READER SURVEY—Dry Eye in Optometry: Trends, Habits and Hang-ups, *P. 30*

REVIEW of OPTOMETRY®

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Low Vision: Concepts and Clinical Skills for Generalists

PAGE 60

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Vision Care Issue

KIDS AND SCREENS:

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Vision Care Issue

KIDS AND SCREENS: DEBATING THE DANGERS

While blue light isn't inherently detrimental to the eye, unmanaged device use may hinder children in other ways. *P. 38*

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Eye Exam May Help Detect Autism

Retinal image analysis helped identify hallmark signs of the condition.

Early intervention is key in the healthy development of children with autism spectrum disorder (ASD), and the lack of effective screening is a major cause of delayed diagnoses and misdiagnoses. A recent study proposed a means of detection by retinal assessment.[1]

Studies have indicated significant associations between certain retinal features and ASD, such as retinal nerve fiber layer thinning and significantly larger optic disc and cup diameters. With this in mind, researchers in Hong Kong launched a retinal image analysis study. "Retinal images can be obtained from very young children instead of relying solely on lengthy clinical and behavioral assessment," they wrote in their paper. "This technique provides an objective screening method that can be implemented in a community setting."[1]

The investigators recruited 70 school-aged participants, of which 46 had a clinical diagnosis of ASD and 24 were age-matched controls. They captured retinal images with a nonmydriatic fundus camera and implemented machine learning technology to optimize retinal information and develop a classification model for ASD.[1]

The sensitivity and specificity of the algorithm were 95.7% and 91.3%, respectively. The area under the receiver operating characteristic curve—a statistical measure of diagnostic usefulness—was 0.974. Importantly, the researchers noted that specificity tended to be lower in females; thus, we are more likely to miss female cases than male cases.[1]

Autistic kids may one day be identified by eye doctors. However, access to eye care remains low in this group.

The study authors concluded that their fully automated system can be an effective screening tool for ASD. They suggested further confirmation before clinical implementation.[1]

Other recent studies underscore the need for autistic kids to get eye exams and the present shortcomings in care.

A population-based retrospective study of more than 10 million children looked for a diagnosis of pervasive developmental disorder (PDD) or autistic disorder and comorbid ocular diagnoses. The prevalence of any ocular diagnosis was 3.5% in the controls, but much higher, at 12.5%, in children with PDD and at 13.5% in children with autistic disorder.[2]

"Our study provides epidemiologic support for an association between autism and ophthalmologic disorders, including amblyopia, strabismus, nystagmus and optic atrophy," says researcher Melinda Chang, MD, of Los Angeles. "This is the first step toward understanding the relationship between autism and visual disorders."[2]

However, another retrospective study found that only 37.6% of ASD children under age five and 50% of those over age five had been examined by an eye doctor. While vision screenings took place at school or a pediatrician's office, no kids under age five also saw an eye doctor.[3]

1. Lai M, Lee J, Chiu S, et al. A machine learning approach for retinal images analysis as an objective screening method for children with autism spectrum disorder. EClinicalMedicine. November 5, 2020. [Epub ahead of print].

2. Chang MY, Doppee D, Yu F, et al. Prevalence of ophthalmologic diagnoses in children with autism spectrum disorder using the Optum dataset: a population-based study. Am J Ophthalmol. September 5, 2020. [Epub ahead of print].

3. Swanson MW, Lee SD, Frazier MG, et al. Vision screening among children with autism spectrum disorder. Optom Vis Sci. October 30, 2020. [Epub ahead of print].

IN BRIEF

A study highlighted the connection between **obstructive sleep apnea (OSA) and retinal diseases** such as diabetic retinopathy, vein occlusion and central serous retinopathy. The severity of OSA and specific biomarkers correlated with retinal disease severity. Also, dysregulation of the gene that governs circadian rhythm is associated with development of proliferative retinal disease, further demonstrating the importance of restful sleep in retinal health.

"OSA creates systemic changes and hypoxic conditions that may incite or exacerbate retinal vascular diseases," the study concluded. "**Retinal changes may be the first clinical manifestations of otherwise undiagnosed OSA**. It's important to refer patients with new-onset retinal vascular disease for appropriate sleep testing."

D'Souza H, Kapoor KG. Retinal vascular manifestations of obstructive sleep apnea. Curr Opin Ophthalmol. 2020;31(6):508-13.

New CXL Approach May Expand Candidate Pool

Good as it is, the standard CXL protocol has been limited to a stromal thickness of more than 400µm, depriving many needy patients of the procedure. However, research suggests an updated method using individualized fluence could expand CXL treatment to ultra-thin corneas. The new method, referred to as "sub400," uses lower fluence to modulate penetration depth. The study reported promising results, with the sub400 technique stopping keratoconus progression about 90% of the time over 12 months.

The standard Dresden protocol combines 3mW/cm^2 UV intensity for 30 minutes, for a total UV delivery (or "fluence") of 5.4 J/cm^2. Limited to corneas with a stromal thickness of more than 400µm, the Dresden protocol crosslinks approximately the first 330µm of the cornea, leaving a 70µm safety margin for the corneal endothelial cells. Corneas with advanced keratoconus often fall below this threshold and require the use of modified protocols, all of which come with major drawbacks, explains researcher Farhad Hafezi, MD, PhD.

The sub400 protocol simplifies things and helps avoid the variability in effect introduced by contact lenses and corneal swelling, Dr. Hafezi adds. It involves measuring corneal thickness after riboflavin application, just prior to irradiation, then calculating total UV fluence based on the thickness.

The success rate is 89% and, since a base intensity of 3mW/cm^2 is used, it can be performed with existing CXL technology in corneas that would otherwise require transplantation, Dr. Hafezi says.

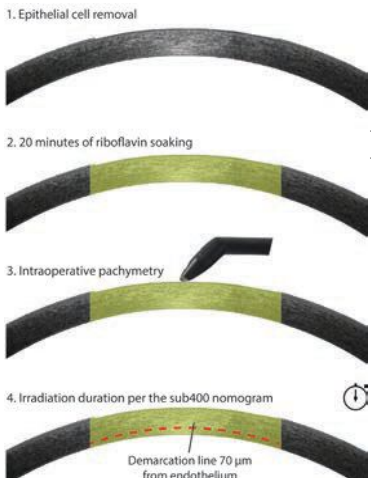


Photo: Farhad Hafezi, MD, PhD

The sub400 protocol uses lower fluence to modulate penetration depth and treat corneas as thin as 214µm.

His team's retrospective, interventional case series included 39 eyes with progressive keratoconus and corneal stromal thicknesses between 214µm and 398µm at the time of UV irradiation. After epithelium removal, UV irradiation was performed at 3mW/cm^2 with the length of exposure depending on the stromal thickness. Participants underwent exams prior to surgery and up to 12 months after the procedure.

After sub400, 35 eyes (90%) achieved tomographical stability at one year, with no signs of endothelial decompensation. The researchers observed a significant correlation between stromal demarcation line depth and irradiation time, but not with change in the maximum keratometry value. On average, the study reported a significant change in the thinnest stromal thickness (-14.5µm), maximum keratometry value (-2.06D) and densitometry (+2.00 grayscale units), but no significant changes corrected distance visual acuity, sphere or cylinder.

Since the demarcation line depth didn't predict treatment outcome, the researchers suggested depth is unlikely related to the extent of CXL-induced corneal stiffness, but rather to the extent of CXL-induced microstructural changes and wound healing.

Hafezi F, Kling S, Gilardoni F, et al. Corneal crosslinking with riboflavin and UVA in ultra-thin corneas: the sub400 protocol. Am J Ophthalmol. December 16, 2020. [Epub ahead of print].

Vegetarian Diet Lowers Risk of Cataracts

Overweight patients experienced the largest impact: a 20% reduction.

It's not just carrots that are good for your eyes, says a new study. The wide variety of protective antioxidants in plant-based diets serve as a potential counteractive measure against cataracts, as they mitigate the oxidative stress that contributes to damage of the crystalline lens. However, vegetarians with an inadequate vitamin B-12 intake can have elevated homocysteine levels, which increases the risk of cortical cataracts. Researchers recently suggested the pros outweigh the cons; a vegetarian diet was associated with a lower risk of cataracts, particularly in overweight patients.

This prospective cohort study assessed people 40 years and older without cataracts (3,095 non-vegetarians and 1,341 vegetarians). The team conducted food frequency questionnaires and screened for cataract development throughout the follow-up period.

Compared with non-vegetarians, vegetarians had higher intakes of soy, vegetables, nuts, whole grains, dietary fiber, vitamin C, folate and vitamin A equivalent. The investigators identified 476 incident cases of cataracts. A vegetarian diet was associated with a 20% reduced risk of cataracts after adjusting for a number of different factors. This association was more pronounced in overweight individuals.

Chiu THT, Chang CC, Lin CL, et al. A vegetarian diet is associated with a lower risk of cataract, particularly among individuals with overweight: a prospective study. J Acad Nutr Diet. 2020;S2212-2672(20):31428-3.

When it comes to ocular surface inflammation, FLAREX® is A PROVEN WINNER

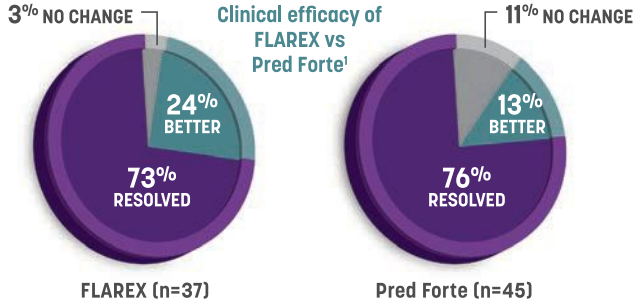
The power of Pred Forte* (prednisolone acetate ophthalmic suspension, USP) 1% with the safety of FML* (fluorometholone ophthalmic suspension, USP) 0.1%[1a]

Ocular surface inflammation is a key etiological factor in Dry Eye Disease[2]

FLAREX offers the efficacy of Pred Forte for ocular surface inflammation[1]

In the FDA pivotal trial evaluating patients with ocular surface inflammation,[a] there was no significant difference in clinical efficacy with FLAREX vs Pred Forte, *P*=0.49.[1]

97% of ocular surface inflammation was resolved or improved with FLAREX vs 89% with Pred Forte[1]



FLAREX is a steroid ester and the *only* acetate derivative of fluorometholone.[3-5] The acetate group improves lipophilicity, allowing greater penetration across the cell membrane.[6]

In clinical trials, there were no adverse reactions reported in the FLAREX and FML treatment groups and FLAREX and Pred Forte treatment groups.[1]

There is no generic equivalent of FLAREX—be sure to prescribe by name[4]

INDICATIONS AND USAGE
FLAREX® (fluorometholone acetate ophthalmic suspension) is indicated for use in the treatment of steroid-responsive inflammatory conditions of the palpebral and bulbar conjunctiva, cornea, and anterior segment of the eye.
IMPORTANT SAFETY INFORMATION
ADVERSE REACTIONS: Glaucoma with optic nerve damage, visual acuity and field defects, cataract formation, secondary ocular infection following suppression of host response, and perforation of the globe may occur.
Please see the Full Prescribing Information on the next page.

[a]**STUDY DESIGN:** The efficacy and safety of FLAREX were evaluated in two identical, randomized, double-blind clinical trials. In one trial of 78 patients with ocular surface inflammation (eg, conjunctivitis, episcleritis, scleritis) in one or both eyes, patients administered either FLAREX (n=41) or fluorometholone alcohol (n=37) every 2 hours for the first 2 days and then every 4 hours thereafter, with signs and symptoms of inflammation assessed at Days 1, 3, 8, and 13. In a separate but identical trial in 82 patients with ocular surface inflammation, patients administered either FLAREX (n=37) or prednisolone acetate 1.0% (n=45). At each visit, investigators determined if signs and symptoms in the involved eye were resolved, improved, unchanged, or worsened. If a patient was rated as signs and symptoms resolved before the end of the study, steroid drops were discontinued and the patient was considered to have completed the trial.[1]

Flarex®
(fluorometholone acetate ophthalmic suspension) 0.1%

FLAREX NDC NUMBER: 71776-100-05

References: 1. Leibowitz HM, Hyndiuk RA, Lindsey C, et al. Fluorometholone acetate: clinical evaluation in the treatment of external ocular inflammation. *Ann Ophthalmol.* 1984;16(12):1110-1115. 2. Craig JP, Nichols KK, Akpek EK, et al. TFOS DEWS II Definition and Classification report. *Ocul Surf.* 2017 Jul;15(3):276-283. doi: 10.1016/j.jtos.2017.05.008. 3. FLAREX [package insert]. Fort Worth, TX: Alcon Laboratories, Inc; 2017. 4. US Department of Health and Human Services, Food and Drug Administration. *Approved drug products with therapeutic equivalence evaluations.* (Orange Book). 40th ed. Washington, DC: US Department of Health and Human Services, Food and Drug Administration; 2020. 5. National Center for Biotechnology Information, PubChem. Fluorometholone acetate. https://pubchem.ncbi.nlm.nih.gov/compound/ fluorometholone-acetate. Accessed September 10, 2020. 6. Sendrowski DP, Jaanus SD, Semes LP, et al. Anti-inflammatory drugs. In: Bartlett JD, Jaanus SD, eds. *Clinical Ocular Pharmacology.* 5th ed. St Louis, MO: Butterworth-Heinemann; 2008:221-244.

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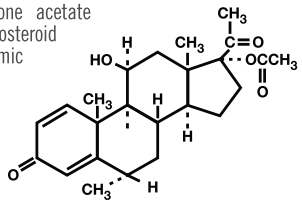
When it comes to ocular surface inflammation, FLAREX® is

A PROVEN WINNER

DESCRIPTION: FLAREX® (fluorometholone acetate ophthalmic suspension) is a corticosteroid prepared as a sterile topical ophthalmic suspension. The active ingredient, fluorometholone acetate, is a white to creamy white powder with an empirical formula of C24H31FO5 and a molecular weight of 418.5. Its chemical name is 9-fluoro-11, 17-dihydroxy-6 -methylpregna-1, 4-diene-3, 20-dione 17-acetate. The chemical structure of Fluorometholone Acetate is presented above:



Each mL contains: Active: fluorometholone acetate 1 mg (0.1%). Preservative: benzalkonium chloride 0.01%.

Inactives: sodium chloride, monobasic sodium phosphate, edetate disodium, hydroxyethyl cellulose, tyloxapol, hydrochloric acid and/or sodium hydroxide (to adjust pH), and purified water. The pH of the suspension is approximately 7.3, with an osmolality of approximately 300 mOsm/kg.

CLINICAL PHARMACOLOGY: Corticosteroids suppress the inflammatory response to inciting agents of mechanical, chemical or immunological nature. No generally accepted explanation of this steroid property has been advanced. Corticosteroids cause a rise in intraocular pressure in susceptible individuals. In a small study, FLAREX (fluorometholone acetate ophthalmic suspension) demonstrated a significantly longer average time to produce a rise in intraocular pressure than did dexamethasone phosphate; however, the ultimate magnitude of the rise was equivalent for both drugs and in a small percentage of individuals a significant rise in intraocular pressure occurred within three days.

INDICATIONS AND USAGE: FLAREX (fluorometholone acetate ophthalmic suspension) is indicated for use in the treatment of steroid responsive inflammatory conditions of the palpebral and bulbar conjunctiva, cornea, and anterior segment of the eye.

CONTRAINDICATIONS: Contraindicated in acute superficial herpes simplex keratitis, vaccinia, varicella, and most other viral diseases of cornea and conjunctiva; mycobacterial infection of the eye; fungal diseases; acute purulent untreated infections, which like other diseases caused by microorganisms, may be masked or enhanced by the presence of the steroid; and in those persons who have known hypersensitivity to any component of this preparation.

WARNINGS: FOR TOPICAL OPHTHALMIC USE ONLY. NOT FOR INJECTION. Use in the treatment of herpes simplex infection requires great caution. Prolonged use may result in glaucoma, damage to the optic nerve, defect in visual acuity and visual field, cataract formation and/or may aid in the establishment of secondary ocular infections from pathogens due to suppression of host response. Acute purulent infections of the eye may be masked or exacerbated by presence of steroid medication. Topical ophthalmic corticosteroids may slow corneal wound healing. In those diseases causing thinning of the cornea or sclera, perforation has been known to occur with chronic use of topical steroids. It is advisable that the intraocular pressure be checked frequently.

PRECAUTIONS:

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

Information for Patients: Do not touch dropper tip to any surface, as this may contaminate the suspension. The preservative in FLAREX® (fluorometholone acetate ophthalmic suspension), benzalkonium chloride, may be absorbed by soft contact lenses. Contact lenses should be removed during instillation of FLAREX (fluorometholone acetate ophthalmic suspension) but may be reinserted 15 minutes after instillation. Patients should be advised that their vision may be temporarily blurred following dosing with FLAREX (fluorometholone acetate ophthalmic suspension). Care should be exercised in operating machinery or driving a motor vehicle.

Carcinogenesis, Mutagenesis, Impairment of Fertility: No studies have been conducted in animals or in humans to evaluate the possibility of these effects with fluorometholone.

Pregnancy: Fluorometholone has been shown to be embryocidal and teratogenic in rabbits when administered at low multiples of the human ocular dose. Fluorometholone was applied ocularly to rabbits daily on days 6-18 of gestation, and dose-related fetal loss and fetal abnormalities including cleft palate, deformed rib cage, anomalous limbs and neural abnormalities such as encephalocele, craniorachischisis, and spina bifida were observed. There are no adequate and well controlled studies of fluorometholone in pregnant women, and it is not known whether fluorometholone can cause fetal harm when administered to a pregnant woman. Fluorometholone should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Nursing Mothers: Systemically administered corticosteroids appear in human milk and could suppress growth, interfere with endogenous corticosteroid production, or cause other untoward effects. It is not known whether topical administration of corticosteroids could result in sufficient systemic absorption to produce detectable quantities in human milk. Because many drugs are excreted in human milk, caution should be exercised when FLAREX (fluorometholone acetate ophthalmic suspension), is administered to a nursing woman.

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

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

ADVERSE REACTIONS: Glaucoma with optic nerve damage, visual acuity and field defects, cataract formation, secondary ocular infection following suppression of host response, and perforation of the globe may occur.

Postmarketing Experience: The following reaction has been identified during post-marketing use of FLAREX® (fluorometholone acetate ophthalmic suspension) in clinical practice. Because reactions are reported voluntarily from a population of unknown size, estimates of frequency cannot be made. The reaction, which has been chosen for inclusion due to either its seriousness, frequency of reporting, possible causal connection to FLAREX, or a combination of these factors, includes: dysgeusia.

DOSAGE AND ADMINISTRATION: Shake Well Before Using. One to two drops instilled into the conjunctival sac(s) four times daily. During the initial 24 to 48 hours the dosage may be safely increased to two drops every two hours. If no improvement after two weeks, consult physician. Care should be taken not to discontinue therapy prematurely.

HOW SUPPLIED: FLAREX (fluorometholone acetate ophthalmic suspension) is supplied in white low density polyethylene (LDPE) bottles, with natural LDPE dispensing plugs and pink polypropylene closures. The product is supplied as 5mL in an 8 mL bottle.
5 mL: NDC 71776-100-05

STORAGE: Store upright between 2°C -25°C (36°F -77°F). Protect from freezing.

Manufactured for:
Eyevance Pharmaceuticals, LLC
Fort Worth, TX 76102 USA

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Marine Life Could Hold Key to New AMD Therapy

A new therapy for AMD may be on the horizon: a polysaccharide called fucoidan found in marine sources, such as brown seaweed, could help protect the eye against environmental influences.

Due to their bioactivity, fucoidans have recently been suggested as a potential treatment for myriad conditions. Looking into this possibility as it relates to the eye, a team of researchers from Germany reviewed 10 *in vitro* studies that showed promising results in VEGF inhibition and, to a lesser degree, oxidative stress protection.

The researchers found fucoidans from *Saccharina latissima* and *Laminaria hyperborean*, both in the brown algae family, were the best candidates for further investigation.

A substance found in brown seaweed could possibly contribute to VEGF inhibition.

As shown in the studies, fucoidans exhibited a species dependency in their bioactivity. Additionally, the investigation results indicated high molecular weight was preferable when considering anti-VEGF function. Still, other factors that may be of importance include the degree of sulfation and fucose content of the extract.

"Therefore, fucose-rich, high molecular weight and highly sulfated fucoidans of the species *Saccharina latissima* and *Laminaria hyperborea* should be the fucoidans of choice for further development," the researchers wrote in their paper.

Taken together, fucoidans show exciting potential as a possible new treatment option for counteracting AMD progression, yet further research needs to be conducted on bioactivity, availability, application and *in vivo* efficacy, the investigators concluded.

Dörschmann P, Klettner A. Fucoidans as potential therapeutics for age-related macular degeneration—current evidence from in vitro research. Int J Mol Sci. 2020;21(23):9272.

Acne Medication Induces Corneal Remodeling

For people battling severe acne, retinoid isotretinoin can make all the difference. However, the drug is also known to contribute to dry eye. A recent study evaluated the side effects of isotretinoin and found that it also induces epithelial thickening and stromal thinning.

The study included 40 eyes of 40 patients with acne vulgaris. The researchers examined each participant with SD-OCT at baseline, at one, three and six months of isotretinoin treatment and at the third month of washout.

The researchers observed a statistically significant increase in all sectors of the epithelial thickness map between baseline and follow-up, except the inferonasal 7mm to 9mm region. Increases in superior, inferior and maximum values in epithelial statistics were significant. At follow-up, stromal statistical values were significant for decreases in the superior, inferior, minimum and maximum values.

The investigators also noted significant differences among central corneal thickness, maximum Ambrosio-related thickness and average pachymetric progression at all follow-ups, as well as significant differences between thinnest pachymetry and surface variance at months three and six. They observed a regression in parameters to baseline values by the third month of washout.

Based on other studies, the researchers suggested isotretinoin induces changes at the molecular level in ocular tissues following drug exposure. However, they pointed out in their paper, "There is no experimental study investigating the matrix metalloproteinase-9 (MMP-9) levels or activity in stroma exposed to 13-cis-retinoic acid (a key ingredient of isotretinoin)." They added that previous studies have connected activation of MMP-9 with corneal thickness reduction or corneal melting.

The study authors concluded that isotretinoin results in remodeling of the corneal layers, resulting in statistical differences in surface variance and pachymetry-related parameters.

Kan J, Li A, Zou H, et al. A machine learning based dose prediction of lutein supplements for individuals with eye fatigue. Front Nutr. 2020;7:577923.

IN BRIEF

A systematic review of 14 studies on **smartphone use**—comprising 27,110 patients ranging in age from 9.5 to 26—revealed a **significant association with visual impairment**. While smartphone overuse was not significantly associated with myopia, poor vision or blurred vision, patients who overused smartphones displayed worse visual function scores. The pooled effect size was 0.76, which was statistically significant.

The results suggest that **regulating device usage and restricting prolonged smartphone use may prevent adverse ocular and visual symptoms**, especially in younger patients. The researchers recommend further research on patterns of use, with longer follow-up on the longitudinal associations, to better inform detailed guidelines for smartphone use in children and young adults.

Wang J, Li M, Zhu D, et al. Smartphone overuse and visual impairment in children and young adults: systematic review and meta-analysis. J Med Internet Res. 2020;22(12):e21923.

Jury Still Out on OCT's Role in Cognitive Impairment

Growing evidence indicates that the retina is impacted in mild cognitive impairment (MCI)—often a precursor to Alzheimer's disease—but a new meta-analysis of previous studies suggests quite a range of presentations that might be classified as indicative of MCI. It notes that further investigations are needed to determine if OCT can be used as a biomarker for MCI at the onset of the condition.

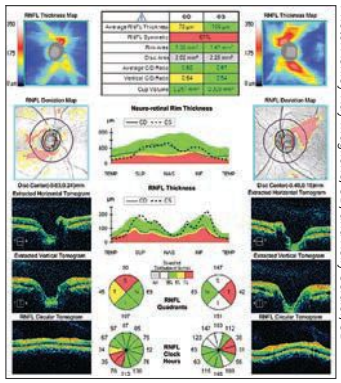


Photo: Ashley Kay Maglione, OD, and Kelly Seidler, OD

OCT of the optic nerves reveals temporal RNFL thinning.

This systematic review and meta-analysis evaluated 15 published research papers on retinal thickness measured by OCT and MCI.

Pooling the data, 58.9% of MCI patients showed statistically significant thinning of the peripheral RNFL compared with normal subjects. Additionally, 61.6% showed a statistically significant reduction in macular volume compared with controls, and 50% of macular ganglion cell-inner plexiform layers (GCL-IPL) experienced significant thinning in MCI patients.

While MCI had a large impact on decreased macular thickness, the researchers noted substantial heterogeneity in macular thickness. The other variables didn't demonstrate a significant difference.

"Several important findings from this review may help to inform future work related to retinal OCT biomarkers for neurodegenerative diseases that present with MCI, specifically Alzheimer's disease," the researchers wrote in their paper. They found evidence that differences in inner retinal measures and macular volume between MCI patients and healthy controls can be detected with OCT. Additionally, studies that scanned both the macula and circumpapillary regions showed differences between the study patients and controls in one of the locations, but not both, the investigators noted.

Since they observed significant heterogeneity between studies, the researchers suggested retinal degeneration associated with MCI is likely to be heterogeneous, with respect to the degree of degeneration between different regions of the retina and tissue involved (i.e., retinal ganglion cell, retinal ganglion cell axon, optic nerve). "Given what we know about the clinical and pathological heterogeneity of Alzheimer's disease, this is not surprising," they wrote.

The researchers suggested the following systemic approach for retinal OCT studies in Alzheimer's-related neurodegeneration:

- Consistent use of the same technology platform, specifically spectral-domain OCT.
- National Institute on Aging and Alzheimer's Association diagnostic criteria for healthy controls, MCI and Alzheimer's patients.
- Larger, longitudinal cohort studies or population-based studies.
- OCT of both eyes and scanning of the macula and circumpapillary regions to determine circumpapillary RNFL thickness, macular volume and thickness and GCL-IPL thickness.
- Alzheimer's biomarkers that include amyloid, tau and neurodegeneration markers along with other associations (i.e., age at symptom onset, degree of white matter disease).

Mejia-Vergara AJ, Restrepo-Jimenez P, Pelak VS. Optical coherence tomography in mild cognitive impairment: a systematic review and meta-analysis. Frontiers in Neurology. 2020,11:578698.

VISUAL IMPAIRMENT DECREASES COGNITION IN ADULTS

As people age, it's normal to experience a decline in both vision and cognition. Research recently published in *Ophthalmology* suggests a possible relationship may exist between the two, with visual impairment increasing the risk of cognitive impairment.

The systematic review and meta-analysis examined the findings of 40 studies that included a total of 47,913,570 patients aged 40 or older.

The investigators found that adults with visual impairment were two times more likely to develop prevalent or incident cognitive impairment. Significant heterogeneity was partially explained by differences in age, sex and follow-up duration. The study also reported that adults with cognitive impairment may be more likely to have visual problems, with most papers (89%) reporting significantly positive associations.

The researchers noted the following to explain why visual impairment is linked with cognitive decline:

- A loss of visual sensory information may lead to cortical atrophy and subsequent neural reorganization, as evidenced by neuroimaging and pathology.
- Alternatively, degraded and impaired visual input may result in errors in perceptual processing, with consequent decline in higher-order cognitive performance.
- Visual impairment may lead to cognitive decline indirectly by limiting the interactive experience of individuals with the environment, resulting in social isolation and restricted participation in mentally stimulating activities.
- Many age-related eye diseases (AMD, glaucoma, diabetic retinopathy) associated with visual impairment have also been linked with cognitive issues and dementia.

The results indicate that vision screening and timely treatment in middle-aged patients may be appropriate risk-reduction approaches for cognitive impairment, the study authors concluded.

Vu TA, Fenwick EK, Gan ATL, et al. The bidirectional relationship between vision and cognition: a systematic review and meta-analysis. Ophthalmology. December 14, 2020. [Epub ahead of print].

Rehab Training Improves Visual Function in AMD

With auditory biofeedback, patients can learn how to optimize their residual vision.

Geographic atrophy results in irreversible central vision loss, but, with acoustic biofeedback, AMD patients can rehabilitate their visual function, a study found. Rehab training optimizes healthy parts of the retina for visual fixation by reorganizing the primary visual cortex.

When central vision degrades, patients develop an eccentric fixation area, or a preferred retinal location (PRL), usually a healthy part of the retina found on the superior or horizontal meridian of the fovea. Previous studies have demonstrated that patients with central vision loss can develop multiple PRLs but may not know how to take advantage of them. Visual rehabilitation aims to show them.

The prospective, non-randomized study included patients with advanced atrophic AMD. The twice-weekly training lasted for five weeks. Patients sat in front of a pattern stimulator and were fit with a corrective lens over the eye with the highest best-corrected visual acuity for scotopic rehabilitation.

As part of their training, patients fixated on the stimulus target. During this process, "a stimulus from the optical pathways through the cortical visual areas is created and read by surface electrodes, which then produce a bioelectric visual evoked potential," the researchers explained. Patients were instructed to fixate on a target using a retinal area, which produces a sound that grows more intense as the patient's fixation improves. "The aim of the training is to ensure that the patient uses a retinal area with optimal biological activity," the study noted.

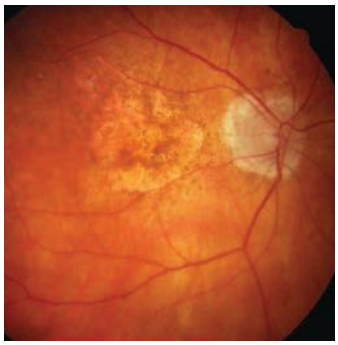


Photo: Joseph Pizzimenti, OD, and Carlo Pelino, OD

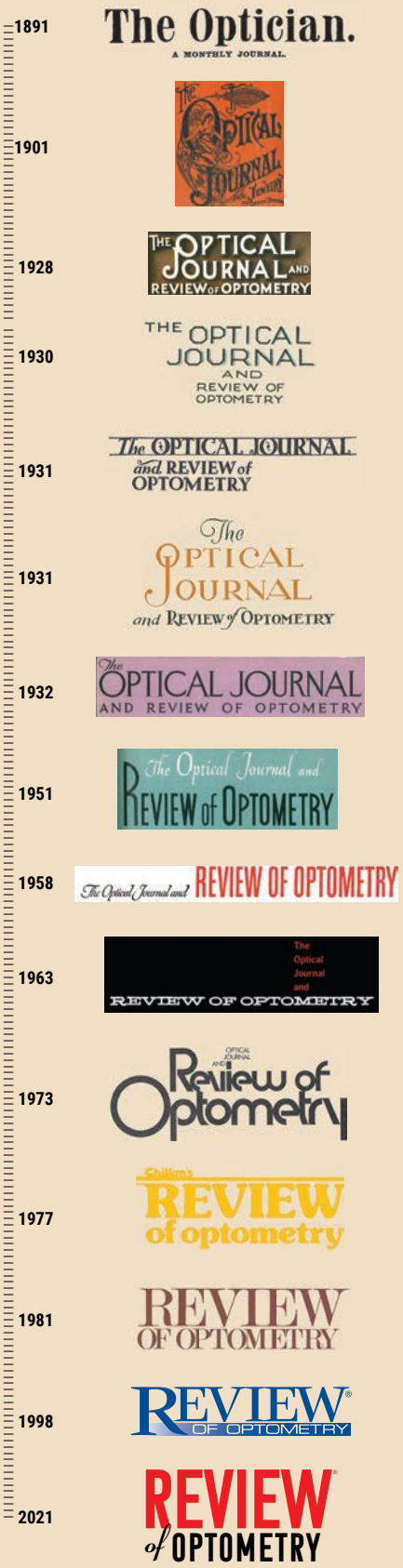
Low vision from advanced atrophic AMD may benefit from auditory biofeedback rehab.

The investigators concluded that their results suggest auditory biofeedback rehab is a good method for improving low vision in AMD. "Our study confirms the evidence of the plasticity of the visual system that can be successfully trained to optimize residual vision, creating new connections between the retina and the visual cortex with a rearrangement of neurons in this area," they wrote in their paper.

Verdina T, Piaggi S, Ferraro V, et al. Efficacy of biofeedback rehabilitation based on visual evoked potentials analysis in patients with advanced age-related macular degeneration. Sci Rep. November 30, 2020. [Epub ahead of print].

From *Optician* to *Optometry*

Through continual retooling to fit readers' interests, *The Optician* became *The Optical Journal* and ultimately *Review of Optometry*.



130 YEARS OF *REVIEW*: A TRADITION OF REINVENTION

Celebrating our anniversary with a new design and a fresh outlook.

BY JACK PERSICO
EDITOR-IN-CHIEF

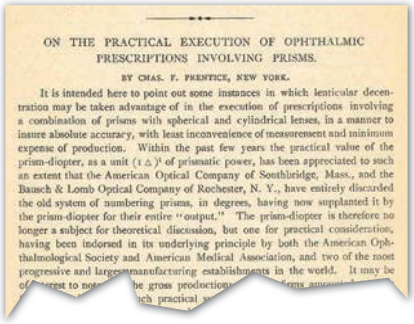
Peer into the history of optometry and you'll soon see that its defining trait—reinvention—existed even before its name did. In 1891, when this publication was founded, the expertise needed to craft eyeglasses was mostly still found in jewelry stores and its practitioners went by the name *opticians*. While that name still adheres today to the professionals who create and dispense eyewear, the so-called refracting opticians of the late 19th century sought out ways to build up their skills in examining and measuring the eye. With their zeal to learn, educate and organize—as they set about building a profession of their own—they continually layered new skills and capabilities atop their foundation in optics, venturing ever further into the workings of the eye as an organ of the body.

Optometry, in all but name, was born.

So too was a publication just for its practitioners when *The Optician* debuted in January 1891, the brainchild of founding editor Frederick Boger of New York. Boger knew that the great minds of his time, people like Charles Prentice and A. Jay Cross—two of optometry's founding fathers—needed an outlet for sharing their ideas, and practitioners struggling to make a go of private enterprise needed concrete advice from the experts.

REVIEW IS OLDER THAN...

- General Electric (1892)
- football (1895)
- movie theaters (1902)
- air travel (1903)
- antibiotics (1907)



ON THE PRACTICAL EXECUTION OF OPHTHALMIC PRESCRIPTIONS INVOLVING PRISMS.

BY CHAS. F. PRENTICE, NEW YORK.

It is intended here to point out some instances in which lenticular decentration may be taken advantage of in the execution of prescriptions involving a combination of prisms with spherical and cylindrical lenses, in a manner to insure absolute accuracy, with least inconvenience of measurement and minimum expense of production. Within the past few years the practical value of the prism-diopter, as a unit (1Δ) of prismatic power, has been appreciated to such an extent that the American Optical Company of Southbridge, Mass., and the Bausch & Lomb Optical Company of Rochester, N. Y., have entirely discarded the old system of numbering prisms, in degrees, having now supplanted it by the prism-diopter for their entire "output." The prism-diopter is therefore no longer a subject for theoretical discussion, but one for practical consideration, having been indorsed in its underlying principle by both the American Ophthalmological Society and American Medical Association, and two of the most progressive and largest manufacturing establishments in the world. It may be of interest to note the gross production [illegible] forms amounted

Charles Prentice, a key player in the creation of optometry, contributed to this publication's earliest issues, as seen in this 1895 article on his innovative system of prism diopters.

"The textbooks are excellent enough in their way," Boger wrote in our debut issue. "But they treat more with generalities than with actualities." By contrast, this publication "has the advantage over the textbook in knowing all that the textbook has taught and applying that knowledge to daily occurrences."

There you have it: identifying and solving real-world problems has been in the DNA of the magazine from its very first issue. Roughly 2,000 issues later, we're still just as dedicated to that mission statement.

Shifting Sands

The late 19th century was a time of rapid development for optometry, wherein many of the pillars of today's profession came to be.

Boger and Prentice, along with Charles Lembke and others, went on to co-found the AOA and advocate

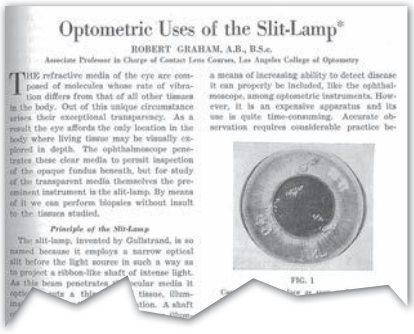
for the advancement of their new profession. An early priority was lobbying legislatures to enact optometry laws that recognized and codified the profession. In 1895, Prentice was even threatened with jail time for charging an exam fee, which was construed as practicing medicine without a license.

Boger and others (notably John Eberhardt) lobbied to call the practitioners *optometrists*. Prentice was a hold-out. His preferred term, *opticist*, never took off.

Cross took up the cause of optometric education and the founding of dedicated optometry colleges.

All the while, this publication was evolving, too. Just four years after its debut, *The Optician* changed its name to *The Optical Journal*, likely to give it a sense of gravitas appropriate to the pursuit of professionalism that marked this period, as practitioners dearly wished to be thought of as more than mere "spectacle peddlers." That spirit of ever-greater professional aspiration has been a hallmark of optometry since its inception and persists today.

You can also trace the rise of optometry in this magazine's logo designs through the 20th century (see sidebar, previous page). In 1910, its name was extended to *The Optical Journal and Review of Optometry*.


Optometric Uses of the Slit-Lamp*

ROBERT GRAHAM, A.B., B.S.c.

Associate Professor in Charge of Contact Lens Courses, Los Angeles College of Optometry

THE refractive media of the eye are composed of molecules whose rate of vibration differs from that of all other tissues in the body. Out of this unique circumstance arises their exceptional transparency. As a result the eye affords the only location in the body where living tissue may be visually explored in depth. The ophthalmoscope penetrates these clear media to permit inspection of the opaque fundus beneath, but for study of the transparent media themselves the preeminent instrument is the slit-lamp. By means of it we can perform biopsies without insult to the tissues studied.

Principle of the Slit-Lamp

The slit-lamp, invented by Gullstrand, is so named because it employs a narrow optical slit before the light source in such a way as to project a ribbon-like shaft of intense light. As this beam penetrates ocular media it opt... tissue, illumination. A shaft

a means of increasing ability to detect disease it can properly be included, like the ophthalmoscope, among optometric instruments. However, it is an expensive apparatus and its use is quite time-consuming. Accurate observation requires considerable practice be-

FIG. 1

Early adopters of the new optical correction of contact lens fitting helped push optometry's medical development forward, as it compelled advancement of their skills into evaluation of the ocular surface. This 1951 overview of the slit lamp introduced the device and its uses.

Ads through the years chronicled fashion trends in eyewear, clothes and design.

Then, over the course of several decades, the "optical journal" aspect was progressively downplayed in the design and dropped entirely in 1977.

Editorial coverage likewise perpetually shifted to the next set of clinical skills and opportunities for ODs, with proponents of scope expansion arguing vociferously in these pages for things that now seem absolutely essential, like use of dilating drops, a controversy in its day.

Meeting the Moment

And today? After a tumultuous year of pandemic and controversy, we're all eager to turn the page. For our 130th anniversary, we've given the publication a front-to-back redesign, marked by an aesthetic that's clean and uncluttered.

Later this year, our website will be reorganized around editorial topics more so than issues of the publication, owing to the lasting value of the articles published herein. We want to make it easier for you to find and enjoy the breadth of expertise your peers share in these pages even after print issues have come and gone.

We're also pushing forward in an effort to diversify our authors and board members, always on the lookout for the next generation of great thinkers and innovators who'll continue to carry the profession forward.

In our debut issue of January 1891, Boger pledged that the publication would "be for its readers a fountainhead of reliable information—a monthly visitor, in whose columns will be found a clear exposition of all the latest ideas and suggestions." That principle has guided us ever since.

As we have been for 130 years, we're excited for what comes next. ■

A Message From Our Publisher

While the first few months of the new year may, in fact, seem a great deal like the last several months of the old year—we have, if nothing else, a renewed sense of hope and optimism that 2021 will mark a stark turning point in humanity's battle against the COVID-19 pandemic.

Fortunately, during the past 10 months, we've all continued to experience precious moments of accomplishment, reward and joy—even if these instances frequently have been dotted with a Mark McGwire-sized asterisk. Perhaps a son or daughter graduated from college (*just two family members were permitted to attend). Or, you purchased a new home (*but had to tour the house virtually). I, too, reached a new milestone last year. In July, I was humbled and honored to be named publisher of the Review Group, following the retirement of my predecessor, mentor and friend, Jim Henne (*during one of the most turbulent times our industry has ever faced).

Throughout this period of enormous uncertainty, however, we've remained steadfastly committed to the development of novel, practical content intended to help you successfully navigate these trying times. And, I couldn't be more proud of our efforts.

Along similar lines, I'm pleased to announce that *Review* has undergone its most comprehensive graphic redesign in over 20 years. You'll notice a bold re-imagining of our logo on the cover, and a modern aesthetic layout for feature articles and recurring columns. It's all part of our tireless efforts to provide you with leadership in clinical care—which also happens to be our new tagline.

—Michael Hoster, Publisher

Helping Heroes See Clear And Stay Safe

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Dr. Michelle Hammond

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Dr. Reza Moradi

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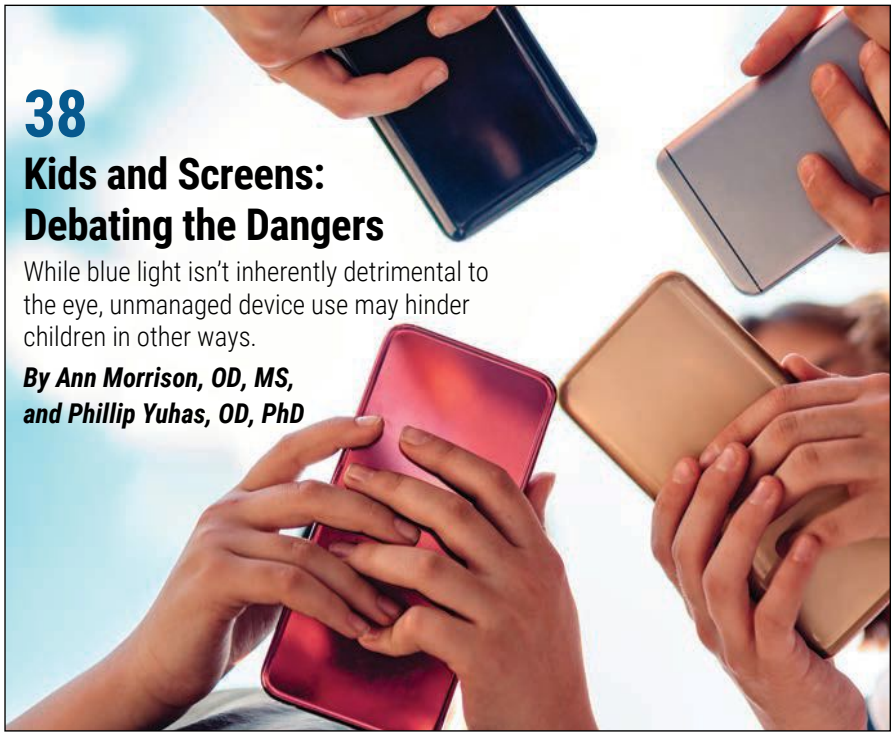
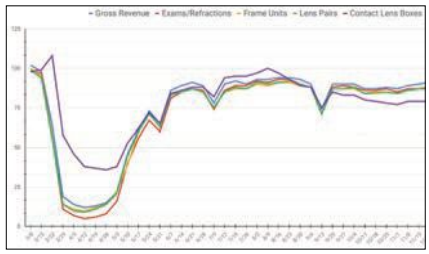
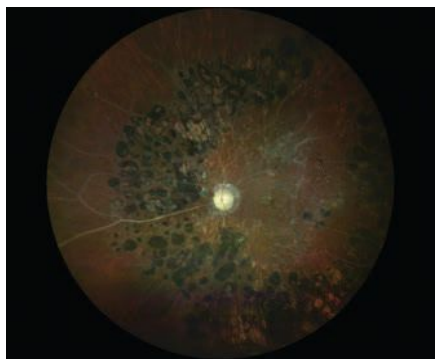
FEATURES

REVIEW OF OPTOMETRY • Vol. 158, No. 1 • JANUARY 15, 2021







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REVIEW OF OPTOMETRY • JANUARY 15, 2021

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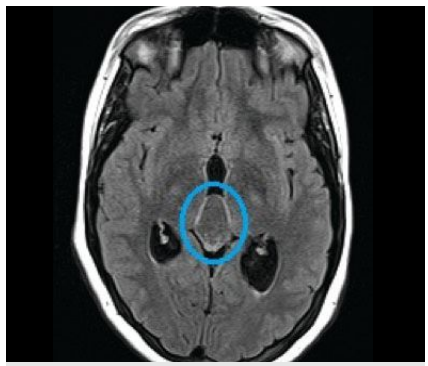

The **FIRST AND ONLY FDA APPROVED SHORT-TERM**
(up to two weeks) Rx treatment for the signs and symptoms of Dry Eye Disease

IN THE BATTLEGROUND OF DRY EYE...

When Dry Eye Flares strike, fight back first with fast.

INDICATION

EYSUVIS is a corticosteroid indicated for the short-term (up to two weeks) treatment of the signs and symptoms of dry eye disease.

IMPORTANT SAFETY INFORMATION

Contraindication:

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

Warnings and Precautions:

Delayed Healing and Corneal Perforation: Topical corticosteroids have been known to delay healing and cause corneal and scleral thinning. Use of topical corticosteroids in the presence of thin corneal or scleral tissue may lead to perforation. The initial prescription and each renewal of the medication order should be made by a physician only after examination of the patient with the aid of magnification, such as slit lamp biomicroscopy, and, where appropriate, fluorescein staining.

Intraocular Pressure (IOP) Increase: Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, as well as defects in visual acuity and fields of vision. Corticosteroids should be used with caution in the presence of glaucoma. Renewal of the medication order should be made by a physician only after examination of the patient and evaluation of the IOP

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

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

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

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

Adverse Reactions:

The most common adverse drug reaction following the use of EYSUVIS for two weeks was instillation site pain, which was reported in 5% of patients.

Please see Brief Summary of Prescribing Information for EYSUVIS on the next page.

kala PHARMACEUTICALS

US-EYS-2000157 www.EYSUVIS.com

EYSUVIS™
(loteprednol etabonate ophthalmic suspension) 0.25%
THE FAST FLARE FIGHTER

EYSUVIS (loteprednol etabonate ophthalmic suspension) 0.25%, for topical ophthalmic use

BRIEF SUMMARY OF FULL PRESCRIBING INFORMATION

INDICATIONS AND USAGE

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Risk of Contamination—Do not to allow the dropper tip to touch any surface, as this may contaminate the suspension.

Contact Lens Wear—The preservative in EYSUVIS may be absorbed by soft contact lenses. Contact lenses should be removed prior to instillation of EYSUVIS and may be reinserted 15 minutes following administration.

ADVERSE REACTIONS

Adverse reactions associated with ophthalmic corticosteroids include elevated intraocular pressure, which may be associated with infrequent optic nerve damage, visual acuity and field defects, posterior subcapsular cataract formation, delayed wound healing and secondary ocular infection from pathogens including herpes simplex, and perforation of the globe where there is thinning of the cornea or sclera.

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

The most common adverse reaction observed in clinical trials with EYSUVIS was instillation site pain, which was reported in 5% of patients.

USE IN SPECIFIC POPULATIONS

Pregnancy—Risk Summary: There are no adequate and well controlled studies with loteprednol etabonate in pregnant women. Loteprednol etabonate produced teratogenicity at clinically relevant doses in the rabbit and rat when administered orally during pregnancy. Loteprednol etabonate produced malformations when administered orally to pregnant rabbits at doses 1.4 times the recommended human ophthalmic dose (RHOD) and to pregnant rats at doses 34 times the RHOD. In pregnant rats receiving oral doses of loteprednol etabonate during the period equivalent to the last trimester of pregnancy through lactation in humans, survival of offspring was reduced at doses 3.4 times the RHOD. Maternal toxicity was observed in rats at doses 347 times the RHOD, and a maternal no observed adverse effect level (NOAEL) was established at 34 times the RHOD.

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

Data—*Animal Data:* Embryofetal studies were conducted in pregnant rabbits administered loteprednol etabonate by oral gavage on gestation days 6 to 18, to target the period of organogenesis. Loteprednol etabonate produced fetal malformations at 0.1 mg/kg (1.4 times the recommended human ophthalmic dose (RHOD) based on body surface area, assuming 100% absorption). Spina bifida (including meningocele) was observed at 0.1 mg/kg, and exencephaly and craniofacial malformations were observed at 0.4 mg/kg (5.6 times the RHOD). At 3 mg/kg (41 times the RHOD), loteprednol etabonate was associated with increased incidences of abnormal left common carotid artery, limb flexures, umbilical hernia, scoliosis, and delayed ossification. Abortion and embryofetal lethality (resorption) occurred at 6 mg/kg (83 times the RHOD). A NOAEL for developmental toxicity was not established in this study. The NOAEL for maternal toxicity in rabbits was 3 mg/kg/day.

Embryofetal studies were conducted in pregnant rats administered loteprednol etabonate by oral gavage on gestation days 6 to 15, to target the period of organogenesis. Loteprednol etabonate produced fetal malformations, including absent innominate artery at 5 mg/kg (34 times the RHOD); and cleft palate, agnathia, cardiovascular defects, umbilical hernia, decreased fetal body weight and decreased skeletal ossification at 50 mg/kg (347 times the RHOD). Embryofetal lethality (resorption) was observed at 100 mg/kg (695 times the RHOD). The NOAEL for developmental toxicity in rats was 0.5 mg/kg (3.4 times the RHOD). Loteprednol etabonate was maternally toxic (reduced body weight gain) at 50 mg/kg/day. The NOAEL for maternal toxicity was 5 mg/kg.

A peri-/postnatal study was conducted in rats administered loteprednol etabonate by oral gavage from gestation day 15 (start of fetal period) to postnatal day 21 (the end of lactation period). At 0.5 mg/kg (3.4 times the clinical dose), reduced survival was observed in live-born offspring. Doses ≥ 5 mg/kg (34 times the RHOD) caused umbilical hernia/incomplete gastrointestinal tract. Doses ≥ 50 mg/kg (347 times the RHOD) produced maternal toxicity (reduced body weight gain, death), decreased number of live-born offspring, decreased birth weight, and delays in postnatal development. A developmental NOAEL was not established in this study. The NOAEL for maternal toxicity was 5 mg/kg.

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

Pediatric Use—Safety and effectiveness in pediatric patients have not been established.

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

NONCLINICAL TOXICOLOGY

Carcinogenesis, Mutagenesis, Impairment of Fertility—Long-term animal studies have not been conducted to evaluate the carcinogenic potential of loteprednol etabonate. Loteprednol etabonate was not genotoxic *in vitro* in the Ames test, the mouse lymphoma thymidine kinase (tk) assay, in a chromosome aberration test in human lymphocytes, or *in vivo* in the single dose mouse micronucleus assay. Treatment of male and female rats with 25 mg/kg/day of loteprednol etabonate (174 times the RHOD based on body surface area, assuming 100% absorption) prior to and during mating caused pre-implantation loss and decreased the number of live fetuses/live births. The NOAEL for fertility in rats was 5 mg/kg/day (34 times the RHOD).

For a copy of the Full Prescribing Information, please visit www.EYSUVIS.com.

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Advertorial Paints a Rosy, and Inaccurate, Picture, AOA Says

Knowing that *Review of Optometry*'s mission is to deliver "optometrists the information they need to provide their patients top quality care in a personally rewarding practice environment," I was shocked to read the November 15 issue that included paid content from Hubble Contacts espousing the potential benefit for doctors of optometry offering the company's contact lenses to their patients. As president of the American Optometric Association (AOA), I can be very clear that our organization has not and will not ever dictate doctors' contact lens prescribing choices, but I also believe it is incumbent upon your publication to provide proper context when writing about a company's business plans, specifically by citing stories in other outlets that provide evidence of past violations of laws and regulations intended to protect the public.

The advertorial stated that "the company was founded on the ideals of providing the safest form of contact lens wear (daily disposables) to patients" affordably and conveniently, and that its philosophy "supports the same health and safety goals for patients that optometrists pursue each day." However, stories in national media outlets, including the *The New York Times* and the business website *Quartz*, paint a different picture. One details how the writer was able to order contact lenses from Hubble despite never having been prescribed them and giving a fake doctor and practice name, without contact information, for verification purposes. Another cited interviews with eight individuals who suffered adverse events after ordering Hubble contact lenses, and referenced concerns expressed by the Federal Trade Commission (FTC) regarding companies that seem to rely upon passive verification as a way to switch patients from their prescribed lenses.

Since Hubble Contacts entered the market in November 2016, the AOA has received over 400 complaints from doctors regarding the company's practices. Those that were of greatest concern to AOA were the cases of patient harm and adverse events. These include instances of patients suffering complications such as neovascularization of the cornea, keratitis, pain and discomfort—all conditions associated with poorly fitting contact lenses.

These cases were directly reported to the FTC by the AOA, so that they could be investigated. Dozens of cases of patient harm have also been directly reported to the FDA and are publicly available for review. We recommend that you take the time to review the *Quartz* and *New York Times* stories, as well as the FDA reports, and consider whether your recent Hubble Contacts advertorial provides the reader with adequate context to judge the current claims made by the company.

Years of vigilance, patient education and relentless advocacy by concerned doctors of optometry across the country, coupled with the tireless efforts of the Health Care Alliance for Patient Safety, the National Consumers League, affiliate optometric associations and the AOA, succeeded in bringing attention to serious concerns regarding Hubble Contacts' business practices. However, one must be aware that the company is able to rely on its access to lobbyists and PR agents in an effort to rehabilitate its image.

By choosing to be a platform for paid content from Hubble Contacts, *Review of Optometry* becomes a part of Hubble's efforts to improve its image. The fact that the company is now stating publicly that it supports proper eye exams and fittings for contact lenses could represent a long-overdue change, but questions remain about whether this represents a firm commitment across the entire company, and *Review of Optometry* missed an opportunity to explore that important question.

In the view of the AOA, *Review of Optometry* owes it to their readers not to simply pass along current claims made by the company, but instead to place current assertions in context by noting for their audience the serious issues cited above. Other stakeholders, including government regulators, consumer groups, and the AOA and AOA-affiliated associations, could have been contacted to provide much-needed background. Hubble Contacts should also have been required to answer questions about its past documented missteps and whether it has fully given up the flawed business model behind them. If the company is in fact committed to stopping the practices cited above and adhering to key health and safety regulations going forward, it should as a first step fully and publicly account for its past practices.

— William T. Reynolds, OD
AOA President

In Response

We thank Dr. Reynolds for his leadership in fighting to protect the well-being of optometrists and the patients they serve. The complaints he raises against Hubble deserve to be aired and investigated. We're glad to see the AOA and FTC taking action to do so.

However, his assertion that *Review of Optometry* should have in some way tempered the content of Hubble's advertising stems from a misapprehension about the jurisdiction of a publication over such pieces. Simply put, an advertorial is an advertisement, produced outside the editorial branch, and no publication—this one or any other—moderates the content of such a piece. Advertisers have autonomy over their message and must prove through their actions that it rings true.

We do, however, bear responsibility for conveying the difference between our independent editorial content and the paid pieces that industry commissions. We pledge to bring greater clarity to this distinction in the future. ■

When ocular itch gets in the way of their day...

ALLEVIATE WITH ZERVIATE™

Available by prescription only.

ZERVIATE delivers the proven power of cetirizine—a leading oral allergy medication—now targeted to the eyes.[1,2,a]

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- Designed for comfortable delivery with Hydrella™, a glycerin and HPMC formulation
- Available in single-use containers for convenience

ZERVIATE™
cetirizine ophthalmic solution, 0.24%
FORMULATED WITH HYDRELLA™

Learn more at MyZerviate.com

STUDY DESIGN: The pivotal trials for ZERVIATE included two Phase 3, double-masked, randomized, vehicle-controlled, parallel-group studies involving 201 patients. Study 2 required more severe allergic conjunctivitis symptoms. Patients were screened for an allergen response using the conjunctival allergen challenge (CAC) model and randomized to receive either ZERVIATE or vehicle. Primary efficacy endpoints were ocular itching and conjunctival redness 15 minutes and 8 hours post treatment instillation.[3]

INDICATIONS AND USAGE

ZERVIATE™ (cetirizine ophthalmic solution) 0.24% is a histamine-1 (H1) receptor antagonist indicated for treatment of ocular itching associated with allergic conjunctivitis.

DOSAGE AND ADMINISTRATION

Instill one drop in each affected eye twice daily (approximately 8 hours apart).

IMPORTANT SAFETY INFORMATION

WARNINGS AND PRECAUTIONS

Contamination of Tip and Solution: As with any eye drop, care should be taken not to touch the eyelids or surrounding areas with the dropper tip of the bottle or tip of the single-use container in order to avoid injury to the eye and to prevent contaminating the tip and solution. Keep the multi-dose bottle closed when not in use. Discard the single-use container after using in each eye.

Contact Lens Wear: Patients should be advised not to wear a contact lens if their eye is red. ZERVIATE should not be instilled while wearing contact lenses. Remove contact lenses prior to instillation of ZERVIATE. The preservative in ZERVIATE, benzalkonium chloride, may be absorbed by soft contact lenses. Lenses may be reinserted 10 minutes following administration of ZERVIATE.

ADVERSE REACTIONS

The most commonly reported adverse reactions occurred in approximately 1–7% of patients treated with either ZERVIATE or vehicle. These reactions were ocular hyperemia, instillation site pain, and visual acuity reduced.

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

HPMC=hydroxypropyl methylcellulose.

[a]Based on a U.S. News report on data from the 2019 Pharmacy Times Survey of Pharmacists' OTC Recommendations.

References: 1. ZERVIATE [package insert]. Fort Worth, Texas: Eyevance Pharmaceuticals LLC; 2020. **2.** *U.S. News & World Report.* Antihistamines for allergies. https://health.usnews.com/health-products/top-rec-antihistamines-oral-8. Accessed October 7, 2019. **3.** Meier EJ, Torkildsen GL, Gomes PJ, et al.Phase III trials examining the efficacy of cetirizine ophthalmic solution 0.24% compared to vehicle for the treatment of allergic conjunctivitis in the conjunctival allergen challenge model. *Clin Ophthalmol.* 2018;12:2617-2628. **4.** Malhotra RP, Meier E, Torkildsen G, et al. Safety of cetirizine ophthalmic solution 0.24% for the treatment of allergic conjunctivitis in adult and pediatric subjects. *Clin Ophthalmol.* 2019;13:403-413.

eyevance pharmaceuticals

ZER-20-AD-77-00

ZERVIATE™ (cetirizine ophthalmic solution) 0.24%

Brief Summary

INDICATIONS AND USAGE

ZERVIATE (cetirizine ophthalmic solution) 0.24% is a histamine-1 (H1) receptor antagonist indicated for treatment of ocular itching associated with allergic conjunctivitis.

DOSAGE AND ADMINISTRATION

Recommended Dosing: Instill one drop of ZERVIATE in each affected eye twice daily (approximately 8 hours apart). The single-use containers are to be used immediately after opening and can be used to dose both eyes. Discard the single-use container and any remaining contents after administration. The single-use containers should be stored in the original foil pouch until ready to use.

CONTRAINDICATIONS

None.

WARNINGS AND PRECAUTIONS

Contamination of Tip and Solution: As with any eye drop, care should be taken not to touch the eyelids or surrounding areas with the dropper tip of the bottle or tip of the single-use container to avoid injury to the eye and to prevent contaminating the tip and solution. Keep the multi-dose bottle closed when not in use. Discard the single-use container after using in each eye.

Contact Lens Wear: Patients should be advised not to wear a contact lens if their eye is red.

ZERVIATE should not be instilled while wearing contact lenses. Remove contact lenses prior to instillation of ZERVIATE. The preservative in ZERVIATE, benzalkonium chloride, may be absorbed by soft contact lenses. Lenses may be reinserted 10 minutes following administration of ZERVIATE.

ADVERSE REACTIONS

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

In 7 clinical trials, patients with allergic conjunctivitis or those at risk of developing allergic conjunctivitis received one drop of either cetirizine (N=511) or vehicle (N=329) in one or both eyes. The most commonly reported adverse reactions occurred in approximately 1%–7% of patients treated with either ZERVIATE or vehicle. These reactions were ocular hyperemia, instillation site pain, and visual acuity reduced.

USE IN SPECIFIC POPULATIONS

Pregnancy

Risk Summary

There were no adequate or well-controlled studies with ZERVIATE in pregnant women. Cetirizine should be used in pregnancy only if the potential benefit justifies the potential risk to the fetus.

Data

Animal Data

Cetirizine was not teratogenic in mice, rats, or rabbits at oral doses up to 96, 225, and 135 mg/kg, respectively (approximately 1300, 4930, and 7400 times the maximum recommended human ophthalmic dose (MRHOD), on a mg/m^2 basis).

Lactation

Risk Summary

Cetirizine has been reported to be excreted in human breast milk following oral administration. Multiple doses of oral dose cetirizine (10 mg tablets once daily for 10 days) resulted in systemic levels (Mean C_{max} = 311 ng/mL) that were 100 times higher than the observed human exposure (Mean C_{max} = 3.1 ng/mL) following twice daily administration of cetirizine ophthalmic solution 0.24% to both eyes for 1 week. Comparable bioavailability has been found between the tablet and syrup dosage forms. However, it is not known whether the systemic absorption resulting from topical ocular administration of ZERVIATE could produce detectable quantities in human breast milk.

There is no adequate information regarding the effects of cetirizine on breastfed infants, or the effects on milk production to inform risk of ZERVIATE to an infant during lactation. The developmental and health benefits of breastfeeding should be considered along with the mother's clinical need for ZERVIATE and any potential adverse effects on the breastfed child from ZERVIATE.

Pediatric Use: The safety and effectiveness of ZERVIATE has been established in pediatric patients two years of age and older. Use of ZERVIATE in these pediatric patients is supported by evidence from adequate and well-controlled studies of ZERVIATE in pediatric and adult patients.

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

NONCLINICAL TOXICOLOGY

Carcinogenesis, Mutagenesis, Impairment of Fertility

Carcinogenicity

In a 2-year carcinogenicity study in rats, orally administered cetirizine was not carcinogenic at dietary doses up to 20 mg/kg (approximately 550 times the MRHOD, on a mg/m^2 basis). In a 2-year carcinogenicity study in mice, cetirizine caused an increased incidence of benign liver tumors in males at a dietary dose of 16 mg/kg (approximately 220 times the MRHOD, on a mg/m^2 basis). No increase in the incidence of liver tumors was observed in mice at a dietary dose of 4 mg/kg (approximately 55 times the MRHOD, on a mg/m^2 basis). The clinical significance of these findings during long-term use of cetirizine is not known.

Mutagenesis

Cetirizine was not mutagenic in the Ames test or in an *in vivo* micronucleus test in rats. Cetirizine was not clastogenic in the human lymphocyte assay or the mouse lymphoma assay.

Impairment of Fertility

In a fertility and general reproductive performance study in mice, cetirizine did not impair fertility at an oral dose of 64 mg/kg (approximately 875 times the MRHOD, on a mg/m^2 basis).

PATIENT COUNSELING INFORMATION

Risk of Contamination: Advise patients not to touch dropper tip to eyelids or surrounding areas, as this may contaminate the dropper tip and ophthalmic solution. Advise patients to keep the bottle closed when not in use. Advise patients to discard single-use containers after each use.

Concomitant Use of Contact Lenses: Advise patients not to wear contact lenses if their eyes are red. Advise patients that ZERVIATE should not be used to treat contact lens–related irritation. Advise patients to remove contact lenses prior to instillation of ZERVIATE. The preservative in ZERVIATE solution, benzalkonium chloride, may be absorbed by soft contact lenses. Lenses may be reinserted 10 minutes following administration of ZERVIATE.

Administration: Advise patients that the solution from one single-use container is to be used immediately after opening. Advise patients that the single-use container can be used to dose both eyes. Discard the single-use container and remaining contents immediately after administration.

Storage of Single-use Containers:
Instruct patients to store single-use containers in the original foil pouch until ready to use.

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BY JACK PERSICO, EDITOR-IN-CHIEF

OUTLOOK

The Pricing Problem

There will always be someone willing to charge less than you. Emphasize quality and personalized attention instead.

Readers of our print edition will already notice that this issue debuts a brand-new look for the publication timed to coincide with our 130th anniversary. You can read on p. 10 a brief retrospective on our history and the profession's, and see a gallery of the many different logos—and names!—this magazine has sported through the years.

That quick trip down memory lane reminded me of how some of the structural problems that independent optometrists face have been around almost literally since day one. Skimming old issues, I came across an editorial on price competition—from 1895. In it, founding editor Frederick Boger related a recent competitive dust-up between grocers and "dry goods" stores, what today we might call a big-box retailer, a place that thrives on a low-cost, high-volume business model.

New York City grocers of the day couldn't compete on price, so they went about publicly condemning and trying to restrict this formidable new competitor. Far from being intimidated, the dry-goods stores used it against the grocers by circulating their laments as proof that the bigger stores offered the better deal—and then their business went up.

Boger warned his readers against making the same mistake. "The more you call the attention of the public to your inability to compete with the peddler or the dry-goods store," he wrote, "the more you seek to curtail their business by neglecting your own to call attention to theirs, the more those people prosper and the more goods they sell."

He reassured his readers to "not be frightened because the dry-goods store sells eyeglasses for 9¢ a pair." Offer the same, he argued, but point out the superiority of your more precise, customized methods and the competitors' advantage will vanish.

In other words, upsell.

"Get people to your store, then you have won half the battle," he concluded. "Treat them right when they come, and you will create a custom and a business that will place you above worry as to what peddlers or dry-good stores are doing."

This magazine has been giving that sort of advice since its earliest days, whether the topic at hand is eyeglass sales or medical eye care. It may sound a little trite by now, but it really does work, especially in the era when struggling businesses live or die by their Yelp reviews.

ODs who are dismayed at all the price competition that surrounds them, from the likes of Warby Parker and 1-800-CONTACTS and a litany of others, would do well to remember that price is only a means to an end, not the end itself, for patients. Communicate the value proposition—and then be sure to deliver on it.

It's fitting that our issue theme for this anniversary month is vision care, optometry's original mandate if ever there was one. We're proud to honor our heritage—and yours—with a return to this essential need, while rounding out our slate with advice on medical and surgical responsibilities, too. The profession, and this publication, have evolved and flourished together for decades. Sincere thanks for your loyal readership. ■

BY PAUL M. KARPECKI, OD,
CHIEF CLINICAL EDITOR

Position Yourself for a Full-throttle Recovery

Once restrictions and safety concerns let up, pent-up demand will unleash a much-needed rebound year.

Last year reminded us that predicting the future is tough. Who would have thought 2020, the "Year of Vision," would have been the "Year of Virus" instead? But the exercise in being prepared for what's likely to come in a new year is still worth the effort, as it can position optometry for great advancement.

So, what's likely to occur in 2021?

1. Vaccines will bring us back to pseudo-normalcy. With two approved and a third on the way, expect the pent-up demand for socialization to manifest. Patients who've been putting off routine care will return. A note of caution: continue to follow the COVID guidelines you've developed. The long-term consequences of SARS-Cov-2—potentially impairing the heart, lungs and/or CNS—are unfortunately significant. Don't let your guard down, but be ready for a return to normal patient volumes and even increased demand for in-office procedures (e.g., thermal MGD treatments), high-end optical and contact lens requests.

2. Eyedrops will tackle presbyopia. Allergan/Abbvie's pupil modulation pilocarpine drop for increasing depth of focus, the first of many topical agents, will likely see approval in 2021. Soon to follow will be Orasis's low-concentration pilocarpine. One will have greater duration of effect but possibly more brow-ache or burning on instillation, and the other may have a low adverse event profile but could require more frequent dosing. At least five more companies are working on drops for presbyopia, including a lens softening agent being studied by Novartis.

3. Blepharitis hits the big time. Common but highly underdiagnosed, blepharitis is on track for a 2022 release of the first medication in recent times with an indication specific to it, a drug from Tarsus Pharmaceuticals.

> **With two vaccines approved and a third on the way, patients who have been putting off routine eye care will soon return.**

The anticipation of a drop for this common disease reminds me of when Restasis was approved for dry eye over 18 years ago. It's a market that was under-diagnosed by about 75%, had traditionally been managed with palliative therapies, and relatively little was understood about effective care strategies until it was severe.

To prepare for the drug's eventual release, ODs in 2021 should begin to increase their focus on the eyelids during exams. Have patients look down while in the slit lamp and scan the base of the lashes for collarettes, then look closely at the lower eyelid lashes for signs of debris extruding in and around the lash follicle.

4. Pharma takes another swing at dry AMD. Though other drugs have failed, there's cause for optimism about two new complement inhibitors effective against geographic atrophy aiming for late 2021 or early 2022. Existing office tools for monitoring, such as dark adaptometry, could be augmented by a bio-photonic hand scanner from Pharmanex that measures carotenoid levels in the skin as a surrogate for retinal status. Sunglasses, HVEL-blocking lenses or screen protectors, and healthy living are all likely to help patients with AMD. Monitoring for wet AMD with OCT in the office and at-home monitoring systems are critical steps too.

Recent Approvals Loom Large

The new therapeutic for ptosis, Upneeq (Osmotica), will be significant in 2021. Patients with mild-to-moderate ptosis are commonplace but many ODs are hesitant to recommend blepharoplasty. Other than the recent alpha-2 AR agonists (Lumify, Bausch + Lomb) for eye whitening, rarely have I seen such a 'wow' response from patients. Strong word of mouth has increased patient referrals dramatically.

The other recent approval, Eysuvis (Kala) for short-term treatment of dry eye, brings an on-label indication to the familiar practice of using lotepredrednol to clamp down on inflammation.

Finally, I expect 2021 will be significant for Oxervate (Dompé), which completely resolved neurotrophic keratitis from persistent epithelial defects or ulcers in 72% of patients. Biologics like amniotic membranes, cytokine extract drops and autologous serum will continue to grow as well.

A new year and new opportunities are upon us. Vaccines with over 94% effectiveness are around the corner and, with it, 2020 will be a once in-a-century memory. Recovery beckons. ■

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 chairman of the affiliated New Technologies & Treatments conferences. A fixture in optometric clinical education, he provides consulting services to a wide array of ophthalmic clients. 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

Scrubs: the Clothes, Not the Benchwarmers

There have been a lot of firsts over the past year, so I decided why not mix up my wardrobe?

Scrubs. Didn't we used to use this word to describe the little pimply-faced souls who barely made the team, sat at the end of the bench, never played in a game and were only there because they were used as fodder in practice for the "real" players? That was back in the good ol' days, aka 2019.

Fast forward to the COVID era. Now, scrubs are the superhero costumes worn by health care workers who choose not to bring the scuzz home from their workplaces. Many optometrists also wear scrubs to the office in light of our current predicament. My partners do. I do too. My son, a surgeon, condescendingly—as a surgeon would—wondered aloud why an optometrist would dare wear scrubs to work. Well, since he deals with unconscious patients, he probably has never been attacked by an errant soft contact lens. Have I been? That's a story for another time.

So, what are the advantages of wearing scrubs as an optometrist? Let me enlighten you:

1. I live in Texas where it was 106° all summer. Scrubs are, in effect, the medical equivalent of wearing a Hawaiian shirt and pajama bottoms to work. Whatever semblance of a cool breeze runs right up your leg all day long. Ahhh.

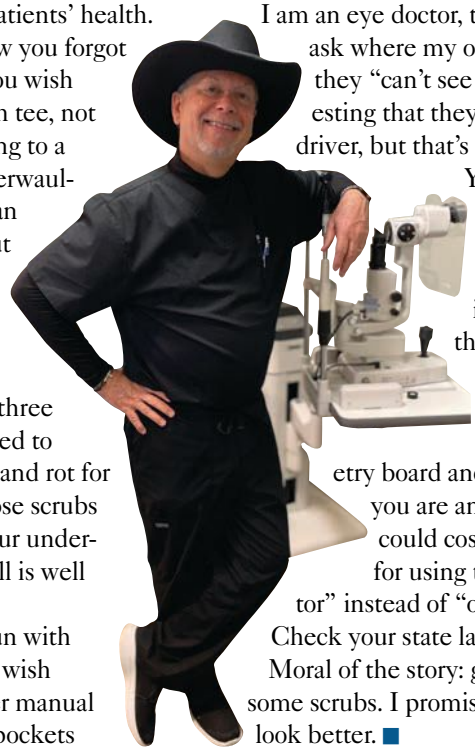
2. The temperature can drop to 48° in the winter (when it's not a beautiful 76°). You can wear long johns under your scrubs and, yes, even Spanx. Not me, of course. That's just something somebody told me, or, more accurately, recommended last year when they saw me with my shirt off at the beach. Ouch.

3. First impressions are more important now than ever. Patients want you to at least appear cleaner and more sterile than ever before. I have always, for 41 years, washed my hands between patients. Now, I do it in front of them. That combined with my slimming black scrubs and matching mask all work together to show that I truly care about my patients' health. Golf clothes only show you forgot how to tie a tie and you wish you were at the eighth tee, not in a dark room listening to a patient in distress caterwauling about why they can no longer read without glasses.

4. Wearing scrubs does a good job of wiping out your dry-cleaning bills. Those three pairs of khakis you used to rotate can hang there and rot for all I care. Just pop those scrubs in the washer with your underwear and socks, and all is well with the world.

5. Scrubs are overrun with pockets. I sometimes wish mine came with a user manual because some of the pockets seem very specific, and I just cannot figure out what they are really for. But it's nice being able to tote around multiple pens and penlights, your cell phone, occluders, the occasional retinoscope, glasses, cleaning supplies, those little screwdrivers, cotton swabs, tissues, little bottles of CBD tincture, ham sandwiches, cans of diet soda, your stun gun and other odds and ends. You name it. Pockets don't discriminate. I even have one large pocket designated solely to stash bagels, cookies and donuts delivered by hopeful sales reps. On the other hand, because there are so many pockets, I often find myself performing La Macarena in search of my car keys. Google it, kids.

6. When you wear scrubs out and about, you instantly have cred and are respected. At least once a week, someone asks me what kind of doctor I am. Usually it is my wife. But sometimes it is a total stranger, and when I tell them I am an eye doctor, they inevitably ask where my office is because they "can't see nothin'." Interesting that they are a school bus driver, but that's beside the point. You are a walking billboard for your practice! Of course, if it turns out that the person who asks is a member of your state's optometry board and you tell them you are an eye doctor, it could cost you a $300 fine for using the word "doctor" instead of "optometrist." Check your state laws.



Moral of the story: get yourself some scrubs. I promise you will never look better. ■

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.

AMD Standard of Care is Not Enough

IRIS REGISTRY

20/83 VA

Average at wet AMD diagnosis according to IRIS Registry real-world data[1]

HOME STUDY

≥20/40 VA

Average at wet AMD diagnosis with ForeseeHome[2]

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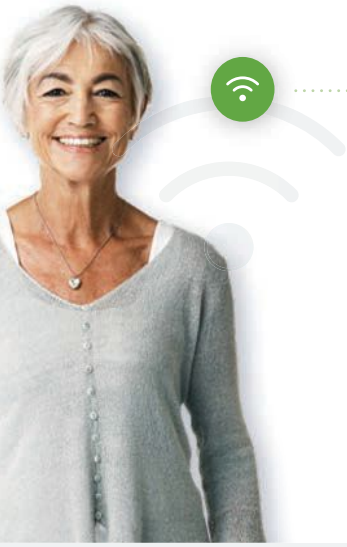

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References: 1. Rao P et al. *Ophthalmology*. 2018;125(4):522-528. **2.** Domalpally A, Clemons TE, Bressler SB, et al. *Ophthalmol Retina*. 2019;3(4):326-335.

See website for FDA Indication for Use.

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Near and Far

Cataract patients would like to know their options, and you're the best person to inform them.

Q I have a long-time patient who is moderately myopic, and now cataracts are interfering with reading and driving at night. She spends most of her time on the computer and wants to rely less on glasses. What IOL should I recommend?

A "There are some new lens implants available, depending on the patient's goals and lifestyle," says Lawrence Woodard, MD, medical director of Omni Eye Services of Atlanta. Optometrists must educate patients on their choices so their surgeon doesn't surprise them.

There are only a few presbyopia-correcting IOL options, so inform patients on the procedures and technologies their surgeon uses. Not all surgeons take advantage of the latest techniques and technologies, so steer patients to those who are on the cutting edge and deliver consistent results.

The Multifocal Menu

For those wishing to rely less on reading glasses, there are both older and newer options. The Symfony lens (Johnson & Johnson Vision), introduced in 2016, is a hybrid extended-depth-of-focus and multifocal IOL that provides good distance and intermediate vision with modest near vision. It also corrects moderate astigmatic errors. However, the reading distance is not as close as many patients prefer, so reading glasses are needed in certain situations. Some patients may also experience significant glare and halos at night.

The PanOptix lens (Alcon) was introduced in 2019 and is the first true trifocal lens available in the United States. This lens provides good near vision as well as good distance and intermediate vision. Because it is a trifocal, patients are generally happy with their quality of vision throughout the near and intermediate ranges. This lens does not diminish contrast sensitivity as much as prior generations of multifocals did, so vision quality in low light conditions is improved.

With a trifocal, there is still the potential for halos at night due to the rings etched into the lens. This has not been a significant issue for Dr. Woodard. "The powers are limited, so be aware if it is available in the appropriate powers before presenting this option," he recommends. Astigmatism can be corrected up to about 2.00D.

Image: Alcon

The Vivity lens could be the latest choice to discuss with presbyopic patients.

The newest presbyopia correction option is the Alcon AcrySof IQ Vivity lens, an extended-range-of-vision IOL that provides high-quality distance and intermediate vision and functional acuity at near. Because this lens is not a multifocal, it doesn't split light but stretches and extends it. Patients who have ocular pathologies such as dry eye, mild macular pucker or age-related macular degeneration may benefit from this lens design. Near vision may not be as good as the PanOptix, but, compared with other multifocal and trifocal lenses, Vivity patients report less glare and halos post-op.[1] Like the PanOptix, astigmatism correction is available up to about 2.00D.

The Vivity was introduced to a limited market in October 2020 but will be widely rolled out soon to interested surgeons. "Any patient who qualifies for a monofocal lens qualifies for Vivity, with the added bonus of some intermediate and perhaps reading vision," says Dr. Woodard.

Warn Your Myopes

With this patient and any who are nearsighted, it is crucial to mention that the near vision they have without glasses will go away completely after surgery unless they choose one of the options mentioned. "If this isn't made clear to them in advance, these patients will be unhappy, and post-op visit chair time will increase significantly," says Paige Foster, OD, of Clarkson Eyecare in Conyers, GA.

As with any premium IOL, there is a significant out-of-pocket cost to the patient. No insurance company, commercial payer or Medicare, will cover it. If the patient is not willing to spend the money, rest assured that you did your job by discussing their choices and documenting what you told them.

"At the end of the day, you don't want patients coming back upset that they weren't given all their options," advises Dr. Foster. ■

Dr. Woodward is a key opinion leader for Alcon.

1. Alcon. AcrySof IQ Vivity extended vision UV absorbing intraocular lenses product information.

About Dr. Ajamian Dr. Ajamian is the center director of Omni Eye Services of Atlanta. He currently serves as general chairman of the education committee for SECO International. Dr. Ajamian has no financial disclosures.

REVIEW OF OPTOMETRY

The OD's TOP CHOICE

Ranked #1 Eye Care Publication In FIVE Critical Readership Categories:

- Total Readers
- Most Read Publication/ Website Within the Last Six Months
- Quality Clinical Content I Use in My Practice
- Average Page Exposures
- Websites Visited within the Last Six Months

Source: *Kantar Media Eyecare 2020 Study*

Practitioners rely on RO more than any other eye care publication

Review **also is number one in readership across the following categories:**

- Total Optometrists
- ODs in High-Volume Practices
- Solo Practitioners
- Annual Practice Revenue ($500k+)
- ODs who Purchase Examination Equipment
- Write Prescriptions (11+ per week)
- Perform Refractions (51+ per week)
- Contact Lens Prescribers
- Years in Practice (1-15 and 15+)
- Among Key Opinion Leaders

To our readers: **Thank you for your loyalty, time and trust. We'll keep working hard to earn your support.**

BY JOHN RUMPAKIS, OD, MBA,
CLINICAL CODING EDITOR

New Year, New Rules

Review the latest changes to the coding system so you can start off on the right foot.

Now that 2020 is behind us and, along with it, the calamity of severe disruptions in the health care universe. We experienced firsthand the power of the government when it declares a Public Health Emergency, and how commercial carriers can rapidly adopt CMS changes. The rapid acceleration and adoption of a significantly modified telehealth rule set had us checking on a daily basis what had changed since the day before. Much of this disruption was also economic, and optometry, like other specialties, had many practices close, unable to weather the economic storm that COVID caused.

Some long-planned significant changes seemed to pale in comparison with the daily news of the pandemic and its stresses and strains on the health care infrastructure. One of these long-planned changes is to the Evaluation & Management (E&M) coding system that has been in place with very little annual modification since 1995. In fact, the last significant change was in 1997—until now.

An Update to Simplify

2021 brings us not only a new year, but also new definitions and rules when using the E&M codes in our practices—and yes, they will be easier and less complicated. Bet you never thought those words would come out of my mouth, right? While I wrote an in-depth piece in October 2020 on these codes, now would be a good time to review the basic tenets of this new coding system.

(1) The level of history and physical exam performed no longer have any bearing on determining the level of the office visit. Every E&M code definition now simply states that the physician should perform a "medically appropriate history and examination."

> **These changes are significant and should result in the doctor spending more quality time with the patient managing their care.**

(2) 99201 has been eliminated from the code set. Since the only difference between 99201 and 99202 was the level of history and examination performed, it was no longer needed. Therefore, the lowest level of E&M visit we can now perform on a new patient is a 99202.

(3) Time has been redefined for E&M coding. Going forward, total or cumulative time spent is composed of:

a. Preparing to see the patient
b. Obtaining and/or reviewing separately obtained history
c. Counseling and educating the patient/family/caregiver
d. Ordering tests, medications or procedures
e. Referring and communication with other health care professionals
f. Documenting clinical information in the health record
g. Coordinating care
h. Independently interpreting results and communicating them to the patient/family/caregiver
i. Performing a medically appropriate examination.

(4) The physician can choose on an encounter-by-encounter basis if they want to use "time" or medical decision-making (MDM) to score and code the encounter.

(5) Ambiguous terms from MDM scoring are removed, and a level encounter has been created between new and established patients if using MDM to determine level of office visit.

(6) Created a new, but shorter prolonged services code 99417 (15-minute increments) to be used if you exceed the time limits on 99205/99215.

These changes are significant and should result in the physician spending more quality time with the patient managing their care rather than spending time counting elements in the history and examination in order to score and code the encounter. The key, of course, is documentation. So, please make sure that you have clear and discernible time recordings for the above-mentioned items so cumulative time is clearly noted and your MDM can be clearly followed.

A new year, new definitions and new rules have arrived for coding our office encounters. For once, it may be easier to embrace the change as it provides greater flexibility and individual choice. Here's to the rest of what 2021 brings! ■

Send your coding questions to rocodingconnection@gmail.com.

About Dr. Rumpakis

Dr. Rumpakis is president and CEO of Practice Resource Management, Inc., a firm that provides consulting, appraisal and management services for health care professionals and industry partners. As a full-time consultant, he has provided services to a wide array of ophthalmic clients. Dr. Rumpakis's full disclosure list can be found in the online version of this article at www.reviewofoptometry.com.

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DRY EYE IN OPTOMETRY: TRENDS, HABITS AND HANG-UPS

Our reader survey finds most ODs opt for simple diagnostic tests and familiar treatments, constrained by financial pressures from advancing their care.

BY JANE COLE
CONTRIBUTING EDITOR

After refractive error, dry eye is almost certainly the most common ocular issue you encounter at your practice. Just consider: 16 million Americans have been diagnosed with dry eye disease (DED) and as many as six million symptomatic individuals may go undiagnosed.[1] With an ever-expanding roster of exam techniques and treatment options to consider, formulating a plan to manage such a heavy caseload can be a challenge. How is this pervasive problem addressed in optometric offices across the country? We surveyed our readers to get a glimpse.

The 215 US optometrists who responded shared their impressions of DED prevalence, diagnostic testing, treatment habits and challenges they encounter managing this condition. Not surprisingly, dry eye is pervasive in their practices, with 70.7% telling us that anywhere from one to three quarters of their patients have symptoms (*Figure 1*). On the high end, 9.3% of optometrists reported the vast majority of their patients have DED or are suspects.

Looking at individual cohorts of patients, there's clearly an age-related increase in prevalence (*Figure 2*). Just 15% of teens and kids experience DED, according to our survey respondents; going up in 20-year increments, the footprint of dry eye grows and grows, topping out at 54.1% of adults in the 61-and-older bracket.

Our results also validate studies and anecdotal evidence that women (56.2%) are more affected than men (33.5%), and post-menopausal women most of all (62.5%).

"Every eye doctor should be screening for signs and symptoms of dry eye disease. It is significantly under-diagnosed," says one doctor who responded to the survey.

DED is ubiquitous and should no longer be an afterthought, adds Chandra Mickles, OD, associate professor and director of the Dry Eye Care Center at Nova Southeastern University's College of Optometry.

"Dry eye is one of the most common reasons patients visit eye care professionals,

Fig. 1. What percentage of your total patient base has dry eye?

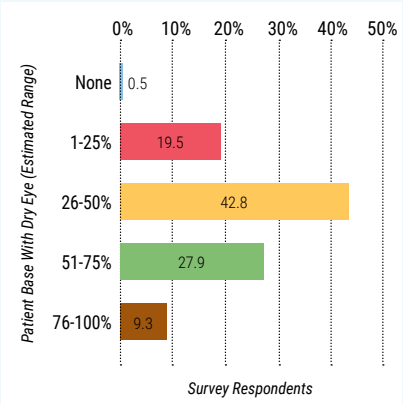
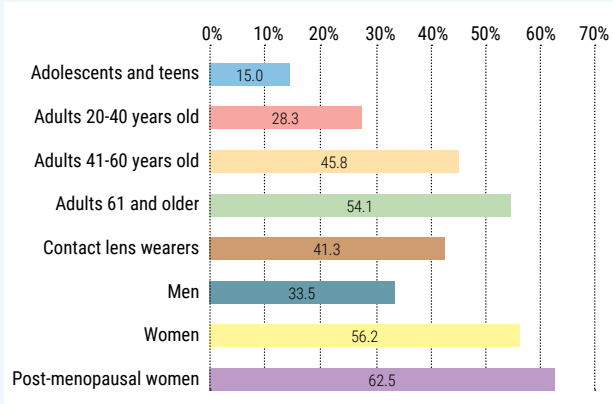


Fig. 2. What percent of your patients in each of these categories suffers from dry eye?



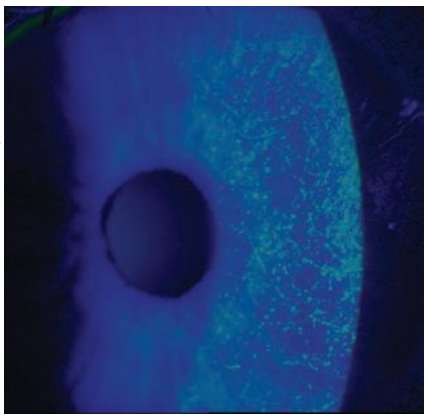


Photo: Katherine Sanford, OD

Pervasive use of digital screens, and the reduced blink rates they induce, was often noted as a cause for recent growth in DED.

Fig. 3. Why has the prevalence of dry eye increased recently?

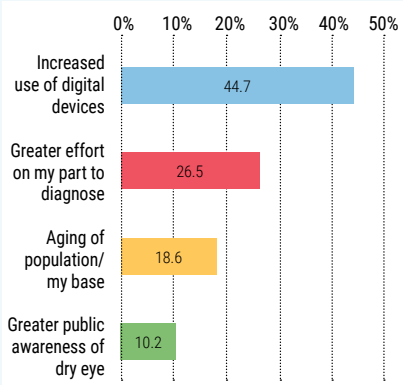
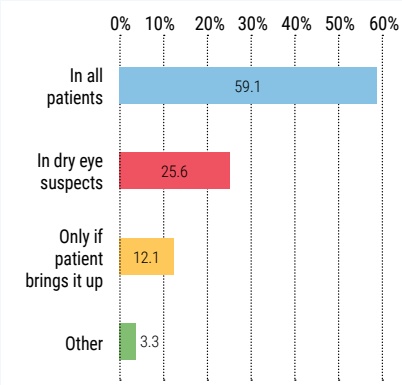


Fig. 4. When do you ask patients about dry eye?



and yet, unfortunately, it is underdiagnosed and untreated. Many patients are suffering from it overtly or in silence," Dr. Mickles says. "Like other ocular conditions, such as glaucoma and macular degeneration, I believe at least basic competency in this area is our duty and well worth the investment."

Still, our survey respondents say they're on the case: 85% said they've been seeing and addressing dry eye more in the last five to 10 years. Digital screen use tops the list of reasons for the increase, followed by greater effort on the OD's part, aging of the population and greater public awareness of dry eye (*Figure 3*).

A Growing Trend

Echoing the survey's findings on DED prevalence, Katherine Sanford, OD, of the VA Medical Center in Memphis, estimates almost 45% of patients seen at her clinic last year were diagnosed with dry eye or meibomian gland dysfunction (MGD). She attributes this in part to patients spending more time on computers, which has been heightened with COVID-19.

Mask wear is also adding to the proliferation of DED, says Mile Brujic, OD, of Bowling Green, OH. "We were already trending upward in dry eye cases, but COVID has taken it to the next level."

Additionally, clinicians now have a greater understanding of dry eye and its various etiologies and treatments, Dr. Sanford suggests.

"I've become more proactive about probing for symptoms during case history as well as screening for anterior segment signs of dry eye, even in the absence of complaints," Dr. Sanford explains. "The addition of diagnostic equipment to our clinic also expanded my ability to more objectively identify tear film and meibomian dysfunction in our patients."

The increase in DED cases may also be due to perception. Individuals with dry eye are typically seen more often—between two to six times a year—so doctors may think they have an influx of new dry eye patients when they are simply experiencing more encounters, says Dr. Brujic.

When to Discuss DED

Even though the majority of respondents said a significant portion of their patients have DED or are symptomatic, just 59% discuss dry eye symptoms with every patient (*Figure 4*). About 26% of responders said they discuss dry eye in suspected cases, and approximately 12% talk about it only if a patient brings it up.

Candice Tolud, OD, of Moorestown, NJ, believes most patients experience some form of dry eye but may dismiss it as a symptom of something else, such as an allergy. The Tear Film and Ocular Surface Society's DEWS II study recommends observation for patients without symptoms, so if Dr. Tolud recognizes signs of DED in a patient who is asymptomatic, she makes them aware of her findings and recommends an OTC artificial tear should symptoms arise before their next visit. In patients who are experiencing symptoms, she immediately addresses this and recommends follow-up for a dry eye evaluation to determine what treatment options would work best.

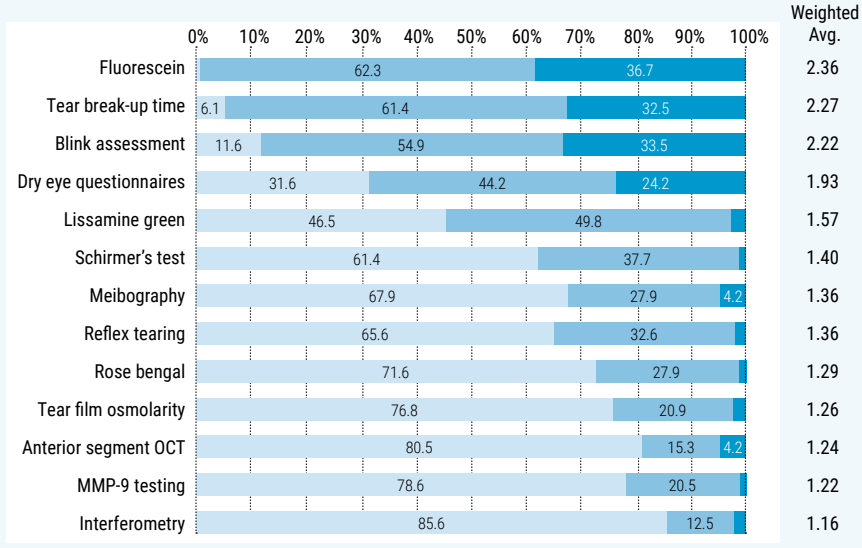
With this approach, Dr. Tolud brings up dry eye at multiple points during the exam, when applicable: during the history if complaints are suggestive of dry eye, during refraction if the individual has fluctuating vision or inconsistent responses and again during the slit lamp exam if she sees signs of tear film instability or corneal/conjunctival staining. She then brings the points together during her final assessment and plan for treatment.

"By linking dry eye to various patient complaints and findings throughout the exam, it helps to enforce the point of dry eye as an underlying cause of patient complaints, and makes the patient more comfortable with the diagnosis and cooperative with the treatment plan," she says.

Testing Trends

There's no shortage of ways to assess prospective dry eye patients, with

Fig. 5. Which of these diagnostic tests do you use?



options ranging from simple slit lamp assessment to sophisticated diagnostic technology. Among our respondents, the most popular choices were cost-effective and simple ones. The #1 testing method in the survey was fluorescein staining, with about 37% saying this was always their first choice in their dry eye diagnostic toolbox (*Figure 5*). Approximately 62% of ODs said they administer fluorescein only in dry eye suspects or in previously diagnosed DED patients.

Ranking second in popularity was tear break-up time (TBUT). Roughly 33% of optometrists responded they always use TBUT, and 61% cited they administer it only in dry eye or suspect patients.

Coming in third in popularity was blink assessment, with about 34% of responders always using this testing method, and 55% commenting they turn to TBUT only in DED patients and suspects.

Though high-tech tools are often lauded for their accuracy, none cracked the top five in our survey. Meibography ranked #7 in popularity and tear osmolarity came in at #10. Other tests doctors said they use less frequently include anterior segment OCT, MMP-9 and interferometry.

When asked which tests provide the greatest clinical value, respondents again favored low-tech options. The majority of doctors ranked fluorescein staining as #1, followed by TBUT and dry eye questionnaires (*Figure 6*). Interestingly, meibography and osmolarity both did better in this ranking, coming in fourth and seventh, respectively, suggesting pent-up demand for these tools among ODs if only they could make the numbers work. By contrast, although blink assessment ranked third among the most popular tests optometrists said they use, this method came in fifth in the survey as having the greatest clinical value.

Even though doctors have their preferred diagnostic approach, it's not enough to assess just one aspect of dry eye, Dr. Mickles cautions. Instead, it should be a multi-pronged approach and include methods of assessing tear quantity, tear quality, ocular surface integrity and meibomian gland function. Advanced technology, such as meibography, is especially advantageous in a specialty practice.

As part of every exam Dr. Brujic performs, each patient undergoes lid margin assessment

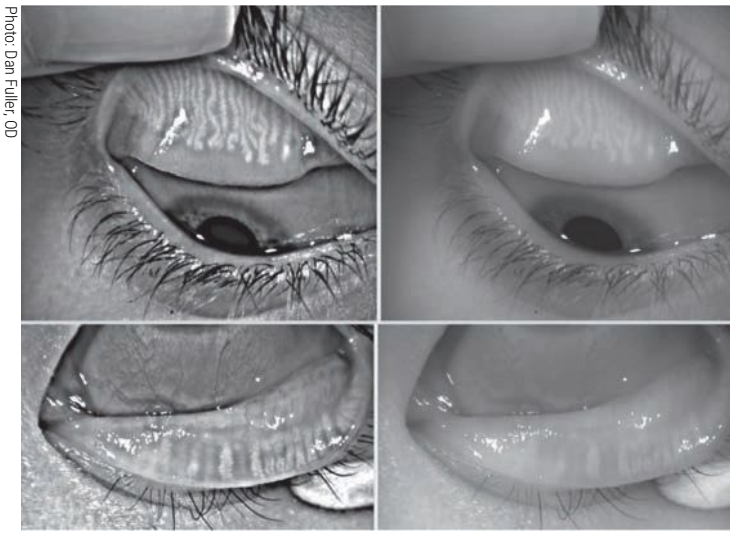
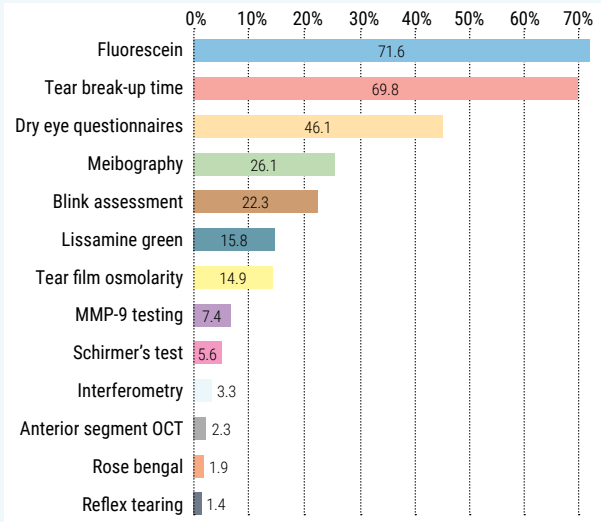


Photo: Dan Fuller, OD

Meibography is high on the list of diagnostic procedures ODs would like to add to their practices—ranking fourth overall in clinical value and first among newer devices—but cost concerns limit adoption.

Fig. 6. Which diagnostic tests do you consider the most clinically valuable?



The Problem

DIGITAL EYE STRAIN

- Eye Strain & Fatigue
- Blurred Vision
- Dryness, Burning, & Irritation

The Solution

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+ Proper Working Distance
+ Frequent Breaks
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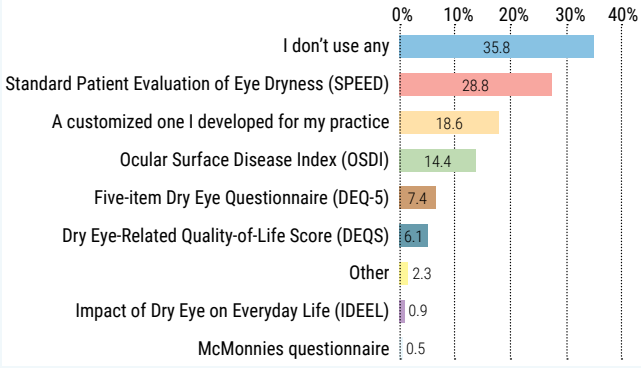
Fig. 7. Do you use a dry eye patient questionnaire? If so, which one?



at high magnification, meibomian gland assessment with eyelid transillumination and fluorescein staining of the ocular surface. Once a dry eye suspect is identified, individuals will also receive meibography with infrared imaging and InflammaDry (Quidel) to assess inflammation levels.

Dr. Tolud uses fluorescein, TBUT, blink assessment and dry eye questionnaires at the initial exam. During a patient's dry eye follow-up visit, she does further testing, including tear osmolarity, MMP-9, meibography, Schirmer's and lissamine or rose bengal staining. "I find these diagnostic tests are great ways to monitor patient progress, and it's a wonderful educational tool as well to show patients over time how their tear quality has improved during the course of their treatment."

Questions About Questionnaires

Even though dry eye questionnaires ranked as one of the top three tests doctors found to be the most clinically relevant, about 36% of responders said they don't use one at their practice (*Figure 7*).

For those ODs who include this screening tool in their testing protocol, the most popular option was the Standard Patient Evaluation of Eye Dryness (SPEED) questionnaire designed by Don Korb, OD, and Caroline Blackie, OD. Next most popular was a homegrown option—the practice's own custom questionnaire.

The third most popular questionnaire was the Ocular Surface Disease Index (OSDI), followed by the Five-item Dry Eye Questionnaire (DEQ-5) and the Dry Eye-Related Quality-of-Life Score (DEQS).

While there are several questionnaires available to clinicians, DEWS II recommends either the OSDI due to its strong establishment in the field or the DEQ-5 due to its short length and discriminative ability.[2]

Dry eye questionnaires are very beneficial in monitoring therapeutic response and quantitatively documenting improvement, Dr. Sanford says. Although her clinic offers several questionnaires, she prefers the OSDI. "It screens for key symptoms associated with dry eye and their impact on vision-related function." Dr. Sanford administers the questionnaire at the initial workup to determine the severity of the patient's dry eye, and repeats it following the start of treatment to quantify improvement.

Note: you can download many of the standardized questionnaires from links found in the online version of this article at www.reviewofoptometry.com.

In-Office Procedures

While new technologies have recently entered the market to manage dry eye and MGD, over half of the doctors who responded to the survey indicated they don't offer in-house treatments (*Figure 8*).

For respondents who do provide in-house services, the top technologies were BlephEx (22.3%) and Johnson & Johnson's Lipiflow (21.9%).

Questionnaire Options

If you're looking to incorporate a dry eye questionnaire in your practice, here are some of the most popular. All can be downloaded in the online version of this article at www.reviewofoptometry.com.

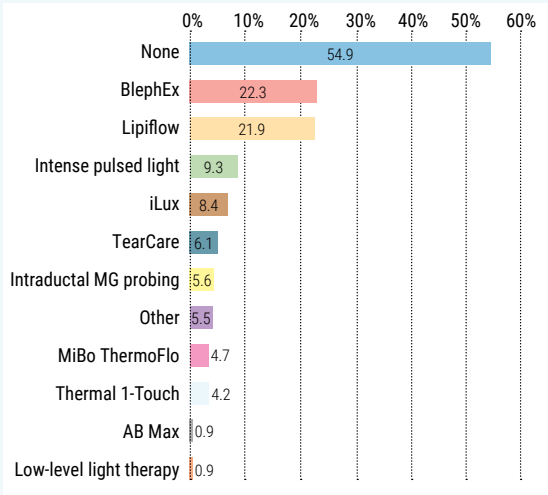
Ocular Surface Disease Index
This is the most widely used questionnaire for DED clinical trials. The OSDI measures frequency of symptoms, environmental triggers and vision-related quality of life.

Standard Patient Evaluation of Eye Dryness
SPEED evaluates both the frequency and severity of symptoms in just eight questions. Although not part of the final score, patients are asked about symptoms over varying periods of time: at the visit, the last five days and the last three months.

Five-item Dry Eye Questionnaire
The DEQ5 has five questions related to visual disturbance, including the frequency of visual changes, how noticeable the visual disturbance is in the morning and at night, as well as how much the visual fluctuation bothers the patient.

Dry Eye-Related Quality-of-Life Score
Developed in Japan, the DEQS questionnaire has shown strong correlations with four subcategories (ocular pain, near vision, distance vision and mental health) of the National Eye Institute's Visual Function Questionnaire.

Fig. 8. Do you offer in-office dry eye procedures? If so, which ones?



Pharmacologic Treatment of Acquired Ptosis:

A Win-Win for Patients and Practices

Melissa Barnett, OD
UC Davis Eye Center
Sacramento, CA

Shane Kannarr, OD
Kannarr Eye Care
Pittsburg, KS

Treating blepharoptosis ('ptosis') has traditionally been the domain of the oculoplastic surgeon. As patients' primary eye care providers, optometrists have grown used to identifying and monitoring ptosis, and if the patient is motivated, making a referral for a surgical consultation, but otherwise taking a more conservative 'watch-and-wait' approach. While surgery certainly benefits many individuals with ptosis, producing good cosmetic and functional outcomes,[1] it is not the ideal course of action for all patients. Generally, surgery is reserved for cases in which drooping of the eyelid is severe enough to create a functional visual field deficit that qualifies for reimbursement, or for patients willing to pay for the procedure out-of-pocket. Further, ptosis surgery is by nature an invasive procedure, with known short-term and long-term side effects, that patients may be hesitant to undergo for cosmetic purposes.[2,3]

Ptosis, a unilateral or bilateral drooping of the upper eyelid, can be treated surgically or pharmacologically.

Despite being among the most common conditions of the upper eyelid, the doctor-patient conversation about ptosis has traditionally been a brief one, especially when the presentation is mild or moderate. Cosmetic issues can understandably be a sensitive subject for patients — and for doctors — particularly when the range of effective treatment options is relatively narrow or limited to surgery. As a result of these challenges, mild or moderate forms of ptosis in particular often remain untreated.

Oxymetazoline 0.1%: a novel treatment for acquired ptosis

It is in this context that the recent approval of a once-daily oxymetazoline 0.1% eye drop for the treatment of acquired blepharoptosis (Upneeq™ [oxymetazoline hydrochloride ophthalmic solution], 0.1%; RVL Pharmaceuticals, Inc., Bridgewater, NJ) is such an exciting development for patients and their eye doctors. The active chemical entity, oxymetazoline, is a potent agonist of α-adrenergic receptors expressed in the superior tarsal (Müller's) muscle.[4–6] When administered to the surface of the eye, Upneeq™ is thought to act via these α-adrenergic receptors to cause contraction of Müller's muscle and raise the upper eyelid.

This novel pharmacologic option expands the therapeutic possibilities for acquired ptosis in an important and potentially game-changing way, providing the opportunity for practitioners to offer an effective treatment to more patients. In phase 3 clinical studies, Upneeq™, self-administered once daily by participants with acquired ptosis provided significant improvement in superior visual field deficits (measured using the automated Leicester Peripheral Field Test [LPFT], a modified Humphrey visual field test designed to assess superior visual field deficits caused by ptosis[7]) and in upper eyelid elevation (evaluated using measurement of marginal reflex distance 1 [MRD-1]). Further, this novel agent had an excellent safety profile, with relatively few ocular adverse events (and even fewer that were suspected of being treatment-related), and no meaningful effect on ophthalmic measures such as intraocular pressure, pupil diameter, or visual acuity.[8]

Opening treatment up to more patients

For patients, this development is a big deal. The cosmetic aspect of unilateral or bilateral ptosis, even in relatively mild cases, can have real impacts, affecting an individual's sense of well-being and leading to increased levels of appearance-related anxiety and depression.[9,10] Ptosis can also have functional impacts, in the form of superior visual field deficits, even when drooping of the eyelid is mild.[7,11,12] Visual field impairment can negatively affect a wide range of daily activities, and therefore lead to reduced independence.[10] In addition, it can result in the gradual adoption of compensatory behaviors, such as head tilting or brow elevation, that can cause meaningful discomfort or pain, that may be addressed, at least in part, by treating the patient's ptosis. Being able to offer a safe, effective, and simple solution for

acquired ptosis therefore has the potential to make a big difference in patients' lives. For a wide range of patients for whom treatment was not previously an option — for example, those with mild or moderate ptosis, those not interested in or wary of surgery, those considering surgery, but open to trying a different approach first, or those with more transient forms of ptosis — pharmacologic treatment in the form of a once-daily eye drop is an exciting opportunity (*Table 1*).

An active approach benefits practices

From a practice perspective, the benefits of actively incorporating pharmacologic treatment of acquired ptosis with oxymetazoline 0.1% are also clear. Patients want to know that their doctor is dedicated to adopting effective, novel approaches, especially when there is an opportunity to make treatment easier or open up treatment to individuals who previously had few options. Just as importantly, patients want to know that their doctor takes a truly comprehensive approach to improving their overall eye health, and that they will always be presented with options tailored to their individual needs. Patients also appreciate straightforward therapeutic options, meaning that the chance to opt for ptosis treatment prescribed by their eye doctor is appealing. This remains as true as ever in today's evolving healthcare environment.

In addition to providing another opportunity to satisfy a potentially large number of patients — ptosis is among the most common conditions of the upper eyelid among adults and prevalence increases with age[13–15] — expanding practice offerings, including pharmacologic treatment of acquired ptosis, offers a chance to support practice growth by keeping current patients happy and creating new patient referrals. Practically, examining patients' eyelids and discussing pharmacologic treatment of ptosis is quick and straightforward. The eyelids can be examined as part of the patient's comprehensive workup, and if ptosis is observed, a brief discussion is all that is needed to present this option and gauge their interest.

Patients are likely to want to try something safe and minimally invasive that has the potential to help their ptosis. Before initiating ptosis treatment, it is essential to confirm pathology of the upper eyelid retractor muscles or aponeurosis and rule out potentially serious underlying neurological or muscular causes such as Horner's syndrome, myasthenia gravis, or oculomotor nerve (CN III) palsy, or conditions that can 'masquerade' as ptosis, such as dermatochalasis.[2,16,17]

Delivering more comprehensive care

Treatment options have long been limited for patients with ptosis and their eye care providers. The availability of a novel pharmacologic therapeutic offers a real opportunity to continue to work toward truly comprehensive eye care, by treating more patients with ptosis. We have the ability to provide ptosis patients with a truly eye-opening experience.

Table 1.

Benefits of incorporating pharmacologic treatment of ptosis into clinical practice.

Patient benefits	Practice benefits
• Therapeutic opportunity for more / previously untreated patients with ptosis – Patients with mild or moderate ptosis – Patients uninterested in or wary of surgery – Patients considering surgery, but open to trying a different or 'bridge' approach – Patients with more transient forms of ptosis (e.g., resulting from periocular neurotoxin injection)	
• Treatment directed and managed by primary eye care provider	
• Opportunity to improve upper eyelid elevation and visual field without surgery[8]	• Practice differentiation and development / maintenance of 'early adopter' reputation
• Ease of use (once-daily eye drop)	• Practice loyalty and referral building

References

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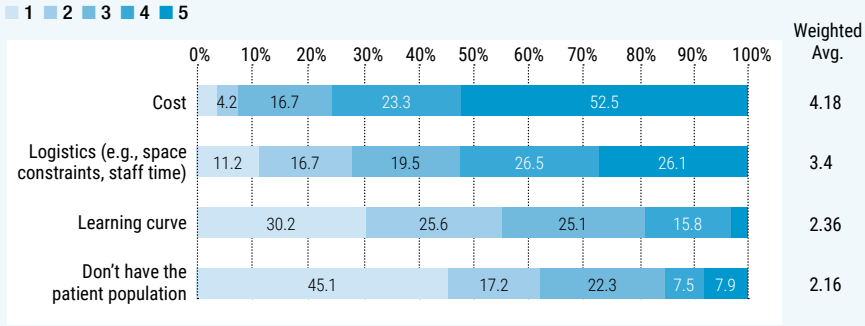
Fig. 9. What keeps you from incorporating new diagnostic or therapeutic devices into your dry eye protocols?

Rated on a 1-5 scale, where 1=no impact and 5=significant impact



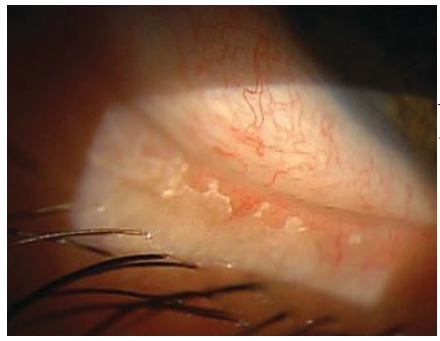


Photo: Paul Karpecki, OD

Bacterial biofilm on the lid margin contributes to MGD and, hence, dry eye. BlephEx treatment—the top choice for office procedures in our survey—removes it.

Dr. Tolud offers Lipiflow, which uses thermal pulsation to heat the meibomian glands to liquefy the meibum and massages the glands at different intensities to expel blockages and stagnant material from the glands. One treatment lasts for 12 minutes, and both eyes are done simultaneously. Effects can be seen for over a year in many patients, she says. "I've had great success with this device in my practice and adjunct therapy, along with topical treatment and warm compresses, for patients where MGD is a contributing factor in their dry eye disease."

BlephEx involves a rotating sponge the practitioner uses to clean and exfoliate the eyelid margins to remove bacterial biofilm and debris that can clog meibomian gland orifices. The process takes approximately seven minutes and is performed on each individual eyelid. Results are optimal if the procedure is repeated every four to six months.

In addition to Lipiflow and BlephEx, Dr. Mickles also uses MiBo ThermoFlo, which provides pressure and heat; unlike Lipiflow, the technology is more user-dependent, as the doctor massages the eyelids during the procedure. Although there is not as much research evidence supporting MiBo ThermoFlo, it can be a more cost-effective approach, she says.

Despite the purported benefits of the new technologies for diagnosis and treatment, sticker shock keeps most optometrists from adding them to their practices. For the majority of doctors surveyed, cost was the most significant prohibitive factor for not incorporating new in-house technologies, with 52.5% calling out price as a significant deterrent (*Figure 9*). Logistics, learning curve and patient need all ranked lower than financial factors.

Trouble with Treatments

Even though several new dry eye treatments have become available over the past decade, some doctors felt the field of options was still limited. In fact, over 33% of responders said more effective treatments would significantly help them do a better job in managing dry eye and another 45% ranked it 4 out of 5 in importance (*Figure 10*). "We need new approaches to treatment," one optometrist commented. "Yes, I am so happy we have more treatments available, but we need more in our arsenal."

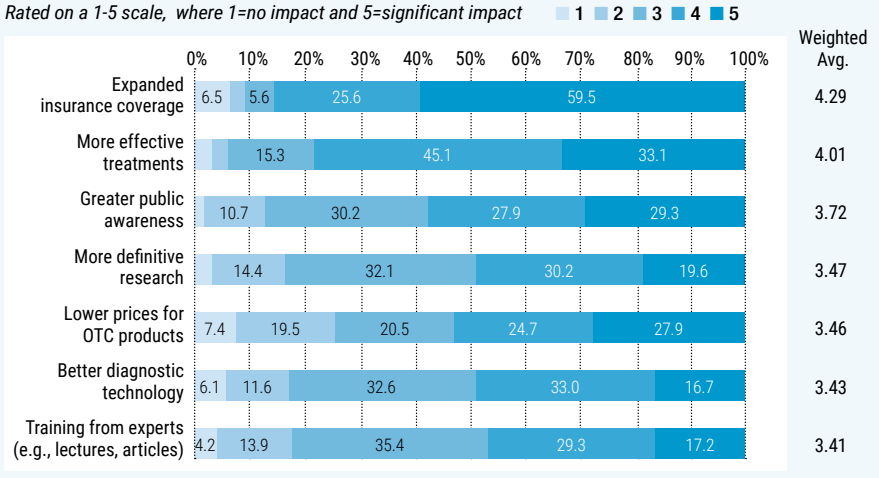
But the biggest deterrent to success is clear: insurance hassles. Nearly 60% of respondents said expanded insurance coverage was the most significant factor that would help them do a better job with dry eye, and another 26% rated this 4 out of 5 in impact.

Despite these setbacks, optometrists are fortunate that this once unappreciated condition is garnering more attention by pharmaceutical companies and device manufacturers, Dr. Mickles says. "While we do face some challenges with current therapies, they are effective when prescribed properly. Enacting customized treatment plans that target the primary cause of patients' DED, along with thorough education, has provided more-than-sufficient dry eye relief for many of my patients."

Dr. Mickles believes the current dry eye treatments are effective, but doctors need to be proactive in educating patients on how to mitigate potential drug side effects and setting

Fig. 10. What would help you do a better job in managing dry eye?

Rated on a 1-5 scale, where 1=no impact and 5=significant impact



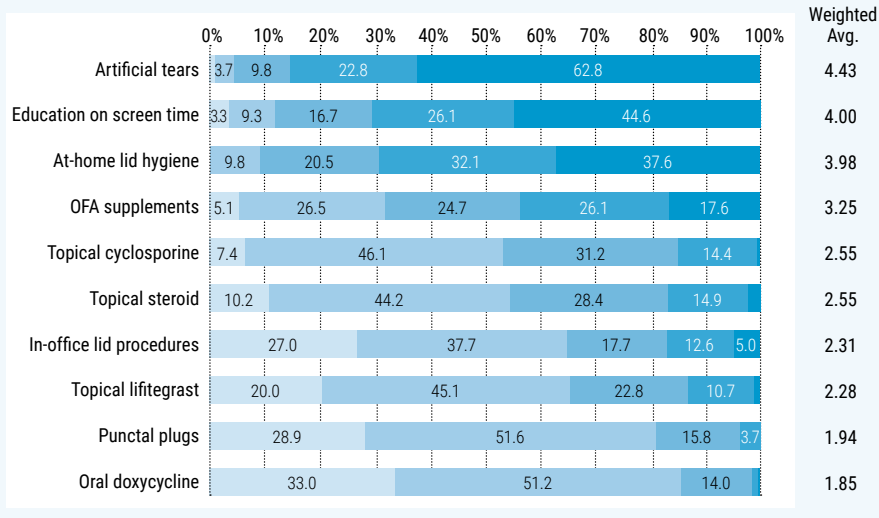
realistic expectations on the timing of symptom relief. Additionally, it is imperative to tell patients that DED is a chronic condition, similar to other diseases such as diabetes, that requires regular monitoring and maintenance.

Top Treatments, Ranked

Considering the current options, most survey participants ranked artificial tears as their most popular treatment choice (*Figure 11*).

Despite their popularity, Dr. Brujic refers to artificial tears as the "Tylenol of dry eye management," since this option makes the patient feel better temporarily but does nothing to improve the ocular physiology. Artificial tears can be recommended as supplemental therapy but not a first-line approach, he suggests. Also, most patients have already tried artificial tears by the time they reach his office, so these individuals usually need another treatment option, such as environmental modifications along with lid debridement and cleaning, meibomian gland warming and evacuation or a topical anti-inflammatory, Dr. Brujic explains.

Fig. 11. In what percentage of your dry eye patients do you use each of the following methods to manage their condition?



Following artificial tears as the most popular treatment, survey responders ranked education on blink rates/screen time second followed by instruction on lid hygiene. Landing at #4 four in popularity was omega-3 supplements, despite reported controversy over fish oil's effectiveness in treating DED, as the DREAM study reported omega-3 fatty acids offered no benefit over an olive oil placebo.[3]

Topical cyclosporines and steroids lagged behind the previously mentioned treatments, which could be in part due to some ODs' concerns about reimbursement from insurance companies, a common gripe noted in our survey and elsewhere.

A Dry Eye in the House

Dry eye is a large and growing problem faced by many, a doctor who responded to the survey said. "This is a great opportunity for optometry to get into the minds of our patients and change the culture of obtaining routine eye care." ■

Paying Your DEWS

The Tear Film and Ocular Surface Society's 2017 DEWS II report, which encapsulated a decade's worth of new research, was the impetus for 62% of respondents to change their approach to DED, they told us. The remaining 38% said the report didn't impact what they do. Those favorable to DEWS II said it caused them to treat dry eye earlier in the disease course and assess all patients, even children. Detractors often said the report was too complex.

For fans and holdouts alike, here's a nuts and bolts summary of DEWS II:

New definition: The definition of DED expands on dry eye as a disease with multiple etiologies, but with the common aspect of a loss of tear film homeostasis due to tear instability, hyperosmolarity, ocular surface inflammation and damage, or a combination of all three.

Prioritizing symptoms: DEWS II offers a step-by-step decision-making process focused on the presence or absence of symptoms and whether symptoms correspond with signs.

Overlap of evaporative and aqueous-deficient DED: Previously, the common consensus was that these two types of dry eye were distinct from one another. DEWS II did away with this philosophy by stating that evaporative and aqueous-deficient dry eye often coincide.

Rethought tear film dynamics: DEWS II replaced the initial three-layer tear film concept with a two-phase model with the lipid layer overlying a mucoaqueous phase, and the entire tear film involved in limiting evaporation.

DED's vicious circle: DEWS II states that the etiology of DED isn't linear, but rather a self-perpetuating circle. For example, tear hyperosmolarity is shown to be the hallmark of DED, working as both a catalyst and consequence of various steps along the circular process. The report affirms there are many entrances into that circle, all of which can result in DED.

Iatrogenic causes: DEWS II raises awareness of DED caused by ophthalmic surgery and medication use. Also noted: the concentration of preservatives in glaucoma medications, specifically benzalkonium chloride, has the potential to cause inflammation and proptosis.

A new approach to diagnosis: DEWS II suggests using triaging questions to help differentiate DED from other ocular surface issues prior to your traditional work-up.

Individualized treatment: Although DEWS II offers many management and treatment recommendations, it advises practitioners to tailor their approach based on individual patients. In other words, there's no one-size-fits-all way to manage and treat DED.

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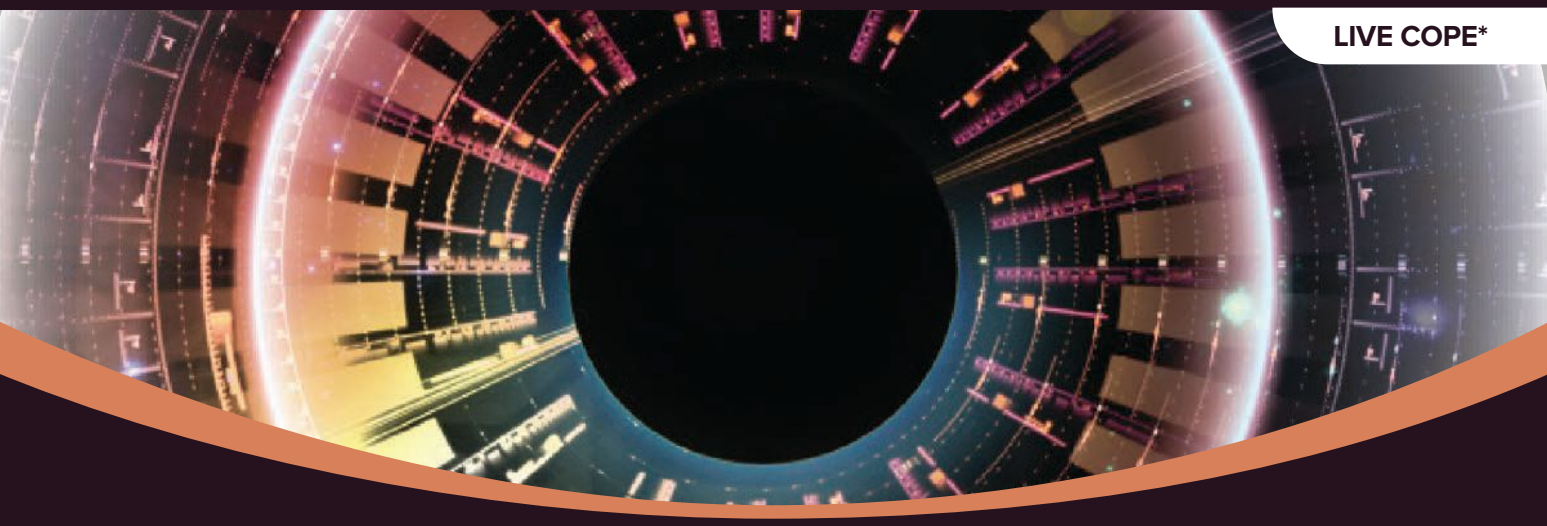

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KIDS AND SCREENS: DEBATING THE DANGERS

While blue light isn't inherently detrimental to the eye, unmanaged device use may hinder children in other ways.

BY ANN MORRISON, OD, MS, AND PHILIP YUHAS, OD, PhD
COLUMBUS, OH

Over the last several decades, there has been a dramatic increase in screen time exposure among children. Infants and children up to age five are exposed to more than three hours a day of screen time. Teenagers spend anywhere from five to seven hours per day using screens beyond the demands of school.[1-3] When the COVID-19 pandemic struck, many children were forced to leave their physical classrooms to begin to learn remotely from home, adding even more daily screen exposure.

With the increase in screen time possible during the pandemic, many patients may inquire about the negative effects that the screens of their personal devices may have on their eyes and health. This article will highlight how digital screens affect the visual system and pediatric development, and will offer recommendations you can provide for your patients.

As Far as the Light Reaches

One of patients' largest concerns is whether the light emitted from screens will physically damage their eyes. Unfortunately, marketing and soft science have muddled our conversations about screen time and blue light exposure. The light emitted from screens contains relatively high amounts of visible blue light, which has a short wavelength and high energy. Unlike even higher energy ultraviolet light, visible blue light can pass through the cornea and the crystalline lens to reach the retina.

In vitro studies provide insight into the effects of blue light incident upon the retina. Most of the blue light is absorbed by the retinal pigment epithelium (RPE), causing the release of reactive oxygen species, which damage lipid membranes, denature proteins and alter DNA.[4-7] Thus, it is not surprising that many laboratory-based studies on cultured retinal cells have demonstrated that long-duration exposures to bright blue light leads to the death of RPE cells and photoreceptors.[8]

When interpreted in a vacuum, these results from the bench point toward potentially damaging effects of blue light exposure. Fortunately for patients, results from large epidemiological studies looking at the effect that sunlight has on retinal diseases including age-related macular degeneration (AMD) do not directly parallel the results from laboratory-based studies.[9-11] Like the screens of personal electronic devices, sunlight contains high levels of visible blue light. Although some studies suggest a link between sunlight exposure and the development and progression of AMD, the preponderance of evidence suggests that sunlight exposure is not a risk factor for AMD.[12-16] Protective elements inherent in the intact eye, such as macular pigment, melanin and the crystalline lens, likely account for this difference by either absorbing high-energy light or by neutralizing reactive oxygen species.[17-20]

The effect that age has on this protection remains unelucidated. Although the aging lens filters out more short-wavelength light than the rela-

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tively young lens, large investigations suggest that recent sunlight exposure is a larger risk than cumulative light exposure for the advancement of AMD. More research is needed to provide a clearer picture.[21]

If sunlight exposure is not clearly linked to AMD, then light emitted from screens is not likely to damage the retina either. The reason is that light emitted from personal electronic devices is substantially dimmer than sunlight. For example, a dreary, cloudy afternoon is over 10 times brighter than the brightest setting on current personal devices, and a nice, sunny afternoon is over 100 times brighter.[22,23]

Simply put, the light emitted from screens of personal electronic devices is not bright enough to damage the retina.[24] A recent publication investigating the theoretical blue light hazard of using screens concluded that light from screens pose a minimal risk to damage the retina because they are so dim.[25]

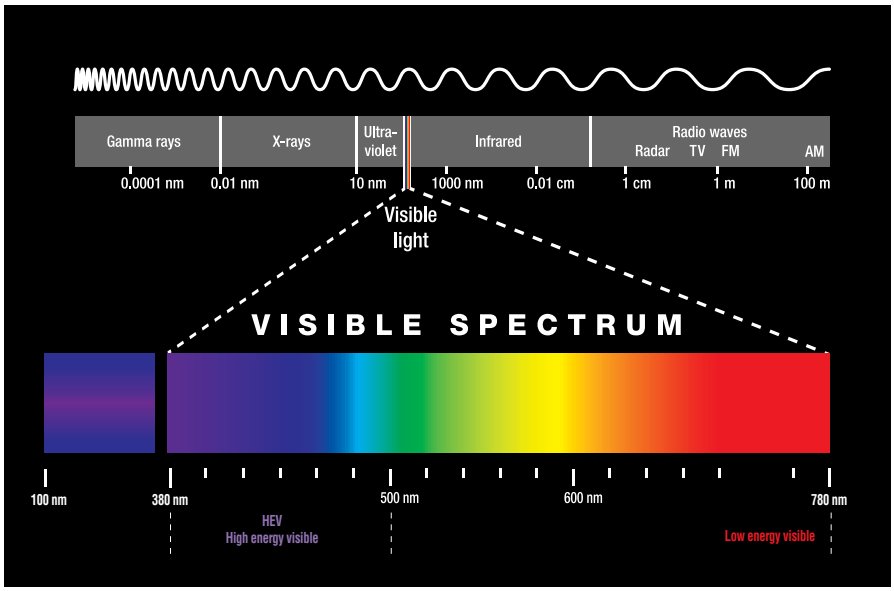


Image: Adapted with permission from Essilor

Within the visible light spectrum, short wavelengths, such as violet and blue, reach the retina and are higher energy than long wavelengths, such as orange and red.

Developmental Concerns

Nevertheless, there is growing evidence that increases in screen time can be harmful to physical, cognitive and social development in children.

As kids spend more time using screens, either for recreation or for school, they spend less time being physically active. A child's likelihood of being overweight or obese grows as their screen time increases. One study noted the likelihood of being overweight or obese rose as "screen time" increased due to watching TV, playing video games and using a computer as well as that the prevalence of overweight and obesity combined has more than doubled among youth aged 12 to 17 over the last 25 years in Canada.[26] Another found watching TV was an independent predictor of the change in the child's BMI.[27] This is a growing concern for pediatricians, as they worry about the secondary effects that obesity will have on the overall health of their patients.

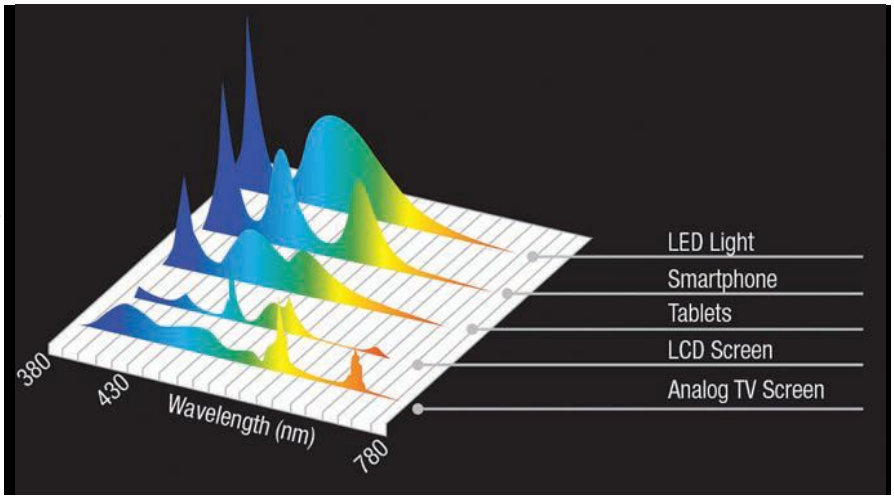
It is important for children to reach developmental milestones appropriately and on time. Reaching milestones as expected gives insight into a child's developmental health. Evidence suggests that increased use of screen time can be linked to developmental delay. One of the important milestones children are expected to meet is developing expressive speech. It appears that mobile media use in 18-month-old children is linked to expressive language delay. Specifically, each 30-minute increase in daily mobile media device use was associated with an increased odds of parent-reported speech delay.[28]

A way to assess if a child is meeting a broad range of developmental milestones is to administer the Ages and Stages Questionnaire, a widely used parent-reported screening measure of five domains: communication, gross motor, fine motor, problem solving and personal-social. It has been shown that greater amounts of screen time use is predictive in how a child will perform on the Ages and Stages Questionnaire. For example, more screen time use at 24 months of age was associated with poorer performance on the questionnaire at 36 months, and similarly, more screen time use at 36 months was associated with lower scores on developmental testing at 60 months of age.[29] If children demonstrate significant delays, it is important that patients are referred properly to receive proper diagnoses and treatment if necessary.

Screen use can provide distractions in a learning environment and, in fact, it appears that screen time is associated with attention problems as measured by a teacher's perception of attention, self-control and impulsivity in the classroom environment. Children who exceed the American Academy of Pediatrics (AAP) recommendations for daily screen use are 1.67 times more likely to have attention problems as reported by their teachers.[30] There is also an association between screen time and self-perceived attention issues. In a study of college students, there is a dose-dependent association with screen time use and self-perceived levels of attention problems and hyperactivity.[31]

There is growing evidence that screen time use is linked with worse psychological well-being. In fact, 14- to 17-year old adolescents who spend seven or more hours per day using screens are two times more likely to be diagnosed with anxiety or depression and are 1.5 times more likely to be diagnosed with anxiety or depression if they spend at least four hours per day using screens.[32]

Beyond diagnoses of anxiety and depression, teenagers report having



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Modern, LED-based screens commonly found on smartphones and tablets contain more short-wavelength light than other wavelengths. Older technologies, such as LCD and analog screens, have less relative blue light than newer technologies.

less curiosity, less self-control, more distractibility, more difficulty making friends, less emotional stability and inability to finish tasks.

Oftentimes we hear claims that near work causes myopia, based on studies that found that children who did more near work were more likely to develop nearsightedness. Because of these findings, we often hear parents concerned that near work, computer, phone and tablet use is going to cause their child to become nearsighted. It is important to note that in larger scale, longitudinal studies (which are better for making causative claims), associations between near work and the development of myopia are weak at best.

More importantly, research suggests that time outdoors may play a larger role in the development of myopia. Studies show that children who spend more time outdoors are less likely to become nearsighted.[33-36] Specifically, children who spent about 14 hours per week outdoors were the least likely to become nearsighted, which may feel impossible to accomplish while students are required to learn remotely during the COVID-19 pandemic.

Impact on Sleep and Vision

Just because light emitted from the screens of personal electronic devices likely does not damage the eye, it does not mean that it is innocuous. Every day, human beings must entrain their circadian rhythms to the solar cycle. Light detection by the eyes is the principal method of this alignment. So, using screens before bed has the potential to trick the body's master clock into acting as if it were still daytime. As a result, the complex mechanism of sleep induction is delayed, total sleep time is reduced and rejuvenating rapid eye movement (REM) sleep is compromised.[32,37] These effects on sleep have considerable effects on the well-being of patients. Patients who use personal electronic devices before bed often feel more tired the next day and have decreased brain activity compared to patients who do not use them.[36]

The mechanisms behind sleep and alertness are complex, but light-mediated melatonin suppression may play a substantial role in these effects.[38] During the pandemic, school-aged children who are participating in remote learning, and high schoolers in particular, fall into this vicious cycle. They wake up and soon turn on their computers for class. After, they spend their free time on social media because there are limited options for in-person interaction. Thus, it is important for optometrists to inquire about this behavior so that they may educate their patients on better screen habits.

Finally, it has been our experience that, since the start of the pandemic, complaints about visual discomfort from computer use have skyrocketed. Digital eyestrain, also known as computer vision syndrome, occurs when the visual demands of prolonged screen time cause symptoms of eyestrain, headaches, blurred vision and eye irritation. The etiology of digital eyestrain is complex and can be difficult to isolate, as disorders of binocular vision and dry eye can present with similar symptoms. Convergence insufficiency, accommodative insufficiency or infacility, as well as other problems with near work can certainly be the underlying cause of digital eyestrain—but do not forget about the ocular surface.

Blink rate is known to drop from about 12 blinks per minute during distance viewing to about six blinks per minute during near work.[39] This reduction in blinks can cause the tears to evaporate, leading to a dried out, inflamed ocular surface. Making patients aware of this phenomenon helps assure them that their symptoms are normal. Remind patients to make sure they take breaks to relax their visual system. Providing a reason for their symptoms empowers them to take the necessary steps to address it.

In a recent publication, researchers urged using caution when making sweeping assumptions about the negative effects of screen use often published in the literature. Many studies provide highly powered investigations where many variables and observations are justified with a flexible analysis that can create statistically significant findings that may not translate into significant clinical findings.[40] Optometrists can educate their patients on the difference between a statistically significant finding in a research paper and a clinically significant one.

Considering the potentially negative effects of screen use is important, but it should be noted that there are benefits to screen time. In young children, programming often viewed on screens can help improve literacy skills, numeracy skills and social skills. In older

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Nighttime filters can help patients reduce the overall screen brightness before bed.

children, programming can improve problem solving and critical thinking skills as well as provide educational, social, and creative benefits.[32] For teenagers, screen use can improve reading, writing, social connections, and political and social awareness, help instill personal values, create new creative forms, and promote self-expression.[32]

How ODs Can Intervene

Optometrists are in a unique position to recommend mitigation strategies for patients who struggle with digital eyestrain or other screen-related ailments. The first step of any intervention plan is to ensure that the patient has accurate, up-to-date spectacle and contact lens prescriptions. It is important to remember to complete a cycloplegic refraction in young patients, as latent hyperopia can often be missed, especially if the patient has accommodative spasm. If patients have asthenopic complaints that are exacerbated with near work, it is important to ensure that there is no underlying binocular vision disorder.

A sensorimotor examination that assesses accommodation, vergence and saccadic function will aide in determining if any underlying binocular vision disorders require treatment. Refractive error correction and a properly functioning binocular vision system are the bedrock of clear and comfortable vision while on electronic devices. If these components of the visual system are disordered, then any additional recommendations are likely to be ineffective.

Appropriate refractive error correction and good binocular vision may not mitigate all symptoms of digital eyestrain. In these instances, consider addressing the patient's ocular surface, even if the common signs of dry eye disease are not present, as ocular surface inflammation can be subclinical.

A good place to start is recommending the "20-20-20 rule," which instructs patients to take a 20-second break to view something 20 feet away every 20 minutes. This approach gives the patient a chance to periodically blink and to relax the binocular vision system. Adding a high-quality artificial tear drop with a lipid component to the 20-20-20 rule may provide addition relief by fortifying the eye's natural tears to stave off evaporation. Instruct the patient to instill the drop before the start of a long computer session, as they may work better to prevent symptoms than to eliminate them once they have started. Keep in mind, people spent less time in front of screens when this rule was first implemented in the 1990s than they do today. If you feel that a child cannot take structured breaks as rigid as the 20-20-20 rule, ensure that they take regular breaks from screens, especially if they also incorporate outdoor time or physical activity.

Some doctors may be inclined to manage the negative effects of screens by eliminating blue light. There is little evidence, however, that blocking blue light with spectacles, especially ones with anti-reflective coatings designed for that purpose, provides much benefit to the patient.[41] A recent study found that eliminating blue light from a computer screen does no more to reduce strain and fatigue than simply dimming the screen.[42] Although blue light is the most effective part of the visible light spectrum at altering sleep patterns, blocking it with ophthalmic products has not been shown to consistently improve sleep quality. This finding is likely due to the fact that all bright light before bedtime, not just blue light, is capable of negatively impacting sleep, both in duration and quality.[43]

Although blue-blocking anti-reflective coatings likely provide little benefit, it does not mean that optometrists cannot suggest simple approaches to managing the light emitted from screens.[42] Many newer personal electronic devices feature filters for nighttime use that reduce the amount of blue light created by their screens. But all bright visible blue light is able to affect sleep, violet through red. So, more importantly, these filters also cut light from the middle and long wavelengths and reduce the overall brightness of the screen—the main culprit. As a result, these filters are likely more effective at promoting sleep and improving viewing comfort than anti-reflective coatings.[44,45] Of course, the best option might be reducing overall screen time and finding other sources of entertainment, especially before bedtime. We frequently recommend to our patients that the bedroom be a "no electronics zone." If patients absolutely must use screens before bedtime, we stress the need to dim their screens, either manually or through a filter.

When it comes to screen time management, the AAP and World Health Organization (WHO) have provided recommendations for infants and young children. While the WHO places more emphasis on non sedentary screen time, both groups suggest avoiding digital media for children two years and younger unless it is used for video chatting or is high quality programming. In children age two to five, screen time should be limited to one hour per day. In children age six and older, there should be consistent limits on time spent and type of

media exposure. The AAP recognizes that the COVID-19 pandemic has forced everyone to use screens at much higher rates and recommends that parents try their best to preserve offline experiences with their children, ensure that their children's media use is positive and helpful and interact with their children as much as possible when they are enjoying screen media.[46] The AAP's website (www.aap.org) has resources available to set up a family media use plan, which can take into account the health, education and entertainment needs of each child in the household, as well as the family as a whole.

To Sum Up

With the growing use of screens in all walks of life, a balanced approach is of utmost importance. We cannot get rid of our dependence on screens and technology, especially as the COVID-19 pandemic continues. We should advise our patients to counter screen time with activities that minimize screen time use. Spending more time outdoors could help prevent the onset of myopia and encourage non sedentary behavior. Taking breaks from screens could combat anxiety, depression and distracted behavior. Stopping screen time use before bed may help with sleep and possibly improve attention and learning.

It may feel unusual to provide advice for patients that does not immediately appear to be ocular or visual health-related; however, eye care providers are often the first to have discussions with patients regarding the effects of screen time. Having a broad understanding of the effects of screen time may help providers develop a more holistic approach to healthcare while improving the quality of life for our patients. ■

RECOMMENDATIONS FOR SAFE USE OF DIGITAL SCREENS IN KIDS

From the World Health Organization:

- One year and younger: no screen time
- One to two years old: sedentary screen time not recommended
- Two to four years old: no more than one hour of sedentary screen time

From the American Academy of Pediatrics

- Younger than 18-24 months: avoid digital media other than video chat
- 18-24 months: watch digital media with children because they learn from watching and talking with you
- Ages 2-5: limit screen use to one hour per day
- Ages 6+: establish consistent limits on time spent and types of media

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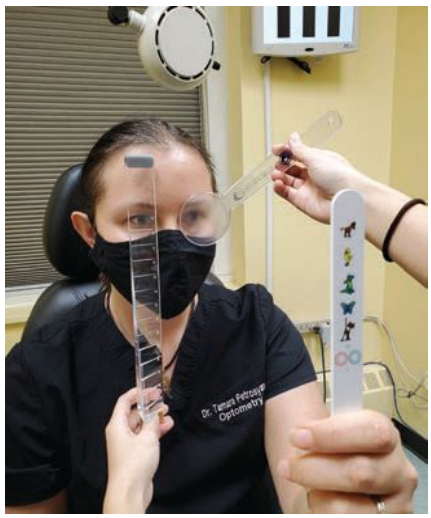
THE DOS AND DON'TS OF BINOCULAR VISION TESTING

Here's how you can avoid common pitfalls and ensure patients of all ages receive the care they need.

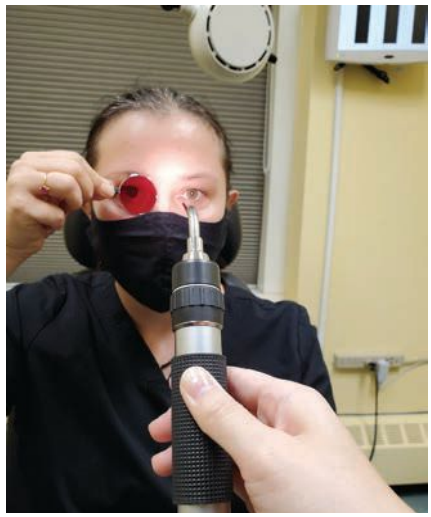
BY TAMARA PETROSYAN, OD
NEW YORK CITY

Binocular vision disorders are prevalent in patients at all stages of life—from pediatric to geriatric—and especially in patients with developmental disabilities and a history of traumatic brain injury.[1-10] They can significantly affect a patient's quality of life and their ability to perform daily tasks.[11-19] Given the prevalence and symptomatology, all practitioners, regardless of their clinical settings, should be well adept at binocular vision testing and understand what is considered normal—and what suggests a binocular vision dysfunction (*Tables 1 and 2*).[20-23]

These tips and tricks can help you avoid some of the common pitfalls of a binocularity evaluation. The accompanying charts are designed as quick references to help you better care for patients with binocular vision dysfunction.



Measure the magnitude of a strabismus when performing a near cover test with an accommodative letter target.



Perform near point of convergence testing with a non-accommodative light target and a light lens.

Ask the Right Questions

People, especially children, don't usually spend their free time talking or thinking about their eyes and visual experiences. A child with a visual dysfunction likely doesn't know that their visual experiences—such as diplopia, asthenopia, frontal headache, getting lost in the page or difficulty understanding what they read—are not normal.

I can't tell you how many patients I have seen for their first eye exam who have a binocularity dysfunction without even knowing it. When questioned, these patients often admit that they had a lot of difficulty getting through school and the issues persist at their job, especially when near work and computer use is involved. As kids, they either struggled through it, found accommodations (such as leaning their face on one hand and effectively oc-

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TABLE 1. NORMATIVE VALUES[20-23]

NORMS IN BINOCULAR VISION TESTING		
Test	**Expected Finding**	**Standard Deviation**
Distance cover test	1 exophoria	±2^
Near cover test	3 exophoria	±3^
Accommodative NPC	5cm to 7cm	±2.5cm to 3cm
Non-accommodative or red lens NPC	7cm to 10cm	±4cm to 5cm
Jump convergence	30cpm	±10cpm
Distance lateral phoria pre-presbyopes	1 esophoria	±1^
Distance lateral phoria presbyopes	1 esophoria	±1^
Near lateral phoria pre-presbyopes	3 exophoria	±3^
Near lateral phoria presbyopes	8 esophoria	±3^
Near AC/A ratio	4:1	±2^
NORMS IN SMOOTH VERGENCE TESTING (BLUR/BREAK/RECOVERY)		
Test	**Expected Finding**	**Standard Deviation**
Distance base-out	9/19/10^	±4/6/4^
Distance base-in	x/7/4^	±x/3/2^
Near base-out	17/21/11^	±5/6/7^
Near base-in	13/21/13^	±4/4/5^
NORMS IN STEP VERGENCE TESTING IN SEVEN-TO-12 YEAR OLDS (BREAK/RECOVERY)		
Test	**Expected Finding**	**Standard Deviation**
Distance base-out	23/16^	±8/6^
Distance base-in	12/7^	±5/4^
NORMS IN STEP VERGENCE TESTING IN ADULTS (BREAK/RECOVERY)		
Test	**Expected Finding**	**Standard Deviation**
Distance base-out	11/7^	±7/2^
Distance base-in	7/4^	±x3/2^
Near base-out	19/14^	±9/7^
Near base-in	13/10^	±6/5^
NORMS IN NEAR VERGENCE FACILITY TESTING		
Test	**Expected Finding**	**Standard Deviation**
12 BO/3 BI	15cpm	±3cpm

cluding an eye while reading, making them monocular), or avoided near vision tasks all together. Optometrists should always ask the right questions to discover these symptoms, because no one else in the patient's life might do so.

Clinicians can use a standardized questionnaire[24-27] (such as the readily available Convergence Insufficiency Symptom Survey or Brain Injury Vision Symptom Survey) or create a customized questionnaire (*Table 3*). I find it is best to provide symptom surveys prior to a patient's visit (via email or a website) to save in-office time and ensure each patient is properly screened for signs and symptoms of binocular dysfunction.

Don't Ignore Symptoms

If a patient reports symptoms but the exam elicits no corresponding signs, consider these testing pitfalls:

Stamina. A patient who normally spends the day performing strenuous vision tasks may present on a good day after a restful night's sleep and before they participate in any strenuous work; thus, the initial findings may appear deceivingly normal. Repeating some of the binocularity and accommodative testing, performing a test several times or rescheduling the patient for another appointment at the end of the day can help to elicit an underlying binocularity problem.[28-30]

Targets. Use proper accommodative and non-accommodative targets for testing, and understand the difference between the two.

Speed. The binocular and accommodative systems must have time to respond to changes. Performing a cover test too fast or moving the targets too fast in testing such as NPC and vergence ranges can result in inaccurate responses and findings.

Onset and comitancy. Acute onset and non-comitant deviations should prompt a careful consideration of whether the strabismus has a pathologic etiology. This is also true of longstanding deviations that are progressing or not responding well to treatment.[31]

Don't Forget Direct Observation and Stereopsis

If strabismus is suspected or reported, the practitioner should first observe if the strabismus is present while the patient is in their habitual state. If it is, you will need to make a few more observations about cosmesis, direction, laterality, frequency, magnitude and comitancy. Also note if the patient has abnormal head posture (head turn, tilt or tip), nystagmus, anisocoria, ptosis, facial asymmetry or epicanthal folds.

In cases where a binocular vision dysfunction is reported, suspected or evident, I like to assess the patient's binocularity before occluding either eye. Once an eye is occluded, breaking down binocularity, you may not be able to evaluate a patient's performance under their natural viewing conditions, especially in patients with a fragile binocular system. This is especially useful on follow-up evaluations where an optimal vision correction has already been prescribed. Improvement in stereopsis through an add can be an additional piece of

TABLE 2. SIGNS/SYMPTOMS OF NON-STRABISMIC VERGENCE DYSFUNCTION[20-23]

CONDITION	DISTANCE	NEAR	SIGNS/SYMPTOMS
Fusional vergence dysfunction (binocular instability)	Ortho, low EP or low XP	Ortho, low EP or low XP	Variability in findings. Normal AC/A; poor distance and near BI/BO range and distance and near BI/BO vergence facility; low NRA/PRA and (+)/(-) on BAF but normal MAF; asthenopia; HA; intermittent blur; visual task poor stamina/concentration/comprehension; worse with time and fatigue.
Basic esophoria	EP	Similar EP to distance	Normal AC/A; poor distance and near BI ranges and distance and near BI vergence facility; low PRA and (-) on BAF; high MEM; asthenopia; HA; end of day fatigue.
Basic exophoria	XP	Similar XP to distance	Normal AC/A; poor distance and near BO ranges and distance and near BO vergence facility; receded NPC; low NRA, MEM and (+) on BAF; distance and near asthenopia; HA; intermittent blur/diplopia worse with fatigue/end of day.
Convergence insufficiency "low"	Ortho	XP	Low AC/A; possible IXT'; poor NPC, stereo, near BO, BO vergence facility and (+) on BAF; low MEM and NRA; asthenopia; HA; intermittent blur/diplopia; near vision task poor stamina/concentration/comprehension; words move on page/screen, worse with fatigue; mostly related to near vision tasks.
Convergence insufficiency "high"	XP	Larger XP than distance	Low AC/A; possible IXT and IXT'; poor NPC, stereo, distance and near BO ranges, distance and near BO vergence facility and (+) on BAF; low MEM and NRA; asthenopia; HA; intermittent blur/diplopia; distance and near vision task poor stamina/concentration/comprehension; words move on page/screen, worse with fatigue; can be related distance and near vision tasks.
Convergence excess "low"	Ortho	EP	High AC/A; poor near BI ranges and near BI vergence facility; low PRA and (-) on BAF; high MEM; asthenopia; HA; intermittent blur/diplopia; near vision tasks-poor stamina/concentration/comprehension; words move on page/screen, worse with fatigue; mostly related to near vision tasks.
Convergence excess "high"	EP	Larger EP than distance	High AC/A; poor distance and near BI ranges and distance and near BI vergence facility; low PRA and (-) on BAF; high MEM; asthenopia; HA; intermittent blur/diplopia; distance and near vision tasks-poor stamina/concentration/comprehension; words move on page/screen, worse with fatigue; can be related to distance and near vision tasks.
Divergence insufficiency	EP	Ortho	Low AC/A; poor distance BI ranges and distance BI vergence facility; distance vision task asthenopia, especially at end of day with intermittent distance vision blur/diplopia.
Divergence excess	XP	Smaller XP than distance	High AC/A; poor distance BO ranges and distance BO vergence facility; normal NPC and stereo; end of day near vision task asthenopia.

clinical information when considering a potential near correction. Repeating stereo testing after finishing the visual analysis and before dilation can also help assess the stability and stamina of the patient's binocular system. I've found that if the patient can achieve the same stereoacuity before and after a visual evaluation (before dilation), it is a favorable sign that the patient has a stable and resilient binocular system.

Focus on the Near Point of Convergence

The near point of convergence (NPC) subjectively evaluates the ability to comfortably, efficiently and binocularly converge one's eyes to a punctum proximum of convergence.[27,32-37] While an important test, it can be fraught with mistakes, including: not having the patient wear their habitual near prescription during testing, not using an appropriate target, moving the target too quickly toward the patient, not keeping the target about 20° below eye level while testing, not watching the patient's eyes during the test and not performing the release and regrasp portion of the test. Taking care with this evaluation may be an inconvenience at first, but getting the hang of it will pay off in a practitioner's assessments and provide the best results.

The practitioner must observe the patient's eyes during testing; if the patient loses fusion but is suppressing, they will not report diplopia, but one of their eyes will deviate due to loss of fusion. The point of subjective diplopia or objective loss of fusion is considered the break. Once the NPC break is reached, the practitioner slowly pulls the target away to find the NPC recovery where the patient subjectively reports single vision or an objective observation of realignment is made.

Many providers stop the test at this point, but there are other useful components. Once the recovery is determined, move the target one inch further from the patient and have the patient look at the target for three

seconds, then at a distance target for three seconds and back at the near target again. Through this series, the practitioner should be observing six components other than break and recovery of NPC:

1. Reach: can the patient direct their eyes to locate the target.

2. Grasp: can the patient sustain visual attention and alignment on the target as it moves closer.

3. Release: can the patient let go of fusion and direct their eyes from the NPC to a more distant point.

4. Regrasp: can the patient direct their eyes from a distant point back to the NPC.

5. Jump convergence: does the patient have a good facility and stamina of jumping from a distant target to the NPC for a length of time.

6. Manipulation: if the patient is having difficulty, can they converge better when manually touching the target. Note any head movement, grimacing, motor overflow or other symptoms.

Because convergence is a team effort between fusional vergence (binocularity) and accommodative vergence (accommodation), it is helpful to identify which system is performing poorly—and that requires carefully chosen targets. When using an accommodative target—in patients with 20/20 BCVA, 20/30 near Snellen letters, Lea symbols or small pictures with various colors and small details—both fusional and accommodative vergence are being evaluated. Make sure the patient is attending the target and keeping it clear. Non-accommodative targets, such as a transilluminator or pen tip, only stimulate fusional convergence.

Since under-accommodation does not encourage accommodative convergence, repeating the NPC with each kind of target can help differentiate fusion vergence (convergence insufficiency) from accommodative vergence (pseudo-convergence insufficiency) dysfunction.

A pseudo-convergence insufficiency occurs if an accommodative dysfunction inhibits its vergence. To further identify a pseudo-convergence insufficiency, place a +0.75D lens OU on top of the habitual near prescription and repeat the NPC. If accommodation is inhibiting vergence, the add lens will relax accommodation and allow the NPC to improve.

Perform NPC with an accommodative letter target and +0.75D OU lenses.

If the NPC improves with the +0.75D lenses, this points to a combined binocular and accommodative dysfunction, while a lack of NPC improvement points to a predominantly binocular dysfunction.

Using a red lens or red/green glasses on top of the habitual near prescription to repeat the NPC can allow a more in-depth evaluation of the control the patient has over their binocular system. The color filters dissociate the images between the two eyes, requiring more control of motor fusion to keep the eyes aligned and the two targets fused. If the red lens NPC is normal (usually reduced by 1cm to 2cm compared with a normal NPC), that signifies a healthy vergence system.

Measure, Don't Guess, the Magnitude

It takes a lot of practice to accurately approximate the magnitude of an ocular deviation, and it should be avoided when possible. This is especially true in a setting where a patient may be followed by various providers, as each one may have their own norm for estimating a deviation.

The magnitude of the deviation can be measured during cover testing and with other free-space binocular posture evaluations (e.g., Maddox rod with prism bar, modified Thorington test card, Brock posture board). When neutralizing and measuring the deviation, the base of the prism should be placed in the same direction as the eye movement on cover testing (base-out prism will neutralize an eso, and base-in will neutralize an exo deviation).

Prism bars or loose prisms should be added until no movement is seen on cover testing or the patient reports an orthophoria position on the binocular posture test. With prism bars, position the flat end of the bar flat on the patient's face so it is touching the eyebrow, the patient looks through the center of the prism, with the bar perpendicular to the fixation object.[32-38]

For near fixation targets, angle the bar slightly inward so that it is perpendicular to the fixation when the patient is converging. If you want to become more versed at approximating an ocular deviation, first approximate and then measure the deviation until your approximations consistently correspond with the measurement. This may take years to perfect, and even then, measurement is preferable when possible.

Perform Proper Cover Tests

A unilateral cover test (UCT) differentiates a hetereophoria from a heterotropia, and an alternating cover test (ACT) measures the magnitude of deviation consisting of both the phoria and the tropia.[32-38] If a tropia is present, the UCT determines the direction, frequency, laterality and magnitude of the tropia. A frosted

Table 3. Customized Binocular Vision Questionnaire

VISION SYMPTOM SURVEY	NEVER	INFREQUENTLY	FREQUENTLY
Blurry vision with reading or doing near work			
Words go in and out of focus when reading			
Headaches with reading or doing near work			
Things far away look blurry after reading			
Vision is worse at the end of the day			
Avoid reading or doing homework			
Hold reading materials close to face			
Eyes feel tired, sore or uncomfortable after reading			
Words run together, move, jump or swim			
Double vision (see two of something when there should be one)			
Close or cover one eye when reading			
Difficulty copying from the board			
Lose your place when reading			
Perform poorly in math, misalign digits or columns			
Difficulty with correct spelling			
Skip words and lines or reread material			
Omit small words when reading or writing			
Reverse letters or numbers when reading or writing			
Write up or downhill			
Feel sleepy or lose concentration when reading			
Trouble understanding or remembering what is read			
Dizziness or nausea with reading			
Homework/schoolwork takes a long time to complete			
Perform below potential at school			
Understand things better when they are verbally explained vs. when you read it yourself			
Attend extra help in school or get therapy (occupational, physical, speech, reading)			
Difficulty with crowded or visually busy pieces			
Difficulty with fine motor tasks, hand-eye coordination and/or sports			

occluder may be preferable because you can see what is happening behind the occluder.

During distance evaluation, the patient must be fixating a distance target, which may require you to use the hallway if you have a short exam lane. During near cover testing, have the patient read out the letters or describe the different characteristics of a target on a fixation stick to ensure they are properly attending and accommodating. Otherwise, accommodative convergence will not be stimulated and an exo deviation may be overestimated or an eso deviation underestimated.

If there is an observable unilateral strabismus, first occlude the non-deviated eye on UCT to see if the strabismic eye will take up fixation. Perform the test slowly for at least 20 to 30 seconds. Cover an eye for three to five seconds and then uncover it for another three to five seconds to allow time for the binocularity to dissociate when one eye is covered and then for the eyes to fixate when both eyes are uncovered. If you move through the test too quickly, you can miss a phoria that breaks down into a tropia or a tropia that increases in magnitude over time.

If a tropia is discovered, use a neutralizing prism to measure the deviation and then perform the ACT. Again, move through the test slowly with sufficient time covering an eye (two to three seconds) before quickly moving the paddle to the other eye.

Amblyopia Isn't a One-eye Problem

Amblyopia is defined as a bilateral or unilateral BCVA of less than 20/20 in the absence of structural or pathological anomalies and in the presence of one or more amblyogenic factor before the age of eight:[39, 40]

- Constant unilateral esotropia or exotropia.
- Anisometropia.
- Bilateral isometropia or unilateral/bilateral astigmatism of amblyogenic amount.
- Stimulus deprivation or image degradation.

Input from the two eyes is segregated into alternating strips in the primary visual cortex (V1), and the cortical layers above and below V1 consist of columns that respond to specific characteristics of an image. The ocular dominance columns compare input from the two eyes by responding more to one eye than the other or equally to both.

Formation of these ocular dominance columns relies both on axon guidance cues (nature) and spontaneous retinal activity (nurture) and can be modified in response to visual experience during the critical period (the first eight years).

Monocular deprivation (blur or strabismus) during the critical period results in a pronounced decrease in the area of V1 representing the deprived eye and a corresponding increase in representation of the sound eye, making amblyopia a "lazy brain" not a "lazy eye" problem.

When the visual system experiences amblyogenic factors such as vision blur or strabismus, it responds with a progressive reduction of visual acuity, which continues to deteriorate until the end of the critical period. Aside from the visual acuity decrease, associated deficits can be found in both the amblyopic and non-amblyopic eyes, including visual perceptual dysfunction, increased sensitivity to crowding, spatial distortions, reduced contrast sensitivity, unsteady monocular fixation, inaccurate accommodative response and poor oculomotor function.

Amblyopia is not a one-eyed problem; the issue is in the conflict between the two eyes taking place in the brain. Penalization and monocular occlusion allows for improvement in the BCVA but does not allow for integration and binocularity in the brain, potentially allowing for more regression after treatment.

Treat or Refer?

Every patient, especially one that is symptomatic, deserves a full visual function evaluation and treatment. If you are unable to provide this evaluation or you can make the diagnosis but cannot treat it, comanage the patient with a behavioral optometrist trained in vision therapy and rehabilitation.

Providers will find that many offices that provide vision rehabilitation do not have an optical and do not provide comprehensive vision services. Opening a dialogue with colleagues to properly comanage patients can help increase patient satisfaction and retention as well as identify a new referral source for the office.[41-43]

You can write a letter to the comanaging clinician requesting the patient return to your optical if their spectacle or contact lens prescription changes or if the patient needs an ocular health evaluation; this can help alleviate any confusion between comanaging providers.

Organizations such as the College of Optometrists in Vision Development (covd.org), Optometric Extension Program Foundation (oepf.org) and American Optometric Association (aoa.org) have doctor locators by proximity, which can aid in finding a referral source as well as courses for those interested in learning more about binocular vision. ■

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THE GENERALIST'S GUIDE TO AMBLYOPIA

These tips and tricks can help you strategize the right treatment approach for each patient.

BY TIMOTHY HUG, OD
PHOENIX

Amblyopia can be described as a reduction of the best-corrected visual acuity of one or both eyes, caused by conditions that affect normal visual development.[1] It is not progressive and does not continue to cause further vision loss after visual maturation. Some may consider it an unavoidable disease process that results in visual difficulties in children, but amblyopia is actually a preventable and manageable condition.

While it can be treated successfully, it can also be undertreated, leaving the patient with long-term visual consequences. This article dives into the specifics of the condition and the factors at play that dictate the right treatment approach.

Visual Consequences

The effects of amblyopia can impact a patient throughout their lifetime, from childhood reading to adult career choices. Amblyopia affects both acuity and binocular function. For example, patients with anisometropic amblyopia may suffer from reduced binocular function on a permanent basis (e.g., monofixation syndrome).[2]

Vision screening in young children is crucial to identify amblyopia early and initiate timely treatment.

Additionally, the amblyopic eye has deficits of accommodation, contrast sensitivity, motion detection and hyperacuity.[3,4] Some studies suggest the amblyopic eye can still retain these deficits, even with improved acuity.

Fixation stability is another known visual dysfunction in amblyopia.[5] If the unsteady fixation of the amblyopic eye leads to confusion during visuoscopy assessment for eccentric fixation, amblyopia may be undetected and possibly undertreated.

Amblyopic patients also have some type of suppression. If macular or extra-macular suppression is causing amblyopia, suppression testing may help confirm amblyopia, instead of just reduced vision from pathology of the visual system.[2]

Types and Staging

Amblyopia is categorized into three main forms:

Refractive. Patients with anisometropia of as little as 1.50D can devel-

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op amblyopia.[2] Bilateral amblyopia can occur in patients with high levels of hyperopia (4.00D or more).

Strabismic. Any constant deviation at both distance and near, as long as it is unilateral, will lead to amblyopia. This is thought to be due to a lack of macular re-enforcement from the suppression.[2]

Deprivation. Amblyopia can also be found in conditions that limit sensory input, such as congenital cataract, and it can be masked by concurrent pathology, such as optic nerve hypoplasia or corneal scarring.

The prevalence of amblyopia is often cited as between 2% and 3%.[2] However, amblyopia may be underreported, as many families do not have access to health care. Screening guidelines and autorefractors have become tools for pediatricians and other health care providers, but the conversion of failed screenings to comprehensive eye examinations for these children is unknown.

Considering the visual maturation process, there is a critical period when insult to the visual development of children will create amblyopia. The earlier this happens, the more severe the amblyopia, especially if left untreated. Consider the child with unilateral congenital cataract, which interferes with visual development from day one, in contrast to the three-year-old who develops anisometropia and subsequent amblyopia. The visual impairment is likely to be less severe, and the treatment more successful, in the latter patient.

The debate on the age at which patients stop responding to amblyopia treatment recently made progress, thanks in part to updates from the Pediatric Eye Disease Investigator Group (PEDIG). This series of studies shows patients as old as 17 can respond to standardized treatment.[6] The findings led researchers to speculate that neural plasticity allows the visual system to respond at least up to age 17, even though visual development slows by the age of seven. Nonetheless, generally speaking, the older the patient and the longer the amblyogenic factor has been in place, the more difficult the amblyopia will be to treat.

Adults with amblyopia have been known to respond to the same treatment options as children, but studies suggest limited improvement in this population. The use of levodopa, a drug used to treat Parkinson's disease, to enhance the neural plasticity in adults showed minimal benefit for both initial treatment and sustained vision gains.[7]

Consider developing handouts for families to increase their understanding of the vision problems associated with amblyopia.

The PEDIG studies suggest strabismic and refractive amblyopia respond similarly to treatment, so perhaps there is no difference in the type of amblyopia, only in the age of onset.[4]

If the amblyopia is more severe in early onset deficits, clinicians should initiate more aggressive treatment at that point.

Treatment

Evidence-based treatment trials for amblyopia exist in the literature, including the multicenter PEDIG studies. Many reports focus on moderate (20/40 to 20/100) and severe amblyopia (20/100 to 20/400) and investigate various treatment protocols, such as two hours of occlusion a day and two days of atropine a week. These are several of the available options:

Correcting the refractive error. This is often the first step for treating patients with moderate anisometropic or strabismic amblyopia, although improvement in the amblyopic eye's vision to curative levels with this technique occurred in only 30% of trial patients.[8] While many clinicians may feel this is an acceptable initial treatment, that also means 70% of patients may require additional therapies.

Guidelines for correcting the refractive errors in amblyopia management include prescribing the full cycloplegic correction for hyperopia, myopia and astigmatism and reducing the hyperopic correction, symmetrically, by up to 1.50D. With the known deficits of accommodation in the amblyopic eye, fully correcting the refractive error can be a simple starting point.

Preventing refractive amblyopia should be a consideration for patients up to age three. Consider prescribing in cases of 1.50D or more of hyperopic anisometropia or 2.50D or more of astigmatic anisometropia. It is better to intervene early rather than wait for the amblyopia to develop and cause other visual deficits.

Occlusion of the non-amblyopic eye. As little as two hours of occlusion a day can be as effective as six hours a day in moderate amblyopia.[9] Two hours of occlusion often seems easier to manage for busy families, but even that can be a barrier to positive outcomes. For some, increasing occlusion to six hours might actually increase compliance, although more

Picture acuity charts can be very useful when working with younger children.

research is needed to better understand the nuances.

If a patient with amblyopia is occluding two hours a day and their visual improvement plateaus, recent studies suggest that increasing the occlusion time to six hours can help.[5] One study reported that 40% of patients who increased occlusion to six hours a day showed improved vision compared with only 18% of patients who continued a regimen of two hours a day.[5]

There are many types of patches available to families for occlusion treatment. The most common type of patch adheres to the skin and can be worn under a patient's glasses. Soft patches that fit over the patient's glasses may also be effective. Another occlusion option is Bangerter foils.

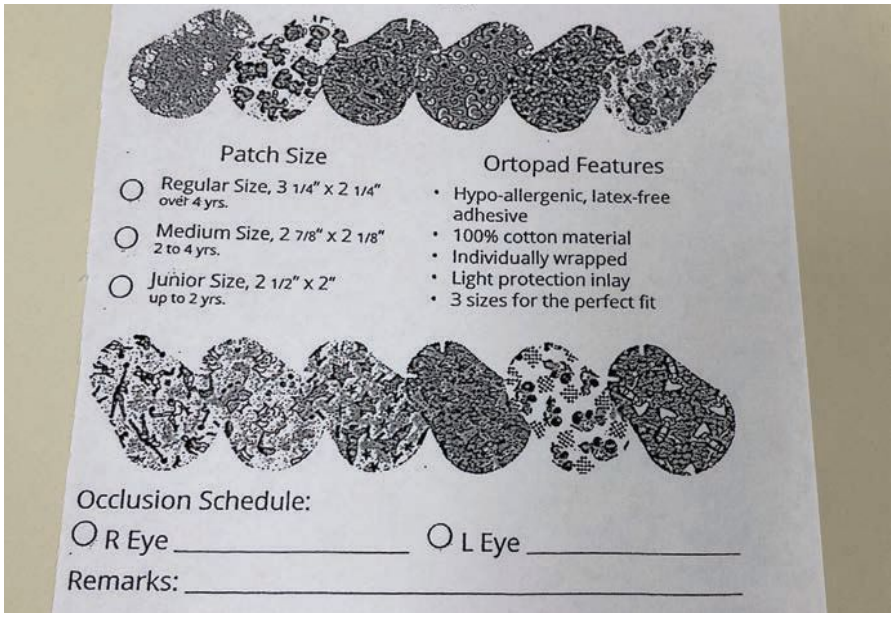
Atropine 1%. This is a proven treatment for hyperopic patients with amblyopia. One drop a day to the non-amblyopic eye can be as effective as two hours of occlusion in moderate amblyopes.[1] Even weekend-only use of atropine is beneficial.[1] While weekend atropine seems to lend itself to convenience and compliance, some families report remembering to use the drop every day is easier than only on weekends. Of note, the weekend regimen can be applied to any two consecutive days that work for a family.

Atropine penalization can also be augmented in patients with hyperopic refractive errors. Removing the correcting lens of the non-amblyopic eye, in addition to atropine installation as a combined treatment, can enhance the visual outcomes in some patients.

Video games. New technological treatment options have been studied, including the use of iPad games and dichoptic viewing tasks. In recent updates, these options show no superiority in treatment outcomes to patching or atropine.

Keep in mind these treatment pearls when deciding on the right path for each patient:

- Because patient and parent buy-in is crucial to treatment success, clinicians must discuss the available choices with everyone involved to ensure the treatment approach will meet the patient's visual needs and mesh with the family's lifestyle. This will go a long way to increase compliance and provide faster visual recovery.
- Often, clinicians can begin with a minimal treatment protocol because they can always intensify occlusion and atropine therapies for patients who do not respond or whose amblyopia does not resolve. Clinicians should set an aggressive goal of 20/20 or no more than one line of difference between interocular acuities. Do not set a low goal and discontinue treatment prematurely.



Providing patients with written occlusion instructions may help with compliance.

• Many clinicians monitor their amblyopic patients at five- to six-week intervals. If the patient does not show any improvement at the first follow-up visit, clinicians can monitor progress over another few visits before deciding to change the treatment plan. One study suggested making modifications after three visits with no improvement.[10] When considering your options, it's worth noting that all amblyopia treatments have shown some improvement in visual acuity and binocular function. Choose what's best for your patient.

• Research shows treatment groups with and without a supplemental hour of near activities achieved the same visual gains.[11]

• For all of these therapies, the key to success is patient compliance. However, it can be difficult to know if a patient's poor progress is due to under-treatment or lack of compliance. When following an amblyopic patient whose vision is not improving, asking about compliance should be your first step before changing the treatment approach.

Regression and Maintenance

Regression rates for atropine and two hours of occlusion are approximately 21%, and most regressions occur in the first six months. The PEDIG studies found that all regressions occurred within the first 12 months after discontinuation of treatment with no tapering.[12]

If a patient is undergoing maximum occlusion therapy (six hours or full-time), they have a higher chance of regressing if they discontinue treatment rather than taper treatment to two hours a day for one additional month.

Clinicians should monitor for regression at three-month intervals to help preserve the visual gains from treatment. If regression occurs, simply restart the treatment protocol.

As the visual maturation process can occur in the first eight to 10 years of life (or longer in some patients), regression is possible for the duration of the young patient's life. To manage or reduce this risk, clinicians can consider maintenance therapy, such as patching for two hours a day until the visual system has matured.

Key Takeaways

Detecting amblyopia can be as simple as comparing the corrected visual acuity between eyes in patients of amblyogenic age. However, amblyopia may be harder to detect in preverbal patients or in patients with concurrent pathology. When in doubt, clinicians can consider initiating treatment in the presence of any visual difference in patients of any age. A trial could be as short as three months, and, if the patient experiences improvement, the clinician can consider the visual implications of any concurrent pathology.

While current studies show binocular function improvements as visual acuity improves, other deficits from amblyopia—such as accommodation, hyper acuity and contrast sensitivity—require further evaluation regarding treatment effects.[1,4,6]

As with most ocular conditions, early detection and treatment are critical for the best outcomes. The first step is always a detailed discussion with the family about treatment options, and the second is proper correction of the patient's refractive error. Clinicians should become familiar with each patient's family, seeing as they are going to work with them a lot over the next 12 to 18 months. Remember, don't be too hasty to end treatment, as under-treating and early discontinuation are risk factors for poorer outcomes. ■

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WHERE DOES VISION CARE FIT IN 2021?

A thriving optical practice needs three *P*s: patients, purchases and profits. Each faces setbacks and obstacles. Here's a look at recent threats and possible ways forward.

BY CHERYL MURPHY, OD
LAKE RONKONKOMA, NY

The success story of optometry over the last few decades can be attributed in part to our early embrace of medical eye care, first and foremost as a service to society—filling a void created as an aging population strains the capacity of a stagnant ophthalmology infrastructure—but also as a means of diversifying our revenue base and challenging our minds with the complexities of disease diagnosis and treatment. Today, optical, medical and surgical care (largely through comanagement) are all within our ambit.

Optometry, in this new guise, is flourishing. And it's a good thing too, because the optical component that was our lifeblood for a century has been steadily declining and shows no sign of reversing its course. Where we once were the gatekeepers of vision care, nowadays we're merely a part—albeit a big one with enormous public goodwill—of a somewhat chaotic and complex distribution system. The once-simple process of getting a pair of glasses is now a morass of competing and not-always-cooperating entities: vision plans, insurance carriers, dedicated optical shops, optometric chain stores, medical eye care practices, direct-to-consumer retailers of corrective lenses and, lately, the anticipated rise of online refraction services.

Let's review how some long-time practitioners are faring in this volatile environment and what strategies for success can be gleaned from their experiences in the trenches.

Pump Up the Volume

Anyone who has been involved in optometry for any length of time can tell you the ways "things have changed since they first started." The year 2020 alone, thanks to COVID, has shaken up the profession and made us rethink the way we clean things, see patients and do business. It was a tough year that often left us struggling to find new strategies on how to adapt. Then again, optometry is an ever-changing profession and has been learning to adapt to the challenges of the day for virtually its entire existence.

Jeffrey Roth, OD, together with his father, Michael S. Roth, OD, have collectively witnessed how the profession has changed over the last five decades. The elder Dr. Roth opened cold in 1973 and built a practice from the ground up in Syracuse, NY. After 30 years of hard work, he sold the practice to his son once he decided to move to California to semi-retire.

Even back in Dr. Michael Roth's day, opening cold was anything but easy. "He once told me a story about how he had two patients—as in, only two patients in the entire practice," Dr. Jeffrey Roth says. "One day, one [of the patients] walked in wanting him to adjust their glasses. He sprung up, whirled the glasses around in his hands and managed to snap them into two pieces. I quickly asked him, 'What did you do then?' He just calmly replied, 'Well, then I had one patient.'"

Dr. Roth admits a lot has changed since his dad started practicing. Dealing with declining insurance reimbursements, online sales of glasses and contacts and "big-box" competitors have been some of the challenges Dr. Roth finds himself up against today as

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a private practice owner. "Optometry has always had its challenges. My father's was an all-cash business—full retail payment for glasses and contacts—[but now], insurances have made things a nickel-and-dime discussion. I'm sure some people don't even walk through the door if we don't take their insurance."

With reimbursements dropping every year and costs always on the rise, Dr. Roth, like thousands of other ODs, has had to drop a few insurance plans—and carefully manage the disengagement from care of long-time patients. "Heck, I saw one family over two years and didn't get paid for a single claim. I was working for free. I just couldn't take that plan anymore," Dr. Roth says.

Optometric practices have been able to survive the continual decline in third-party reimbursements so long as patient volume was steady or growing. Pandemic-related shutdowns last year showed just how dependent many practices are on patient volume—and the ensuing dispensary revenue—when it abruptly dried up in mid-March. A recent report from the Vision Council notes that independent eye care providers experienced a 13.2% decline in optical sales from September 2019 to September 2020. Weekly sales and revenue data from Jobson Research shows how all measures of an optical's performance remained depressed from late-March to the end of 2020 (*Figure 1*).

Perhaps the COVID crisis will push more ODs to finally opt out of their worst plans. However, there are ODs out there like Michael B. Silverman, OD, who opened his practice in Coral Springs, FL, cold in 1996. He says that, unlike Dr. Roth, he doesn't plan on dropping any vision plans despite their reimbursement rates plummeting over the years. He has, however, started focusing on making his office run as efficiently as possible and added new technologies that help him do so in order to see a higher volume of patients to compensate for the lower payments he's receiving.

"Vision plans are a 'two-edged sword,'" Dr. Silverman says. "On the positive side, they can generate a huge number of new patients and customers, especially for a new practice." Keep those patients happy and they'll refer co-workers, friends and family your way. "On the negative side, the reimbursements for eye exams and glasses through these vision plans are dismal and require you to see more patients per day to keep up revenue." Unfortunately, he adds, "Despite how much patients appreciate me and my services, they will go elsewhere if I no longer accept their vision plan."

Product sales margins are also continually being squeezed. Dr. Roth says, "We need industry to give us a fighting chance when it comes to the optical side of things, be it with cost of goods or access to inventory." Dr. Roth also laments the consolidation of industry power through mergers and acquisitions. "We should look for ways to bring in fair market competition."

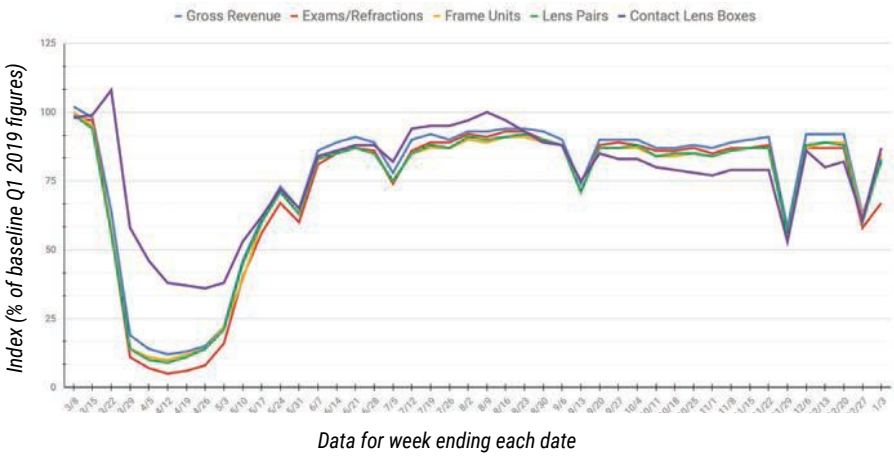
In a bitter irony, practices feel the heat of competition from big-box retailers but have no recourse to level the playing field, especially in contact lens sales. The new FTC rule on contact lens release saddles optometrists with onerous new paperwork hassles to document prescription release *and* looks the other way at the transgressions of online lens retailers, like product substitution and passive verification.

Dr. Roth says he is trying not to worry about online retailers and hopes that patients will recognize the skill and hard work that goes into his practice to deliver a high level of quality care. "Online entities do not have any interest in the health and well-being of the patient, so I don't try to compete with them. I educate my patients regarding their health and show [them] how I can make a difference." He also says that while online retailers have made the sales of glasses and contact lenses harder, "Price-wise, I can't compete, and if I tried to, it would be a race to the bottom, so that's not something I'm willing to do."

Dr. Silverman postulates, "For the next few years, from a business point of view, the biggest obstacles and challenges for private practice ODs and those with retail optical shops alike will undoubtedly be the presence of online retailers selling glasses and contact lenses and giving online eye exams." Dr. Silverman says, "Profits from glasses and contact lens sales will continue to drop off significantly due to this mass swing for buying products online."

However, he thinks that online eye exams themselves will not take as big of a bite out of the market as

FIG. 1. WEEKLY ECP SALES DATA INDEX, MARCH TO DECEMBER 2020



The index baseline, represented by a figure of 100, was developed from an average of seven days in the first quarter of 2019. All other time periods are calculated as a percent increase or decrease from the 100 baseline index of that period. *Source: Jobson Research.*

some might fear, and he adds that he has already seen inaccuracies and misdiagnoses with online exams. To reassure us, he says, "There will always be people who appreciate direct, person-to-person care. The optometric community has to continue reaching our high standards and show the public that our world-class, in-person eye care services are far superior to [those of] online eye exams and services."

Vision Correction Evolves

Of course, it's not enough just to get patients through the door; they also need to be motivated to purchase corrective lenses from you. Here, optometric practices face pressures most notably from online sellers but also perhaps from newer optical corrections with enough long-term success that they might reduce or eliminate recurring product sales.

Some ODs have pondered, similar to the trepidation they experienced with the development of refractive surgery decades ago, whether the array of premium IOLs (multifocal, toric and multifocal toric) could work so well that they might cause a decline in revenue for the optical dispensary side of practices. The short answer: not yet, but better designs are continually pushing the envelope.

Eric Donnenfeld, MD, a founding partner of Ophthalmic Consultants of Long Island and clinical professor of ophthalmology at New York University, says optometrists should not fret but rather focus on how to better build their comanagement relationships with MDs. He says his cataract practice has grown dramatically over the last several years as the population ages and interest in quality surgical outcomes grows. "Concomitantly, as technology has improved, so has my use of premium IOLs," he says. "Currently, I implant 20% multifocal IOLs, 15% toric IOLs and 5% multifocal toric IOLs."

"There is no doubt that multifocal IOL technology continues to improve," says Dr. Donnenfeld. "The most recent generation of IOLs has much better vision quality at distance while providing near vision as well. However, the use of presbyopic IOLs has not grown significantly over the past decade and remains at a 6% market share of all cataract surgeries." He explains that the newest generation of presbyopic IOLs, Vivity (Alcon) and Eyhance (Johnson & Johnson Vision), are refractive rather than diffractive and do not split light. "They provide better distance vision than previous generations of multifocal IOLs but only intermediate vision. Patients often still require reading glasses."

Even if implanted lenses do one day become good enough to put a damper on the post-cataract glasses market, optometrists will still be needed for their expertise in vision testing and patient counseling preoperatively. Bringing our refractive expertise to the table on this component of the surgical experience will position ODs to be an essential part of vision correction no matter how it's achieved.

Dr. Donnenfeld says, "The next big thing in presbyopic IOLs will be true accommodating IOLs that give quality vision at near and far without an increase in glare and halo." Several of these lenses, notably Juvene (LensGen) and PowerVision (Alcon), will enter FDA clinical trials in 2021, he notes.

Interestingly, Dr. Donnenfeld says the biggest optical challenge to optometry will not be presbyopic IOLs but the increased accuracy of distance-correcting IOLs, eliminating the need for distance correction and allowing the patient to wear over-the-counter readers. "My advice to my optometric colleagues is to embrace comanagement of cataract surgery, as this will continue to grow and ophthalmologists will appreciate the care our optometric

Time for Telehealth?

The issues Drs. Roth and Silverman relate are not the only obstacles optometry has been working to overcome in recent years, and it seems there will be even more changes in the future.

"Optometry will face many challenges and opportunities as we navigate the next decade together," says Howard Purcell, OD, president and CEO of the New England College of Optometry. "Dealing with the pace of change will be the primary issue—that in itself brings both challenge and opportunity." Dr. Purcell notes that artificial intelligence, virtual reality, telehealth and 3D printing are a few important examples of disruptive technology. He's of the opinion that these trends, when properly harnessed, can bring a new source of financial support to optometric practices.

Dr. Purcell encourages ODs to meet these changes and the pace of change head-on. "We must embrace, critique, validate and test these new technologies and identify their true value. Encouraging more innovation from within the profession will be essential," says Dr. Purcell.

Telehealth is one such innovation that Dr. Purcell urges ODs to consider adopting, especially as the pandemic has already demonstrated its potential value. "Telehealth and its associated opportunities are here and now. It is a great adjunct to our care delivery when used appropriately." Of course, most practices learned this the hard way during last year's practice shutdowns, as telehealth was the only means most of us had of extending any sort of care to our patients.

Dr. Purcell encourages ODs to stick with it and find ways to integrate these capabilities on a regular basis, even after the pandemic. "Telehealth can be an important vehicle to, for example, triage emergencies, manage contact lens follow-ups, lead vision therapy sessions and facilitate at-home low vision device evaluations." He also points out one often-overlooked component of telehealth: the opportunity for doctor-to-doctor consultations of cases, which can improve patient outcomes and satisfaction. "I would recommend all ODs critically evaluate these new technologies and maintain an open mind to the opportunities and advantages they may ultimately provide."

In March 2020, the American Optometric Association (AOA) held a free webinar on telehealth and telemedicine to help teach ODs about the different types of telehealth and how to bill and code for each. AOA members can find more information on telehealth and how to incorporate it into practice on the organization's website under the "Guide to Telehealth-Based Care" section.

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colleagues can provide," says Dr. Donnenfeld.

What about recent presbyopia-correcting eye drops that are making headlines? The question remains whether or not this will be another thorn in optometry's side. Dr. Donnenfeld says, "Presbyopia-correcting drops are an exciting new pharmacologic approach to improving near vision. They essentially come with two different approaches: lens-softening drops, which still require a good deal of investigation, and miotics that improve depth of field." Several miotics are entering phase II and III clinical trials and should be available in the near future, potentially as soon as this fall.

"The question that is raised is whether they'll replace optical correction for near, and the short answer is no," says Dr. Donnenfeld. "Yes, presbyopia drops will dramatically improve near vision, but they often will also mildly reduce the quality of vision at distance, especially when given in both eyes. Furthermore, presbyopia-correcting drops are short-term solutions. For many reasons, these pharmacologic approaches to presbyopia will be successful, and for just as many reasons, patients will still require optical correction when the miotics are not sufficient or appropriate to use."

In Dr. Donnenfeld's opinion, these drops will serve as a tool for eye care providers and should be embraced to improve patient quality of life and offer a new revenue source for practices.

Dr. Silverman agrees. "Each type of drop likely has pros and cons," he says. "While I do believe these drugs can make it into the mainstream for treatment and management of presbyopia, for those concerned about lost revenues in optical sales from reading glasses, bifocals and/or progressive lenses, I wouldn't close up the optical shop just yet!"

Make the Most of Medical

Cautiously adopting new advances after careful consideration, showing the value of high quality, in-person care and doing what we can to make up for dwindling optical and contact lens sales due to outside competitors are just a few of the ways optometrists are adjusting their sails to the changing winds in optometry. Luckily, for years now—since even before the advent of DPA/TPA certification—optometry as a profession has worked hard to push forward and expand its scope to become more medically driven in order to use the high level of education that ODs receive and maintain through their CE courses and training instead of primarily relying on optical revenue.

"The need for optometry to take on even more medical-based care is there," says Randall Thomas, OD, MPH, of Concord, NC. "While there are currently numerous attacks on traditional optometry from many sides, there is also an enormous unmet need for medical eye and vision services," he notes. "You have the opportunity to be proactive now, or panic when traditional optometric services are being done by non-optometrists, leaving the traditional types wondering what happened.

"As they say, 'The times, they are a-changing.' Be prepared to enjoy the fullness of being a forward-thinking, progressive medical eye doctor. The choice is yours, but with each passing year, the window of opportunity is narrowing. So, let's get to work!" ■

11 Lessons for a Bright, Prosperous Future

BY RANDALL THOMAS, OD, MPH
CONCORD, NC

1. Realize that you are indeed a health care physician, and practice as a physician, not a salesperson.

2. Sincerely consider the Golden Rule as you interact with patients.

3. Commit to taking care of nearly all patients who come to you; said another way, commit to dramatically decreasing your referrals.

4. Meet with area physicians to introduce yourself and explain what you can do to partner with them to enhance patient care.

5. Tell every patient you see that you are a "real" eye doctor, and say to them, "Call me first with any eye problem you might have." There is the perception that optometrists only spin dials and fit eyeglasses and contact lenses. Enough is enough. You have to share your story (and relay your expertise and training) with every patient. Your surgical counterparts certainly tell their patients the same thing.

6. If you have a dental emergency, you have the expectation that if you call your dentist's office, they or a member of their call team can be reached and you'll get the care you need. Why on earth should patients not expect the same from their eye doctor? We have to educate them that we do really care, and we demonstrate that by being accessible.

7. Visit all your local Urgent Care facilities, explain to them that you are available to help them with their patients with eye/vision problems, and leave business cards. Be available, or partner with area optometrists to share such 24/7 optometric availability.

8. Let area rheumatologists know you have expertise in Plaquenil evaluations. (Of course, make sure you can deliver on that.)

9. Meet with area primary care physicians and educate them on your expertise in diabetic retinopathy assessment. There is a huge unmet need out there, and us playing a large role in this clinical arena would be beneficial to all interested parties.

10. Subscribe to the journals *Ophthalmology*, *American Journal of Ophthalmology* and *JAMA Ophthalmology*. Until we all seriously apply ourselves to reading such journals, we will never attain the level of expertise that our patients expect us to have. We all already have access to optometric magazines, but extending our range of journal reading is absolutely critical to true professional growth.

11. Our offices must have an OCT, a state-of-the-art perimeter and a pachymeter. You just can't provide physician-quality medical eye care without them.

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LOW VISION: CONCEPTS AND CLINICAL SKILLS FOR GENERALISTS

Learn how to comprehensively assess the visual status of your patients and coordinate their care with an appropriate specialist.

BY ERIN KENNY, OD, AND CHRISTIN DeMOSS, OD
PHILADELPHIA

Given the vital role vision plays in every aspect of life, all optometrists—regardless of specialty—must be able to distinguish between visual problems that can be corrected with conventional interventions and those that cannot. Low vision, which interferes with everyday activities, cannot be fixed with glasses, contact lenses, or other standard treatment approaches.[1] Therefore, it is critical that primary care optometrists understand how to support these patients in their practice, even if their role is limited to assessment and comanagement.

This article will provide an update on the pathophysiology behind low vision, how it manifests clinically and the decision-making process a primary care optometrist can use to determine what can be managed in your practice and what requires referral to a low vision specialist.

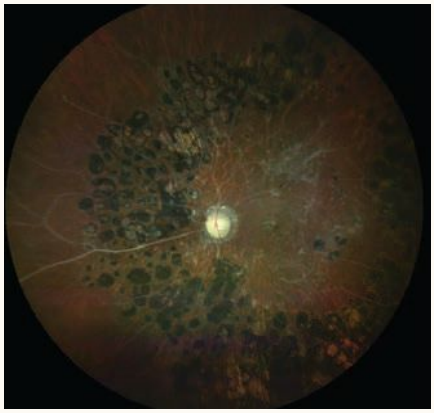

Fig. 1. This widefield fundus photograph demonstrates sclerotic blood vessels, optic nerve pallor and retinal laser scarring in a patient with a history of proliferative diabetic retinopathy status post panretinal photocoagulation treatment.

Ocular Pathology Review

Let's review the top causes of persistent visual deficits with an eye toward understanding how they present.

Diabetic eye disease. In 2019, the International Diabetes Federation estimated that about 10% of the global population—approximately 463 million people—are living with diabetes.[2] Diabetic eye disease, which includes diabetic retinopathy and diabetic macular edema, is the most common microvascular complication of diabetes.[3] Of the two types of diabetes, diabetic retinopathy is more commonly seen in patients with Type 1 diabetes. The literature suggests up to 90% of patients with Type 1 diabetes will develop proliferative diabetic retinopathy after 30 years.[4]

Optometrists play an integral role in detecting and managing diabetic eye disease and, in many cases, are the first to detect the condition. They should not only be familiar with determining the stage of diabetic retinopathy, but also with the possible functional vision side effects, even in cases where acuity is not affected. Functional vision side effects are often not reported until the appearance of macular edema or following retinal laser therapy (*Table 1*).

Many times, the sight preserving treatments of diabetic eye disease re-

About the authors

Dr. Kenny is currently the chief of the William Feinbloom Vision Rehabilitation Center and an assistant professor at Salus University. She has lectured on the national and international level with a focus on vision rehabilitation. **Dr. DeMoss** is a clinical instructor at Salus University's Pennsylvania College of Optometry and The Eye Institute. She assists with the low vision rehabilitation didactic course and sees patients in both the primary care and low vision service at The Eye Institute. Neither author has any financial interests to disclose.

sult in the most profound functional vision complaints. Current treatment options for proliferative diabetic retinopathy include retinal laser and intravitreal anti-VEGF injections. Treatment options for non-proliferative diabetic retinopathy, include central laser photocoagulation (grid, focal) and intravitreal anti-VEGF injections. Even when visual acuity improves after these treatments, patients will likely experience permanent functional vision impairments.

The greatest functional vision impairment is commonly seen in patients with a history of proliferative diabetic retinopathy with panretinal photocoagulation. This includes:

–*Visual field constriction:* missing/tripping on curbs or stairs and many times do not feel comfortable in unfamiliar environments, difficulties with continuous reading, unable to localize objects in their environment.

–*Impaired contrast sensitivity:* difficulties with reading or activities of daily living.

Age related macular degeneration (AMD). This is the leading cause of irreversible blindness in individuals over 50 years of age.[9] The prevalence of AMD increases with age and is highest in individuals over the age of 80.[10] AMD is a chronic, progressive disease characterized by the accumulation of extracellular debris known as drusen between the RPE and Bruch's membrane.[10,11] While much remains unknown about AMD, the different stages and indicated treatments are well documented (*Table 2*).

There are two main forms, non-exudative and exudative, with non-exudative AMD accounting for about 90% of all AMD cases. Risk factors for AMD include age, Caucasian race, positive smoking history, genetics, systemic hypertension and history of excessive sunlight exposure.[11]

Optometrists are key providers in diagnosing and managing early AMD and comanaging late-stage AMD. It is important to understand functional vision implications of this condition, which include:

–*Central scotoma:* common in late-stage disease, patients may complain

Table 1. Diabetic Retinopathy Staging (ETDRS Classification)[3,5-8]

ETDRS Classification	Clinical Findings	Management
Mild NPDR	≥1 MA but less than moderate NPDR	Monitor 12 months
Moderate NPDR	Hemorrhages and/or MAs ≥ standard photograph 2A and/or exudates, venous beading or IRMA less than severe NPDR (less than 4-2-1 rule)	Monitor 6 months
Severe NPDR	4-2-1 rule: severe hemorrhages in all four quadrants, venous beading in two or more quadrants, IRMA in at least one quadrant	Monitor 2-4 months. Consider retina referral
Early PDR	New vessel growth; less than high-risk PDR	Retina referral x 1 week
High-risk PDR	NVD or new vessel growth within 1DD of ONH with or without vitreous hemorrhage, or NVD or ≥1/4 DD NVE with vitreous or pre-retinal hemorrhage	Retina referral x 48 hours
Clinically Significant Macular Edema (CSME)	Thickening ≤500um of center of macula and/or hard exudates ≤500um of center of macula and/or 1DD zone of thickening ≤500um of center of macula	Retina referral x 2 weeks

NPDR: *non-proliferative diabetic retinopathy,* ***PDR:*** *proliferative diabetic retinopathy,* ***MA:*** *microaneurysm,* ***IRMA:*** *intraretinal microvascular abnormality,* ***NVD:*** *neovascularization of the disc,* ***DD:*** *disc diameter,* ***NVE:*** *neovascularization elsewhere*

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

- Assess visual status in various disease categories.
- Review staging of different diseases and the likely visual prognoses.
- Discuss how vision outcomes have changed with newer treatment options.
- Prepare patients for the low vision journey.

Target Audience: This activity is intended for optometrists engaged in the care of patients with vision loss from ocular disease.

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

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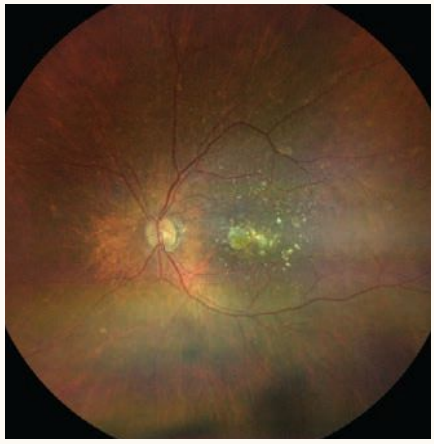

Fig. 2. Late AMD with large confluent drusen and a small area of central geographic atrophy.

of missing lines or losing their place while reading, patients may eccentrically view during distance and/or near vision testing, distance acuity and near reading acuity may not correlate.

–*Dark adaptation impairment:* especially earlier in the disease course, patients may complain of difficulties with adjusting to drastic changes in lighting, patients with previous history of asymptomatic photochromatic lens wear may report lenses not adjusting quickly enough.

–*Contrast sensitivity impairment:* patients may report difficulties with reading or activities of daily living.

Glaucoma. This group of ocular disorders is defined by progressive, permanent optic nerve cupping with corresponding visual field defects and retinal ganglion cell loss. The most common types of glaucoma include primary open angle and primary angle-closure.[13] Glaucoma currently affects nearly 2.25 million Americans ages 40 and older with 1.6 million of those individuals experiencing significant visual impairment.[14] It is estimated to be the second leading cause of irreversible blindness in the United States and is the leading cause of irreversible blindness in black and Hispanic individuals.[13,14]

Optometrists play an integral role in the treatment and management of glaucoma with topical and, in some states, surgical interventions. They frequently make referrals for surgical interventions but may not always recognize the functional vision implications of glaucoma.

As eye care providers, we should be aware of the functional vision impairments that correspond with each stage of glaucoma. Mild glaucoma can result in increased glare sensitivity, impaired contrast sensitivity and impaired light-dark adaptation. Functional vision impairments associated with moderate stage disease include increased glare sensitivity, impaired contrast sensitivity, reduced depth perception and visual field loss. Patients with advanced glaucoma may have increased glare sensitivity, impaired contrast sensitivity, reduced depth perception, visual field loss and decreased visual acuity (*Table 3*).

While some patients with glaucoma report functional vision complaints early on in the disease, many do not report problems until the disease reaches advanced stages. Eye care providers should probe patients for the functional vision complaints listed above and make the appropriate recommendations or referral(s) to address their patients' concerns.

Night blindness. Nyctalopia can be an exclusive disorder or the result of another ocular pathology. Disorders such as retinitis pigmentosa (RP), choroideremia, gyrate atrophy and congenital stationary night blindness are all inherited retinal dystrophies that result in nyctalopia. Treated proliferative diabetic retinopathy with panretinal photocoagulation can also cause night blindness, as well as vitamin A deficiency, zinc deficiency and uncorrected myopia. For the purpose of this article, we will focus on RP and congenital stationary night blindness.

RP is one of the most common inherited retinal disorders, with a prevalence of one in 3,500 to 4,000 in the United States and Europe.[15] Early stages of the disease result in night blindness and mid-peripheral field loss, specifically a ring scotoma. This ring scotoma can cause mobility issues but also reading and near work problems. As the disease progresses, the ring scotoma spreads out peripherally before it starts to move in to affect central vision. Late stages result in central vision loss and may result in complete blindness. RP is a pathology where rods are affected first, hence why it is defined as a rod-cone dystrophy (RCD). These dystrophies present with retinal atrophy and pigment clumping in the periphery, and eventually maculopathies in the later stages.

Clinical presentation typically depends on the inheritance pattern of the disease.[16] Generally, autosomal recessive RP presents with night blindness and severe vision loss earlier in life in comparison to autosomal dominant inheritance, which has a more gradual onset in adulthood and has visual sequelae that are less se-

Table 2. Beckman AMD Classification[12]

Severity Stage	Criteria
No aging changes	No drusen; no pigmentary abnormalities
Normal aging changes	Presence of only small drusen, no pigmentary abnormalities
Early AMD	Presence of medium drusen, no pigmentary abnormalities
Intermediate AMD	Presence of large drusen and/or pigmentary abnormalities
Late AMD	Choroidal neovascular membrane and/or any areas of geographic atrophy

Pigmentary abnormalities: *any hyper- or hypopigmentation not associated with other retinal disease.* ***Small drusen:*** *≤63µm.* ***Medium drusen:*** *≥63µm and ≤125µm.* ***Large drusen:*** *>125µm. For reference,* ***125µm*** *= diameter of a retinal vein at optic nerve head.*

Seeing Beyond "Acuity"

Vision is the culmination of a multi-step process where light rays enter the eye and are converted into electrical signals by the retina to be processed by the brain. Relying on a singular measure like visual acuity for a complex process provides only a one-dimensional measurement of vision. Taking advantage of multiple measurement techniques allows for a more comprehensive overview of all aspects of a patient's vision.

As optometrists, we should be knowledgeable about all measurement systems to best care for and manage the visual status of our patients. This includes, but is not limited to, visual acuity, peripheral visual field, central visual field, glare sensitivity, color vision and contrast sensitivity. All of these components can be affected throughout the varying stages of different ocular conditions. With the right examination techniques and awareness, primary care optometrists can identify and provide patients with simple recommendations or the appropriate referral.

vere.[17] The most severe results come from the x-linked recessive inheritance pattern. These patients have a similar clinical presentation in onset and severity as autosomal recessive.[20] Additionally, there are sporadic mutations as well, which can result in varying severity. Genetic testing and pedigrees can help determine the inheritance pattern of RP.

Congenital stationary night blindness is an inherited retinal dystrophy that occurs at birth. Patients present with normal visual fields and it can present as incomplete or complete forms. Once again, genetic testing can be beneficial to determine the type and severity of the disease. Complete forms will show a more severe defect in the rod photoreceptor signal transmission and, as a result, worse night vision or rod response in ERGs. This disorder is not progressive and will remain stable throughout life, therefore, lacking "stages" that we see in other pathologies. Mobility and lighting should be discussed with these patients due to their ocular complaints.

Color deficiency and day blindness. A variety of ocular disorders can result in color deficiencies and photosensitivity for our patients, including optic neuropathies, maculopathies and neurological disorders. Color deficiency can also present as a benign, inherited disorder. Red-green color blindness, which is made up of varying protanopes, deuteranopes, proton anomalies and deuteranomalies, affects nearly 8% of males.[18] Let's now review the prognosis and staging of achromatopsia and cone-rod dystrophies.

Achromatopsia is a disorder that can present in the complete (typical) or incomplete (atypical) form. The distinguishing points between the two types is dependent on the residual cone function. The complete form of achromatopsia results in decreased visual acuity around 20/200 and severe photophobia and light sensitivity by six months old.[18] It is not a progressive disorder but often results in hemeralopia, also known as day blindness. Complete achromatopsia results in the inability to distinguish colors at all. Incomplete achromatopsia can result in better acuities (as good as 20/80) and less significant clinical findings due to partial cone function. In the incomplete form, patients may be able to discern between shades of grey and cognitive recognition of these "colors." Both forms of achromatopsia benefit from red tints (whether in spectacles or contact lenses) since the rod is the main functioning photoreceptor. It should be noted that the fundoscopic examination of these patients frequently show no evidence of the disease, but a central scotoma is often present on visual field examination.

Cone dystrophies, along with cone-rod dystrophies (CRD), usually present in the first three decades of life.[19] CRDs and RCDs will have the same end result of severe vision loss, but the timing of onset of the photoreceptor dysfunction is what differentiates them. CRDs usually present earlier in life and result in central vision loss, dyschromatopsia, light sensitivity and central scotomas before the disease progresses to affect the rods and cause night blindness.

Most CRDs are broken into two stages. Stage 1 is known for a decreased central visual acuity which results in a "noticeable deviation of gaze to project images on parafoveal regions of their retina that are less damaged."[20] Stage 1 also consists of severe photophobia and different levels of color deficiency. ERG findings show the cone responses are significantly more impaired than rod responses. Funduscopic findings may include pigment deposits and macular atrophy. Temporal optic nerve pallor may be noticed due the papillomacular bundle being affected. During this stage, light sensitivity should be evaluated with a variety of tints and filters and magnification should be explored due to the central blur. Stage 2 of CRD shows a continuing decrease in visual acuity,

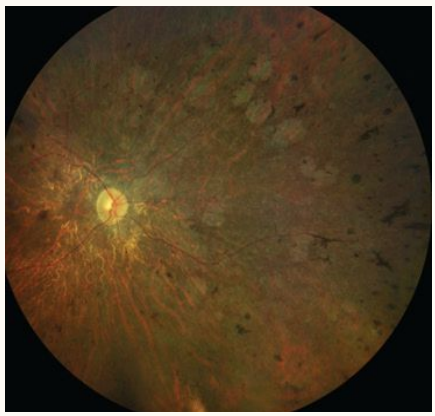

Fig. 3. A late-stage retinitis pigmentosa patient with severe retinal atrophy, bone spicules and attenuated vessels.

Table 3. Assessment of Functional Vision

Functional Vision Impairment	Functional Vision Complaint
Glare sensitivity	Outdoor and/or indoor glare concerns
Impaired contrast	Difficulties reading in dim lighting; difficulties with ADLs like cooking and cleaning; difficulties with mobility like missing curbs or stairs
Difficulties with light-dark adaptation	Complaints of difficulties adjusting to significant lighting changes
Reduced depth perception	Tripping on stairs or curbs; difficulties with certain ADLs like pouring liquids
Visual field loss	Tripping on stairs or curbs; difficulties with certain ADLs like pouring liquids; losing place while reading; difficulties localizing objects in visual field; objects or people seem to appear out of nowhere

ADL: activity of daily living

along with the additional night blindness and loss of peripheral field as a result of the rods being affected.[20] Due to the loss of both rods and cone function of RCD and CRDs, these patients often need extensive vision rehabilitation.

Low Vision Management

ICD-10 coding defines low vision as best corrected visual acuity ranging from worse than 20/70 to 20/400 or better in the affected eye(s) and blindness as worse than 20/400 (*Table 4*).[21] Although ICD-10 coding defines low vision and blindness this way, optometrists using vision measurements beyond visual acuity are aware that a patient can complain of functional vision difficulties well before their vision meets the ICD-10 guidelines. Low vision rehabilitation is not reserved solely for patients with low vision or blindness based on ICD 10 guidelines and should be considered for patients with any acuity with functional vision concerns.

Optical and non-optical visual function management. After collecting the information about a patient's functional vision, it is important to be knowledgeable and realistic about the devices and services available. While it is imperative to provide patients with hope regarding low vision rehabilitation, it is just as important to avoid unrealistic expectations. One of the most common errors is stating that a low vision provider can simply offer glasses to help a patient see better. Referring doctors should instead educate patients that low vision providers maximize a patient's remaining vision or provide alternatives such as text-to-speech devices to turn nonfunctional vision into functional vision. It also prevents the patient from focusing on a "magic" pair of glasses.

Low vision devices are categorized into working distances: near, intermediate and distance. Near devices can help patients with near-related tasks, such as reading, writing or threading a needle. Intermediate devices can help patients with that working distance consistent with using a computer or reading music while playing an instrument. Distance devices can be useful when a patient needs to spot signs or see the television better. In combination with non-optical approaches, optical devices are a great way to help a patient achieve their functional vision goals.

There are a number of near and intermediate optical devices available. For example, microscopes, which are spectacle mounted convex lenses, are simply a high add power. They can be set in a variety of ways, including full fields, prism half eyes or even high add bifocals. Microscopes are defined by any add power that is over +4.00 diopters. Another near device that is often recommended and familiar to patients is a handheld magnifier. This tool is the same convex lens that is used in a microscope but placed on a handle. This allows the magnifying lens to be held at a greater distance away from the eye. Handheld magnifiers often provide illumination with a built-in light which can be beneficial to many of our patients with impaired contrast.

Stand magnifiers are another near magnification option. These devices are a plus lens that is mounted at a particular distance from the reading material on a stand. These can be helpful for patients who do not want to hold a device and are not interested in the close working distance a microscope often requires. A telemicroscope is a device that can be used at intermediate distances as well as near. It is the combination of a telescope and a microscope. Video magnification is another optical device utilized for near magnification. They come in a variety of forms, including portable and desktop video magnification. These devices are beneficial for patients who may require magnification, increase in contrast and a larger field of view.

Primary care optometrists can consider providing simple optical and non-optical aids for patients with mild visual impairment. The main concept used for low vision near optical devices is equivalent power. Determining one functional power for a patient's specific goal is a quick and easy way to make simple device recommendations without referral:

Step 1: Determine your patient's visual goal (*e.g.*, reading, writing, sewing)

Step 2: Assign an acuity needed to perform that goal:

- 8pt font is equivalent to 1M sized print, which equals 20/50 vision at 40cm

Step 3: Set up a proportion using your patient's best corrected near reading vision and goal vision

- Patient's near vision OU is 2M at 30cm (0.3/2M) with a +3.00 add
- Patient's goal vision OU is 1M
- Proportion:
  0.3/2M = x/1M
  x = 0.15cm
  D = 1/0.15cm = +6.75

Step 4: Provide your patient with a +6.75D add to read 1M (8pt font) at 15cm

It is important to note that if a threshold near vision acuity is used instead of a reading near vision acuity, the equivalent power calculated will only help the patient spot read the goal line, not read comfortably. It is recommended to always start the equivalent power calculation with reading acuity for this reason.

A telescope is the only optical device that can be utilized for improvement of distance acuity. There are two categories of telescopes: handheld or spectacle mounted. In addition, the only two types of telescopes we use in low vision are Keplerian and Galilean. Depending on the patient's goals, a low vision doctor will recommend the appropriate setting of each device. For example, a patient with low magnification needs (e.g., visual acuity is 20/80) may use a handheld Galilean telescope to accomplish the goal of spotting street signs (*e.g.*, a target goal of 20/40).

Primary care providers can consider recommending telescopes for patients who need distance magnification. Determining the appropriate telescopic power is simple:

Step 1: Determine your patient's visual goal (*e.g.*, street signs, TV)

Step 2: Assign an acuity needed to perform that goal

- 20/40 is a great starting point for street signs

Step 3: Determine the magnification needed

- Patient's distance vision OD/OS/OU is 20/120
- Patient's goal vision 20/40
- Patient's vision/goal vision = 120/40 = 3x

Head-mounted technology (HMT) offers magnification, increased contrast, different polarity options and different field of view options to benefit patients with varying ocular diseases. HMT has its role in low vision but should not be considered the end-all solution for every patient. While each low vision device arguably needs some level of rehabilitation or training, HMT devices in particular require significant training to ensure patient success. Primary care providers should be aware these devices exist and can educate patients on the device capabilities; however, they should consider referring to a low vision provider for device determination and training.

Smartphones and tablets are one of the most significant advancements the low vision industry has seen in recent years. These devices are readily accessible to many patients and offer numerous vision accessibility features. Adjustable features include enlarged font, increased contrast, different polarity options, text to speech and virtual assistants. In addition, free and low-cost downloadable applications can provide functions such as optical character recognition (text-to-speech), color identification and money identification. The new functional history question all patients are now asked is: "do you have a cell phone and if so, what kind is it?" The patient's response can alter our starting point for showing optical devices. Primary care providers can absolutely offer recommendations for phone and tablet accessibility features and applications.

Non-optical solutions. In addition to simple optical device and smartphone/tablet recommendations, non-low vision optometrists should consider making suggestions regarding lighting. Another simple low vision rehabilitation concept is the perpendicular light concept. Two bulbs of equal wattage and equal distance to a page will provide different levels of illumination depending on the angle at which the bulb is held. Bulbs held perpendicular will provide greater illumination. Additionally, the closer the bulb to the page, the greater the illumination. A 75-watt bulb held five feet away will provide less illumination than a 50-watt bulb located two feet away.

Simple recommendations that can be made to patients to increase contrast and reading acuity include purchasing a gooseneck desk lamp and floor lamp that can be manipulated to provide direct, perpendicular illumination on the reading material. Recommending lighting that is positioned away from the patient's eyes is also important to reduce complaints of glare sensitivity.

Table 4. Low Vision ICD-10 Codes*

ICD-10 CODE	Description	Qualifiers**
H54.20	Low vision, both eyes	Monitor 12 months
H54.10	Blindness, both eyes	Worse than 20/400 in each eye
H53.41	Scotoma involving central area	Central scotoma
H53.71	Glare sensitivity	Any glare complaints
H53.72	Impaired contrast sensitivity	Reduced contrast with appropriate testing***
H53.48	Generalized contraction of visual field	Any visual field constriction

**The codes in this table are only samples of general low vision codes. There are over 35 ICD-10 low vision codes. Reference the American Academy of Ophthalmology's Vision Rehabilitation Preferred Practice Pattern for the full set of low vision codes.[22]*

***World Health Organization change to definition of blindness document[21]*

****MARS Contrast Sensitivity, Pelli-Robson Contrast Sensitivity, LEA Contrast Sensitivity*

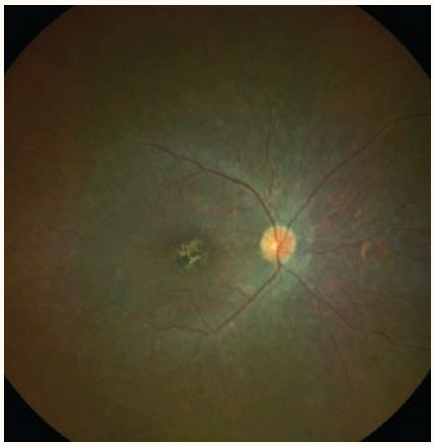

Fig. 4. This photo shows a cone-rod dystrophy with overall retinal atrophy and pigmentary changes in the foveal region.

In contrast to lighting, sun lenses and tints can be beneficial for glare reduction and contrast enhancement. There is no hard and fast rule to which tint goes with each pathology. Rather, tints and sun lenses should be evaluated based on transmission and color. Depending on a patient's needs and where the glare actually occurs, we can make recommendations for sunglasses, tint overlays, acetate filters and settings/accessibility adjustments. It is not uncommon for patients to have multiple tints depending on the different situations when they complain of glare.

Field enhancement. Although most providers summarize a patient's vision as central visual acuity, a clinician must not forget about the options we can provide for our patients with visual field loss. With regards to field loss, prism is the most common device for visual field enhancement. It should be reiterated to patient's that they will not regain their lost visual field, but we will enhance their remaining field.

Sectoral Fresnel and Eli Peli prisms are tools that can be used with a patient who has a hemianopsia. Sectoral prisms work by instructing the patient to scan into the prism placed on the side of the patient's defect. The prism will allow the image to be shifted into the field that they are able to use. Eli Peli prisms, on the other hand, are placed above and below the patient's pupil. This allows the patient to have an early warning of objects on the side of their defect without having to scan to the side of their field loss. Yoked prism can also be used for reading in a patient with hemianopsia. This type of prism does not expand the field but rather shifts the image, allowing less head turn to be needed to read. For patients with concentric field loss from pathologies, such as RP and glaucoma, a reverse telescope may be an option. This tool minifies the image the same amount of the magnification of the telescope. For example, a 2x telescope, when reversed, will enhance the patient's visual field by two times. However, the patient's central acuity will also be reduced by two. All field enhancement devices should be finalized for functionality with a rehab specialist.

Psychosocial aspects and additional referrals. Functional vision loss, no matter what stage, can affect a patient's entire life. Psychosocial concerns can include job jeopardy, depression/anxiety, difficulties with connections in the community, difficulties at school, inability to drive and overall decreased quality of life.

A patient who is suffering from functional vision loss may also benefit from providers that are not optometrists, such as orientation and mobility specialists, vision rehabilitation therapists, certified low vision therapists, and counselors. State agencies (lowvision.preventblindness.org/us-orgs/#p) are a great starting point to help these patients get connected to specialists they may need.

To Sum Up

Optometrists are at the forefront of managing a wide variety of ocular disorders with varying visual acuities and stages such as diabetes, macular degeneration and glaucoma. They should be just as knowledgeable about the low vision treatment options and recommendations for each stage of these disorders as they are with the current pharmaceutical and surgical options. ■

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OPTOMETRIC STUDY CENTER QUIZ

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1. In 2019, the International Diabetes Federation estimated what percentage of the global population is living with diabetes?
a. 3%.
b. 10%.
c. 1%.
d. 13%.

2. All of the following correspond with clinically significant macular edema except:
a. Thickening ≤ 500µm of center of macula.
b. Hard exudates ≤ 500µm of center of macula.
c. 1DD zone of thickening ≤ 500µm of center of macula.
d. >5 microaneurysms ≤ 500µm of center of macula.

3. Which of the following age groups has the highest prevalence of age-related macular degeneration?
a. 50-60 years old.
b. 60-70 years old.
c. >80 years old.
d. None of the above.

4. Non-correlating distance acuity and near reading acuity in an AMD patient likely suggests:
a. Impaired contrast sensitivity.
b. Difficulties with dark adaptation.
c. Color vision impairment.
d. Central scotoma.

5. Patients with AMD may report which of the following functional vision concerns?
a. Losing their place while reading.
b. Needing greater amounts of lighting for reading.
c. Difficulties with photochromatic lenses.
d. All of the above.

6. Which condition is the second leading cause of irreversible blindness in the US?
a. Diabetic retinopathy.
b. Macular degeneration.
c. Retinitis pigmentosa.
d. Glaucoma.

7. A glaucoma patient with asymmetric acuities of 20/30 OD and NLP OS may complain of the following functional vision concerns:
a. Tripping on curbs or stairs.
b. Difficulties with pouring liquids.
c. Bumping into people and objects on the left side.
d. All of the above.

8. Panretinal photocoagulation can result in which of the following functional vision concerns?
a. Missing/tripping on curbs or stairs.
b. Difficulties with continuous reading.
c. Difficulties with localizing objects in the environment.
d. All of the above.

9. Which of the following may cause night blindness?
a. Retinitis pigmentosa.
b. Panretinal photocoagulation treatment.
c. Uncorrected myopia.
d. All of the above.

10. Cone-rod dystrophies often have the same end stage clinical presentation as _____.
a. Diabetic retinopathy.
b. Exudative age-related macular degeneration.
c. Rod-cone dystrophies.
d. Achromatopsia.

11. People with achromatopsia may complain of _____.
a. Light sensitivity.
b. Reduced central acuity.
c. Reduced peripheral vision.
d. Both A and B.

12. The most severe form of retinitis pigmentosa results from which inheritance pattern?
a. Sporadic.
b. Autosomal dominant.
c. Autosomal recessive.
d. X-linked recessive.

13. What is the initial scotoma that patients with retinitis pigmentosa may experience?
a. Peripheral islands.
b. Central scotoma.
c. Mid-peripheral ring scotoma.
d. Hemianopsia.

14. Which of the following clinical tests help to further explore a patient's functional vision?
a. Contrast sensitivity.
b. Visual field testing.
c. Color vision.
d. All of the above.

15. The _____ can be prescribed in the primary care setting and is a spectacle mounted convex lens.
a. Handheld magnifier.
b. Stand magnifier.
c. Microscope.
d. Video magnifier.

16. What distance device can provide magnification at distance?
a. Handheld magnifier.
b. Stand magnifier.
c. Telemicroscope.
d. Telescope.

17. Which of the following are options for field enhancement for patients with visual field loss?
a. Prism.
b. Reverse telescope.
c. No options for patients with visual field loss.
d. Both A and B.

18. Which of the following are non-optical options to help patients with their visual status?
a. Cell phones.
b. Lighting.
c. Glare control.
d. All of the above.

19. A patient can read 4.0M size print at 40cm with a +2.50 add fluently and comfortably. What is the equivalent power that should be used to help this patient 1.0M size print?
a. +10.00D.
b. +4.00D.
c. +2.50D.
d. +5.00D.

20. Which of the following is not a psychosocial aspect a patient with functional vision loss may experience?
a. Job jeopardy.
b. Legality to drive.
c. Improvement in quality of life.
d. Depression/anxiety.

Examination Answer Sheet

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5. Ⓐ Ⓑ Ⓒ Ⓓ
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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. Assess visual status in various disease categories. ① ② ③ ④ ⑤
22. Review staging of different diseases and the likely visual prognoses. ① ② ③ ④ ⑤
23. Discuss how vision outcomes have changed with newer treatment options. ① ② ③ ④ ⑤
24. Prepare patients for the low vision journey. 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:

_____

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Nuances of Neuropathy

Advances in neurobiological research and dry eye have paved the way for potentially breakthrough treatments.

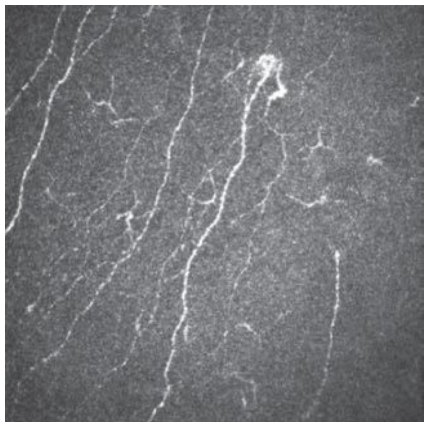
Q My post-LASIK patient has severe neuropathic ocular pain. I have tried punctal occlusion, Restasis, Xiidra, oral doxycycline and topical steroids to no avail. What other choices do I have?

A Individuals with a particular dry eye profile may have a neuropathic etiology to their ocular complaints, according to Divy Mehra, BS, and Anat Galor, MD, MSPH, of the Bascom Palmer Eye Institute. They note that neuropathic ocular pain can be frustrating for patients, as they exhibit dry eye symptoms but do not find relief with traditional therapies, and practitioners, who face treatment challenges.

The Ins and Outs

Neuropathic ocular pain is caused by a lesion or disease within the trigeminal system and may manifest as spontaneous or evoked ocular pain.[1] Nerve abnormalities can occur in peripheral nerves and central pathways connecting the cornea and ocular surface to the brain. They result in subthreshold activation of nociceptive neurons following subnormal or abnormal stimuli.[1]

Neuropathic ocular pain is a diagnosis of exclusion and should be preceded by a complete history, thorough examination and effective management of eyelid, conjunctiva and tear film abnormalities. Factors suggestive of neuropathic ocular pain include specific comorbidities (migraine, fibromyalgia), signs (pain upon touch, distal nerve termination, swelling and hyperreflectivity) and symptoms (wind and light sensitivity), as well as sign and symptom disagreement (with symptoms outweighing signs) and resistance to dry eye therapy.[2-6]



***In vivo* confocal microscopy can identify swollen distal nerves.**

The Ocular Pain Assessment Survey and Neuropathic Pain Symptom Inventory were developed to assess ocular pain. Nerve testing can also be incorporated into the clinical examination. For example, corneal sensation can be tested with a cotton tip or dental floss. Hypersensitivity to touch suggests hyperalgesia. The proparacaine challenge test evaluates the effect of topical anesthesia on ocular symptoms. Anesthesia should dampen the firing of peripheral, or corneal, nociceptors, eliminating pain from ocular surface damage or peripheral nerve abnormalities. Persistent pain following anesthesia suggests central, or non-ocular surface-related, mechanisms are involved.

First, treat all nociceptive sources of pain, such as tear dysfunction and ocular surface inflammation. If a neuropathic contributor is suspected, consider therapies targeting neural pathways. Local therapies, such as autologous serum tears or other blood products, may prove effective in those with peripheral ocular pain.

If a central component is suspected, consider systemic neuromodulators. Alpha2-delta ligands gabapentin and pregabalin have shown efficacy in managing neuropathic ocular pain. Other systemic neuromodulators may be used alone or in conjunction with alpha2-delta ligands, including serotonin-norepinephrine reuptake inhibitors, tricyclic antidepressants and antiepileptics.

Adjuvant therapies have also been used to target peripheral and central neural pathways, including transcutaneous electrical nerve stimulation, botulinum toxin A injection, periocular or ganglion blockage with a corticosteroid/anesthetic combination and acupuncture.

Importantly, neuropathic ocular pain has been linked to mood disorders and poor psychological coping mechanisms.[7] An interdisciplinary approach addressing psychological, behavioral and neurological factors is imperative to successfully manage these cases. ■

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Dr. Shovlin, a senior optometrist at Northeastern Eye Institute in Scranton, PA, is a fellow and past president of the American Academy of Optometry and a clinical editor of *Review of Optometry* and *Review of Cornea & Contact Lenses*. He consults for Kala, Aerie, AbbVie, Novartis, Hubble and Bausch + Lomb and is on the medical advisory panel for Lentechs.

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Rediscover Your Red-Free

While this monochromatic filter may be underused, don't overlook its ability to shed light on a variety of conditions.

BY STEPHANIE LEBURG, OD, PHILADELPHIA

Imaging technology continues to advance at a fast pace. While the advent of new tools and techniques enhances our current practices and diagnostic abilities, we should be cautious not to lose our appreciation for some of the fundamental options that we already have at our disposal. Monochromatic filters are simple and readily available tools that are often taken for granted.

Filter Out Your Options

When white light is used to view the eye and its contents, we are able to examine the ocular tissues in their normal state and appreciate their natural colorful hue and saturation. This is very much a necessity, especially when assessing for subtle pallor of the neuroretinal rim. However, during a funduscopic exam, our ability to diagnose certain ocular findings is often limited by the lack of contrast between the area of concern and the surrounding tissue due to their seemingly similar coloration. A monochromatic filter greatly improves the contrast and resolution of the tissues in question, allowing for better localization and accurate diagnosis.[1]

There are several well-known monochromatic filters used on ophthalmoscopic examination. For example, the cobalt blue filter is frequently used, as it provides the necessary wavelength of illumination to excite fluorescein and better visualize the mires when performing Goldmann applanation tonometry. It is the often-underused red-free filter, however, that may be the most versatile.

The red-free filter, or "green" filter, is an available illumination setting on most modern slit lamps, direct ophthalmoscopes, binocular indirect ophthalmoscopes and fundus cameras. Longer wavelengths on the red end of the visible spectrum are blocked by this filter when it is applied to white light.[2] Essentially, this filter blocks out the visual "noise" and allows us to see greater contrast between the structures and tissues. This is especially significant on fundus examination; the predominant color of the retinal background is a reddish hue.

The most commonly used red-free filters have a peak transmission of 540nm to 570nm in wavelength, allowing for observation of the greenish color that is seen when the filter is used in a slit lamp or other illumination device.[3] The utility of the filter extends beyond improving retinal contrast; in fact, every area of the eye, from anterior to posterior structures, can benefit in some way from examination with this multifaceted filter.

Anterior. Beginning with the outer segment of the eye, the red-free filter can enhance intraocular pressure (IOP) measurements. The gold standard for IOP measurement, Goldmann applanation tonometry, uses cobalt blue light to accompany the instilled fluorescein dye. Alternatively, studies have suggested that IOP measured with the red-free filter and a topical anesthetic also yields accurate results.[4] For many patients, this method was better tolerated and more comfortable than traditional blue light with fluorescein and reduced the risk of accidental spillage with fluorescein dye and stained clothing.[4] It is also worth considering if topical fluorescein cannot be procured or if there is reason to suspect a fluorescein allergy.

Another potential anterior segment use of red-free filters is in the case of urgent or emergent presentations of red eyes. The filter causes blood vessels and blood to appear darker—almost black—enhancing contrast.[3] When differentiating between similar conditions, such as episcleritis and scleritis, an accurate and timely diagnosis is crucial to employ the appropriate treatment and management plan. This important distinction can be made by applying the red-free filter to improve localization of the congested vessels and depth of inflammation.[5]

In the same manner, the red-free filter may also be employed in cases of traumatic microhyphema. It is often difficult to identify small areas of bleeding with a dark iris as a backdrop. Accentuating red blood cells can also help distinguish between pigmented cells that may be a remnant of old inflammation and active inflammatory white blood cells when viewing the anterior chamber. In such cases, pigmented cells within the anterior chamber disappear, while active white blood cells remain visible.[5]

Posterior. Where the red-free filter really shines, however, is in the back of the eye. To fully appreciate its value, we must understand the light dynamic and the retina. The visible

About Dr. Labib

Dr. Labib graduated from Pennsylvania College of Optometry, where she now works as an associate professor. She completed her residency in primary care/ocular disease and is a fellow of the American Academy of Optometry and a diplomate in the Comprehensive Eye Care section. She has no financial interests to disclose.

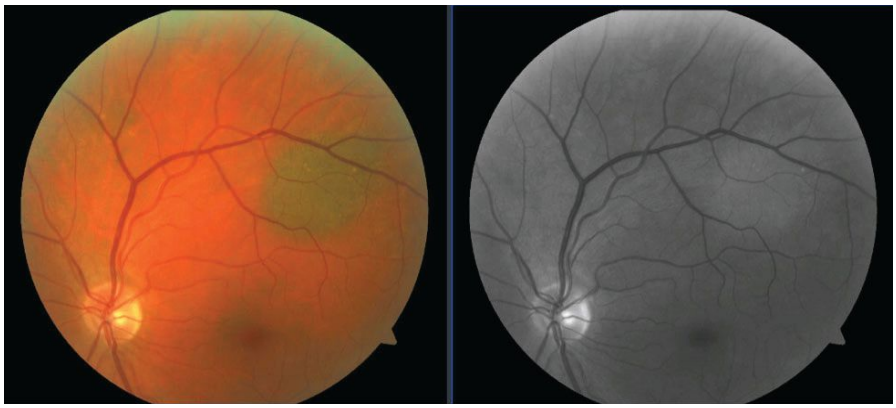

Fig. 1. A choroidal nevus is seen superior-temporal to the optic nerve (left). Choroidal lesions disappear or become much lighter with use of the red-free filter as blood vessels appear black against the uniformly dark background caused by the retinal pigment epithelium (right).

spectrum is divided into short (blue), intermediate (green) and long (red) wavelengths. Shorter wavelengths are heavily scattered by the ocular media and primarily impaired by changes in the eye, such as cataracts. The blue light unable to be transmitted to the retina is reflected by the internal limiting membrane and the additional anterior retinal layers to provide good visualization.[1] For this reason, a blue filter is a good option when attempting to photograph anterior retinal pathology, such as fibrovascular membranes in cases of proliferative diabetic retinopathy or epiretinal membranes.

Green wavelengths are not as heavily scattered by the ocular media, meaning that more of this light reaches the back of the eye. Green, or red-free, light is better suited to visualize the retinal nerve fiber layer (RNFL), especially when cataracts are present.[3] To some extent, green light is reflected by a healthy, intact RNFL. If there has been localized damage to the RNFL from glaucoma, a darker wedge will be seen juxtaposed between the normal healthy RNFL striations. There is good correlation between RNFL defects seen with the red-free filter and with thinning of the RNFL seen on OCT.[6] The enhanced contrast offered by the red-free filter can also assist in more accurately assessing the cup-to-disc ratio, especially in the case of a shallow cup.[7]

Green wavelengths have the added benefit of penetrating into the deeper retinal layers. Most of the transmitted green light is reflected by melanin in the retinal pigment epithelium, resulting in a uniformly dark background best for visualizing retinal pathology.[2] Generally, if a naturally appearing red-hued structure is viewed through a red wavelength filter, it will appear lighter. However, if the same structure is viewed through the contrasting green filter, it will appear black. By this principle, blood vessels absorb green light and appear black because of the hemoglobin they contain.

Green light at 570nm is the ideal wavelength to view blood vessels and evaluate their caliber, crossing changes or the presence of pathology.[1] For this reason, there is a risk of underestimating certain types of retinopathy, such as that which occurs with diabetes or hypertension where small hemorrhages are a common finding.[8] Modern fundus cameras use a grayscale color scheme for their blue, green and red wavelength filters. This also serves to increase the resolution, given that every pixel is dedicated to the grayscale and decreases chromatic aberrations.

Green wavelengths do not penetrate into the choroidal layer. This explains the well-known phenomenon of choroidal lesions seemingly disappearing when the red-free filter is applied. Choroidal nevi are the most common intraocular tumors, and though they are benign, they require close monitoring for conversion to possible malignant melanoma.[9] Red-free fundus imaging is an essential piece of the initial documentation and continued monitoring of a choroidal nevus (*Figure 1*).

Takeaways

The red-free filter has a lot to offer optometrists in both routine and urgent or emergent care. Its primary advantage is the increased contrast it offers between the ocular structures under examination and their vasculature. Some of its applications are well-known to clinicians and frequently used. Others, however, are routinely underused and could play a helpful role in the diagnosis of a variety of conditions. ■

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ABOUT THE AUTHOR

Dr. Leburg is an instructor at the Pennsylvania College of Optometry, where she completed a residency in primary care/ocular disease in 2017. She divides her time between precepting interns at the Eye Institute and teaching in the clinical skills program at Salus University. She has no financial interests to disclose.

When the Pressure's On

Elevated IOP is bad. Combine it with a rise in ICP, and you've got a potential emergency on your hands.

BY ALISON BOZUNG, OD, MIAMI

A 19-year-old female was referred for suspicion of papilledema. She was first diagnosed with the condition 1.5 years prior. At three different ophthalmic exams over the preceding 18 months, both her referring optometrist and an ophthalmologist recommended she undergo neuroimaging studies. Despite their suggestions, she did not pursue further work-up and was lost to follow-up.

Examination

Upon presentation, the patient's best-corrected visual acuity was 20/25 in both eyes without an afferent pupillary defect. Extraocular motilities were unremarkable. Intraocular pressures were 26mm Hg OD and 27mm Hg OS. Her blood pressure was 146/83 and body mass index (BMI) was >30. She did not have a fever.

Slit lamp exam of the anterior segment was unremarkable. The dilated fundus examination revealed nasal elevation of the optic nerve in both eyes without spontaneous venous pulsation *(Figure 1)*. Visual fields and OCT are available for review *(Figures 2 and 3)*.

The patient denied transient visual obscurations, diplopia, medication use (tetracycline, birth control) and hypertension. She endorsed mild pulsatile tinnitus, which worsened upon lying down, moderate daily headaches and recent weight gain of about 30lbs over the past year.

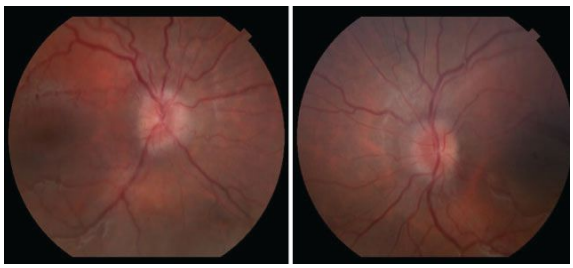


Fig. 1. Fundus photographs at the initial visit revealed mild bilateral optic nerve edema.

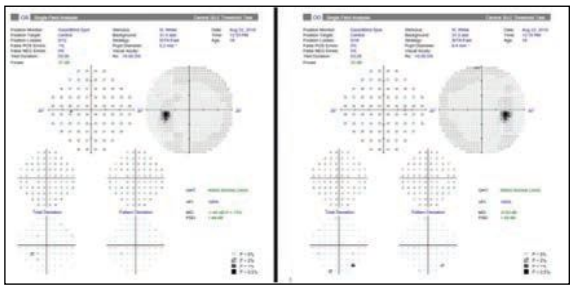


Fig. 2. Results of 30-2 Humphrey visual fields at the initial visit were within normal limits.

Given our clinical exam findings and the patient's symptom profile, we ordered MRI with and without contrast and magnetic resonance venography. Radiological review of the neuroimaging revealed enlarged ventricles, partially empty sella and a 2.97cm-by-2.07cm non-enhancing cystic lesion in the region of the pineal gland compressing the tectum and narrowing the cerebral aqueduct *(Figure 4)*.

Discussion

In clinical practice, we often favor more common differential diagnoses over those that are more rare as we consider disease process etiologies. Given our patient's age, gender and BMI, we should consider idiopathic intracranial hypertension as a leading diagnosis. This case demonstrates the need to entertain more rare differentials, even though they may seem unlikely.

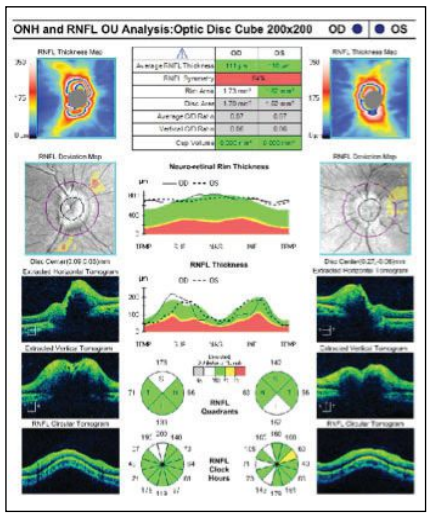


Fig. 3. OCT retinal nerve fiber layer analysis at the initial visit revealed slightly increased values, suggesting possible disc edema.

Papilledema, by definition, results from elevated intracranial pressure (ICP). Space-occupying lesions, increased cerebrospinal fluid (CSF) volume due to overproduction or decreased drainage, decreased skull volume and idiopathic causes may all result in elevated ICP. Symptoms of elevated ICP are not specific to etiology but may include headaches, nausea, vomiting, pulse-synchronous tinnitus, blurred vision, transient visual obscurations, diplopia and lethargy. Less commonly, behavioral changes, memory loss, gait disturbance, respiratory depression, bradycardia and bladder incontinence may also be observed.

About Dr. Mangan

Dr. Mangan is a board-certified consultative optometrist from Boulder, CO, and a fellow of the American Academy of Optometry. He is an assistant professor in the department of ophthalmology at the University of Colorado School of Medicine. His focus is on ocular disease and surgical comanagement. He has no financial interests to disclose.

Hydrocephalus is a condition hallmarked by enlarged ventricles in the setting of clinical signs or symptoms of increased ICP. Globally, the prevalence of hydrocephalus in the pediatric population (0 to 18 years) is 71.9 per 100,000 patients.[1] Adults (19 to 64 years) appear to have the lowest prevalence at 10.9 per 100,000 patients, and the highest prevalence has been reported in those older than 65 at 174.8 per 100,000 patients.[1] The prevalence of hydrocephalus varies greatly based on geography, and the etiology differs by age.[1]

When a physical blockage is present in CSF passages or ventricles, it is termed *obstructive hydrocephalus*. Neuroimaging is critical to visualize enlarged ventricles and determine the nature of the blockage, whether secondary to tumor, hemorrhage, infection or congenital defect. Though treatment is individualized and highly dependent on the etiology, shunt systems and endoscopic ventriculostomy are generally the two preferred procedures. In cases with a space-occupying mass, tumor resection may be done as a stand-alone treatment or in tandem with another procedure.[2]

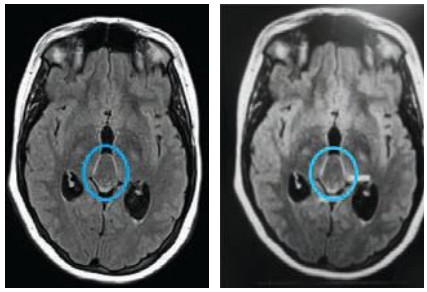
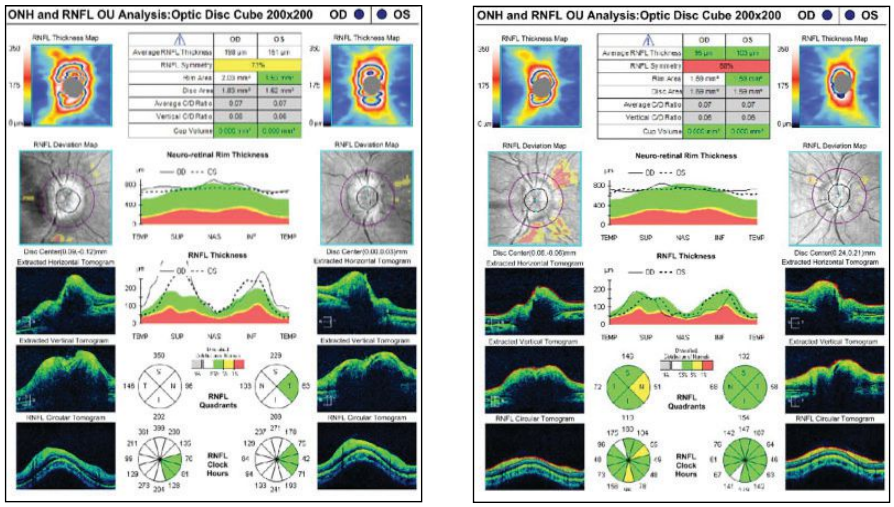


Fig. 4. MRI revealed a large pineal cyst (blue circles).

Based on our results, we diagnosed the patient with obstructive hydrocephalus secondary to a large pineal gland cyst. The pineal gland is a small neuroendocrine organ averaging 7.4mm in length by 2.4mm in height.[3] It is located behind the third ventricle and helps regulate the body's biological reaction to light and dark through the production of melatonin. One study states there is an incidence of pineal cysts in approximately 1% to 4% of individuals undergoing MRI.[4] The prevalence is higher in females, and these cysts occur most commonly during the second decade of life.[4]



Figs. 5a & 5b. RNFL scans at two weeks (left) and two months (right) post-surgery revealed initial worsening and subsequent improvement of disc edema.

Benign pineal gland cysts are typically less than 1cm in diameter, but their anatomical position may allow for compression of the third ventricle and obstruction of CSF flow if large enough, as seen in our patient.[4]

Treatment

Once the patient was educated on her condition, she became more amenable to further evaluation and treatment. Despite the likely long-standing nature of her diagnosis, the impetus was on us to ensure urgent follow-up with neurology. We discussed the case with the on-call neurosurgery team, and they agreed to see our patient the following day.

Four days after her initial presentation, the patient underwent a complete resection of the lesion via suboccipital craniotomy. Pathology revealed it was a benign pineal cyst. About two weeks after surgery, a refractive evaluation and comprehensive exam endorsed stable vision with very mild headaches but worse optic nerve edema *(Figure 5a)*. No further intervention was deemed necessary at that point, and she was monitored carefully.

At the patient's two-month follow-up, her headaches had resolved and optic nerve edema had significantly improved *(Figure 5b)*. She was instructed to continue follow-up with routine ophthalmic visits to monitor her optic nerve function and ocular hypertension.

To Sum Up

This case highlights the importance of maintaining a broad differential during your evaluation no matter how rare the potential diagnosis. Despite the initial delay in diagnosis due to poor follow-up, our patient ultimately did well and experienced resolution of her symptoms. ■

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ABOUT THE AUTHOR

Dr. Bozung works in the Ophthalmic Emergency Department of the Bascom Palmer Eye Institute in Miami and serves as the clinical site director of the Optometric Student Externship Program. She has no financial interests to disclose.

BY MARK DUNBAR, OD

RETINA QUIZ

Timing is Everything

Take immediate action once you determine that this particular condition is affecting your patient.

A 66-year-old female established patient sent a message via her electronic health review saying she started seeing a new onset of floaters in her left eye for the past four days and wanted to know if she should be seen in-person for an eye exam. The message was read the next day, and she came in two days later. A review of her medical record showed that she had been seen almost 18 months prior. At that visit, she was noted to have resolving Bell's palsy on the right side and posterior vitreous detachment (PVD) in both eyes. Besides the PVDs, her retinal exam was unremarkable.

On this most recent examination, her best-corrected visual acuity measured 20/20 OD and 20/40 OS. Extraocular motility testing was normal. Confrontation visual fields were full-to-careful finger counting OU. Her pupils were equally round and reactive to light; there was no afferent pupillary defect. The anterior segment examination was unremarkable.

Fundus examination of the right eye was normal. A PVD was present. In the left eye, a PVD was also present in addition to pigment cells in the anterior vitreous. There were obvious fundus changes (*Figure 1*). OCT was performed and is available for review (*Figure 2*).

Take the Retina Quiz

1. What is the correct diagnosis?

a. Rhegmatogenous retinal detachment
b. Exudative retinal detachment
c. Retinal pigment epithelium (RPE) tear
d. Chronic retinal detachment with subretinal fibrosis

2. How would you characterize the macula?

a. Macula is on
b. Macula is off
c. Splitting fixation
d. There is a macular schisis

3. How should this patient be managed?

a. Observation
b. Pars plana vitrectomy (PPV), endo laser and possible scleral buckle procedure (SBP)
c. Injection of gas and laser photocoagulation
d. Surgical retinotomy and gas fluid exchange

4. What is the time frame that this needs to be treated before it affects the final visual outcome?

a. Within 24 hours
b. Within 3 days
c. Within 7 days
d. Within 14 days

5. What is the likely visual outcome at this point?

a. Likely 20/20
b. Between 20/25 and 20/50
c. Between 20/60 and 20/200
d. Worse than 20/200

For answers, see page 82.

Discussion

Our patient has a macula-off rhegmatogenous retinal detachment. A retinal tear can be seen along the superior temporal arcade. The OCT confirms the macula is off, but just barely. In fact, the macula may still be on temporally, but it is clearly off superiorly where we can see fluid and separation of the retinal from the RPE. Despite being macula-off, visual acuity was surprisingly good, which likely indicates that the macula has not been off for very long.

There are a few interesting questions to consider. Why did she develop a retinal tear after already having had a PVD? The assumption is that every tractional force occurring on the retina is relieved after developing a PVD, but that's not always the case because the vitreous can still be attached anteriorly, causing traction. That is clearly what has occurred in our patient.

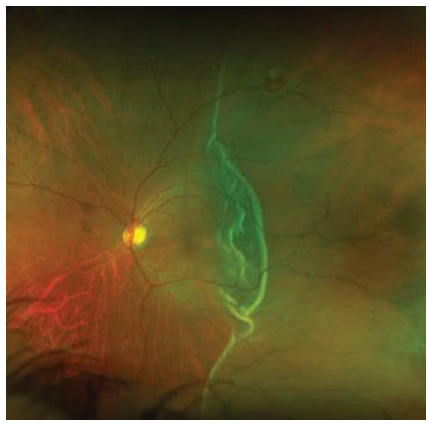

Fig. 1. This is the widefield fundus photo of the left eye of our patient. What does this finding represent?

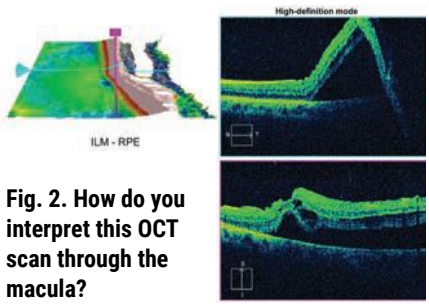

Fig. 2. How do you interpret this OCT scan through the macula?

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.

Horseshoe tears most commonly develop as a result of traction at the posterior margin of the vitreous base. The base represents a circumferential zone where the vitreous is attached to the peripheral retina. It measures about 2mm to 6mm wide and straddles the ora serrata. The adhesion of the vitreous at the peripheral retina is usually evenly distributed circumferentially.

Through the natural aging process, the vitreous begins to liquefy, and irregularities develop in the shape and extent of where it attaches to the retina. This, in turn, may result in isolated areas of focal traction on the retina that may result in the development of a horseshoe tear. It is believed that these irregular focal adhesions are responsible for a majority of retinal tears not associated with lattice degeneration.[1]

Don't Delay

It's clear the patient needs surgery to repair the retinal detachment, but how quickly does this need to occur? Does it need to be done on the same day (that we diagnosed the retinal detachment) or can it wait until the next day or even the day after? This becomes particularly important in the era of COVID-19, where surgical patients must be tested for the virus and negative prior to surgery. This could possibly result in a delay. At what point does waiting compromise the visual outcome?

There are a number of predictive factors for poor visual outcomes of macula-off retinal detachment. These include the initial presenting visual acuity, duration of the macular detachment and height of the retinal detachment. Obviously, worse acuity, longer duration of the detachment and more bullous detachments are all associated with worse visual outcomes.

For our patient, we don't know how long she has had the retinal detachment, but her symptoms probably give us a good clue—i.e., from the time her symptoms began until she was seen and diagnosed was seven days. We also don't know how long the macula has been off, but based on her reasonably good acuity and the OCT findings, it hasn't been more than a day or two. These are all great prognostic indicators for a good visual outcome.

A number of studies have tried to determine optimal timing for repair of macula-off retinal detachments. Most have shown the best visual outcomes are achieved when the surgery is performed within seven days of the macular detachment.[2,3] However, the window of opportunity for optimal visual success may be less than that. One meta-analysis found that a delay of more than three days was associated with statistically worse final visual outcome. Eyes that had surgery within three days averaged a final visual acuity of around 20/30, whereas eyes that were operated on between four and seven days averaged a final visual acuity of around 20/70.[4]

Our patient was referred to a retina specialist and seen the same day. She was tested at that visit for COVID-19 using real-time reverse-transcriptase PCR assay (SARS-CoV-2 DiaSorin Simplexa assay) and was negative. She had surgery the following day via PPV, injection of 16% C_3F_8 gas and endo laser without a scleral buckle.

This process took under three days, which should give her the best opportunity for achieving optimal visual success. She will likely not see immediate results, as she will likely develop a cataract from the surgery and gas injection, which will ultimately result in needing cataract surgery.

On day one post-op, her retina was attached. By week three, she was able to pinhole to 20/60, but she still had a gas bubble present and she was well on her way to developing a cataract. We will continue to follow her. ■

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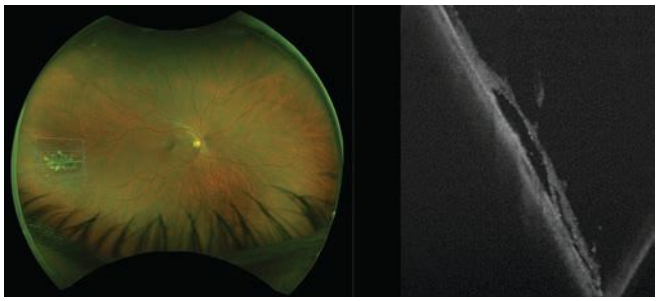
DIAGNOSTIC TESTING

See Even More with UWF Imaging Advances

Good news for widefield imaging fans: Optos is adding new capabilities to its Daytona and Silverstone retinal imagers and upgrading the imaging processing of its entire product line, which also includes the California and Monaco devices.



The new Explorer Mode shows correspondence between lesions on the fundus image and OCT scan.

Daytona will now offer improved optics for better visualization and automatic laterality detection to improve image capture time. The new version also features an updated design and user interface.

The latest version of Silverstone, which combines UWF imaging with swept-source OCT, includes a Repeat Scan tool that Optos says is useful for monitoring of change over time. A new Explorer Mode displays OCT scan type and location on the optomap image, improving access to and assessment of OCT scans. Finally, auto contrast is now available for angiography capture.

And all four products in the Optos line will get new processing technology that Optos says improves image clarity and detail across the entire 200° image to aid detection of pathology both centrally and in the periphery.

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The items are packed in cases large enough for doctors to customize by adding complimentary products, prescriptions or patient education paperwork, according to Bruder. Co-managing optometrists can provide the self-contained kit in their practices or via Bruder's new online portal, specifically designed for pre-surgical patients.

DISPENSARY

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To boost dispensary sales and create a more patient-friendly browsing experience, the new Merchandiser Pro software from Eye Designs allows you to generate 3D merchandising models, featuring frame board layouts, frame holders, shelving, signage and more. The software allows the user to adjust configurations to match the frame count of their particular display units. The company says this user-friendly, cloud-based software allows users to generate plan-o-grams like retailing professionals.

Lens Treatment Protects and Tints Quickly

If your practice has an optical lab, you can use a new coating from Coburn to add scratch resistance and tinting to ophthalmic lenses. Called ProCoat, the product adheres easily, get high marks on clarity and stability and is usable across a broad range of lens materials, says the manufacturer. A company press release says labs and doctors no longer have to sacrifice abrasion resistance for tintability and vice-versa.

Coburn says ProCoat is fast-curing and achieves higher yields at a lower cost so labs can be sure they are making a solid investment toward their lens coating operations. It is also free of volatile solvents, making it safer to ship and handle.

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BY ANDREW S. GURWOOD, OD

DIAGNOSTIC QUIZ

Rarer than RP

A progressive chorioretinal atrophy causes photoreceptor damage at a young age. Sound familiar? It's not.

A 17-year-old Black female presented to the office with a chief complaint of blurry vision OU of one month's duration. She was interested in a new spectacle prescription. He had no prior history of trauma or pain. Her systemic and ocular histories were unremarkable. She denied allergies of any kind.

Diagnostic Data

Her best-corrected entering visual acuities were 20/30 OD and 20/30 OS, at distance and near. Her external examination was normal, and there was no afferent pupillary defect. Refraction produced an excellent visual response. Her anterior segment structures were normal and Goldmann applanation tonometry measured 17mm Hg, OU. Her cup-to-disc ratios were 0.2 round OD and 0.25 round OS. The pertinent posterior segment findings are demonstrated in the photographs.

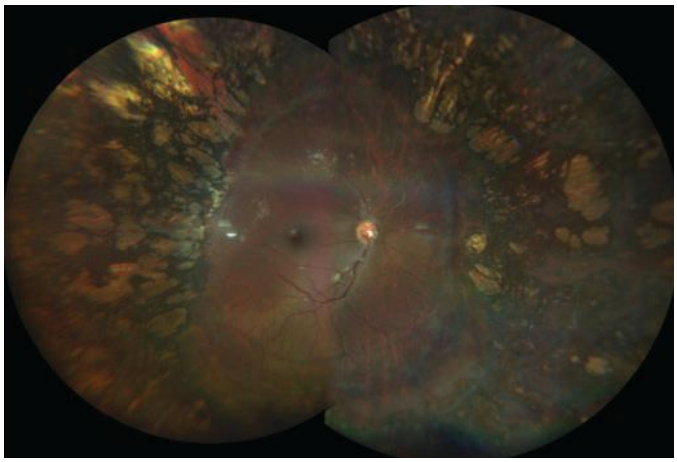
Next Steps

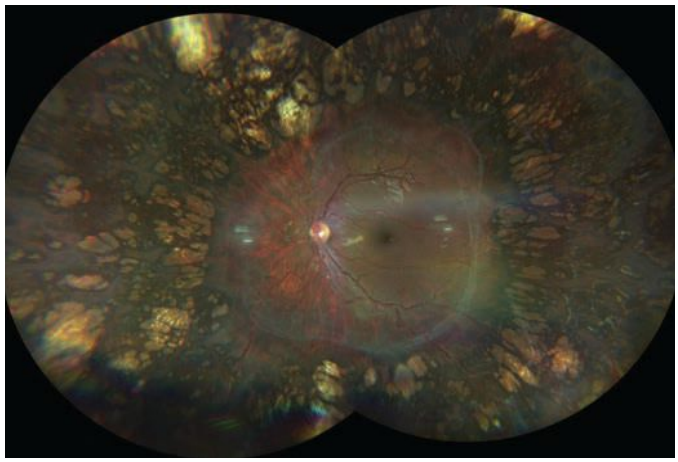
Additional studies that might yield diagnostically pertinent data include 30-2 automated perimetry to look for peripheral constriction, electroretinogram and dark adaptometry looking for rod function suppression, a 5- or 21-line raster optical coherence tomography scan of the macula and widefield color fundus photography to document baseline status.

Correspondence with her general medical team might suggest laboratory work looking for raised plasma levels of ornithine and urinalysis looking for high levels of excretion of lysine and cystine.

Your Diagnosis

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





The photos above show the right fundus (left image) and left fundus (right image) of our patient. What might cause such a presentation?

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 76)—Q1: a, Q2: b, Q3: b, Q4: b, Q5: b

NEXT MONTH IN THE MAG

Coming in February, *Review of Optometry* will present a series on diagnostic skills and techniques. Articles will include:

- Demystifying Perimetry: How it Works and What it Means
- Improve Your Interpretation of Macular OCTs
- 20 Questions to Ask When You See Diplopia
- Take a Guided Tour of the Retinal Periphery

Also included in February:

- Ocular Manifestations of Vaccine-preventable Diseases in Kids
- The Eyelids in Health and Disease—*Earn 2 CE Credits*

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FOR MOST PATIENTS, DRY EYE SYMPTOMS HAVE AN EPISODIC IMPACT

FLARES: THE SPEED BUMPS OF DRY EYE

Most patients with Dry Eye suffer from short-term, episodic exacerbations—***Dry Eye Flares.***[1-3]

Many patients don't suffer from continuous symptoms.[3]

REENVISION DRY EYE

kala PHARMACEUTICALS

References: 1. Brazzell RK, Zickl L, Farrelly J, et al. Prevalence and characteristics of dry eye flares: a patient questionnaire survey. Presented at: AAO 2019: October 12-15, 2019; San Francisco, CA. **2.** Brazzell RK, Zickl L, Farrelly J, et al. Prevalence and characteristics of symptomatic dry eye flares: results from patient questionnaire surveys. Poster presented at: AAOPT 2019: October 23-27, 2019; Orlando, FL. **3.** 2020 Study of Dry Eye Sufferers. Conducted by Multi-sponsor Surveys, Inc.