9. Physiologic anisocoria: (A) Anisocoria is evident in bright illumination, and both pupils respond briskly to light. (B) The anisocoria is slightly greater in dim illumination.

Fig. 10. A right Horner syndrome: (A) In light, ptosis and miosis are evident in the right eye. (B) Five seconds after removing the light, there is significant anisocoria. (C) Fifteen seconds after removing the light, the anisocoria is less compared with that after five seconds.

pupil was considered. He quit using the Opcon-A, and the anisocoria and blurriness went away. This pattern of anisocoria is common in patients using sympathomimetic drops while wearing contact lenses.

Physiologic anisocoria. *Figure 9* shows a patient experiencing a particularly severe headache. Her coworker noticed she had different pupil sizes. The anisocoria is slightly more evident in dim illumination, she does not have ptosis, the pupils are reactive to light and the pupils dilate equally. This is consistent with physiologic anisocoria.

Approximately 20% of the population has physiologic anisocoria.[5] There are no serious clinical implications. This can be more evident in dim illumination because of mechanical restrictions reducing the anisocoria as the pupils constrict in bright light.[6] The mechanical restriction of the smaller pupil gives the larger pupil a chance to catch up. If unsure whether the anisocoria is physiologic, look for a dilation lag.

Horner syndrome. *Figure 10* shows anisocoria greater in dim illumination. There is ptosis in the right eye, the eye with the smaller pupil. Pupil reactions to light are normal. The most distinguishing feature occurs when bright light is quickly removed from the eyes; the involved pupil dilates much slower than the other eye. This is called a dilation lag. This is most obvious by comparing the amount of anisocoria five seconds and 15 seconds after removing the light (*Figure 10*). With a sympathetic problem (Horner syndrome), the anisocoria will be greater after five seconds. A dilation lag will not occur with physiologic anisocoria.

Characteristic signs of Horner syndrome include ptosis, miosis, anhidrosis and a dilation lag. Iris hypochromia will be present if the condition is congenital or longstanding (*Figure 11*). Hypochromia is never present in acute Horner syndrome.

Figure 11 shows a patient with a right preganglionic Horner syndrome. The left cheek is redder with sweat beads, indicating anhidrosis or lack of sweating on the right side. The distribution of the anhidrosis can give a clue to the lesion location. The sympathetic pathway starts in the hypothalamus. Fibers travel down the brainstem to the upper spinal cord where central fibers synapse with pre-ganglionic fibers. Preganglionic fibers exit the spinal cord, pass across the pulmonary apex and follow the carotid artery to the superior cervical ganglion. Postganglionic fibers start at the superior cervical ganglion, travel in the wall of the internal carotid artery to the cavernous sinus and then follow divisions of cranial nerves V and III to the pupil and Müller muscle.

While fibers to the pupil and eyelid follow the internal carotid artery, sweat fibers follow the external carotid artery.

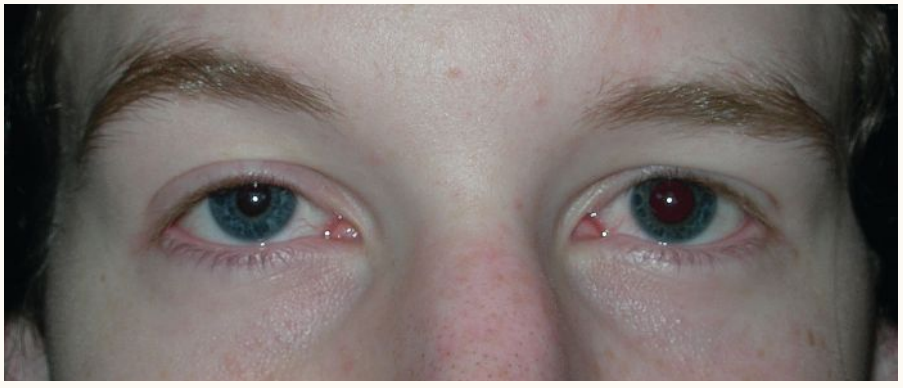

Fig. 11. Right Horner syndrome. The right pupil is smaller compared with the left, there is ptosis of the right eyelid and the right iris is of lighter color compared with the left iris.

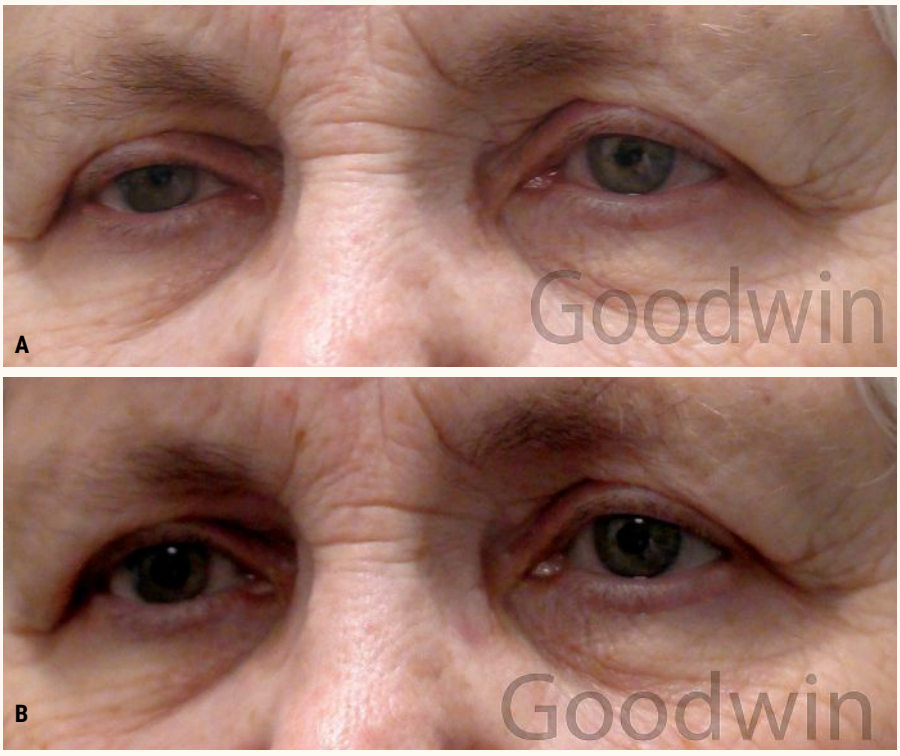

Fig. 12. Pharmacologic testing for Horner syndrome: (A) Before apraclonidine drops, miosis and ptosis are evident in the right eye. (B) After apraclonidine drops, there is reversal of the anisocoria (the right pupil is now larger than the left) and improvement of the ptosis.

Therefore, a preganglionic lesion will cause loss of sweating to the entire half of the face. A person with a postganglionic lesion will have normal sweating on both sides of the face. This is true except for a small portion on the medial forehead, which is supplied by fibers following the internal carotid artery.

Causes of Horner syndrome vary depending on whether the lesion involves the central, preganglionic or postganglionic fibers. Stroke, demyelination, trauma, malignancy of the lung or iatrogenic causes are common reasons for preganglionic Horner syndrome. The most emergent cause of Horner syndrome is an internal carotid artery dissection, which causes a postganglionic Horner syndrome.

Internal carotid artery dissection is a tear within the arterial wall. This results in a hematoma or clotting within the artery which can cut off blood flow to the brain. Internal carotid artery dissection can occur with trauma or spontaneously. Up to 58% of carotid artery dissections present with pain of the face, head or neck.[3] Horner syndrome is present in 41% of carotid artery dissections.[7] Carotid artery dissection is an emergency due to the very high risk of stroke. These patients need an emergent MRI and MRA of the head and neck. They'll be admitted immediately and treated with anticoagulants.

Pharmacologic testing is necessary to ensure the patient actually has Horner syndrome. Physiologic anisocoria and ptosis by themselves are both very common, so the presence of both, even in the same eye, does not necessarily mean the patient has Horner syndrome. Apraclonidine will not dilate a normal pupil, but because iris dilator suprasensitivity occurs with Horner syndrome, it will dilate a Horner pupil (*Figure 12*).

Improvement of the ptosis also occurs. It takes a while to develop suprasensitivity after a nerve is damaged. Therefore, if the Horner syndrome is acute, apraclonidine will not work. Generally, it takes two to five days to develop suprasensitivity.[5]

Emergent Causes of Pupillary Disorders

Almost all true emergent conditions in optometry can be picked up by a pupil examination. With Horner syndrome, we are particularly worried about internal carotid artery dissection due to the risk of stroke. Both a cranial nerve III palsy involving the pupil and aberrant regeneration can indicate an aneurysm. A mid-dilated pupil with high intraocular pressure indicates angle-closure glaucoma.

The included flowchart with the emergent diagnoses only covered anisocoria, but an RAPD can be indicative of one of the most emergent conditions we deal with in ophthalmic disease: arteritic ischemic optic neuropathy. If you see an RAPD in a person over the age of 50, consider sending the patient for an emergent erythrocyte sedimentation rate and C-reactive protein to rule out giant cell arteritis. In addition, a central retinal artery occlusion or large retinal detachment, which are also emergencies, can cause an RAPD.

Pupil abnormalities are commonly encountered by eyecare practitioners. Conducting a careful pupil examination can aid in recognizing and diagnosing important ocular and systemic conditions. While performing the pupil exam, keep in mind the most emergent causes of pupil abnormalities so that these are managed in a timely manner. ■

1. Lam BL, Thompson, HS. An anisocoria produces a small relative afferent pupillary defect in the eye with the smaller pupil. J Neuroophthalmol. 1999;19(3):153-9.

2. Greenwald MJ, Folk ER. Afferent pupillary defects in amblyopia. J Pediatr Ophthalmol Strabismus. 1983;20(2):63-7.

3. Kardon R, Kawasaki A, Miller NR. Origin of the relative afferent pupillary defect in optic tract lesions. Ophthalmology. 2006;113(8):1345-53.

4. Hwang JM, Kim C, Kim JY. Relative afferent pupillary defect in patients with asymmetric cataracts. J Cataract Refract Surg. 2004;30(1):132-6.

5. Falardeau J. Anisocoria. International Ophthalmology Clinics Volume. 2019;59(3):125-39.

6. Steck R, Kong M, McCray K, et al. Physiologic anisocoria under various lighting conditions. Clin Ophthalmol. 2018;12:85-9.

7. Baumgartner R, Bogousslavsky J. Clinical manifestations of carotid dissection. Front Neurol Neurosci. 2005;20:70-6.

8. Remington L, Goodwin D. Clinical Anatomy and Physiology of the Visual System, 4th ed. Philadelphia, PA: Elsevier; 2021.

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1. You are performing a swinging flashlight test. You are counting to three each time you move the light from one eye to the other. You see that the right eye starts dilating at the count of three. The left eye starts dilating at the count of one. Which of the following is true?
a. The person has a right RAPD.
b. The person has a left RAPD.
c. The person has no RAPD.
d. The person has a bilateral RAPD.

2. You are performing a swinging flashlight test on a patient with a fixed right pupil. The left pupil constricts when shining light in the right eye. The left pupil dilates when shining light in the left eye. Which of the following is true?
a. The person has a right RAPD.
b. The person has a left RAPD.
c. The person has no RAPD.
d. The person has a bilateral RAPD.

3. Which of the following will not cause an RAPD?
a. Optic neuritis.
b. A large retinal detachment.
c. An optic tract lesion.
d. Central serous chorioretinopathy.

4. Which will cause an RAPD despite normal vision?
a. A lesion in the brachium of the superior colliculus.
b. Compressive optic neuropathy.
c. Demyelinating optic neuritis.
d. All of the above.

5. Which will not cause anisocoria?
a. An RAPD.
b. Horner syndrome.
c. Cranial nerve III palsy.
d. Tonic pupil.

6. Your patient has a complete cranial nerve III palsy with a dilated pupil. Which diagnosis should you consider first?
a. Diabetes.
b. Tonic pupil.
c. An aneurysm.
d. A pineal gland tumor.

7. Which pupil appearance is consistent with angle-closure glaucoma?
a. Pinpoint pupils that are not reactive to light but are reactive to accommodation.
b. Mid-dilated pupils that are not reactive to light but are reactive to accommodation.
c. Dilated pupils associated with ptosis and extraocular muscle restriction.
d. Mid-dilated pupils that are not reactive to light or accommodation.

8. Which is not a cause of light near dissociation?
a. Tonic pupil.
b. Dorsal midbrain syndrome.
c. Aberrant regeneration.
d. All of the above can cause light near dissociation.

9. Which of the following can result in light near dissociation due to aberrant regeneration?
a. Congenital causes.
b. A past cranial nerve III lesion.
c. Aneurysm.
d. All of the above.

10. Which of the following is not a characteristic of tonic pupil?
a. Anisocoria greater in dim illumination.
b. Irregular pupil border.
c. Iris streaming.
d. All of the above.

11. Which of the following results in slow (not brisk) light near dissociation?
a. Tonic pupil.
b. Argyll Robertson pupil.
c. Dorsal midbrain syndrome.
d. Aberrant regeneration.

12. Your patient has anisocoria greater in bright light. You instill 0.12% pilocarpine in both eyes. The right pupil decreases in size. The left pupil does not change in size. Which is the most likely diagnosis?
a. Right pharmacologically dilated pupil.
b. Left pharmacologically dilated pupil.
c. Right tonic pupil.
d. Left tonic pupil.

13. Which of the following is a potential cause of tonic pupil?
a. Retinal detachment surgery.
b. Orbital inflammation.
c. Diabetes.
d. All of the above.

14. You instill 1% pilocarpine in both eyes. The previously dilated pupil does not constrict. Which is the most likely diagnosis?
a. A pharmacologically dilated pupil.
b. Tonic pupil.
c. Cranial nerve III palsy.
d. Physiologic anisocoria.

15. Which percentage of your patients should have physiologic anisocoria?
a. 1%.
b. 5%.
c. 20%.
d. 50%.

16. Your patient has anisocoria greater in dim illumination. The anisocoria is greatest five seconds after removing light from the eye and diminishes 15 seconds after removing light from the eye. Which is the most likely diagnosis?
a. Tonic pupil.
b. Physiologic anisocoria.
c. Cranial nerve III palsy.
d. Horner syndrome.

17. Anhidrosis of the entire left side of the face is indicative of which of the following?
a. A preganglionic Horner syndrome.
b. A postganglionic Horner syndrome.
c. Either a preganglionic or postganglionic Horner syndrome.
d. Neither a preganglionic or postganglionic Horner syndrome.

18. Which is the most emergent cause of a Horner syndrome?
a. A remote history of stroke.
b. An internal artery dissection.
c. Demyelination.
d. Past surgery on the upper back.

19. Your patient has miosis and ptosis in the right eye. You instill apraclonidine in both eyes. Which is indicative of Horner syndrome?
a. Worsening of the ptosis.
b. Dilation of the right pupil.
c. Constriction of the right pupil.
d. None of the above.

20. You see an RAPD in a 66-year-old patient. Which diagnosis should be ruled out emergently?
a. Demyelinating optic neuritis.
b. Giant cell arteritis.
c. Diabetes.
d. Horner syndrome.

Examination Answer Sheet

Evaluation and Diagnosis of Pupil Disorders

Valid for credit through February 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.

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Answers to CE exam:

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

Post-activity evaluation questions:

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

21. Recognize the pathophysiology of pupil abnormalities. ① ② ③ ④ ⑤
22. Create a workup for the abnormal pupil patient. ① ② ③ ④ ⑤
23. Identify when additional tests and/or monitoring are required. ① ② ③ ④ ⑤
24. Manage patients with pupil abnormalities. 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
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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 123599 RO-OSC-0223

BY PAUL M. KARPECKI, OD
CHIEF CLINICAL EDITOR

Right Tool for the Job

These small but mighty instruments can help you better perform a number of procedures and will enhance your practice.

It's been said, "You can easily do any job as long as you have the right tool." Optometrists may overlook valuable tools at their disposal to provide premium care to patients. The following discussion gives an overview of several of the newest ocular surface–based instruments and what you may need to implement them in your practice.

Eyelid Everters

One of the more exciting new instruments is the Meivertor. Its disposable silicone tips gently grasp lashes with a simple turning motion and the eyelid is everted. The advantage is that it frees the other hand. Additionally, it can also keep the everted eyelid in place longer for procedures such as concretion or inclusion cyst removal. It's easier on you and the patient for a quick upper eyelid assessment during a routine exam or to identify a potential foreign body.

Meivertor grasping the lashes to evert the eyelid.

Gone are the days of having difficulty everting an eyelid or missing a subtle foreign body. Additionally, if you offer meibography, you have a tool that staff can easily use to effectively capture the image without the need for a second technician to hold the eyelid.

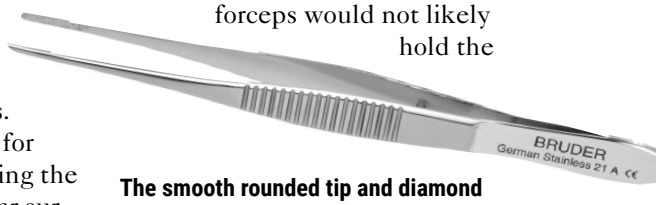
Forceps

These include toothed and non-toothed styles. Toothed instruments allow for greater control during procedures rather than conventional forceps or hands. With greater control, you are able to provide efficient and effective care to patients in comparison to conventional means. Newer instruments also allow for smooth edges and tips, removing the potential for insult to the ocular surface. These provide added comfort for patients, potentially removing the need for anesthetics. Additionally, you are able to be more precise by staying within the slit lamp to administer treatment.

One unique instrument is a diamond dust covered, smooth-end forceps, which is employed in the removal of a bandage contact lens (BCL). The use of fingers to pinch a BCL can sometimes remove epithelium along with it—especially in the early healing course of an abrasion or recurrent corneal erosion—impart pathogens or cause injury. The BCL forceps break suction instantly by grasping the BCL at the temporal edge and removing it. Because the forceps have a smooth end, you can't poke or injure the conjunctiva as you slide it under the BCL. Once it's grasped, it is an easy removal and practically impossible to cause an abrasion.

The removal of inclusion cysts is one instance where using toothed forceps instead of jeweler forceps would be a more effective and valuable treatment option. Traditionally, inclusion cysts are drained by puncturing the affected area with a large-gauge needle; however, this procedure yields high recurrence rates.

A more robust treatment option would be to use the toothed forceps to elevate the central portion of the cyst, allowing you to create an incision immediately below the area for an increased drainage zone. Jeweler's forceps would not likely hold the cyst in the center and could pose a risk for injury by their sharp leading edge. The curved end of the toothed forceps allows you to grasp the cyst without worry of injury. Control of the conjunctiva throughout the procedure is maintained due to the inside toothed nature of the forceps as opposed to the smooth inside of jewelers.



The smooth rounded tip and diamond dust on the forceps prevent epithelial cell damage when removing a BCL.

Insertion of punctal plugs can be accomplished through various means. Unless insertion is performed with a pre-loaded plug, forceps must be involved. In order to properly grip the plug, the doctor is required

About Dr. Karpecki

Dr. Karpecki is medical director for Keplr Vision and 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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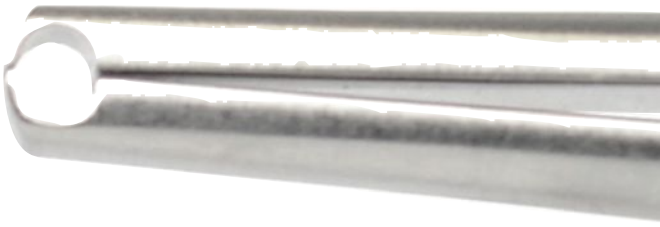
to have the punctal plug inside the forceps. Due to the smooth nature of regular jeweler's forceps, a higher level of pressure must be applied when clamping the plug. This pressure can cause the punctal plug to be crushed or to fly off as it is squeezed. The sharp tip of jewelers may also increases risk of potential injury to the patient. Punctal plug forceps (Bruder) have a groove designed to fit these extended-duration plugs, which provides control of the plug while minimizing pressure. It also allows the plug to be nearly parallel with the forceps. Parallel angle insertion is less challenging than a traditional perpendicular angle, thus reducing stress for you and the patient.

The grooves in these extended-duration punctal plug forceps allow for easy capture and insertion.

The implementation of cryopreserved amniotic membranes is becoming commonplace in practices across the nation. Although insertion of the Prokera Lens Forceps is easily performed with one's fingers, the removal of the ring post-treatment can be the challenge. The smooth leading edge allows you to easily grasp and maintain better control, which results in more comfort for the patient. When a patient experiences discomfort during removal, proper gaze may become unstable. Irregular fixation during removal can further lead to excess damage of the ocular surface, redacting the purpose of the amniotic membrane. Other methods such as fingertip removal or another type of forceps could be applied, but will not supply the necessary control and grasp needed to most efficiently and safely remove the amniotic membrane remnant. Because these forceps are rounded, you can't injure the conjunctiva as you try to grasp the ring edge.



Prokera forceps allow for easy removal of the remnant ring without the risk of trauma to the ocular surface.

The Apollo Amniotic Membrane (Atlas Ocular) forceps share a similar smooth-edge, which also provides better safety but also protects the delicate membrane and prevents it from folding. There are multiple ways to position a dehydrated amniotic membrane on the eye. A more sterile environment is maintained due to the forceps' ability to grasp the membrane within its original packaging. Placement of the membrane is similar when using other forceps, due to the membrane having a high affinity to the ocular surface. The instrument's design allows for the position of the membrane to be more precise and prevents compared to sharp-edge or pointed forceps.

Debridement/Scaling

Research has shown that eyelid margin debridement has a significant positive impact on patients with meibomian gland dysfunction (MGD), blepharitis and evaporative dry eye. It can increase MG function and significantly reduce dry eye symptoms. A properly crisp, designed tool can remove biofilm, keratin and debris covering the MG orifices. Simply run it across the lid margin over the MGs of the lower eyelid. It takes about five to 10 seconds and the patient response is instant and positive. Once again, the proper tool makes a difference. A golf club spud instrument is typically too dull and a foreign body spud is too sharp and can harm the eyelid tissues, especially where a scalloped lid margin may exist. An eyelid debrider (Bruder) seems to have the ideal edge. The technique involves debriding by running the instrument over the MG orifices in a lateral direction.

MGD Paddles/Expression Tools

It is essential to diagnostically express MGs. Although they can be expressed digitally, having an instrument is typically more effective. With the patient in the slit lamp, simply place a soft-edged paddle behind the lower eyelid and with your thumb on the outside, slide the paddle upward. You can readily see the expression and grade five MGs in the lower eyelid central region in about five seconds.

Instruments are essential to successful optometric practice and newer designs, especially in the area of ocular surface disease, are making practice safer, more effective and easier. It's well worth incorporating many of these tools to enhance your practice, better perform procedures and elevate the care you provide. ■

1. Korb DR, Blackie CA. Debridement-scaling: a new procedure that increases Meibomian gland function and reduces dry eye symptoms. Cornea. 2013;32(12):1554-7.

2. Lemp MA, Crews LA, Bron AJ, et al. Distribution of aqueous-deficient and evaporative dry eye in a clinic-based patient cohort: a retrospective study. Cornea. 2012;31(5):472-8.

Dry Amnion Forceps (Bruder) allow for easy placement, protecting the membrane and preventing it from folding over.

Lid debriders have been shown to improve MG function.

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Lepidoptometry?

Be careful when handling milkweed, as incidents in the garden can lead to vision loss.

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

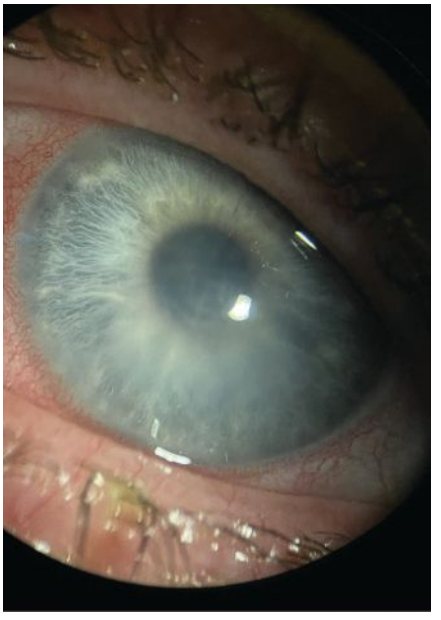
Three recent patients presented urgently in distress about their sudden loss of vision. The first was a 24-year-old woman who presented with an acute loss of vision in her right eye of three days' duration. She described it as hazy and had only mild discomfort. Her visual acuity was 20/100 in that eye. The second patient was a 63-year-old woman who similarly had an acute reduction of vision in her left eye for one day. She had mild discomfort and her acuity in the involved eye was 20/200. The third patient was a 50-year-old man who presented with bilateral blurred vision for one day, measuring at 20/200 OD and OS with moderate discomfort.

The three cases all shared a distinct clinical appearance. There was moderate conjunctival redness without discharge, and the patients' corneal epithelium were all intact without staining. However, there was significant corneal stromal edema and profound folds in Descemet's membrane. In all cases, assessment of the anterior chambers was difficult due to the lack of corneal clarity, but there only seemed to be rare few cells, if that. Intraocular pressure was normal in all eyes.

While the stromal and endothelial edema in the face of an intact epithelium may seem confusing and possibly point to a manifestation of herpetic disease, the appearance was classic for a certain phenomenon. When pointedly asked, the women acknowledged being amateur lepidopterists who cultivated gardens to attract butterflies, and the man was a landscaper who had been removing weeds when the incident happened. Thus, they all confirmed that they had been exposed to milkweed (*Asclepias*) and were manifesting milkweed toxicity.

Background

Popular with residential and urban gardeners, milkweed is a hardy, native perennial most appreciated for its color and fragrance, as well as a habitat for one of the most easily recognized and appreciated butterflies, the monarch (*Danaus plexippus*). Central to the conservation strategy of restoring the monarch butterfly population in the United States is the residential planting of milkweed, the monarch's obligatory host plant.[1] While the milkweed's nectar supports the many pollinators, insects and fauna that rely on it, monarch butterflies lay eggs on the underside of its leaves, where newly hatched caterpillars feed exclusively on the leaves of the milkweed plant.[1]



Stromal edema and folds in Descemet's membrane from milkweed toxicity.

Milkweed is named for a milky substance within the plant tissue called latex, which contains a high concentration of naturally occurring cardiac glycosides termed cardenolides, which are exuded when the plants are damaged.[2] Cardenolides, present in milkweed leaves, stems, roots and latex are natural toxins that protect the plant, as well as the insects that ingest them, from predation.[2,3]

In humans and large animals, cardenolides can be toxic when ingested, due to inhibition of sodium-potassium pump activity in endothelial cells.[2,4] Therapeutically, cardenolides found in milkweed and other plant species have long been used for their cardiotonic, or stimulant, activity, with the most well-known being digoxin, used in the treatment of congestive heart failure and atrial fibrillation, which was initially isolated from the foxglove plant (*Digitalis lanata*).[4]

Indirect ocular exposure to cardenolides resulting in stromal edema is the most common symptom that can occur through contact with milkweed latex, stems, leaves or roots through eye rubbing following handling, although

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.

Milkweed is considered the monarch butterfly's obligatory host plant.

direct exposure with milkweed latex has also been described.[5-10] Cardenolide levels differ by species, and the concentration of cardenolides varies throughout milkweed tissue, with up to 100-fold higher concentration in latex vs. leaf tissue.[2]

When in contact with the ocular surface, cardenolides are able to penetrate an intact cornea and act to inhibit endothelial sodium-potassium pumps, resulting in corneal stromal edema and a reduction in visual acuity.[5-10]

Treatment

While eye washing is indicated following direct exposure to milkweed latex, indirect ocular exposure after handling and eye rubbing may not be realized until visual symptoms develop, which may be hours after exposure. Treatment of corneal toxicity due to milkweed exposure centers on topical ophthalmic corticosteroids.[5-10]

While dexamethasone and triamcinolone have been described to increase sodium-potassium pump density and prevent inflammation-mediated reduction in sodium-potassium pump activity of corneal endothelial cells, the resolution of corneal edema due to milkweed toxicity has been described using a variety of strong topical ophthalmic steroids.[5-11] The time to resolution of corneal edema and complete visual recovery after beginning treatment is generally rapid and occurs within two weeks, with a single reported case requiring 270 days.[5-10]

Once milkweed toxicity was confirmed by the distinct clinical appearance and compelling history, treatment was straightforward. Because the epithelium was intact in all three patients, there was no need for a topical antibiotic. The most effective treatment is a topical steroid of moderate to strong potency (*e.g.*, prednisolone, difluprednate, loteprednol) dosed four to six times per day. Mild cycloplegia can also be used.

Each of the three patients was prescribed prednisolone acetate 1% four times daily, with the reminder to shake the medication bottle well prior to instillation. All showed marked improvement in vision within two days and all completely resolved within 10 days. All patients were relieved and grateful that the diagnosis was easily found through proper recognition.

Corneal endothelial toxicity due to milkweed contact and exposure continues to be more and more common and often overlooked as a diagnosis. These three recent patients illustrated the need to recognize a classic clinical appearance and follow-up with a very directed history.

Every rose has its thorn, and while all milkweed species carry the risk of corneal toxicity, there's certainly no need to pull them from the garden. Basic gardening safety including eye protection, wearing gloves, immediately washing hands after handling plant material and avoiding eye rubbing go a long way for preventing milkweed corneal toxicity. ■

1. Baker AM, Redmond CT, Malcolm SB, et al. Suitability of native milkweed (*Asclepias*) species versus cultivars for supporting monarch butterflies and bees in urban gardens. PeerJ. 2020;8:e9823.

2. Züst T, Petschenka G, Hastings AP, et al. Toxicity of milkweed leaves and latex: chromatographic quantification vs. biological activity of cardenolides in 16 *Asclepias* species. J Chem Ecol. 2019;45:50-60.

3. Duffey SS, Scudder GGE. Cardiac glycosides in North American *Asclepiadaceae*, a basis for unpalatability in brightly colored hemiptera and coleoptera. J Insect Physiol. 1972;18(1):63-78.

4. Abbott AJ, Holoubek CG, Martin RA. Inhibition of Na+,K+-ATPase by the cardenolide 6'-O-(E-4-hydroxycinnamoyl) desglucouzarin. Biochem Biophys Res Commun. 1998;251:256-9.

5. Lee YJ, Han SB, Hyon JY. Corneal endothelial dysfunction caused by *Asclepias curassavica* in a young farmer. Am J Ophthalmol Case Rep. 2019;16:100564.

6. Yang JF, Beal CJ. Corneal toxicity secondary to latex from *Asclepias curassavica* in a pediatric patient. Cornea. 2021;40:1607-9.

7. Venkateswaran N, Tonk RS, Berrocal A. Corneal edema in a gardener. JAMA Ophthalmol. 2020;138(9):998-9.

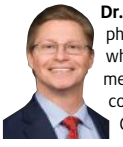
8. Mikkelsen LH, Hamoudi H, Gül CA, Heegaard S. Corneal toxicity following exposure to *Asclepias tuberosa*. Open Ophthalmol J. 2017;11:1-4.

9. Matsuura K, Hatta S, Terasaka Y, Inoue Y. Extensive bilateral corneal edema six weeks after cataract surgery: keratopathy due to *Asclepias physocarpa*: a case report. BMC Ophthalmol. 2017;17(1):5.

10. Amiran MD, Lang Y, Yeung SN. Corneal endothelial toxicity secondary to *Asclepias fruticosa*. Eye (Lond). 2011;25(7):961-3.

11. Macdonald JM, Geroski DH, Edelhauser HF. Effect of inflammation on the corneal endothelial pump and barrier. Curr Eye Res. 1987;6(9):1125-32.

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.

An Unnerving Situation

Newer minimally invasive surgical techniques exist to reinnervate a neurotrophic cornea.

BY JASON BESECKER, OD
MERIDIAN, ID

Neurotrophic keratitis (NK) is a degenerative disease of the cornea that leads to loss of corneal sensation. If left untreated, it can lead to perforation of the cornea and permanent vision loss.[1-2]

Patients with NK often present with a chief complaint of fluctuating vision, with little to no complaints of discomfort. They will have decreased corneal sensation in at least one quadrant of the cornea—this is the hallmark of the disease.[3] Ocular surface findings could include persistent punctate epithelial keratitis, irregular/rough epithelium, neovascularization of the cornea, decreased tear prism, persistent epithelial defect, corneal ulceration, and—worst-case scenario—perforation.

There are several viable medical treatments for NK, and we will describe a surgical option when conservative treatments fail to regain corneal sensation: corneal neurotization.

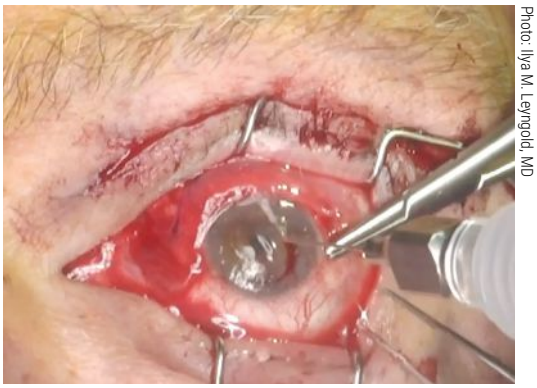


Photo: Ilya M. Leyngold, MD

Nerve branches are secured to the sclera to help re-establish sensory innervation during corneal neurotization.

Corneal Neurotization

This minimally invasive surgical procedure is performed under general anesthesia and grows new corneal nerves from a donor nerve tissue by either an autograft or allograft.[4] When using an autograft or allograft, there are multiple ways a surgeon can re-establish sensory innervation to a neurotrophic cornea. Techniques for autograft use ipsilateral or contralateral supraorbital and/or supratrochlear nerves to reinnervate a neurotrophic cornea. Newer minimally invasive techniques use an acellular nerve allograft, which may minimize the risk of undesirable outcomes such as long visible scars, facial nerve injury and donor site morbidity.[4]

Here we will describe minimally invasive corneal neurotization using a nerve allograft.

For a video of the procedure, read this article online at www.reviewofoptometry.com.

Nerve Allograft

Eyelid crease incisions are performed to harvest the supraorbital or supratrochlear nerve. In some cases, the infraorbital nerve can be used. The surgeon will either use the supratrochlear or supraorbital nerve based on best-fit diameter to the nerve allograft.[4]

For contralateral nerve transfer, bilateral eyelid crease incisions are made, and for ipsilateral transfer, unilateral incisions are made. Contralateral nerve transfer is done in cases where there is ipsilateral trigeminal neuropathy. After isolation of the donor nerve, it is then severed one to two centimeters below the incision site. The processed nerve allograft is then sutured to the donor nerve, and a nerve connector or amniotic membrane is used to protect the severed nerves and aid in the joining of the allograft to the host nerve.[4]

The nerve graft is tunneled through a blepharotomy incision to the contralateral side. Nerve fascicles are released from the graft through an incision in the epineurium and then tunneled to the corneoscleral limbus in the subconjunctival space. The perineurium of the nerve fascicles are then sutured to the sclera. Lastly, a permanent or temporary tarsorrhaphy is performed to protect the cornea while reinnervation takes place. The eye is then patched for a 24-hour period.[4]

Postoperatively, patients are instructed to use a topical antibiotic QID for one week. All preoperative drops that were being used to medically manage NK are resumed after removal of the eye patch. Patients are advised against strenuous activity or heavy lifting for two weeks.[4] ■

1. Bonini S, Rama P, Olzi D, Lambiase A. Neurotrophic keratitis. Eye (Lond). 2003;17(8):989-95.

2. Labetoulle M, Baudouin C, Calonge M, et al. Role of corneal nerves in ocular surface homeostasis and disease. Acta Ophthalmol. 2019;97(2):137-45.

3. Dana R, Farid M, Gupta PK, et al. Expert consensus on the identification, diagnosis and treatment of neurotrophic keratopathy. BMC Ophthalmol. 2021;21(1):327.

4. Leyngold IM, Yen MT, Tian J, et al. Minimally invasive corneal neurotization with acellular nerve allograft: surgical technique and clinical outcomes. Ophthalmic Plast Reconstr Surg. 2019;35(2):133-40.

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About Drs. Cunningham and Whitley **Dr. Cunningham** is the director of optometry at Dell Laser Consultants in Austin, TX. He has no financial interests to disclose. **Dr. Whitley** is the director of professional relations and residency program supervisor at Virginia Eye Consultants in Norfolk, VA. He is a consultant for Alcon.

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BY JAMES L. FANELLI, OD

Advancing Toward Advanced Disease

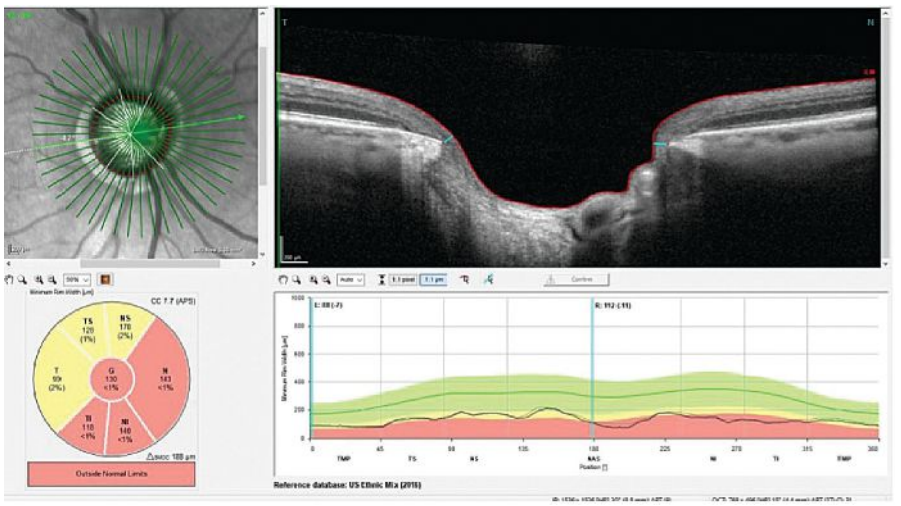
Only about 10% of glaucoma patients fall into this category; be sure to know how to manage those who present to you.

By offering glaucoma management services, you will inherit new patients who have previously been diagnosed with glaucoma and you will certainly have your share of undiagnosed patients who present to your office often for reasons unrelated to their uncontrolled glaucoma. In either case, the glaucoma patients you end up seeing will have mild, moderate or advanced disease.

It's estimated that the majority of patients with glaucoma have either mild or moderate disease. When you account for the estimated 10% of glaucoma patients with advanced disease, upwards of 90% of glaucoma patients fall into the mild, moderate and advanced stages. The other 10% are the refractory cases, who seem to worsen even with advanced surgical care.

As primary eyecare providers, optometrists are perfectly positioned to manage mild, moderate and advanced cases of glaucoma. Sometimes, those with progressive disease who are unresponsive to topical therapy will need surgical interventions, some of which are successfully and regularly performed by optometrists. Even those advanced glaucoma patients who remain stable without the need for surgical intervention can remain in the realm of optometric care throughout their care.

This is the first of two columns dedicated to managing patients with advanced disease.



A thinned BMO 360° OD, with the temporal rim thinned to about 100µm.

Case

In November 2019, a new patient presented to establish care after moving to the area. This 78-year-old Caucasian male had an established history of glaucoma diagnosed approximately four years earlier. When initially seen he was prescribed latanoprost OU HS. Medications at that time consisted of losartan, atenolol, amlodipine, ezetimibe and 81mg of aspirin. He was intolerant of statins and reported no allergies to medications.

His initial IOPs were 13mm Hg OD and OS, with pachymetry readings of 596µm OD and 570µm OS. His best-corrected visual acuities were 20/25- OD and OS. His pupils were ERRLA with no afferent pupillary defect.

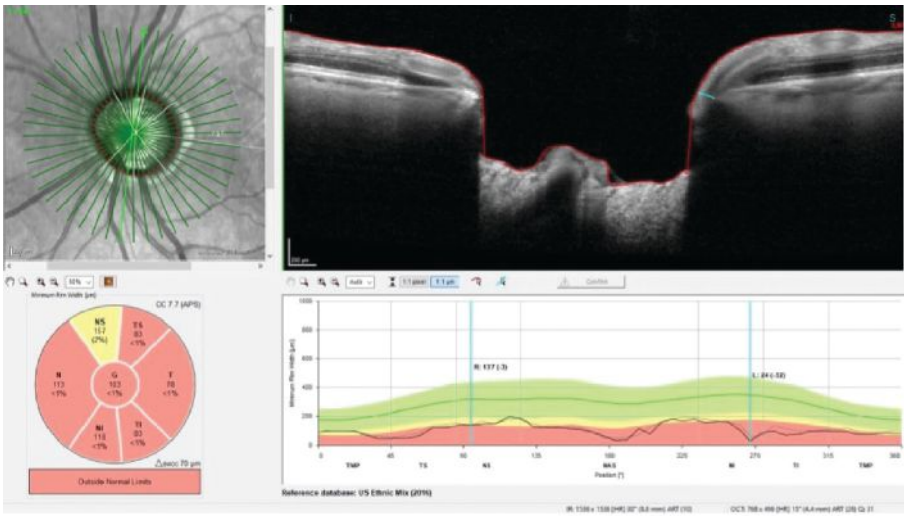
A slit lamp examination of his anterior segments was essentially unremarkable, with open angles and a clear anterior chamber. He was pseudophakic OU.

Through dilated pupils, his IOLs were clear and centered, and both capsules were clear and intact. His cup-to-disc ratios were judged to be 0.80x0.80 OD and 0.85x0.85 OS. The optic nerves were of average size. The retinal vasculature was characterized by mild arteriolarsclerosis OU. The maculae were clear with fine RPE granulation noted subfoveally OU. There was a small nevus along the superior arcade that was one disc diameter in size OS. The peripheral retinal evaluation was essentially unremarkable.

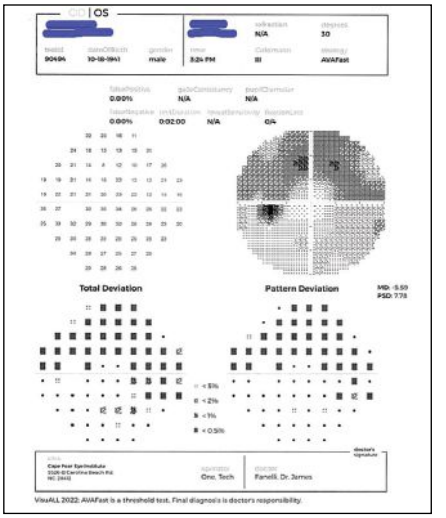
At the initial visit, HRT3 and OCT images of both optic nerves were obtained. The HRT3 findings coincided with the estimation of normal-sized optic nerves with thin neuroretinal rims OS>OD.

Given the patient was compliant with latanoprost, was establishing

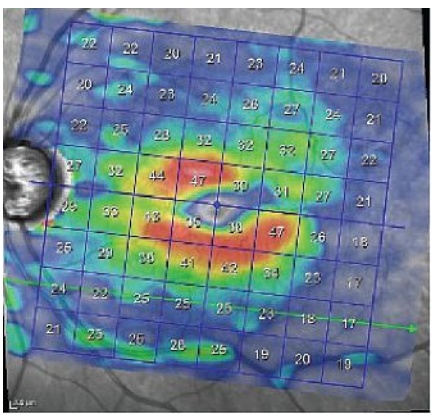
About Dr. Fanelli **Dr. Fanelli** is the founder and director of the Cape Fear Eye Institute in Wilmington, NC. He is chairman of the EyeSki Optometric Conference and the CE in Italy/Europe Conference. He is an adjunct faculty member of PCO, Western U. and UAB School of Optometry. He is on advisory boards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



Thinned BMO neuroretinal rim tissue OS, with some thinning of the superior rim down to a paltry 24µm of tissue.



The visual field defect seen in the patient's left eye.



Ganglion cell layer loss just inside the inferior arcade and loss superotemporally to the foveola involving the perifoveal retina.

care with me for the first time and did not appear to be uncontrolled, I did not change his glaucoma treatment regimen and scheduled a follow-up. I explained to him that my goal was to establish that his glaucoma was well-controlled, and in order to do so I would need to see him twice more at three-month intervals to obtain various metrics related to his glaucoma. Once I determined him to be stable, we would then cut our visits back to approximately every five to six months.

The patient complied and was seen regularly as scheduled. Over the subsequent visits, visual fields were obtained that demonstrated arcuate defects OS>OD consistent with the structural findings. Gonioscopy revealed IV+ open angles with minimal trabecular pigmentation; there were no angle abnormalities. Multicolor optic nerve images were obtained.

The patient was seen most recently in November 2022 for a scheduled follow-up, at which time OCT images and visual fields were obtained. He was deemed stable from a glaucoma progression perspective.

Discussion

Our protocol when obtaining OCT scans of the optic nerve in the context of glaucoma is to obtain scans of the neuroretinal rim, the perioptic RNFL and the macular ganglion cell layer in both maculae. Not surprisingly, the patient's RNFL circle scans showed damage in the nerve fiber layer adjacent to the nerve consistent with the damage seen in the neuroretinal rim OS>OD. The macular ganglion cell layer of the left eye showed an inferior temporal wedge defect and superior temporal loss of the ganglion cells involving the foveal avascular zone.

While the patient's latest visual field studies were stable, of particular note was the left eye's results. The visual field showed a distinct superior arcuate defect, owing to the significant RNFL loss inferiorly. It also showed an inferior nasal defect related to the ganglion cell loss. Note also that both the superior and inferior hemifield defects spared a good portion of the central 10° of the visual field due to the relatively robust central ganglion cell layer.

And herein lies the point of this case. While this patient has advanced glaucoma, he has remained stable for the two years I've seen him. Furthermore, his visual field defects, in particular that of the more advanced left eye, have not involved fixation, and that plays a significant role in his lack of symptomatology. In other words, his fields don't look as bad as I was expecting given the extent of his damage.

Does he need any change in therapy at this time? No, not at all. And that is because he has advanced glaucoma that is stable. Will he remain stable? There is no way to answer that question at this time, other than to say we will know the answer only after diligent and stringent follow-up and monitoring. Certainly, his disease won't improve; he'll either stay stable or get worse. Close surveillance will be key here. Can he get worse? Of course. Will he get worse overnight? Not likely, but he can show significant progression if he's not being cared for by the right provider in the right way. And who is considered this adept provider? It should be you. ■

A Serous Problem

This inflammatory disorder can potentially cause blindness.

BY RAMI ABOUMOURAD, OD
MIAMI

A 21-year-old Hispanic male presented with increasing redness, pain and blurred vision in the right eye. His review of systems was unrevealing, and he denied any similar prior episodes. His medical, ocular, social and family histories were all unremarkable. He denied any history of trauma or substance abuse.

His visual acuity (VA) was 20/40 OD and 20/20 OS. Extraocular motilities and confrontation visual fields were full OU. His pupils were equally round and reactive in both eyes, and there was no relative afferent pupillary defect; color vision was full OU. Intraocular pressure was 13mm Hg OD and 15mm Hg OS by applanation. Anterior segment exam revealed 3+ sectoral temporal injection of deep scleral vascular plexus OD without any corneal involvement, anterior chamber cell or flare or vitritis. There were no signs of inflammation OS. Furthermore, there was significant tenderness to palpation of the right globe and pain with lateral eye movements. Posterior segment findings can be seen below.

Take the Retina Quiz

1. How would you interpret the OCT findings of the right eye?
a. There are vitreous cells.
b. There is intraretinal fluid.
c. There is subretinal fluid.
d. There is a choroidal effusion.

2. How would you interpret the B-scan ultrasound?
a. There is a retinal detachment.
b. There is myositis.
c. There is infilitration of Tenon's capsule and accumulation of sub-Tenon fluid.
d. All of the above are true.

3. What is the most likely diagnosis?
a. Central serous retinopathy.
b. Posterior scleritis or panscleritis.
c. Purtscher retinopathy.
d. Vogt-Koyanagi-Harada disease.

4. All of the following may accompany this disease at presentation except?
a. Ocular hypertension.
b. Orbital myositis.
c. Retinal detachment.
d. Severe vitritis.

5. Which of the following regarding prognosis is false?
a. There is an increased risk of mortality when scleral necrosis is present.
b. Vision loss is most frequently secondary to rhegmatogenous retinal detachments.
c. With prompt identification and treatment, vision loss may be limited to less than two lines of Snellen visual acuity.
d. None of the above.

For answers, see page 90.

Diagnosis

Fundus examination of the right eye revealed a hyperemic optic nerve with trace peripapillary edema (*Figure 1*). Additionally, there were chorioretinal striae and multifocal areas of whitened subretinal exudation dispersed throughout the posterior pole with extension into the temporal midperiphery (*Figure 1*). Fundus examination of the left eye was normal.

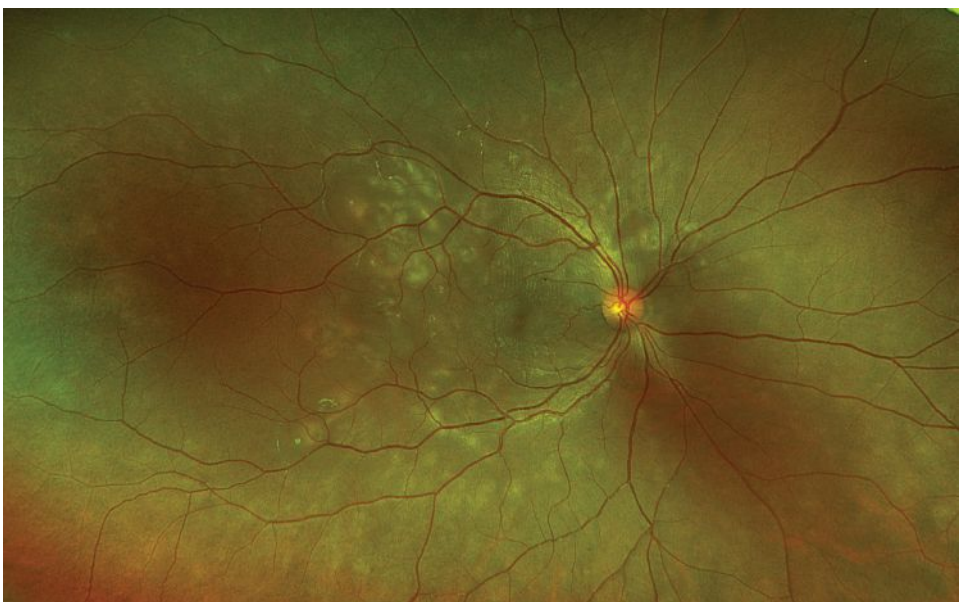


Fig. 1. Optos widefield fundus photography of the right eye at presentation.

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.

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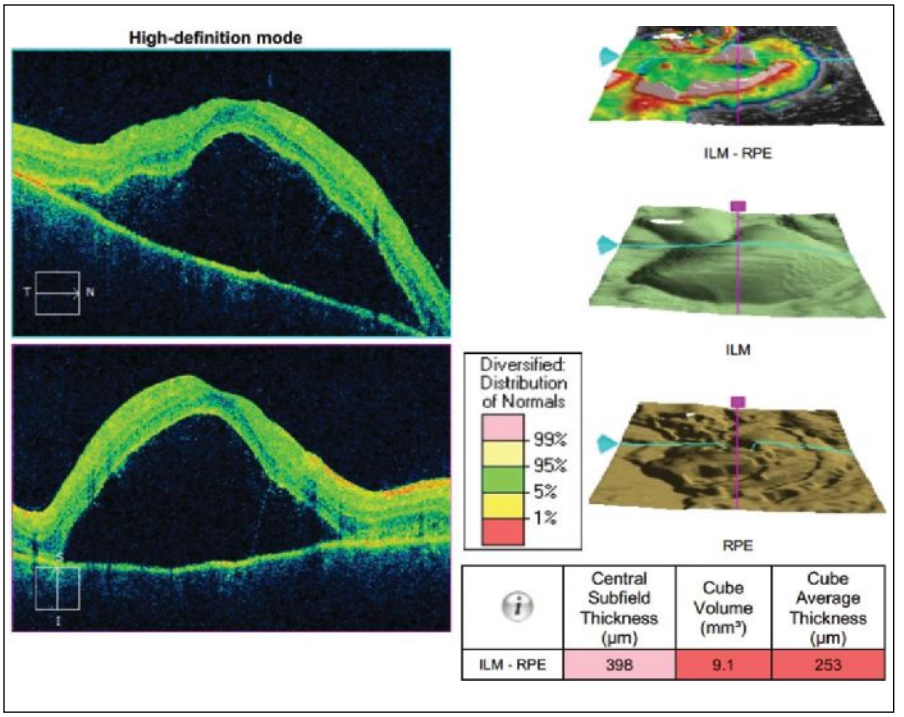

Fig. 2. Cirrus OCT of the right macula.

OCT confirmed subretinal fluid within the macula (*Figure 2*). B-scan ultrasonography demonstrated multifocal retinal detachment involving the macula and extending temporally, diffuse thickening of the fundus (retina, choroid, sclera) and a prominent "T sign" (*Figures 3A & B*). Additionally, the lateral rectus muscle was thickened and hypoechoic, suggestive of concomitant myositis (*Figure 3A*).

The patient was diagnosed with panscleritis of the right eye. Initial management involved indomethacin 50mg three times daily and obtaining standard scleritis labs. Once infectious etiologies (*i.e.*, syphilis and tuberculosis) were excluded, he was switched to oral prednisone 60mg daily. This was tapered over five weeks, and he demonstrated complete resolution of inflammation and subretinal fluid. He achieved a final VA of 20/25 in the affected eye.

Discussion

Posterior scleritis is an inflammatory disorder involving the scleral coat of the eye posterior to the equator and insertion of the rectus muscles.[1] It is a potentially blinding condition that can present confined to the posterior segment or with concomitant anterior segment involvement as well (*i.e.*, panscleritis). A case series of 99 posterior scleritis patients showed that 36% presented with panscleritis and 59% developed panscleritis during follow-up.[2-4]

While large-scale data regarding epidemiology, clinical features and prognosis are limited due to low clinical incidence, smaller case series have allowed for some understanding of the disease process. Posterior scleritis most commonly presents in the fifth decade of life with a female predilection.[1,3,4] Scleritis is generally noninfectious and associated with an underlying systemic disease in 35% to 50% of cases but can also be infectious in nature.[1,3,4] Patients who present with panscleritis or are 50 years and older have a greater risk of systemic disease.[4]

Posterior scleritis may be accompanied by orbital myositis, low-grade anterior or posterior uveitis, exudative retinal detachment, choroidal detachment, chorioretinal folds and optic disc edema.[1,4,5] Ocular hypertension can occur but is frequently due to ciliochoroidal effusions with anterior rotation of the iridolenticular diaphragm and secondary angle closure.[4]

Differential diagnoses can include central serous retinopathy, Vogt-Koyanagi-Harada disease, sarcoidosis, Purtscher retinopathy and lupus retinopathy. Posterior scleritis is often a diagnosis of exclusion based on careful history, clinical exam and ancillary imaging. A thorough work-up is also necessary to exclude infections such as syphilis and tuberculosis and systemic vasculitides such as granulomatosis with polyangiitis, which can be life-threatening if untreated.[1-4]

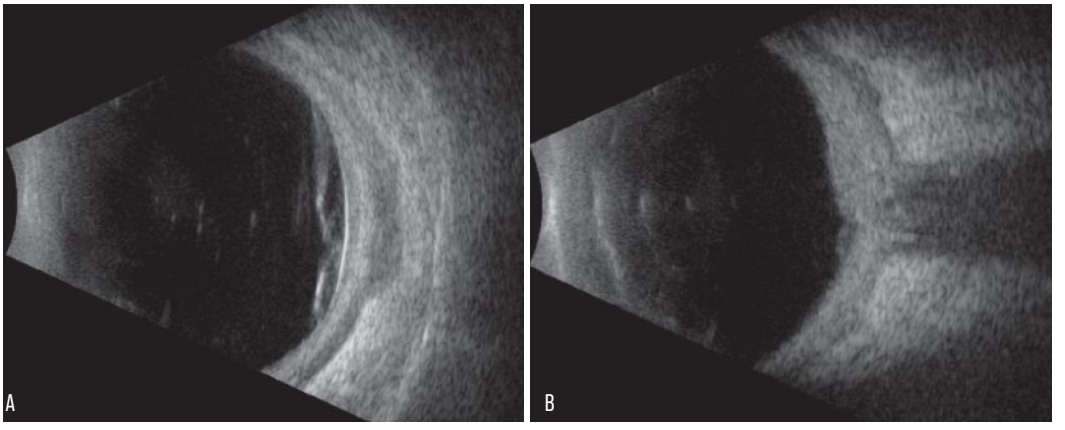

Fig. 3. (A) Transverse B-scan of the globe at the 9 o'clock hour at the equator. (B) Vertical axial B-scan over the posterior pole.

Ancillary imaging may be useful to confirm diagnosis by visualizing the scleral inflammation on CT/MRI ("ring sign" of scleral enhancement) or B-scan ultrasonography ("T sign" of sub-Tenon fluid accumulation). Generally, B-scan ultrasound is the most informative adjunct imaging modality, with as many as 17% of posterior scleritis patients undetectable without it, but it can be limited in its ability to detect early scleral necrosis.[1,3,4] The characteristic "T sign" describes the accumulation of fluid in the sub-Tenon space surrounding the optic nerve (the arms of the "T") and the shadowing of the optic nerve (the stem of the "T").[1,3,4] However, the most common B-scan finding is diffuse or nodular scleral thickening more than 2mm, which is seen in greater than 50% of cases, whereas the "T sign" is only seen in 25% to 41% of cases.[3,4]

Treatment

Oral NSAIDs are often a first-line option while awaiting serology results, then switching to targeted anti-microbial therapy is recommended if an infectious cause is identified.[1,3,4] Once infectious etiologies are excluded, treatment is often escalated to oral prednisone at a starting dose of 1 to 1.5 mg/kg/day.[1,3-5] Severe or refractory cases may be given an intravenous pulse of corticosteroid first, or even require steroid-sparing immunomodulatory therapy.[1,3,4] Surgical intervention is rarely necessary but may be indicated to provide tectonic support for scleral necrosis with impending perforation.[1,5]

Visual prognosis is highly variable; the majority of patients maintain less than a two-line difference from baseline vision at up to 22 years of follow-up, and of those who suffer vision loss, the majority are 20/80 to 20/200.[4] Vision loss is often due to chronic macular changes and/or optic atrophy.[4] The necrotizing subtype portends a poorer visual and systemic prognosis, particularly if not identified promptly, further highlighting the importance of systemic evaluation for associated life-threatening vasculitides.

Although our patient achieved a desirable outcome, he was counseled on the serious nature of his condition and the need for continued monitoring to ensure that any recurrence is addressed promptly. ■

1. Yanoff M, Duker J. Ophthalmology. 5th Ed. 2019.

2. Gass JDM. Stereoscopic atlas of macular disease: a fundoscopic and angiographic presentation. Saint Louis: Mosby, 1st Ed. January 1, 1970.

3. Lavric A, Gonzalez-Lopez JJ, Majumder PD, et al. Posterior scleritis: analysis of epidemiology, clinical factors and risk of recurrence in a cohort of 114 patients. Ocul Immunol Inflamm. 2016;24(1):6-15.

4. McCluskey PJ, Watson PG, Lightman S, et al. Posterior scleritis: clinical features, systemic associations and outcome in a large series of patients. Ophthalmology. 1999;106(12):2380-6.

5. Watson PG, Hayreh SS. Scleritis and episcleritis. Br J Ophthalmol. 1976;60(3):163-91

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PRODUCT REVIEW

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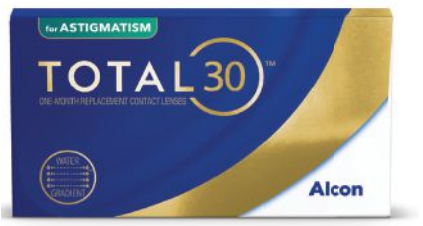
▸ CONTACT LENSES

Alcon to Launch Total30 Toric Contact Lens

Patients with astigmatism who prefer to wear reusable contact lenses over daily disposables will soon have another option from Alcon. The company recently announced that a reusable toric lens in its Total30 line will be available "in early 2023." Total30 lenses are another of Alcon's product lines that feature what it calls a water gradient design, wherein a core of silicone hydrogel gradually transitions to a water content level of nearly 100% at the lens surface.



The lenses are coated with a gel-like surface that helps to maintain moisture for up to 30 days while also helping to resist bacteria and lipid deposits, Alcon says. It also uses the same toric stabilization method as other Alcon products to keep lenses in place on the eye, helping maintain comfort and clear vision.

Total30 for astigmatism is now the second reusable toric lens offered by Alcon, the other being AirOptix Plus HydraGlyde for astigmatism.

▸ PHARMACEUTICALS

Compounded Antibiotic Available For In-Office Use

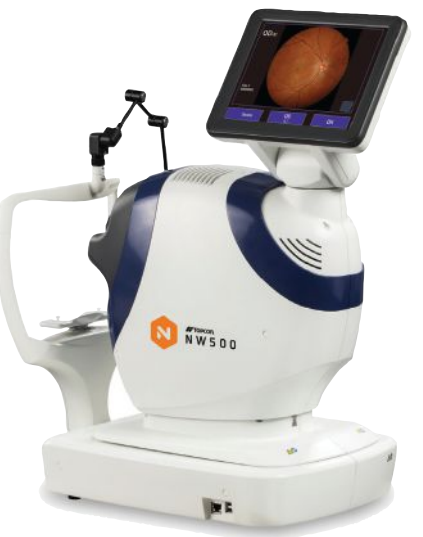
Back in October, ImprimisRx announced that its compounded antibiotic, called Fortisite—formulated with tobramycin 1.5% and vancomycin 5%—could be ordered by patients through the ImprimisRx 503A pharmacy. Now, the antibiotic is also available to physicians for in-office use through the company's 503B outsourcing facility, according to a press release. This means that eyecare providers will be able to keep the drug on hand at their clinic to use in cases of ocular infection where immediate treatment may result in a more positive outcome for the patient.

To ease the financial burden of continuously stocking antibiotics as they expire, ImprimisRx developed what it calls a Patient Access Program, which promises a 100% replacement guarantee for any expired 503B Fortisite product. The company says that the formulation—which comes in a 7mL bottle—can last for up to 180 days when kept refrigerated at a temperature of 5°C. The recommended temperature range for storing the antibiotic is 2°C to 8°C, and it should also be protected from light, according to the product insert.

▸ IMAGING TECHNOLOGY

Retinal Fundus Camera Works in Ambient Light

Optometry practices across the US are increasingly investing in retinal imaging devices that serve as invaluable tools for both the detection and management of posterior segment conditions. Joining the robotic fundus camera market is a new model from Topcon, called the NW500 non-mydriatic retinal camera. The company says that the fully automated device can capture sharp-quality images even in ambient light and without the need to dilate the patient.



The NW500 camera features a 12-megapixel sensor and can obtain images from the three traditional fixation points (disc, center and macula), in addition to nine others used for peripheral photography, Topcon says in the product's press release. It also claims that the camera's slit scan illumination and rolling shutter mechanism improve its ability to photograph pupils as small as 2.0mm.

According to developers, the processing speed of the NW500 exceeds that of the company's existing TRC-NW400 retinal camera. Topcon also points out that thanks to the device's full automation and touch-screen control, technicians at your practice will be able to capture the fundus images, freeing up your time as the doctor to assess the scans and care for your patients. ■

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BY ANDREW S. GURWOOD, OD

DIAGNOSTIC QUIZ

Going Back and Forth

Your exam elicits an abduction nystagmus and some gaze positions produce diplopia. What's your next move?

A 74-year-old man presented to the office with a chief complaint of blurry vision in both eyes of four months' duration. He said the issue had gradually become worse. He also commented that he "had to look at people to make his vision right over the last three months." He did not report any pain and denied trauma. He was properly medicated for hypertension and diabetes and denied allergies of any kind.

Clinical Findings

His best-corrected entering visual acuities were 20/30 OD and 20/30 OS. His external examination was remarkable for the extraocular muscle motility findings demonstrated in the photographs below. (He initially reported no double vision).

There was no evidence of afferent pupillary defect and his confrontation visual fields were full. His anterior segment findings were normal. Goldmann applanation tonometry measured 17mm Hg OU. Dilated fundus examination found no posterior pole or peripheral pathologies, with cup-to-disc ratios measuring 0.3/0.3 round and sharp and pink discs noted.

For Additional Information

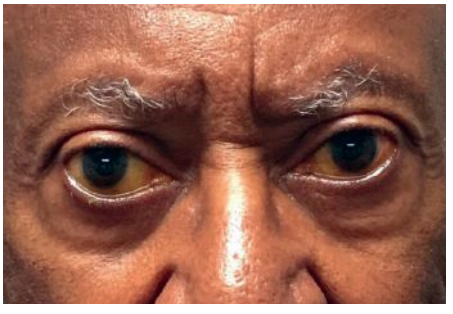
Additional studies used to further investigate this case included measuring the deviation in five positions of gaze (primary, up, down, left, right). Gaze left was scrutinized for an abduction nystagmus, which was found.

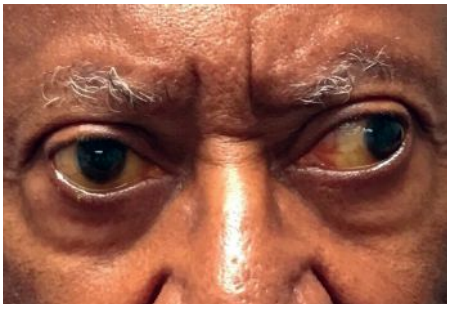
After further discussion, "horizontal diplopia" was present on gaze left. Health history questions were also asked in an attempt to identify other neurological signs or symptoms (*e.g.*, dizziness, loss of balance, disequilibrium, difficulty speaking, limb drift, face droop, headache, tinnitus, numbness, tingling).

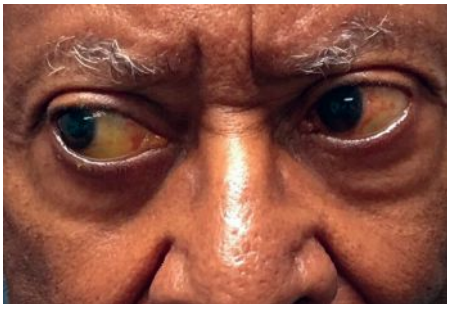
Your Diagnosis

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

Dr. Gurwood thanks Nick Karbach, OD, for his contributions to this case.







Gaze assessment yielded the findings seen above. What could be causing this presentation? Would you rate the level of care needed to address his status as routine, urgent or emergent?

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 82)—Q1: c, Q2: d, Q3: b, Q4: d, Q5: d

NEXT MONTH IN THE MAG

In March, we present our annual issue devoted to ophthalmic pharmaceuticals. Articles will include:

- Dry Eye Drugs: What's New and What's Next
- Presbyopia Meds: Improve Your Success as Options Expand
- Fight for Your Right to Rx! Combating Restrictive Formularies
- Know the Ins and Outs of Oral Steroids
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- New Ophthalmic Lenses Worth Checking Out

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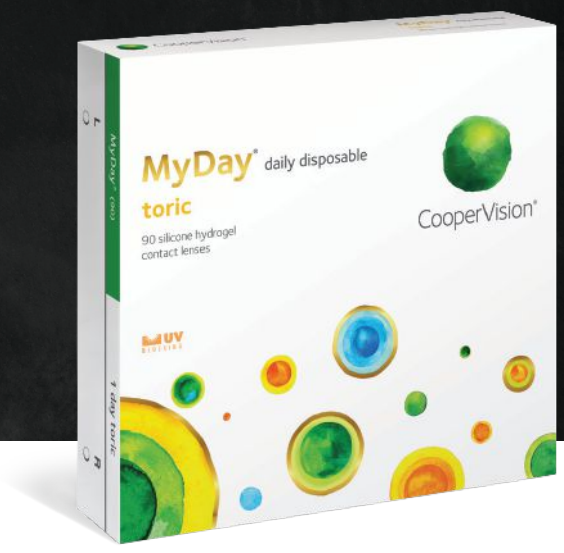

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1. CVI data on file, 2021; Rx coverage database n=83,540 aged 14 to 70 years.
2. CVI data on file, 2021. Based on number of prescription options available in the USA across all soft 1-day toric lenses as reported by the 4 main manufacturers.

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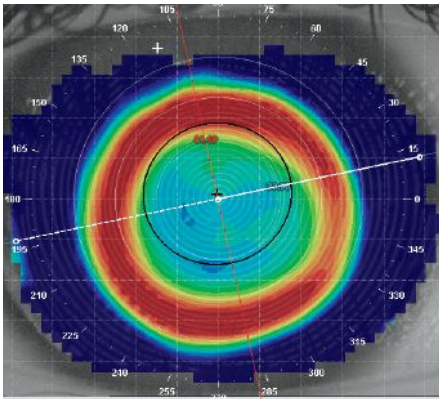

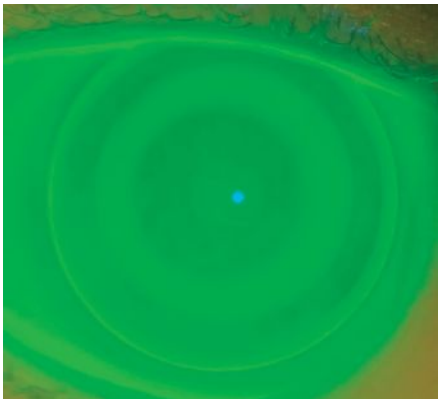

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