

Focus on Refraction: Emmetropia isn't Perfect, p. 28

REVIEW[®] OF OPTOMETRY

August 15, 2018

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42ND ANNUAL
CONTACT LENS REPORT

BEFORE

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AFTER

New surface treatments can give you a fresh start with contact lens patients.

p. 36

Plus:

Dissecting the Soft Contact Lens, **p. 30**

The Compromised Cornea: Take Cover, **p. 42**

EARN 2 CE CREDITS—Sclerals: Boom, Don't Bust, **p. 50**

ALSO INSIDE

Play a Part in Postoperative Glaucoma Care, p. 59 • Take Dry Eye Therapy to the Next Level, p. 66

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IN THE NEWS

Researchers recently discovered **mitochondrial dysfunction in eyes with ocular hypertension (OHT)**, even before signs of primary open-angle glaucoma (POAG). The study used a fundus camera modified to measure full retinal thickness fluorescence to detect flavoprotein fluorescence (FPF) and OCT to measure the retinal ganglion cell-plus layer (RGC+) thickness. **Both macular FPF and the macular FPF/RGC+ thickness ratio were significantly increased in OHT compared with control eyes.**

Geyman L, Suwan Y, Garg R, et al. Noninvasive detection of mitochondrial dysfunction in ocular hypertension and primary open-angle glaucoma. *J Glaucoma*. 2018;27(7):592-9.

A new study found adults who said they consume at least **one serving of oranges a day had more than a 60% reduced risk of late AMD** 15 years later compared with those who never consumed oranges at baseline. The researchers suggest an independent and protective association between dietary intake of flavonoids and the likelihood of having AMD.

Gopinath, B, Liew G, Kifley A, et al. Dietary flavonoids and the prevalence and 15-y incidence of age-related macular degeneration. *Am J Clin Nutr*. July 6, 2018. [Epub ahead of print].

New data suggests **obstructive sleep apnea (OSA) increases the risk of developing optic neuropathy (ON)**. The study also found treatment with continuous positive airway pressure (CPAP) does not reduce the risk. OSA patients had a 1.95-fold higher risk of developing ON compared with non-OSA patients in each age group, and, contrary to expectations, OSA patients treated with CPAP were at a higher risk of developing ON.

Sun MH, Liao YJ, Lin CC, et al. Association between obstructive sleep apnea and optic neuropathy. *Eye (Lond)*. April 26, 2018. [Epub ahead of print].

Glaucoma ODs/MDs Agree Half the Time

The highest diagnosis agreement rate was based on disc hemorrhage.

By Jane Cole, Contributing Editor

Ophthalmologists and optometrists working in a team practice agreed on a mutual diagnosis of glaucoma progression slightly more than half the time when they were masked to their colleagues' diagnosis, a recent study reports.

In an attempt to determine agreement in identifying glaucoma progression among four providers at a glaucoma practice—including two ophthalmologist glaucoma specialists and two optometrists—researchers used multiple glaucoma tests in a team model. The study also assessed which tests resulted in higher agreement levels and those tests favored by providers to base their decisions on glaucoma progression.

The clinicians were blinded to the patient's identity, previous assessments, the identity of the patient's care provider and assessments made by their colleagues in this two-year prospective study of 200 patients (399 eyes). The doctors independently reviewed patients' clinical data, disc photographs, OCT and visual fields.

The clinicians then rated each eye as either "progression" or "no progression of glaucomatous disease." Investigators looked for three different diagnosis trends: agreement among optometrists,

agreement among glaucoma specialists and agreement among all clinicians.

The study found the two optometrists agreed with each other's diagnosis 74.2% of the time, while the glaucoma specialists agreed with each other 78.7% of the time. All four clinicians agreed with each other 54.4% of the time.

Clinicians had the highest agreement rate when the progression decision was based on disc hemorrhage (92%), while the lowest agreement rate was based on OCT progression analysis (36%). Compared with optometrists, the study found glaucoma specialists used OCT more frequently to determine disease progression.

"Fair to moderate agreement levels were found among providers in their assessment of glaucoma progression, suggesting that a team approach to glaucoma management may be effective," researchers said. But they also noted that "there is room for improvement, which could be met by further refinement of the definition of glaucoma across the team," especially regarding the role of OCT in glaucoma diagnosis.

Shah S, Choo C, Odden J, et al. Provider agreement in the assessment of glaucoma progression within a team model. *J Glaucoma*. June 4, 2018. [Epub ahead of print].

PACK-CXL Treatment Fights Fungus

Investigators continue to find new applications for corneal collagen crosslinking (CXL) in the management of infectious corneal wound healing. New research out of Turkey shows that CXL with photoactivated riboflavin (PACK-CXL) can treat certain kinds of fungal keratitis infections.

The investigators, who published their findings in the June issue of *Acta Ophthalmologica*, examined 64 rabbit corneas infected with *Fusarium solani* or *Candida albicans* and divided them into four groups: a control group, a PACK-CXL treated group, a voriconazole-alone group and a PACK-CXL combined

with voriconazole group. Then, the researchers tested the amount of colony-forming units (CFUs) of reproduced microorganisms in each group. In both PACK-CXL groups, fewer hyphae and non-specific stromal changes were

observed. But the group that combined the voriconazole with PACK-CXL did particularly well, maintaining the original number (100CFU/ml) applied. The PACK-CXL-alone group had 150CFU/ml and the voriconazole-alone

group had 200CFU/ml. For perspective on how effective that is, consider the control group's 4,000CFU/ml.

The results, the study concludes, make the case for a combined PACK-CXL and voriconazole treatment of fungal keratitis at the early stage of the disease.



Cases of fungal keratitis, such as this one due to an infection from *Fusarium solani*, may benefit from adding CXL to the treatment regimen.

Özdemir H, Kalkancı A, Bilgihan K, et al. Comparison of corneal collagen cross-linking (PACK-CXL) and voriconazole treatments in experimental fungal keratitis. *Acta Ophthalmol.* June 4, 2018. [Epub ahead of print].

Optometry Balks at Proposed KY Vision Plan Cessation

“We have a fairly large Medicaid population here. There’s no industry, no jobs, no decent wages. Most people seem to work minimum wage fast food jobs,” explains James Sawyer, OD. He’s been practicing in the town where he was born and raised—Monticello, KY (population, 6,116; median household income, \$26,005)—for 32 years now, and he says his personal income has remained relatively flat since he first opened.¹ But, “coming back to my home town was a priority for me,” he says.

So, he set up shop in an old grocery store, hired a staff of four and, when he’s not seeing patients, advocates for optometry by sitting on the Medicaid Optometric Technical Advisory Committee. It’s never been easy to encourage patients to come to the optometrist. If their coverage doesn’t include a new pair of glasses, he says, many don’t see the point in getting routine exams at all. He estimates approximately 60% of his patients receive Medicaid benefits.

Soon, though, he may be seeing fewer patients than ever, as the state

adopts new rules cutting off vision benefits for routine services to Kentucky’s 450,000 patients impacted by expanded Medicaid coverage.

“I wish they’d come to Monticello for a while and see how people struggle to get by,” he says.

Short Sight

In a move the American Optometric Association (AOA) referred to as a “short-sighted and retaliatory choice,” Kentucky Governor Matt Bevin announced the cuts Monday, July 2, after a judge rejected his

(continued on page 8)

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References: 1. Alcon sales data on file. 2. Wirtitsch MG, Findl O, Menapace R, et al. Effect of haptic design on change in axial position after cataract surgery. *J Cataract Refract Surg.* 2004;30(1):45-51. 3. Visser N, Bauer NJ, Nuijts RM. Toric intraocular lenses: Historical overview, patient selection, IOL calculation, surgical techniques, clinical outcomes, and complications. *J Cataract Refract Surg.* 2013;39(4):624-637. 4. Potvin R, Kramer BA, Hardten DR, Berdahl JP. Toric intraocular lens orientation and residual refractive astigmatism: An analysis. *Clin Ophthalmol.* 2016;10:1829-1836.

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News Review

A Retinal Consult in the Palm of your Hand

An artificial intelligence (AI) app just hit the digital shelves—and it's designed to become a part of your retinal exams. The Fluid Intelligence app (Retina-AI) uses algorithms to analyze optical coherence tomography (OCT) images for macular edema and subretinal fluid. The app has shown a greater than 90% accuracy in detecting these clinical findings, according to the company.

According to a press release, the app is designed to help eye care providers better interpret retinal OCT images in the absence of a retinal specialist. If an optometrist has a macular degeneration patient in the clinic and is unsure whether the degeneration is actively wet or not, "the optometrist can take a picture of the OCT retinal scan and get a prediction as to whether that patient urgently needs an eye injection or not," the company claims.

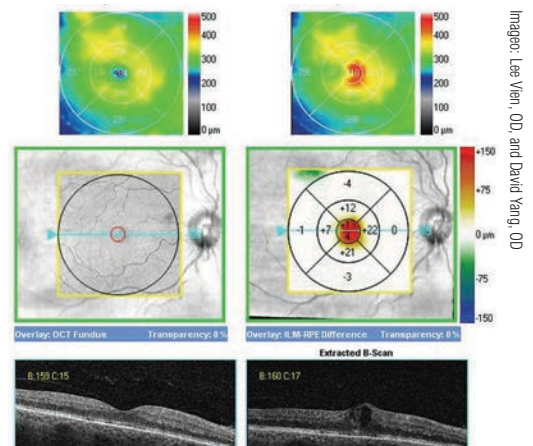
While an intriguing app that may help guide untrained or geographically isolated practitioners, users should approach it with a certain level of caution, says Andrew Rixon, OD, an attending optometrist at the Memphis VA Medical Center in Tennessee. "At present there is limited information on what constitutes the company's claims of '90% accuracy,' and there is also the implication that a picture of the OCT retinal scan involves one slice that is selected for analysis."

ODs who use OCT should strive to improve

their own interpretation skills, Dr. Rixon says. "This extends beyond the analysis of a single structural OCT slice of retina to include the entirety of the involved area." That also includes the clinical funduscopy evaluation and the use and interpretation of multimodal imaging, he adds. "This is the only way to comprehensively guide our management patterns. We need to drive the machine; the machine cannot drive us."

"Although AI has been proposed to perform as well as human experts, in 2018 the clinician is still the ultimate determinant of how to manage these patients," Dr. Rixon concludes. "A promising app such as this should remain as a helpful supplement."

Retina-AI. Retina-AI releases the first artificial intelligence mobile app for eye-care providers: fluid intelligence by Retina-AI. July 13, 2018. www.retina-ai.com/news/fluidintelligence. Accessed July 20, 2018.



A new app can give clinicians a resource to help them interpret OCT scans—like this one demonstrating the development of DME over a period of less than four months—when a retina specialist isn't available.



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2018 Income in Review

For many ODs, 2017 was an up-and-down year, income-wise—is this year any better? *We want to hear about how your income is doing in 2018 for our annual income survey.*

Last year, respondents in the field for 11 to 20 years hit a mid-career plateau, reporting only a 0.5% higher income than those in the field fewer than 11 years. Is the same true for 2018, or did you get that income bump 53% of you were hoping for last year?

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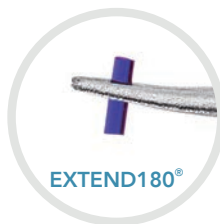
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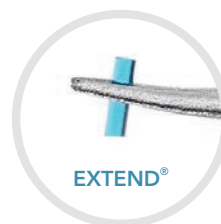
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Medicaid Cuts

(continued from page 4)

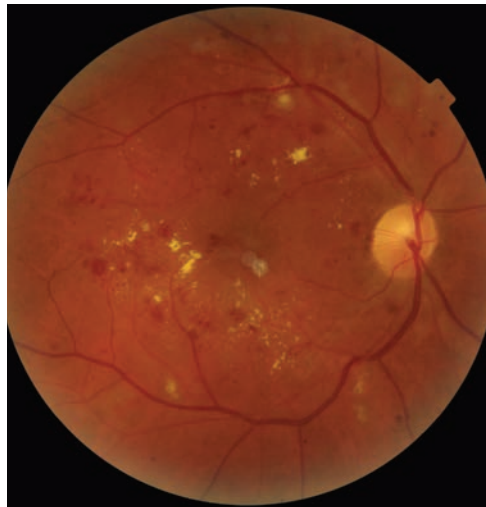
original health proposal. That original proposal would have required people to work or volunteer at least 20 hours a week and pay monthly premiums. The Bevin Administration told the *Louisville Courier-Journal* the suspension of vision benefits was “an unfortunate consequence of the judge’s ruling.”²

Doctors fear removing these benefits could leave recipients in dire straits. “Often, medical issues are detected during routine visits the population will now likely forego since they are not covered,” explains Aaron McNulty, OD, who practices in Louisville, KY.

Doctors may also face some hard choices. “I’ll probably have to look for another place to practice if Medicaid is not intact,” Dr. Sawyer says, adding that he’d likely be forced to shutter his solo private practice and work as an employee for a large group practice. “The patients will suffer, and I think it will end up costing the state a lot more in disability claims.” For example, he says if a patient loses vision because they missed preventable disease progression, that’ll take more people out of the workforce and qualify them for disability coverage.

In fact, diabetic retinopathy is one of the leading causes of blindness and in 2017, doctors of optometry diagnosed more than 400,000 cases of diabetic retinopathy in patients who did not know they had diabetes, the AOA says in a statement.

“We know that undiagnosed chronic systemic disease such as diabetes is a massive problem, not



Routine screening revealed severe nonproliferative diabetic retinopathy with probable clinically significant macular edema.

only for individual patients but for the healthcare system as a whole. In a largely rural state such as Kentucky, optometry has an extensive footprint (111 of 120 counties) and we are well equipped to reduce the cases of undiagnosed diabetes. This improves individual outcomes and saves money for the state in the long run,” says Dr. McNulty.

The federal government funds approximately 80% of the state’s \$11 billion-a-year Medicaid program.

Organized Optometry

The decision has led to an outcry from optometric advocates and other groups, particularly the Kentucky Optometric Association (KOA), which was taken by surprise. “We were initially disappointed when the KY HEALTH waiver application was filed, and ‘routine vision benefits’ were treated as something that the able-bodied, adult population had to ‘earn,’” says KOA Executive Director Dinah

Bevington. “Only after the KY HEALTH program was halted did we learn that the administration had actually filed a State Plan Amendment to the Medicaid plan in KY, which impacted covered adults. On April 23rd, the administration filed the amendment to remove all routine vision services for the population, regardless. We were caught completely off guard when the KY HEALTH program was halted, yet we reverted back to a plan that had a substantial change—there was no longer routine vision coverage.”

Dr. Sawyer adds that organized optometry isn’t the only one who intends to challenge the governor’s decision. “The payers see the frustration—they’ve signed on to take care of their members, the patients of Kentucky, but the lack of knowledge about what the government is doing is tremendous.”

“The KOA will continue to advocate for patient access and will partner with the Cabinet to help get these services re-authorized as soon as possible,” says Ms. Bevington.

Dr. Sawyer believes that with a little education about optometry, the governor will come around to reinstating the Medicaid benefits. “If the governor could come down to Wayne County and spend a week with us and see the needs of the people, he’d see the perspectives are completely different,” he says. “I hope common sense will prevail.” ■

1. Data USA. Moticello, KY. <https://datausa.io/profile/geo/moticello-ky>. Accessed July 10, 2018.

2. Yetter D. Bevin cuts dental, vision benefits to nearly 500K Medicaid recipients. www.courier-journal.com/story/news/2018/07/02/democrats-blast-matt-bevin-cuts-medicaid-rash/749974002. July 2, 2018. Accessed July 10, 2018.

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Contents

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Dissecting the Soft Contact Lens

The quest for comfort goes beneath the surface.

BY KAREN K. YEUNG, OD, AND CINDY K. DINHH

PAGE 30

Polish Up Your Practice: Today's Contact Lens Surfaces

Sometimes it pays to be superficial—at least when it comes to contact lens advances. These surface treatments can increase patient comfort.

BY HEIDI WAGNER, OD, MPH

PAGE 36

The Compromised Cornea: Take Cover

Bandage lenses are crucial for corneal protection, but can present both clinical and coding challenges. Here's what you need to know.

BY CHRISTINE W. SINDT, OD

PAGE 42



Earn 2 CE Credits:

Scleral Lenses: Boom, Don't Bust

These strategies can help you prevent a scleral lens complication surge in your practice.

BY NURIT ARIEL WILKINS, OD

PAGE 50

ALSO INSIDE

GLAUCOMA SERIES, PART 4:

Play a Part in Postoperative Glaucoma Care

For every procedure our patients undergo, optometrists must develop a follow-up routine. Here's how to get started.

BY MICHAEL CYMBOR, OD

PAGE 59

Take Dry Eye Therapy to the Next Level

Here's how to up your game when treating even the most severe dry eye patient.

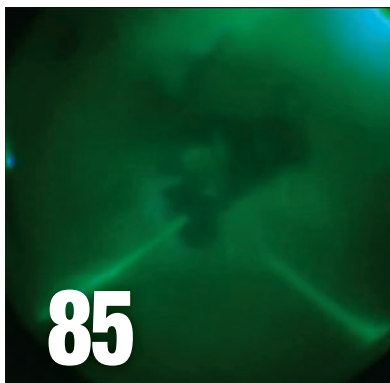
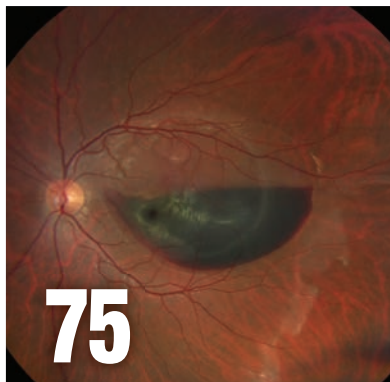
BY JUSTIN KWAN, OD

PAGE 66

Departments

Review of Optometry August 15, 2018

- 3 News Review**
- 16 Outlook**
A Tale of Two States
JACK PERSICO
- 18 Through My Eyes**
The Canary in the Coalmine
PAUL M. KARPECKI, OD
- 20 Chairside**
Where are All the Characters?
MONTGOMERY VICKERS, OD
- 22 Clinical Quandaries**
Playing the Field
PAUL C. AJAMIAN, OD
- 24 Retina Dilemmas**
Peel Back the Layers
**DIANA SCHECHTMAN, OD,
AND JAY HAYNIE, OD**
- 28 Focus on Refraction**
Emmetropia isn't Perfect
**PAUL HARRIS, OD, AND
MARC B. TAUB, OD, MS**
- 45 Coding Connection**
Corneal—and Coding—Protection
JOHN RUMPAKIS, OD, MB
- 73 Cornea + Contact Lens Q&A**
The Cut after Colonization
JOSEPH P. SHOVLIN, OD
- 75 Retina Quiz**
A Knuckle Sandwich in the Eye
**ERIC DILLINGER, OD, AND
MARK T. DUNBAR, OD**
- 78 Therapeutic Review**
Keep an Eye on NAION
**JOSEPH W. SOWKA, OD, AND
ALAN G. KABAT, OD**
- 80 Ocular Surface Review**
The Dry Eye Misalignment
PAUL M. KARPECKI, OD
- 82 Glaucoma Grand Rounds**
A Little of This, A Little of That
JAMES L. FANELLI, OD
- 85 Surgical Minute**
Trauma Drama
**ALAN FRANKLIN, MD, PHD,
DEREK N. CUNNINGHAM, OD, AND
WALTER O. WHITLEY, OD, MBA**
- 86 Classifieds**
- 89 Meetings & Conferences**
- 89 Advertisers Index**
- 90 Diagnostic Quiz**
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About the survey

The survey was conducted online within the United States by Edelman Intelligence on behalf of Shire between November 14, 2017 and December 3, 2017. The consumer arm of the survey included a total of 1,001 U.S. adults ages 18+ with self-reported Dry Eye symptoms or diagnosed with Dry Eye, and the professional arm of the survey included 1,000 eye care professionals in the U.S. who are optometrists (n=500) or ophthalmologists (n = 500) (ECPs).





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Outlook

By Jack Persico, Editor-in-Chief



A Tale of Two States

The battle in Oklahoma shows just how far optometry has come, and how much it has to lose.

Optometrists in Oklahoma practice on the frontier of the profession, with state laws allowing minor surgical procedures like SLT, capsulotomy and more. With underserved rural communities in need of care, they made their case to expand their scope of practice—and then delivered. Time and again, Oklahoma ODs have shown themselves good stewards of the profession's reputation by living up to the duties entrusted to them by the passage of these permissive laws.

The word *optometry* signifies high quality, broad-scope care in Oklahoma. Now that word is in jeopardy of being rebranded to fit the high volume, limited-scope care Walmart likely wants for its stores.

Long shut out of optometry in Oklahoma, Walmart is fighting back with an appeal to voters themselves. A consumer advocacy group with backing from Walmart is pushing a ballot initiative that would wrest control over optometry from the state board and give it to corporations. The proposal “does not prohibit optometrists and opticians from agreeing with retail mercantile establishments to limit their practice.”

In other words, it's open season on optometry. If Walmart wants to define the profession as a refraction-and-retail mill, curtailing clinical services, this would give them that right. Oklahomans walking into a Walmart would effectively cross into a Bizarro Oklahoma where ODs don't do what they do everywhere else in the state.

How does that serve the public interest? The argument boils down to ‘half a loaf is better than none.’

First, advocates make it sound like they're playing the same access-to-care card optometry itself used for expanded scope of practice, but with lots of fear-mongering talk about how lobbyists and special interests have kept kids and old folks from getting the eye care they deserve. “Low-income households are economic victims of the eye care monopoly” is a typical line you'll find on the group's website, www.yeson793.com. Nevermind that hundreds of independent practices operating without coordination is hardly a monopoly—scary words trigger emotions.

Next, they do admit some surgical procedures ODs perform won't be part of their version of optometry. So how, then, is this helping those needy old folks with glaucoma or posterior capsular opacity? Well, it isn't. But Walmart is hoping the prospect of low budget eyecare will be enough to sway public sentiment. Then, beholden to no one, they can remake optometry however they choose.


Walmart built its business on price and convenience. But when it sells brand-name products, they're the same as anywhere else. You can buy Cheerios or Budweiser or a Samsung TV at Walmart and get the exact same product as from another retailer. Now, it's trying to sell a store-brand knock-off of optometry while trading on the brand name's goodwill. That would be like selling a 64-piece box of Crayola crayons that only has 50 in it and hoping kids won't notice.

Sorry, Walmart, you can't do that. You don't own that brand. And if you can't stock brand-name optometry, don't stock it at all. ■

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The Canary in the Coalmine

The first dry eye signs typically appear in contact lens wearers—a prime opportunity for ODs to step in and catch it early. **By Paul M. Karpecki, OD, Chief Clinical Editor**

The last 20 years have provided myriad contact lens innovations, including daily disposal modalities, silicone hydrogel technology and water gradient contact lenses, hyaluronic acid for tear retention and new preservative-free solutions. And yet the contact lens dropout rate has not changed. Many of these patients want to stay in contact lenses, but we're missing the early signs of ocular surface diseases such as meibomian gland dysfunction (MGD), blepharitis and dry eye disease (DED) that are thwarting comfort.

Digital device use is a significant factor in this equation as well. Considering its growth has paralleled these contact lens innovations, that trend has hampered the contact lens success we should have seen.

Studies show blink rates drop from 20 times per minute to about four to five times per minute while using digital devices.¹⁻³ When the blink rate drops by 75%, surface exposure, insufficient expression of the meibomian glands and cleaning of the lid margins all become issues. With a proper blink, the lower lid moves medially. This is both a meibomian gland pumping mechanism and a cleaning motion. Without that full blink, glands become obstructed and significant biofilm, hyperosmolarity and inflammation develop. These early effects on the tear film impact contact lens wearers first, as these patients require an adequate tear film on the ocular surface and the contact lens surface.

Uncover the Problem

If we could keep patients in their contact lenses for one to two more decades, it would be transformational. And it all starts with diagnosis. But we often wait until the patient is far too advanced and already ready to drop out of contact lenses. By then it's too difficult to return them to comfortable contact lens wear. Research explains this through adaptive immunology, or the ability for the immune system to remember and quickly return to this state with any subsequent insult.

Clinicians should remember that corneal staining is a late-stage indicator. It's the equivalent of beginning glaucoma treatment only after you have peripheral visual field loss. The key is to use both diagnostic tests and symptom questionnaires that help identify disease at an early stage. Although osmolarity testing may be the easiest and most predictive of early DED, other options include something as simple as meibomian gland expression, meibography and assessing the blink capacity.

Clinicians must also look closely at the lid margins for early biofilm development because, according to the dry eye blepharitis syndrome theory, early biofilm development may play a key role in both MGD and DED. By the time we see scurf, debris or collarettes on the lashes, we're at advanced stages.

Open the Toolbox

With a formal diagnosis in hand, hopefully early when the patient

just begins to notice mild contact lens issues such as decreased wearing time or end-of-day discomfort, clinicians can turn to any number of treatments. Hydrating compresses, lid debridement and in-office expression treatments are all good options, as are lid scrubs and in-office blepharoexfoliation for biofilm development. Inflammation at the early stages can be addressed with Xiidra (lifitegrast, Shire) or Restasis (cyclosporine, Allergan), as well as supplementation with GLA/EPA/DHA-based omega fatty acids.

Solve the Puzzle

When you combine these treatments with newer contact lens materials and modalities, you can achieve improvements quickly, keep patients in contact lenses longer and advance your practice. You'll be serving patients better—and patient word-of-mouth recommendations spread quickly these days.

Optometry, more than any other profession, has one particular item that can help identify dry eye disease early: contact lens wear. Everyone benefits when you care for your contact lens patients carefully and identify their issues early. In doing so, you beat dry eye and keep patients in successful contact lens wear. ■

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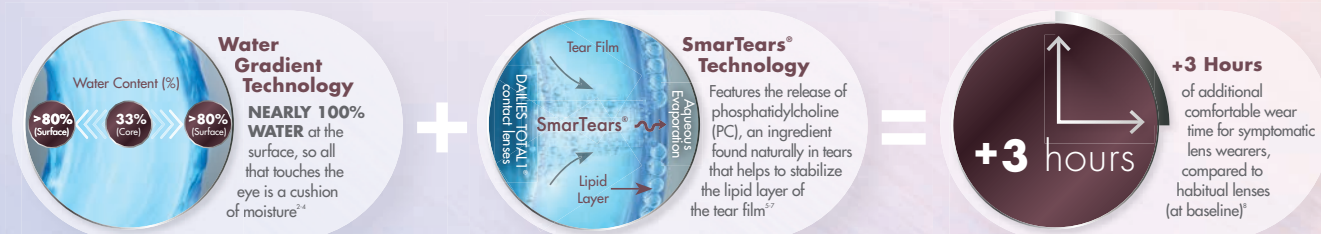
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DAILIES TOTAL1® contact lenses,^{8,14,16} these patients can feel more confident, focus on the task at hand and get more out of each experience.

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Where are All the Characters?

Kids these days need to step up their game to spice up this profession.

By Montgomery Vickers, OD

Have you ever thought about what makes you special? Or have you fallen into the trap of conformity that comes from the uniformity of your schooling and continuing education? Back in the day, each optometry school had a personality and was staffed by personalities; you could almost tell which school ODs attended by their knowledge and application of it.

Good ol' Pennsylvania College of Optometry (PCO) was significantly involved in medical optometry in the late '70s, and the school leaders were instrumental in the medical optometric movement. Because PCO was so medical, we had some insane professors in chemistry, biology, medical diagnosis and treatment. Yet, I wasn't sure how to take a PD or measure a seg height until I saw my first patient and realized he didn't give a crap about his arcus. He just wanted to see the preacher and his hymnbook.

I soon realized folks from Southern College of Optometry actually knew how to prescribe a contact lens, docs from Illinois had a broader range of knowledge on just about every topic and no stupid docs came out of THE Ohio State School of Optometry (so far, but I am still watching you). And SUNY docs, well, they're from New York, so they think they know everything.

But these days, kids have a better chance of being accepted into optometry school than they do hearing the word "Trump" on a newscast. But are they

unique? They seem to be cloned. Homogenized.

Time for Some Spice

It is time for you to become colorful and amazing. You are not boring! OK, you are, but let's pretend something interesting is in there somewhere. Here's the plan:

1. Get a tattoo. Not a snake around your neck or "L-O-V-E" on your knuckles. Just something that will remind you of that little nugget of fearless creativity God gave you. What tattoo did I get? I would never do something so dumb. My patients already know I am crazy.

2. Take dance lessons. This will make you so much more graceful and will help with the hunchback you developed staring at whatever that thing is you found in that retina. I myself took Two-Step lessons. Of course, to practice in Texas, you have to pass a practical exam that includes the Two-Step, so it was a practical choice.

3. Offer something no one else can. Maybe leech-assisted chalazion removal? I just tell patients I don't like to write the number eight. The staff reminds them they will hear that story every

year unless they purchase their contact lenses from us.

4. Dress like you have a soul. For some folks that means wearing a nutty tie every once in a while. For others, zipping your fly would be a good start. It helped my practice.

5. Remember something about every patient. Do they love baseball? Are they in a band? Did they recently escape from a prison? This is important stuff, and it must be far more accurate than their cup-to-disc ratio. Especially those who escaped from prison. They hate when you think they're in a band.

6. Get a hobby. Not golf—something cool like not texting. I erect skyscrapers. Oh, and I marry and divorce wealthy superstar actresses. That's why I take Fridays off.

Be special. You are, aren't you? Let your freak flag fly! Optometry (yawn) needs it. ■



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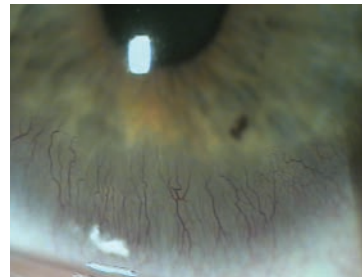
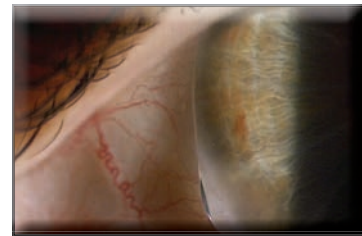
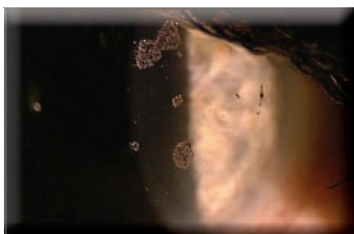
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Playing the Field

Keep an open mind when dealing with tricky neuro cases. **Edited by Paul C. Ajamian, OD**

Q A patient complains of vision loss OS and a headache for the past month. Where do I go from here?

A With vision loss of potential neuro origin, it's important to remember that it's easy for patients to cheat on confrontation field testing if you aren't attentive. It's useful for screening, but dig deeper if the results don't make sense, advises Paula Johns, OD, of Santa Fe, NM.

Dr. Johns recently treated a 71-year-old Native American female with these symptoms. Medical history was significant for kidney transplant, immunosuppression and deep vein thrombosis. Her ocular history included pseudophakia and low tension glaucoma, which was well controlled with latanoprost Qhs.

During the exam, best-corrected visual acuity was 20/20 OD and OS. Dr. Johns found no relative afferent pupillary defect, and the patient's anterior and posterior segment findings were normal. Confrontation field testing appeared to be normal.

Based on these initial findings, Dr. Johns considered a possible diagnosis of an old branch retinal artery occlusion, presenting as a whitening of the retina in the acute phase but returning to a normal appearance, as found on dilated fundus exam here.

Dr. Johns had the patient return in two days for further testing, including automated visual fields, where she expected to find an altitudinal visual field defect. Instead, she discovered a complete homonymous hemianopsia. Based on those findings, Dr. Johns predicted a left occipital lobe abnormality and ordered a CT scan immediately.

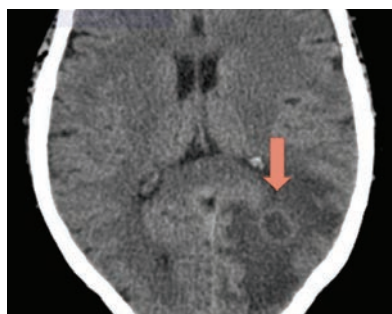


Photo: Paula Johns, OD

Fig. 1. The patient's CT revealed a ring-enhancing lesion and vasogenic edema.

Differentials

Since homonymous hemianopsia is found in myriad conditions, Dr. Johns considered several diagnoses, including stroke, its most common cause in adults.¹ But a tumor cannot be ruled out initially—10% of cases are caused by one.² If a tumor is suspected, imaging with CT or MRI should be ordered with special attention to the part of the brain expected to have the lesion, she says.

Trauma is another possible etiology, accounting for 10% to 12% of cases.^{2,3} Such lesions can be occipital. A majority (54%) of homonymous hemianopsia patients with traumatic brain injury have multiple brain lesions.^{2,3}

Other differentials to consider are multiple sclerosis (MS) and Alzheimer's disease. The posterior form of Alzheimer's can cause homonymous hemianopsia, and patients may not experience other Alzheimer's symptoms. Brain imaging may be normal or may show cerebellar atrophy.^{2,4}

Cases arising from MS are uncommon; when it presents, optic neuritis is the most common ocular

manifestation. Visual field defects in MS usually have good prognosis and resolve over months.^{2,5}

Infection is yet another potential cause, and a brain abscess can lead to a symptomatic mass effect. If infection is present, the CT will show an abscess. Although rare, infection can be more common in immunocompromised patients.^{1,6}

Imaging and Next Steps

This patient's CT showed a ring-enhancing lesion to the left occipitoparietal lobe with surrounding vasogenic edema (*Figure 1*). The assessment was left homonymous hemianopsia secondary to suspected brain abscess. The patient was sent to a local emergency room.

At the hospital, the initial suspicion was toxoplasmosis. However, the patient tested negative on cerebrospinal fluid analysis, so the next steps were craniotomy and abscess drainage. The culture showed *Nocardia*, a gram-positive bacteria found in plants and soil that can quickly spread from its primary infection site to end-organ systems such as the brain. The patient was treated long-term minocycline and imipenem. Within a year, she had full recovery of the visual fields.

In challenging cases like this, the importance of CT or MRI imaging cannot be overstated, Dr. Johns says. A stroke is the most common diagnosis, but other pathologies must be considered. "By catching the brain abscess before it became more symptomatic, this patient survived what could have been a fatal infection," she says. ■



Sally M. Dillehay, OD, EdD

THE IMPORTANCE OF STEREOACUITY FOR MULTIFOCAL CONTACT LENS SUCCESS

A frequent question in online forums is “What multifocal contact lens is best for...?” Comments often include “This brand is better for that, and that brand is better for this.” One comment not generally discussed is the importance of stereoacuity to the success of multifocal contact lenses.

Why might stereoacuity be an important factor for multifocal contact lens success? Broadly defined, stereoacuity is the use of subtle differences between the two eyes to provide the perception of depth.¹ It requires good vision binocularly and intact bilateral visual pathways to operate.² Stereoacuity is vital for gross motor tasks such as crawling, running and jumping, and fine motor tasks such as writing, cooking, sports and turning pages.³

Although monocular clues exist for depth perception, stereoacuity is an important factor for quality of life in some populations,⁴ and occupational performance for surgeons and dentists.^{2,5} Drivers with decreased stereoacuity appear to be involved in more accidents.⁴ Binocularly is essential for complex visual presentations and good eye-hand coordination.^{2,4} Use of cell phones and computers require excellent eye hand coordination, and stereoacuity can be advantageous for these visual tasks.⁶

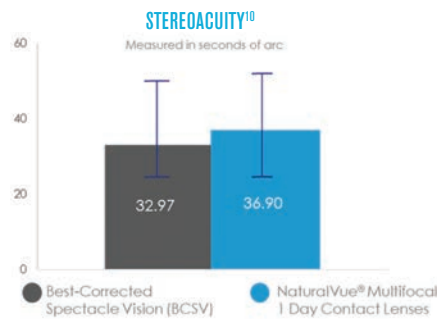
Any impact on the visual system will tend to disrupt stereoacuity, including brightness, contrast and image sharpness.⁷ Griffin referred to stereoacuity as the “barometer of binocularity.”⁸ Schor considered stereoacuity a “benchmark test for peak clinical performance of binocular vision.”⁹ The first requirement to achieve excellent levels of stereoacuity is to achieve excellent levels of vision.¹

NaturalVue Multifocal, a unique center distance extended depth of focus multifocal contact lens design, provides spectacle level visual acuity, within two letters of best-corrected spectacle vision at all tested distances.¹⁰ NaturalVue Multifocal also demonstrated stereoacuity within five

seconds of best corrected spectacle-vision.¹⁰

Richdale, et al,¹¹ determined that stereoacuity (126 sec.)

was the most likely factor in the ultimate preference rate of a center near multifocal (CNMF) over monovision after one month of lens wear. Woods, et al,¹² did not find a preference for a CNMF over monovision after two weeks of lens wear; however, their results demonstrated similar levels (102 to 110 sec.) of stereoacuity between the CNMF tested and monovision. Both of those studies were fairly short term. In a study of more than 200 well-adapted, long-term wearers of eight different brands of CNMF lenses (average wearing time



5.6 ± 4.1 years), the average stereoacuity was 185.8 ± 101.8 seconds.¹³ That value is likely an underestimate of the long-term impact of a CNMF on stereoacuity, as nearly 40% of the participants could not achieve even 400 seconds.

Taking those 40% into account, a more realistic estimate was approximately 272 seconds, a substantially low value given the normal expected range is 30 to 40 seconds.²

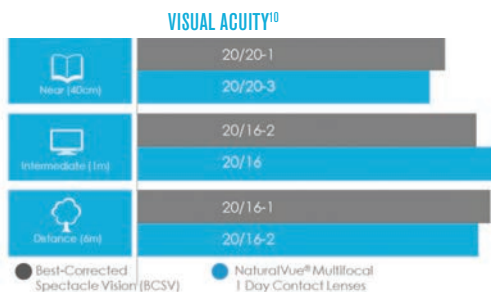
NaturalVue Multifocal achieves excellent subjective visual ratings and preferences as compared to patients' habitual corrections.¹⁰ After one year of wear, the repurchase rate for NaturalVue Multifocal was 92%.¹⁰ The published repurchase rate after one year for multifocal contact lenses in general is 57%, with the predominant reason for discontinuation being vision-related problems.¹⁴

Saladin stated that stereoacuity “sits at the top of the food chain of vision.”²¹ With these published studies, perhaps it is time to start considering the importance of stereoacuity to the success of multifocal contact lenses.

Sally M. Dillehay, OD, EdD is the Chief Medical Officer for ClinTrialSolutions, LLC. Her background includes more than 30 years of research in vision and contact lenses. She serves as a consultant to Visioneering Technologies, Inc. Dr. Dillehay is the former Chief Medical Officer, Vice President, Clinical & Regulatory Affairs for VTI.

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REDEFINING VISION



Peel Back the Layers

Managing patients with an epiretinal membrane often requires patience—and knowing when the time is right to refer. **By Diana Shechtman, OD, and Jay M. Haynie, OD**

An epiretinal membrane (ERM) is a fine layer of tissue that forms on the surface of the retina. Because it has contractile properties, the underlying retina can reshape, leading to visual symptoms of blurred vision, metamorphopsia, macropsia or monocular diplopia that do not always improve with refraction.

The prevalence of ERM varies and may be seen in up to 7% of the population, although the annual incidence of newly identified cases increases in patients with retinal disorders. With improved diagnostic capabilities with spectral-domain optical coherence tomography (SD-OCT) imaging, clinicians can more easily identify an ERM in the absence of significant visual symptoms—likely indicating the actual incidence is much greater. But being able to identify them earlier doesn't necessarily mean we need to remove them earlier, if at all.

ERMs occur secondary to vitreous changes, contraction or an

incidental posterior vitreous detachment in most cases, although other potential causes include peripheral retinal breaks, retinal detachment, vitreous hemorrhage, trauma, uveitis and intraocular surgery. An ERM can be associated with surface retinal traction that causes lamellar macular changes, partial-thickness macular holes and cystoid macular edema (CME). ERMs rarely cause a full-thickness macular hole, however.

Once an ERM is diagnosed, questions of management and when to refer for retinal surgery are of utmost importance.

ERM management can include medical treatment of any CME with topical steroids or nonsteroidal anti-inflammatory drugs, or surgical removal of the membrane. The primary goal of treatment is to reduce symptoms and any associated frustration. Unfortunately, even with surgical removal some patients will continue to have blurred vision with macropsia,

although the metamorphopsia may resolve entirely.

Clinicians often struggle to know when a referral is appropriate for these patients. The top concern for any treating OD is whether the patient has symptoms or is frustrated with their vision. If not, ODs can continue to see these patients once or twice yearly for primary care, SD-OCT imaging and follow up. If the patient is experiencing symptoms and reduced visual quality, a retina referral is warranted. Some retina surgeons require a reduction in visual acuity to a level of 20/60 to 20/80 before considering surgery, although most patients are more bothered by symptoms of distortion than blurred vision, and this experience most often drives the decision to remove an ERM.

Distortion Deterred

Case by Dr. Haynie

A 74-year-old Caucasian male was referred for an evaluation of poor vision in the right eye for the



Fig. 1. The patient's fundus image reveals a surface ERM in the right eye.



Fig. 2. FA shows surface retinal traction and vascular tortuosity.



Fig. 3. FA also highlights the presence of CME.

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past year. His medical history included hyperlipidemia treated with Lipitor (atorvastatin, Pfizer). His ocular history included prior cataract surgery in both eyes and retinopexy for a peripheral retinal tear in the right eye. His best-corrected visual acuity measured 20/300 OD, and Amsler grid testing revealed central metamorphopsia. Dilated examination revealed a prominent surface ERM in the right eye (Figure 1), while fluorescein angiography (FA) confirmed surface retinal traction, vascular tortuosity (Figure 2) and cystoid macular edema (Figure 3). SD-OCT demonstrated increased macular thickness with a surface ERM and macular traction (pucker) in the right eye (Figure 4).

After reviewing the risks, benefits and alternatives to retinal surgery—including that postoperative visual acuity and symptoms may take up to 12 months to reach maximal improvement—he elected to undergo pars plana vitrectomy (PPV) with peeling of the ERM and internal limiting membrane (ILM) and fluid-gas exchange.

He was positioned face down during the first 72 hours post-op. After six months, his visual acuity improved to 20/50 OD with resolution of metamorphopsia. SD-OCT images revealed a reduction in macular thickness, a smooth retinal surface and some restoration of the foveal contour (Figure 5).

Membrane Management Compared

Commentary by Dr. Shechtman

The extent of visual impact for the individual patient is what truly drives our retina specialists to pro-

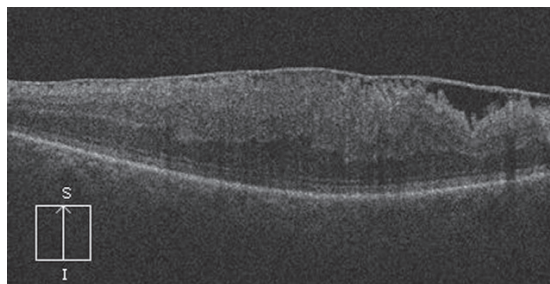


Fig. 4. The right eye's OCT imaging shows both increased macular thickness and macular traction in addition to the surface ERM.

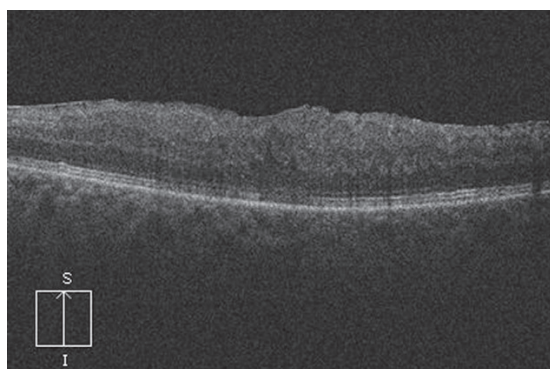


Fig. 5. Six months post-PPV, the patient's OCT shows significant improvement: reduced macular thickness, a smooth retinal surface and some restored foveal contour.

ceed with surgical intervention. Overall, most patients experience visual improvement following surgical intervention, although complete restoration of visual function is not always achieved. Thus, when we recommend surgical intervention, the patient's symptomology is always considered. I often recommend our referring ODs seek a consult when the ERM begins to impact the patient's daily activity or when they note a *correlating* visual acuity of less than 20/40. We do not customarily operate on patients with mild and non-progressive symptoms (especially in a patient who is *not* complaining), as results may be unsatisfactory.

The determination to proceed with surgical intervention varies on an individual basis. We may recommend surgery to a patient whose

visual acuity is 20/40 but is significantly bothered by the associated metamorphopsia, while we may simply observe a patient with a visual acuity of 20/60 who is not visually impacted by the ERM. Other considerations may include the status of the contralateral eye (e.g., is the patient a monocular patient?), the potential for further progression (particularly if it is associated with visual deterioration) and progression of structural changes.

Where I practice, treatment for ERM includes PPV with membranectomy (with or without intravitreal Kenalog to identify posterior hyaloid) and with or without ILM peel. If we choose to include ILM peel, we tend to use indocyanine green angiography to stain the ILM.

Surgery is often associated with excellent restoration of the normal retina architecture. However, many variables impact visual restoration, including: onset of symptoms, preoperative symptoms and visual acuity and secondary complications following surgery.

When surgery is recommended, patient education is critical. The patient needs to be aware of possible complications such as iatrogenic retinal breaks, retinal detachments, paracentral choroidal neovascularization or macular hole formation, cataract formation, etc. Furthermore, the patient should be aware of the small possibility of recurrence. Proper expectations regarding long-term visual function recovery are crucial for overall patient satisfaction with the management approach. ■



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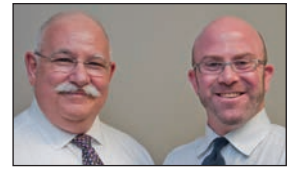
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Emmetropia isn't Perfect

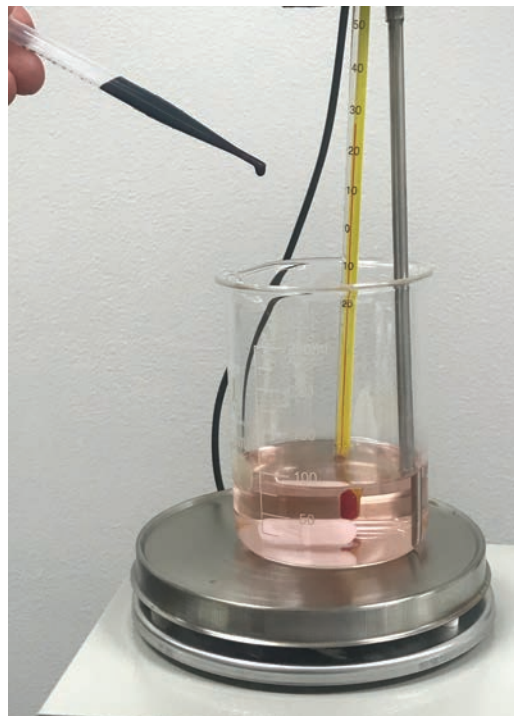
Hyperopia is expected at distance. This month, we explore its purpose and why it exists in the visual process. **By Marc B. Taub, OD, MS, and Paul Harris, OD**

It is easy to feel like your head is going to explode when a colleague asks a simple question that makes you stop and think... and think and think. The late Robert A. Kraskin, OD, asked, "Of what value is the +0.75 on the distance refraction to the human organism?" The answer that I (Dr. Harris) had been primed to give was also a simple one. I raised my hand and said, "A buffer." Then, he asked me to explain what I meant. It was only over time that I developed an understanding of buffers and the value of hyperopia to the visual process.

Finding a Solution

My first exposure to the word "buffer" was in the context of chemistry class and pH values. If you take two unbuffered solutions of equal volume and different pH values and mix them, you end up with a pH halfway between the initial values of each solution. However, things change when you buffer a solution. Simply put, a buffer is a solution that resists pH changes when either an acid or an alkali is added. A misconception is that buffering a solution will fix its pH at 7.0—the border between acid and base—when in actuality, a solution can be buffered to any pH.

Imagine we have a beaker of buffered solution at 8.0pH and a dropper of strong acid at 1.5pH. When the acid drop first attacks the buffered solution, the buffer counteracts the stress of the attacking solution and neutralizes it. The pH of the solution in the beaker remains at 8.0. As we continue to apply drops of acid to the solution, the buffer repeatedly absorbs the attacks, and all is well. However, there is a practical limit to all buffers, and



As acid attacks the buffered solution, the buffer fights back and resists an impending pH change.

at some point, the buffer runs out of its ability to stabilize the pH in the beaker. At this point, the pH begins to shift toward less base and then less acid as the attack continues.

Stress and Myopia

The analogy here is that the +0.75 is the buffer for accommodative stress, which results from the near-centered visual activities we engage in during our waking hours. That mile marker (+0.75) is the expected distance refraction through which our patients should still be able to read a good 20/20 at distance.

Research into what is now termed near-induced transient myopia (NITM) has discovered variations in refractive findings on a series of regular cycles, such as diurnal or daily cycles, with different lengths. If

we assume normal hours for a person's sleep cycle, we would see no NITM at the beginning of the day, but it would get worse and worse throughout the day, directly proportional to the amount and intensity of sustained close work done and many other associated factors—such as attitude, appraisal, rest and nutrition, to name a few. It is interesting to note that some NITM shows up first in only one meridian with minus cylinder axis 90, which changes as the day progresses and indicates what is happening.

Mapping the +0.75 of hyperopia onto the chemistry example, the +0.75 is the buffering agent. The close work done, with the host of factors modulating the responses to the stressor, is the acid attack. As the near work is carried out, some of the buffer is consumed. Thus, refractions done later in the day on the same

patient often show more myopia or less hyperopia than those done earlier in the day. We must take precautions with the refractive data determined later in the day.

Seeing the Signs

Not all patients follow the same cycles. For some patients—those who practice good nutrition, get eight hours of sleep, exercise regularly and use good posture while performing close work—the variation in their distance refractive findings from 8am to 8pm is quite little. But, shift each of those factors to the negative side and you get wide variations over the course of the day, the week (best Monday morning and worst Friday evening) and the school year (best in September and worst in May).

The presence of the +0.75 at distance, through which our patients can still read 20/20, is a measure of their buffer and its availability to help them meet the visual needs of their day. The absence of the +0.75 in the distance refraction means that, at the first sign of NITM creeping in, they will experience distance blur. At first, this blur is short-lived. When patients look up from their computer or phone, things may look a bit blurry before they eventually come into focus. After more time passes, however, that blur becomes worse and takes longer to clear up. Late in the day, the blur may be rather significant and last for an extended period of time. That blur is a sign that the patient lacks proper rest, exercise or nutrition.

In Plane Sight

To confirm this, a colleague from Arizona, Rob Lewis, OD, and I conducted an experiment. We both are garden-variety hyperopes and love to read. When traveling to meetings in each other's cities, we would meet each other at the airport with retinoscopes in hand. NITM was noted every time, and more often than not, it was asymmetric with some minus cylinder axis 90. When getting off the plane, both of us noted that signs in the distance were blurrier than usual. Those signs would clear up over time, but the longer the flight and the more time spent doing sustained close work, the longer it took for distance vision to return to baseline.

Our patients need their buffers identified and preserved whenever possible. In the meantime, the next time you travel and read more than you usually do, check your vision at distance before and after you do that close work, and see for yourself how well your buffer is or is not protecting your distance visual acuity. Or, on your next family trip, bring along your retinoscope, and be sure everyone reads, reads and reads some more—or plays videogames—and then check their retinoscopy when you arrive. ■

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42nd Annual Contact Lens Report

Dissecting the Soft Contact Lens

The quest for comfort goes beneath the surface. **By Karen K. Yeung, OD, and Cindy K. Dinh**

Despite today's robust contact lens market, researchers continue to strive for the most comfortable and the healthiest lens possible, spending countless hours and resources improving oxygen content and lens tribology. "Tribology?" you may ask, unfamiliar with the term. The concept combines the more familiar notions of *wettability*, *friction* and *lubricity* when describing how two surfaces interact as they come into contact with each other. It is an apt way to think about the challenges inherent in contact lens wear. Lenses with a lower coefficient of friction may be associated with more end-of-the-day comfort, for example, and wetting agents are often incorporated into contact lens solutions to improve comfort.¹

As the industry evolves and churns out newer lens options, clinicians sometimes struggle to understand which aspects of a lens will impact a patient's success. To help, this article discusses oxygen permeability, water content, modulus and tribology, in regard to the lens lubricity and wetting angle, and how they are being implemented in the latest contact lenses.

Oxygen Transmissibility

Dk/t, the unit of measurement for oxygen permeability through a contact lens, depends on the thickness of the lens. Re-evaluating the classic Holden-Mertz oxygen

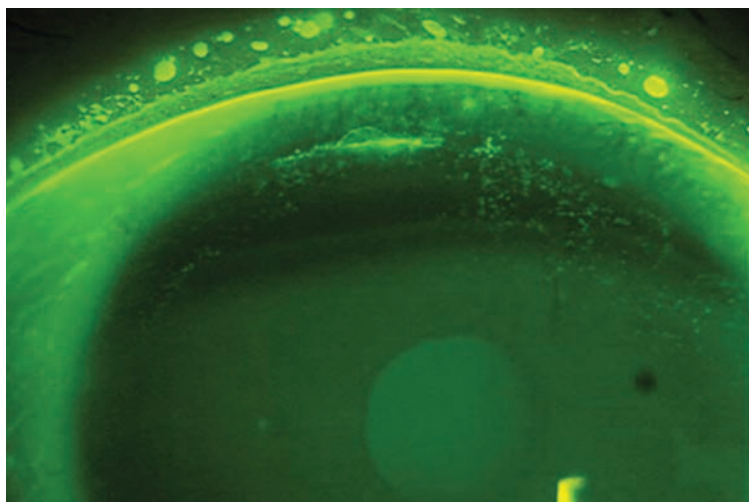


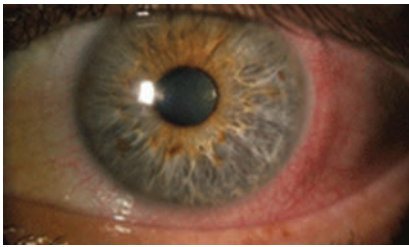
Photo: Sathi Srinivasan, PhD, BSOptom

Superior epithelial arcuate lesions, as seen here, can result from mechanical friction of a contact lens on the cornea and are mostly seen in those who wear high-modulus SiHy contact lenses.

transmission values, researchers estimate that the average Dk/t required to preclude corneal hypoxic changes is 25 Fatt units to 30 Fatt units for daily wear lenses and 125 Fatt units for extended wear lenses.²

Unfortunately, clinicians rarely know the Dk/t values of the contact lenses they prescribe because labeling requirements do not mandate their inclusion. Contact lens manufacturers only provide the Dk/t of the center of a -3.00DS lens. This, however, is the thinnest portion of a minus lens, and the local Dk/t of the thickest portion of the lens should be evaluated instead, as this

Photo: Ken Daniels, MD



Controlling the Dk/t, wettability, friction and lubricity of a patient's contact lens material can minimize lens issues, such as the contact lens-associated red eye pictured here.

Other researchers estimate that a peripheral Dk/t of 30 Fatt units or 40 Fatt units on a myopic contact lens should protect most corneas from developing neovascularization.⁶ As older HEMA contact lenses are replaced with silicone-hydrogel (SiHy) materials that have ever-expanding parameters and options, corneal hypoxia will hopefully become an issue of the past.

The latest SiHy contact lenses do not have as high of a Dk/t as the first generation SiHy lenses, but they have well-exceeded the minimum oxygen transmissibility values to prevent corneal hypoxia and more or less eliminated hypoxic stress.⁷ In addition, several studies document improved signs of hypoxia with decreased limbal hyperemia and end-of-the-day redness concurrent with rapid and sustained improvements in symptoms of comfort and dryness after patients were refit from HEMA to SiHy contact lenses.⁸⁻¹³

According to the Tear Film and Ocular Surface Society's International Workshop on Contact Lens Discomfort, stricter experimental designs are needed to prove that oxygen permeability, not factors such as surface and bulk properties, increases contact lens comfort.¹ Unfortunately, an experiment that controls for all lens factors may never be possible. Contact lens manufacturers, however, continue to diligently create new materials and designs to help improve lens comfort.

Water Content

The higher the water content in a contact lens, the more oxygen reaches the cornea during lens wear. HEMA lenses with lower water content have lower lens hydration and are more comfortable than their higher water content counterparts.^{14,15} This is because a HEMA contact lens with high water

is the limiting factor for oxygen permeability.^{3,4}

One study shows that limbal hyperemia is dependent on soft contact lens oxygen transmissibility in the lens periphery.⁵



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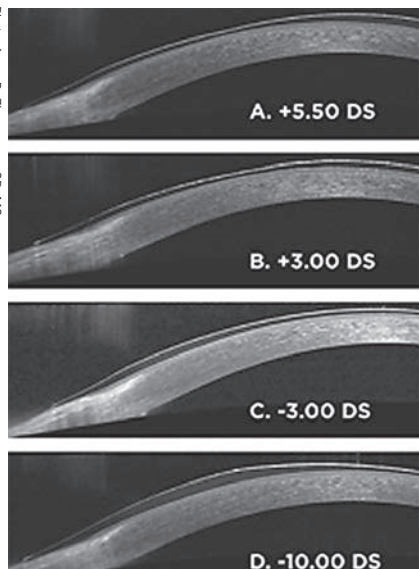
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Photo: Aaron B. Zimmerman, OD, MS



Listed here are soft lens thickness profiles of various powers (A-D). Each image is half a spherical lens from the approximate optic center to the edge. The center thickness of the -3.00DS lens is 70 μ m.

content loses moisture to the environment and absorbs water from the tears, potentially making the contact lens less comfortable.

For SiHy contact lenses, however, this association is not well-established; few studies correlate water content with lens comfort.¹ We do know that the water content of SiHy lenses has increased from 24% to 74%

over a 10-year period.¹⁶ This, combined with surface coatings, has led to a notable decrease in contact angle hysteresis, from greater than 40° in lotrafilcon A to less than 10° in delefilcon A.¹⁶ These advances have had a positive effect on our contact lens wearers; the less hysteresis, the more comfortable a lens is on the eye.

Modulus

This refers to the flexibility of the contact lens, which can significantly impact a wearer's success. The flexibility of the lens depends on the contact lens material, thickness and diameter.¹⁷ A softer material is generally considered more comfortable, and higher-modulus contact lenses are associated with poorer comfort, corneal staining, superior epithelial arcuate lesions, giant papillary conjunctivitis and mucin balls.¹⁸ However, lenses with a lower modulus can be difficult to handle, have limited eye movement and have altered optical performance from flexure.¹⁹

In HEMA lenses, the modulus directly correlates with the water content, which ranges from 30% to 80%.²⁰

First-generation SiHy contact lenses originally had lower water content and higher modulus compared with HEMA lenses, making them stiffer. Second- and third-generation products decreased the amount of

silicone and increased water content to improve lens comfort. Over a 10-year period, the silicone contact lens modulus decreased significantly, from 1.400MPa to 0.025MPa.¹⁶

The modulus of the latest generation of silicone contact lenses is now similar to the medium and high water content HEMA materials. Most of the studies that refit HEMA wearers into SiHy lenses report similar or higher levels of success, even when a lens with a high modulus was used.²¹

Friction and Lubricity

This is where the concept of tribology really comes to the forefront. Contact lenses that have little friction and a lower propensity for surface degradation have good lubricity.

The coefficient of friction is inversely correlated with contact lens comfort and can be lowered by adding surface coatings, plasma treatments or lubricants or by embedding bipolar surface-active agents—surfactants—into the lens material.^{1,22-24} One study found that an ultra-thin coating on a SiHy contact lens reduces surface friction and significantly improves comfort to levels achieved in patients not wearing contact lenses.²³ A reduction of 0.025 in the friction coefficient—as measured by sliding a contact lens down an incline plane—is associated with a one-unit improvement on a comfort 10-point scale.²²

The innate hydrophobic nature of silicone makes it necessary to add surfactants to lenses to increase their wettability and comfort.²⁵ Surfactants, while initially introduced to aid in removing lipid deposits, also lower surface tension and increase wettability.²⁶

Researchers are now developing compounds found naturally in the body, notably phosphorylcholine and albumin, to improve biocompatibility. These agents

Measuring the Contact Angle Hysteresis

When using the Wilhelmy plate technique, a rectangular sample of contact lens material is immersed in and removed from a solution. The forces that the sample undergoes as it is lowered into and taken out of the liquid are recorded and used to calculate the contact angle. The advancing contact angle is measured as the sample is inserted in the solution, and the receding contact angle is found when the lens is removed from the liquid. The difference between the advancing and receding contact angles is known as the contact angle hysteresis.

Campbell D, Carnell SM, Eden RJ. Applicability of contact angle techniques used in the analysis of contact lenses, part 1: comparative methodologies. *Eye Contact Lens*. 2013;39(3):254-62.

mimic membrane layers, minimize lipid deposition and reduce protein adsorption and inflammatory responses.²⁷ Surfactants are also added to multipurpose contact lens solutions to maintain lubricity, control the signs and symptoms of dry eye and enhance the stability of the tear film.

Wettability

The degree to which the tear film can cover and maintain itself over a contact lens is important to successful lens wear but difficult to truly quantify.²⁸ *Ex vivo* wettability is evaluated by finding the angle between the tear film and the contact lens; a wetter contact lens material has a smaller contact angle. Although many ways to measure contact angles exist, there is no standard technique. Thus, the measurements and units for a given material may vary between research groups.²⁵

Overall, wetting angles alone are not sufficient to obtain a physically meaningful surface-wettability evaluation, and *ex vivo* results do not always correlate with *in vivo* comfort. Clinically, *ex vivo* wettability is often measured by the disruption of the tear film and the tear evaporation rate.²⁹⁻³¹ While HEMA lens wettability is important in patients with dry eye, it is clinically indistinguishable in patients with a stable tear film.²⁵

To improve the wettability of HEMA lenses, contact lens manufacturers may add wetting agents to blister packages and contact lens solutions. Common wetting agents include polyvinyl alcohol and hyaluronic acid, which are embedded in contact lenses and released from the lenses as they are worn throughout the day.

Because wetting agents embedded in HEMA lenses leach out over time, it is necessary to use a contact lens solution with wetting agents to uphold the lens wettability.³² Additionally, surfactants added to contact lens cleaning solutions increase the viscosity and lower the surface tension of the lens.²⁶

Silicone-based contact lens wettability is dependent on the surface treatment of the lens in combination with wetting agents embedded in the lens matrix rather than wetting agents in the contact lens blister package. One study found that some SiHy contact lenses are actually more wettable than HEMA lenses, especially when soaked in a surfactant-free solution.³² Active surface agents in HEMA soft contact lenses leach out from the lens matrix and must be replenished by contact lens solutions with wetting agents.³²



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Table 1. SiHy Contact Lens Comfort Parameters

Contact Lens	Manufacturer	Material	Wetting Agents	Water Content	Dk/t @ -3.00DS	Modulus (MPa)
Air Optix Aqua with Hydraglyde	Alcon	Lotrafilcon B	Plasma-treated TRIS, DMA, PEG	33%	138	1.00
Dailies Total1	Alcon	Delefilcon A	Phosphatidylcholine, internal water gradient	33% at core, 80% at surface	156	0.76
Ultra	Bausch + Lomb	Samfilcon A	PVP, siloxane	46%	163	0.70
Biofinity	Coopervision	Comfilcon A	No added surface treatments	48%	160	0.80
My Day	Coopervision	Stenfilcon A	Siloxane, methacrylate	54%	100	0.40
Acuvue Oasys 1-Day	Johnson & Johnson Vision	Senofilcon A	2nd gen TRIS, internal PVP	38%	147	0.72
Vita	Johnson & Johnson Vision	Senofilcon C	2nd gen TRIS, PVP	41%	103	0.77

Thompson TT. Tyler's quarterly soft contact lens parameter guide. TQ. 2018;35(3):1-68.

Today's Lens Options

The majority of recent-generation SiHy contact lenses contain modifications to improve comfort primarily by trying to boost wettability (Table 1). Here is a look at some of the latest lenses on the market that use extra wetting technology:

- Alcon's Air Optix Aqua with Hydraglyde lens contains a plasma surface treatment and a surface wetting agent designed to create a hydrophilic surface that resists lens deposits, according to the company.³³
- Alcon's Dailies Total1 lens has a 33% water core wrapped in a gel-like outer layer that transitions to 80% at the surface and almost 100% water at the outermost surface of the lens.³⁴
- Bausch + Lomb's Ultra lenses contain a high concentration of wetting agent polyvinylpyrrolidone (PVP) on the lens surface.³⁵ PVP is also distributed throughout the lens, allowing water to be stored within the matrix. This results in a relatively high water content of 46%.³⁶
- Coopervision's Biofinity lens combines two forms of silicone with hydrophilic monomers in a process that the company says makes additional wetting agents or surface treatments unnecessary.³⁷
- Coopervision's My Day lenses have the lowest amount of silicone (4.4%) compared with others in this class.³⁸ According to the manufacturer, this allows for more space within the lens for hydrophilic materials, a 100Dk/t, a water content of 54% and a modulus of 0.40MPa.³⁸
- Johnson & Johnson Vision's Acuvue Oasys 1-Day lens distributes PVP evenly throughout the lens

matrix in an attempt to replicate the properties of mucin as a means of improving the lens' interaction with the tear film.²⁶ The lens is also packaged in an electrolyte-balanced solution designed to mimic human tears.²⁶

- Johnson & Johnson Vision's Vita lenses use a combination of two modified silicones and, compared with Acuvue Oasys, 30% more PVP integrated throughout the lens matrix to improve hydration and comfort without needing surface treatments, according to the manufacturer.²⁶

Comfort is Key

Contact lenses have many components that interact with one another *in vivo* on the eye, making what might feel like a simple process—fitting a contact lens—rather complicated. While extensive research into the various contact lens materials exists, more is needed to truly understand what makes the ideal contact lens. Fortunately, technology is moving in the right direction to allow for higher oxygen permeability, sustained lubricity and inherent wettability in lenses to maximize patient comfort and ocular health. ■

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Ms. Dinh is an undergraduate in the biochemistry department at UCLA. She will graduate in June 2019.

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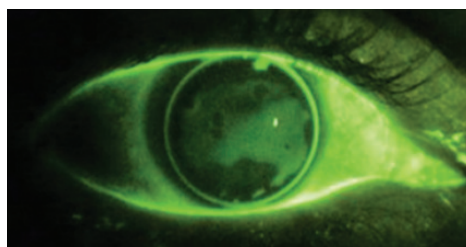
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42nd Annual Contact Lens Report

Polish Up Your Practice: Today's Contact Lens Surfaces

Sometimes it pays to be superficial—at least when it comes to contact lens advances. These surface treatments can increase patient comfort. **By Heidi Wagner, OD, MPH**

Contact lens experts have turned their attention to the contact lens surface and how it contributes to performance. This review of the strengths and limitations of current lens materials can help you better understand why surface treatments may be the next innovation in lens wear.



This image depicts poor wetting of a GP lens surface.

How it All Started

Contact lenses have come a long way from the days of polymethyl methacrylate acid (PMMA), a predecessor to today's gas permeable (GP) contact lens materials.

GP lenses. All but obsolete, PMMA contact lenses exhibited excellent optical qualities and lens stability and were resistant to lens deposits. These characteristics allowed for easy manufacturing and long replacement intervals.¹ PMMA was also impervious to rigorous wear and care practices and could withstand forceful handling and exposure to off-label cleaning products such as dishwashing liquid. Given the material's impermeability to oxygen and other gases, successful PMMA lens wear relied on adequate tear exchange to supply oxygen to the eye and remove metabolic byproducts.

In the late '70s, silicone was added to create a silicone acrylate (SA) material, a step closer to today's rigid GP lenses. Materials were then categorized according to oxygen permeability, or "Dk" value. In these early prod-

ucts, Dk increased in proportion to the silicone. The new material came with limitations, however, including significant protein deposition, flexure and parameter instability; they were also easily broken and scratched.

Fluorine was later added to minimize protein deposition, maintain oxygen permeability and improve wettability of the fluoro-

silicone acrylate (FSA) lens materials that are commonly used today.¹ However, these lenses still exhibit more flexure and surface scratches than PMMA.

With earlier generation GP materials, lenses with lower Dk polymers exhibited greater dimensional stability and wettability, which translated to improved vision and comfort.¹ Conversely, lenses manufactured with higher Dk materials were less likely to elicit ocular complications associated with hypoxia. Most of today's products optimize stability and wettability without sacrificing oxygen permeability.

Despite these significant improvements, contact lens deposition and wettability remain problematic, and poor wettability is frequently associated with today's FSA products. Specific patient populations are more susceptible, as ocular conditions predisposing the patient to poor lens surface wettability include severe dry eye, limbal stem cell deficiency, atopy and corneal exposure from nerve palsy or lagophthalmos.

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Surface Treatments



Images: Aiyssa Woodruff

Fig. 1. This artist's conception of contact angles—as measured by the sessile drop technique—shows (from left to right) low, medium and high angles.

The resurgence of scleral lenses, with their ability to vault the cornea and create a tear reservoir between the cornea and lens, provides new opportunities as well as challenges. The post-lens tear reservoir continuously bathes the cornea, allowing comfortable wear during waking hours. Patients with irregular corneas who experience lens intolerance or frequent dislocation with corneal lenses can now achieve adequate lens stability and wear time. Sclerals are often a management option for dry eye, particularly when conventional treatments are insufficient.²⁻⁴ They are also indicated for the treatment of conditions associated with neuropathic ocular pain.^{4,5}

While the lens-cornea fitting relationship promotes lens stability and limits corneal exposure, some patients may experience severely diminished comfort due to poor contact lens wettability. High Dk lens materials are integral to a successful physiologic response; however, lipid deposition is exacerbated by the properties of high Dk lens material, limited tear exchange and the conditions that predispose the wearer to this lens modality.

Soft contact lenses. In parallel to GP material developments, manufacturers added silicone to conventional hydrogel polymers, creating contemporary silicone hydrogels (SiHy) that were initially developed to eliminate hypoxia in overnight wear.⁶

Early generation materials were characterized by favorable properties such as exceptionally high oxygen permeability and lower dehydration but less desirable properties such as a higher modulus, hydrophobicity and lipid deposition. As a result, first-generation SiHy lenses rapidly eliminated ocular complications attributed to hypoxia but induced lens-related adverse events ascribed to the mechanical properties of the polymer, such as contact lens papillary conjunctivitis and superior epithelial arcuate lesions.⁷

Moreover, surface treatments only partially addressed the hydrophobic properties of silicone. Further innovations have yielded contemporary

products that optimize the qualities of both silicone and hydrogel polymers, culminating in lenses that are more wettable and biocompatible than their predecessors.

However, both clinical acumen and the literature point to contact lens discomfort as a principal limitation in lens wear. While SiHy lenses are now comparable in comfort to hydrogels, the contact lens dropout rate has remained stable at 15% to 20%.⁷ Despite improvements in technology, a substantial proportion of lens wearers discontinue contact lens wear, citing symptoms of ocular dryness and lens awareness.⁸⁻¹⁰

Problems on Top

Contact lens surface properties include: wettability (the ability of a solution to sustain contact with a surface), friction (the force that resists motion between two bodies in contact), lubricity (the capacity for reducing friction—a term describing the “slipperiness” of the material) and deposit resistance (the tendency of protein, lipid and other tear components to adhere to a lens surface).

Surface wettability is presumed to influence the biocompatibility of the lens surface. It may be assessed clinically by observing the interaction between the tears and the contact lens. *In vitro* wettability can be quantified by measuring the angle between a liquid and a surface. A small angle is attributed to the ability of the tears to spread over the lens, or a hydrophilic lens surface, while a large angle indicates poor wetting, or a hydrophobic lens surface.

Sessile drop, captive bubble and Wilhelmy plate techniques are well-established methods employed to measure contact angles *in vitro*. In the sessile drop technique, solution is applied to the contact lens surface with a syringe and computer software analyzes the recorded images.

In the captive bubble technique, a contact lens is submerged in water and a syringe is used to place an air bubble on the lens surface. The angle formed between the contact lens surface and

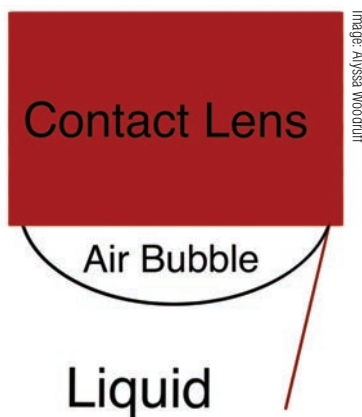


Image: Aiyssa Woodruff

During the captive bubble technique, the investigator places an air bubble on the surface of a contact lens submerged in water and then measures the angle formed between the lens surface and air bubble.

air bubble is measured in a similar manner to the sessile drop technique. In the Wilhelmy plate technique, a rectangular sample of the lens material is immersed and removed from the solution. The advancing contact angle is calculated as the sample is inserted in the solution and the receding contact angle is calculated as the lens is removed.¹¹ While laboratory-based measurements are not always indicative of performance on the eye, these methods provide useful measures of lens surface properties.¹²

Biotribology—the study of friction, lubrication and wear in biological systems—is integral to the understanding of the ocular environment and its interaction with contact lenses. In the application of biotribology to a contact lens on the eye, material scientists have employed the analogy of car hydroplaning: when hydration is plentiful, the ease of the car sliding is independent of the qualities of the car tires. However, when the water dissipates, the frictional behavior changes in response to other environmental characteristics.¹³ Likewise in contact lens wear, when wettability and lubrication are compromised, vision and comfort are compromised.

Recent studies demonstrate a strong relationship between subjective comfort and lens lubricity, as measured by the coefficient of friction.¹⁴⁻¹⁷ As a result, scientists are adapting existing lens materials and creating new lens surfaces to reduce friction and increase surface lubricity.¹⁸ Recent work suggests understanding the relationship between lubricity and comfort and

The Contact Lens-Dry Eye Paradox

Contact lens wear is known to disrupt the tear film and triggers symptoms of dryness in previously asymptomatic patients. The Tear Film and Ocular Surface Society's International Workshop on Contact Lens Discomfort characterized contact lens discomfort (CLD) as "adverse sensations related to lens wear [...] resulting from reduced compatibility between the contact lens and the ocular environment." CLD has been attributed to decreased wearing time and discontinuation of contact lens wear.¹ Lens material is one of the parameters influencing the compatibility between the contact lens and the ocular environment.

At the same time, scleral contact lenses are an established management option for ocular surface disease.²⁻⁴

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¹ Schanzlin, Olkowski, Coble, Gross. NuLids II Study, April 2018



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Surface Treatments

developing strategies to improve lubricity may promote contact lens comfort and decrease contact lens dropout.

Solutions in the Works

To combat contact lens surface issues, researchers have invented several manufacturing techniques and additional lens surface treatments:

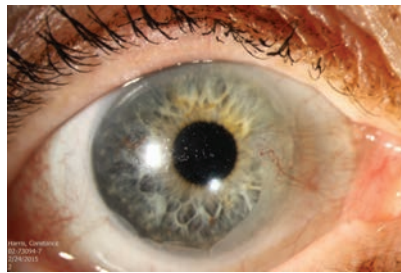
Plasma processing. This is used for both SiHy and GP contact lenses to create a clean, more hydrophilic lens surface that promotes initial lens comfort and reduces fogging. Plasma is sometimes described as a fourth state of matter, as its characteristics differ from those of solids, liquids or gases.¹⁹ Plasma is ionized gas consisting of positive ions and free electrons in proportions resulting in, for the most part, no overall electric charge.

GP lenses are exposed to high-energy radio waves in an ionized gas chamber. While laboratories increasingly use water-based, rather than solvent-based, reagents, plasma treatment can further eliminate impurities from the manufacturing process. The process modifies the lens surface but not the basic properties of the lens material. The lens surface becomes ionized, increasing its ability to attract more liquids. The hydrophilic nature of the treated surface impacts the adhesion characteristics, repelling protein, bacteria and other lens contaminants.²⁰

Plasma processing, optional but available on many GPs, has rapidly become routine, if not standard of care.

GP plasma-treated lenses are typically shipped wet in a conditioning solution. Lens care products that contain an abrasive cleaner should not be used on plasma-treated lenses. There are mixed reports regarding the use of alcohol-based cleaners; while such products do not damage the overall lens, the treatment effect may dissipate more rapidly as the surface returns to its original state.

Plasma treatment promotes initial comfort, but the effect decreases over time in GP lenses. While the surface cleaning may be temporary, the altered surface structure may be more permanent and the wettability and inhibition of lens deposits can last for weeks or months.²⁰ In contrast, plasma processing in SiHy lenses is inherent in the lens material; without it these materials would be extremely hydrophobic.



These images depict a soft contact lens before (top) and after (bottom) Hydra-PEG treatment.

Hydra-PEG (Tangible Science).

This coating is intended to improve wettability, increase surface water retention and lubricity, and minimize lens deposits and fogging.²¹ The coating is a 90% water polyethylene glycol (PEG)-based polymer that has traditionally been used in wound care management.²² The manufacturer describes it as a coating that encapsulates the lens in an ultra-thin polymer, mimicking the mucin-like surface of the cornea.

The lens surface coating can be applied to all contact lens materials including hydrogel, SiHy and GP, including scleral and hybrid lenses. At this time, Contamac, SynergEyes and Bausch + Lomb are global licensing partners that offer Hydra-PEG on some of their products.

Additional care considerations exist when prescribing lenses with this coating. A coated lens may be more difficult to handle and may require a brief adjustment period

for lens application and removal. Approved cleaners include Boston Simplus (Bausch + Lomb), Unique pH (Menicon) and Clear Care Cleaning and Disinfection Solution (Alcon). Buffered, preservative-free sterile saline is the recommended rinsing agent. Enzymatic, abrasive or alcohol-based cleaners should be avoided, as they may damage the coating and reduce its effectiveness. In contrast to plasma treatment, Hydra-PEG enhances wettability across the life of the lens if patients follow the care regimen.

The Future Looks Superficial

Surface treatments on the horizon will likely provide benefits well beyond refractive correction:

Antimicrobial films. Researchers have developed a process to coat lenses with an antimicrobial film to inhibit microbial colonization and biofilm formation with the ultimate goal of reducing the risk of contact lens-related microbial keratitis.²³

Wearable electronics. Plasma treatments and Hydra-PEG have been further developed to create lens materials that are both biocompatible and conductive. This could presumably be used in the development of smart contact lens technology, which serves as a platform for wearable technologies that can monitor health status in real time.²⁴

Regenerative technology. Other researchers have developed contact lens surface treatments that can be used as a substrate for the culture of limbal cells responsible for the maintenance and repair of the corneal surface.²⁵ Thus, this surface treatment technology could potentially contribute to the management of limbal stem cell deficiency and aid in other regenerative technologies.

Since their invention, contact lenses have always presented clinicians a challenging balancing act: keeping patients comfortable while also addressing their vision needs. Today's surface treatments are a significant weapon in the fight against wetting, lens deposition and friction issues—and something clinicians should consider them for patients who present with any of these complaints. ■

Dr. Wagner is a professor of clinical optometry and director of extern programs at Ohio State University.

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42nd Annual Contact Lens Report

The Compromised Cornea: Take Cover

Bandage contact lenses are crucial for corneal protection, but can present both clinical and coding challenges. Here's what you need to know. **By Christine W. Sindt, OD**

A therapeutic bandage lens is any contact lens used to promote healing, relieve pain and protect the ocular surface. The placement of these therapeutic lenses, whether temporary or as part of a long-term treatment plan, should be thought of as a medical treatment or procedure, rather than a lens per se. It is a medical prosthesis for someone who has been injured, is necessary for the health of the eye (not for vision correction) and can minimize the risk of progressive disability, ocular morbidity or both (*Figure 1*).

While a rewarding experience, fitting and billing for therapeutic bandage lenses can be complicated. These clinical and coding tips can help you ensure patients received the coverage they need to heal.

Defining the Terms

The ocular surface can be protected by several modalities, including a soft contact lens, gas permeable (scleral) lens or even, one day a 3D-printed bio-gel. While some soft lenses have applied for the FDA

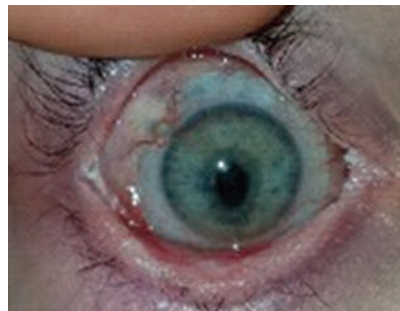


Fig. 1. Therapeutic bandage lenses, medical prostheses for injured patients, are not for vision correction. They are a medical treatment to avoid progressive disability, ocular morbidity or both.

indication and approval for bandage lenses, newer materials and designs may offer the advantage of a larger variety of parameters, biocompatibility and ocular surface protection (*Table 1*). Many of these therapeutic devices would be considered off-label use of the material or lens design, but are within the standard of care for treatment of the disease.

While soft contact lenses are frequently referred to as bandage contact lenses, it is more appropriate to refer to therapeutic scleral lenses as

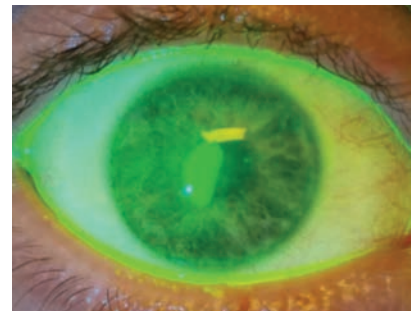


Fig. 2. This patient received a bandage contact lens after corneal collagen crosslinking. After removal of the bandage lens, the patient suffered an epithelial defect.

therapeutic scleral *prosthetic devices*. This terminology helps clarify the distinction between a highly customized device and an off-the-shelf disposable product that requires less skill to fit and which is (generally) replaced more frequently. This distinction also has billing implications.

Choosing a Lens

Soft bandage lenses are often used for wound coverage, such as placement after surgical procedures including superficial keratectomy,

Technology in balance



Health



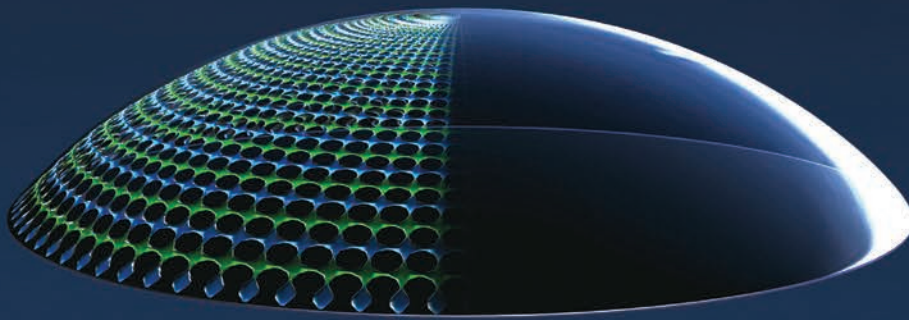
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Therapeutic Lenses

Table 1. FDA-approved Soft Bandage Lenses

Brand	Manufacturer	Most +	Most -	BC	Diam.	Dk	CT	H ₂ O
Acuvue Oasys with HydraClear Plus	Johnson & Johnson Vision	+8.00	-12.00	8.4, 8.8	14.0	103.0	0.070	38.0
Air Optix Night & Day Aqua	Alcon	+6.00	-10.00	8.4, 8.6	13.8	140.0	0.080	24.0
PureVision	Bausch + Lomb	+6.00	-12.00	8.3, 8.6	14.0	99.0	0.090	36.0
UCL 55%	United Contact Lens	+20.00	-20.00	8.3, 8.6, 8.9, 9.4, 9.7, 10.0, 10.3	14.0, 14.5, 15.0, 16.0 to 24.0 in 2.0 steps	18.8	0.130	55.0

Source: eyedock.com

phototherapeutic keratectomy and corneal collagen crosslinking. They can also be used for the delivery of drug compounds and management of bleb leaks. Disposable lenses, generally high Dk silicone hydrogel, are commonly used post-surgery to cover the wound and control pain. Disposables, with the advantage of being ubiquitous and inexpensive, can be effective in the treatment of persistent epithelial defects and exposure keratopathy, especially in combination with autologous serum eye drops and punctal plugs, according to research.¹⁻³ Some conditions such as bleb leaks require custom-made soft lenses.

Bleb leaks are a frequent complication after glaucoma surgery, with up to 30% of blebs leaking within the first two months post-procedure.⁴ The associated complications are quite serious, ranging from hypotony to endophthalmitis. Management of the leak will depend on the location, the rate of aqueous loss and the type of flap and surrounding conjunctival tissue. Serious

leaks need to be surgically corrected, but small leaks located close to the limbus may be tamponaded by a soft bandage lens (*Figure 3*). Clinicians should exercise extreme caution when fitting blebs, as factors such as lens size are crucial to success. The lens must be large enough to completely cover the leak; otherwise, the wound may increase in size. Similarly, if the lens edge rubs into the bleb, it may cause a bleb erosion.

Both hydrogel and silicone hydrogel lenses are good bandage lens options for bleb leaks. The lens should cover at least 2mm to 3mm past the limbus, so diameters of 16mm to 18mm are typical. The lens is left in place for two to four weeks as continuous wear. If the bleb and anterior chamber are formed, but the eye is still Seidel positive, the bandage lens should be reapplied. Topical antibiotics help to prevent infection while the lens is in place.

Therapeutic scleral prosthetic devices are used in long-term treatment plans when a chronic and ongoing injury to the ocular surface



Fig. 3. Large filtering bleb holes, like this one, require surgical correction. Small holes near the limbus can be managed with therapeutic bandage lenses.



Fig. 4. This patient with graft vs. host disease has fibrosis of the superior palpebral conjunctiva.

exists, such as Stevens-Johnson syndrome and graft vs. host disease. These diseases in and of themselves pose clinical challenges, as they represent highly inflammatory states and, even after years of successful lens wear, may have episodic flares of ocular surface inflammation, resulting in granuloma formation, deep stromal neovascularization and mucus production. These patients' eyelids can be highly fibrotic, causing lens-lid sensations (*Figure 4*). Additional structural concerns such as ectropion/entropion, severe meibomian gland dysfunction (MGD),

Old Dog, New Tricks

In the future, soft bandage contact lenses may be integral for the delivery of drugs, such as antibiotics, anti-glaucoma medications and anti-inflammatory agents. Research shows drug-laden contact lenses can increase the bioavailability of the drug by up to 50%, which eventually reduces the dose, dosing frequency, systemic drug absorption and associated side effects.¹ Investigators continue to explore many drug delivery systems, including soaking the lens in the drug, molecular imprinting, nanoparticles and liposomes. Crosslinked hyaluronic acid bandage gels also show promise in corneal healing in extremely compromised eyes.²

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Photo: Lee AWARD, MD

Coding Connection

By John Rumpakis, OD, MBA, Clinical Coding Editor



Corneal—and Coding—Protection

Billing for a bandage contact lens is simple—until it isn't. Here's how to do it correctly.

A patient presents urgently with an eye that is painful, light sensitive and red. He says he was playing basketball with friends. The basketball hit him in the head and he thinks it scratched his eye. So he thought it would be a good idea to come and get it checked out.

This scene plays out in any number of varying presentations in optometric practice, as the underlying diagnosis, corneal abrasion, is a fairly common clinical finding. For many patients, a bandage contact lens is an excellent treatment approach; it can provide protection during the healing process, relieve pain and protect the ocular surface.

While the clinical presentation and treatment regimen may seem straightforward, the coding for it may not be. Let's break it down to determine how to code the encounter from start to finish, including the diagnosis, initial treatment and follow-up care.

CPT Considerations

When coding with CPT for a corneal abrasion, you will have an office visit to code; in this case either a 920X2 or a 992XX code could be appropriate to use for describing your professional services in examining the patient, determining the primary diagnosis and developing a treatment plan.

Assuming your treatment plan includes applying a soft bandage contact lens, you would use 92071 to describe this service. CPT Code 92071 is defined as: "Fitting of contact lens for treatment of ocular surface disease."

This code, first appearing in January 2012, does not include the bandage contact lens material—only the service portion of the care provided. You can bill for the bandage lens material as well, provided you are not using a trial lens from your inventory.

You should also keep in mind that for most presentations there is no difficulty in billing both the office visit and the bandage contact lens fit on the same date of service.

In total, the coding for the first encounter, assuming it was the right eye, would be something like this:

CPT Coding

- 920X2 or 992XX
- 92071-RT (using the laterality modifier is critical to match your diagnosis)

ICD-10 Specifics

ICD-10 has a slew of codes specific to corneal abrasions and sports-related ocular injuries, and it can be a challenge to know them all. If you were to correctly and completely code the patient example above, it would look like this:

- S05.01XA – Injury of conjunctiva and corneal abrasion without foreign body, right eye, initial encounter
- W21.05XA – Struck by basketball right eye, initial encounter
- Y92.310 – Basketball court as the place of occurrence of the external cause
- Y93.67 – Activity, basketball

Many carriers don't require the W or Y ICD-10 codes, but they are appropriate coding protocol, and you should get in the habit of using them. The seventh character indicates the status of the injury and care. "A" would indicate that this is the initial visit, and the patient is under active management.

Upon follow-up two to three days later (depending on the size of the abrasion) when you remove the bandage lens, simply code an office visit commensurate with the service performed. Without complications, a 992XX code may be the appropriate choice here. With respect to the ICD-10 code, S05.01XD is appropriate, the "D" indicating a subsequent encounter.

Foreign Body Complications

If your encounter involves a foreign body, this changes everything for CPT coding. The Correct Coding Initiative edits only allow billing for the corneal foreign body removal, as an office visit is already included in the surgical procedure code; the bandage contact lens fit is not allowed to be billed on the same day as the minor corneal surgical procedure. You shouldn't modify your care because of this; you just can't bill for the office visit unless there are extenuating circumstances and you meet the definition of using a modifier.

The use of soft bandage contact lenses is commonplace in optometric practices. Knowing the rules and compliance issues that affect your medical record keeping and coding is just as essential as the clinical care you provide.

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

Therapeutic Lenses

symblepharon formation and limbal stem cell deficiency can complicate the fit (Figure 5).

Although tremendously helpful for many patients, therapeutic lens wear can be fraught with complications. Long-term use of lenses, especially with concomitant use of long-term antibiotics and steroids, can lead to resistance and unusual infectious pathogens.⁵ To mitigate these risks, clinicians should carefully evaluate whether the lens needs to be worn at night. In cases where continuous wear is indicated, a prophylactic antibiotic should be prescribed. In some cases of long-term management with continuous therapeutic scleral prosthetic lens wear, clinicians should consider educating the patient to remove the lens morning and night for cleaning and disinfection, which would eliminate the need for antibiotics (Figure 6).

Additionally, lid hygiene is an integral part of successful long-term therapeutic lens wear to prevent infection and inflammatory events (Figure 7). Patients may have a fear of touching and damaging their eyes when they have significant eye problems and avoid lid hygiene rituals. Lid hygiene treatments such as hypochlorous acid, however, can control the lid biome in an easy, safe and effective way during therapeutic lens treatment.

Other frequent complications include dry eye, lens deposits and corneal hypoxia. Often, the doctor must perform a risk-benefit analysis to determine how to handle each patient based on the indications for use and complications. For example, in the case of persistent epithelial defect with progressive scar or possible perforation, the hypoxia risk is often considered a minimal consequence compared with the risk of imminent loss of the eye. As the eye heals, wearing schedules and lens

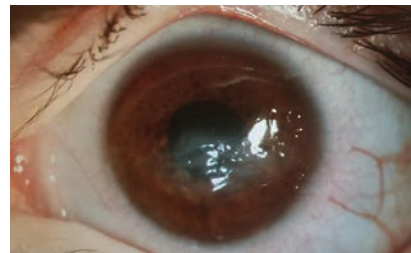


Fig. 6. This patient with neurotrophic cornea and severe lagophthalmos wears his prosthetic scleral device 24/7 and had significant resolution over three years, at right.

designs should be adjusted.^{6,7}

Cover Your Coding Bases

The first step to properly coding for a therapeutic bandage lens is ensuring the codes support its use. Clinicians cannot use refractive codes or refractive conditions, such as keratoconus, as the primary diagnosis code when billing for a bandage device (Table 2). While the device may have a vision benefit, that cannot be the primary reason for fitting. How the lens therapy is billed depends on the specific diagnosis and other treatments or procedures implemented concurrently. For example, a bandage lens cannot be billed if it is part of a standard treatment protocol and placed on the same day as a surgical procedure (Table 3).⁸

However, subsequent fitting of a bandage contact lens can be billed as a 92071 CPT code after the surgical

day (see, *Corneal—and Coding—Protection*, p. 45). This code is payable per eye and should be submitted with -RT, -LT or -50 for a bilateral procedure. The device itself is not considered part of the fitting code and should be billed separately using the appropriate contact lens V code.

While this code is payable during the global postoperative period, it can only be billed once. Therefore, if a patient is coming back weekly for adjustment or replacement of the bandage contact lens, the contact lens services are not considered a fitting and should be included in the E&M code for that day. Because the supervision rule does not apply to this code, a technician may perform this service. This code is never used for removal of a bandage lens.

The payment on this code is typically very low, with a Medicare national average of \$38.52.



Fig. 5. Structural concerns such as ectropion/entropion, severe MGD, symblepharon formation and limbal stem cell deficiency may require highly customized prosthetic devices.

Table 2. Diagnostic Codes in Support of Therapeutic Bandage Lenses⁸

G51.0 - Bell's Palsy
 H16.01X - Central Corneal Ulcer
 H16.05X - Mooren's Corneal Ulcer
 H16.07X - Perforated Corneal Ulcer
 H1612X - Filamentary Keratitis
 H16.21X - Exposure keratoconjunctivitis
 H18.83X - Recurrent erosion of the cornea
 M35.01 - Sicca syndrome (Sjögren) with keratoconjunctivitis
 S05.0XXX - Injury of the conjunctiva and corneal abrasion without foreign body
 T15.0XXX - Foreign body in the cornea

**Be sure to include which eye and if initial, subsequent encounter or sequela of the event.

Redefining Performance: A Sports Vision Specialist Makes a Difference

Eye care can shape the path for kids and professional athletes



By Keith Smithson, OD

*Sports Vision/Concussion Specialist
Northern Virginia Doctors of Optometry
Reston, VA*



The eye care that young people receive can have an enormous influence on the choices they make. Recently, a 16-year-old high school student came into my office needing help. She was a talented soccer player with the physical gifts to excel on the field. We did the usual tests and found that her eyes were healthy. She didn't need glasses or contact lenses. But on the field, her performance told a different story. She knew she wasn't seeing the ball as well as she could, and she was visibly frustrated.

My office had the tools to solve the mystery. After administering a battery of tests that measured her depth perception, visual processing speed, and her neurological quantification of ball movement, we concluded that the problem was muscular. I prescribed a regimen of eye exercises for her to improve reaction speed and efficiency in the muscles around her eye. If I had stopped after the traditional eye exam, said her vision was fine, and sent her home, this young woman might have never discovered how her eyes were holding her back. She might have started to question her ability or quit playing soccer altogether. Now, if she keeps up with her eye exercises, her performance won't be hindered by her vision. Who knows how far she can go?

Youth athletics and contact lenses are a natural fit

Eye care is pivotal for young people and goes beyond improving skills on the field. Contact lenses can take the place of glasses and contribute to a young person's self-esteem. They can improve acuity and peripheral vision, which may help kids move with greater precision while playing sports, as well as in daily life.

A thorough and accurate vision diagnosis can help a young person perform to their potential. We have access to amazing technology in the eye care profession, and we can use it to make a difference.

Bausch + Lomb provides us with one form of that technology in their remarkably innovative contact lenses. Bausch + Lomb Biotrue® ONEday contact lenses are my go-to contact lenses for youth sports, and it's easy to see why.

The aspheric optics provide crisp, clear vision, and they provide comfort so patients can stay active all day. These daily disposable contact lenses can be beneficial for kids in the often less-than-hygienic world of youth athletics. Bausch + Lomb Biotrue® ONEday contact lenses also offer UV protection,* which is a big plus for kids who spend hours in the sun each day. And parents are usually pleased with the affordability of the contact lenses.

Keeping our eye on the ball

Whether they're kids or adults, athletes need to be able to see well to perform at an optimal level. I provide eye care to every professional sports team in Washington, D.C., and I've helped players in a variety of sports see the ball or puck better with a change in contact lenses.

Bausch + Lomb Biotrue® ONEday contact lenses are my go-to contact lenses for youth sports, and it's easy to see why."

A professional baseball player came to me with a vision problem that was affecting his performance. Baseball demands extraordinary visual acuity. He was experiencing unexpected blur because his contact lenses were overcorrecting for his minor astigmatism. He was also unsatisfied with the comfort level of his contact lenses. I prescribed him Bausch + Lomb Biotrue® ONEday contact lenses, and the player was thrilled with how the lenses performed. The aspheric optics gave him the sharp vision he needed, and the innovative lens material helped make his eyes comfortable. Changing from his older toric lenses to Bausch + Lomb Biotrue® ONEday contact lenses helped with sharpness and comfort as well.

I've seen similar results with hockey players, Little Leaguers, and nonathletes of all ages. Having the right prescription and wearing high-quality contact lenses from Bausch + Lomb can provide comfort and clarity for nearly anyone. It's important for us to take time with each patient and work to find the best approach for them.

Kids learn many life lessons from sports, including persistence, how to be a team player, and how to work hard for what they believe in. If we provide eye care that helps a young person overcome challenges in a sport, we help them experience the life lessons that they might otherwise have missed. I believe that the eye care profession can work to bring advanced diagnosing methods to all of our patients. We can make innovative technology and detailed exams available to everyone, not just elite athletes. If we treat each young patient's diagnosis as an opportunity to help them perform better in life, there's no telling what they may accomplish. ■

**WARNING: UV-absorbing contact lenses are NOT substitutes for protective UV-absorbing eyewear, such as UV-absorbing goggles or sunglasses, because they do not completely cover the eye and surrounding area. The effectiveness of wearing UV-absorbing contact lenses in preventing or reducing the incidence of ocular disorders associated with exposure to UV light has not been established at this time. You should continue to use UV-absorbing eyewear as directed. NOTE: Long-term exposure to UV radiation is one of the risk factors associated with cataracts. Exposure is based on a number of factors such as environmental conditions (altitude, geography, cloud cover) and personal factors (extent and nature of outdoor activities). UV-blocking contact lenses help provide protection against harmful UV radiation. However, clinical studies have not been done to demonstrate that wearing UV-blocking contact lenses reduces the risk of developing cataracts or other eye disorders.*



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Therapeutic Lenses

The 92071 CPT code is specific to soft lenses, not a therapeutic scleral prosthetic device. The appropriate code for these lenses is V2627 (scleral cover shell), not V2531 (contact lens, GP, scleral), which is for the correction of vision. Many medical plans no longer cover scleral lenses and services because they are covered under vision plans; however, they will cover a therapeutic scleral prosthetic device for protection of the ocular surface. The Medicare national average for the V2627 code is \$1,232.25.

The rules on the V2627 code are vague and vary by insurer. Some insurers use the V2627 code solely for coverage of the durable medical equipment portion of the service, while others include the evaluation, fitting and follow-up care for up to six months. Office visits are always billed separately for evaluation of the ocular disease.

It is not always clear how often the V2627 code can be billed. For example, it is used for a painted ocular prosthesis, which is traditionally replaced less frequently than a therapeutic scleral prosthetic device. Replacement devices are supported when necessary to prevent a significant disability, when the prior prosthesis was lost or destroyed due to

Table 3. Procedures That Include the Placement of a Bandage Contact Lens on the Same Day of Service

65435 - Superficial keratectomy
 65780 - Ocular surface reconstruction; amniotic membrane transplantation
 65781 - Limbal stem cell allograft (e.g., cadaveric or living donor)
 65782 - Limbal conjunctival autograft (includes obtaining graft)
 68371 - Harvesting conjunctival allograft, living donor
 66999 - Refractive surgery (unlisted procedure code)
 65770 - Keratoprosthesis
 0402T - Corneal collagen crosslinking

Corneal Therapy Goes High-tech

In an effort to better mimic the natural cornea for medical therapy, researchers have been working on several 3D-printed bio-gel tissues that show promise for treating many corneal conditions, including limbal stem cell deficiency.^{1,2} Investigators out of Germany recently invented a 3D cornea-mimicking tissue using human stem cells that was then implanted in a porcine organ culture.¹ After seven days, the 3D-bioprinted structures attached to the host tissue, showing for the first time the viability of 3D-printed corneal tissue as a possible corneal therapy in the future.¹

Using an existing 3D digital human corneal model, other researchers in the United Kingdom successfully fabricated corneal structures that resemble the native human corneal stroma. The 3D-bioprinted structures were made from collagen-based bio-ink containing encapsulated corneal keratocytes and showed high cell viability both at day one post-printing and at day seven.²

These exciting innovations, while years away from clinical application, may one day transform how we care for corneal wound patients.

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circumstances beyond the recipient's control, the prior prosthesis can no longer be rehabilitated or a combination. Be sure to call the insurer prior to fitting and designing a therapeutic scleral prosthetic device to discuss the specific coverage and rules.

Therapeutic device fitting can be one of the most rewarding and clinically fulfilling experiences. It is also full of medical and financial risks. Before starting a fit, be sure you understand the time and materials necessary to care for the patient and the financial compensation. Often, standard fitting protocols do not apply to therapeutic lenses; instead, these patients require novel designs and materials. Experience, however, can heal all wounds. ■

Dr. Sindt is the director of contact lens service and clinical professor at the University of Iowa.

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8. Ophthalmic Coding Coach, American Academy of Ophthalmology.

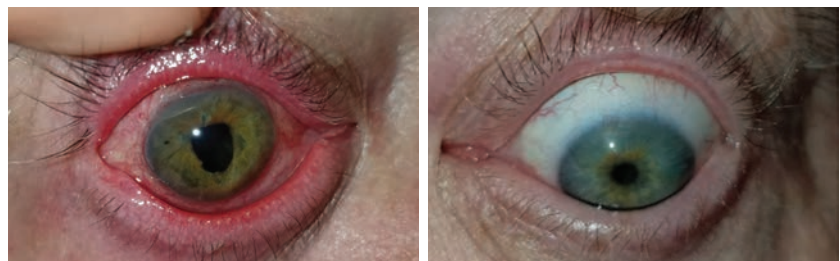


Fig. 7. This patient with severe meibomian gland dysfunction after trauma discontinued the habitual lid hygiene during therapeutic lens wear, at left, compared with contralateral eye at right.

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42nd Annual Contact Lens Report

SCLERAL LENSES: BOOM, DON'T BUST

These strategies can help you prevent a scleral lens complication surge in your practice. **By Nurit Ariel Wilkins, OD**

Scleral contact lenses have become increasingly popular due to improved materials, fitting techniques and more educated practitioners—all of which have led to greater success in patients. While this lens modality has traditionally been a last resort for visual correction, it is quickly becoming a first-line option for treatment and vision improvement in patients with refractive errors as well as with many ocular diseases.

Scleral contact lenses can delay the need for surgical intervention in patients with keratoconus or

other corneal ectasias and provide improved vision in patients who have already undergone surgery.¹ Likewise, they provide an alternative treatment for ocular surface disease and improved vision and resolution of symptoms in patients who have failed other treatments.² They also provide excellent visual acuity and comfort in patients with high ametropia.³

While scleral contact lenses create an opportunity to provide patients with optimal vision that would otherwise be unattainable, they also create a great responsibility for

practitioners to care for patients with complex ocular diseases. Part of that responsibility includes mitigating the increase in adverse events and complications that can result from the use of scleral lenses. Contact lenses introduce new risk factors to the ocular surface, and clinicians must not only manage the presenting ocular disease, but also prevent iatrogenic complications.

Clinicians should implement the best fitting techniques and follow patients with more complex pathology more closely with evaluation of the ocular surface and the contact

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Goal Statement: While scleral contact lenses have traditionally been a last resort for visual correction, they are quickly becoming a first-line option for treatment and vision improvement in many patients with and without ocular disease. With increasing popularity comes an increased risk of adverse events and complications. This article reviews prudent strategies clinicians can implement—such as fitting techniques and following patients with more complex pathology more closely—to manage scleral lens wear while also preventing iatrogenic complications.

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Fig. 1. This scleral contact lens edge is impinging on the conjunctival blood vessels, causing conjunctival blanching and circumlimbal injection.

lens fit at every visit. Educating patients about their condition, signs and symptoms of potential complications and of proper lens care can also go a long way toward helping prevent adverse events and promote safe scleral contact lens wear.

This article reviews prudent strategies to manage the complexities of scleral lens wear while also preventing iatrogenic complications.

Protect the Periphery

With an optimal scleral contact lens fit, the entire edge of the lens lands in alignment with the conjunctival surface without compressing the tissue. It can be difficult to achieve this aligned fit in patients with toric scleral or irregular conjunctival tissue such as conjunctivochalasis, pterygium, pinguecula or a filtering bleb. In fitting patients with complex physiology or pathology, more customized lens options are required to attain an optimal fit.

Irregular conjunctival and scleral surfaces commonly cause poorly fitting scleral landing zones, or haptic zones, by causing the lens to fit too tightly (compressing the conjunctiva) or too loosely (lifting off of the surface of the eye). Poor lens align-

ment leads to complications such as blood vessel blanching, discomfort, lens fogging, corneal and conjunctival desiccation and conjunctival prolapse. By understanding how to improve edge designs, often by incorporating toric haptics, practitioners can design optimal landing zones and avoid these conjunctival complications.⁴

Conjunctival blanching of blood vessels. This occurs when the contact lens lands or settles too tightly onto the conjunctival surface, compressing the blood vessels and impinging on blood flow (*Figure 1*). Blanching may not be evident initially, but can manifest throughout the day as the lens settles, eventually causing redness, circumlimbal congestion and discomfort.⁵ If lens wear is tolerated despite the poor fit, a compression ring with rebound hyperemia may occur once the lens is removed. Blanching can be sectoral, as commonly seen in patients with toric sclera, or it can occur around the entire haptic zone.

Impingement on the conjunctival blood vessels around the entire haptic zone can lead to lens seal-off, in which the lens becomes excessively suctioned onto the eye and may

result in difficult and painful lens removal. Additionally, lens seal-off creates stagnation of the pre-corneal tear and fluid reservoir, which can lead to epithelial toxicity.^{6,7} Prior to dispensing lenses, contact lens practitioners should optimize the edge design to avoid compressing the conjunctiva. The edge design can be improved by flattening the peripheral curves, increasing the diameter to spread out the landing zone or, in some cases, by reducing the sagittal depth of the lens.

Pterygium. Sectoral impingement can be exacerbated by conjunctival abnormalities such as pterygia or pingueculae. A pterygium is a 'wing-like' triangular growth of conjunctival tissue that encroaches onto the cornea.⁸ Hypertrophy of conjunctival epithelium and subconjunctival connective tissue creates irregular elevation of the conjunctival surface.

A pterygium induces irregular astigmatism, which cannot always be corrected with spectacles or conventional contact lenses. Scleral contact lenses provide excellent visual correction for patients with irregular astigmatism and therefore are a great choice for patients with pterygia; however, the elevation in the conjunctiva creates an irregular landing zone for scleral contact lenses (*Figure 2*).⁹

In these patients, clinicians must be careful to improve the vision without exacerbating the pathology. Pterygia usually occur nasally, causing the scleral contact lens to impinge upon the elevated area.

Patients with chronic conjunctival inflammation or irritation, a potential risk factor for a worsening pterygium, should wear contact lenses with caution, as poorly fit scleral contact lenses can exacerbate the lesion and accelerate the need for surgical intervention.¹⁰

Practitioners can often use lens

design strategies to prevent chronic mechanical stimulation or irritation of the elevated conjunctiva. These may include optimizing the diameter, vault, edge design or by implementing a notch into the edge of the lens. For example, selecting a lens diameter that causes the lens to land on the conjunctiva without impinging on the elevated tissue will prevent it from causing irritation or inflammation. Incorporating a notch is another useful technique in which the manufacturer removes part of the edge of the lens to ensure the lens avoids compressing the elevated conjunctiva.⁵

Lens fogging. When the edge of the lens is too flat and does not land in alignment with the conjunctival surface, the pre-corneal tear layer and fluid reservoir can seep out throughout the day, causing lens fogging and blurry vision, as well as corneal and conjunctival desiccation. Patients often complain of discomfort, as the elevated edges of the lens create a foreign body sensation and rub against the palpebral conjunctiva, causing irritation or papillary conjunctivitis. Clinicians can steepen the peripheral curves to avoid these complications.

Conjunctival prolapse. Conjunctivochalasis is redundant bulbar conjunctival tissue, usually between the limbus and lower eyelid.¹¹ This finding is common in elderly patients and may be associated with thyroid disorder.¹² The conjunctival redundancy can lead to symptoms of dryness, tearing, redness, poor lid-globe congruity and poorly fitting scleral contact lenses.¹² It can create an uneven

landing zone for the scleral contact lens, usually inferiorly, leading to a poorly fitting scleral haptic zone. In addition to disrupting the lens fit, conjunctivochalasis can also lead to conjunctival prolapse, in which the conjunctival tissue becomes trapped under the scleral contact lens.¹³ This is usually a benign finding, although with prolonged conjunctival prolapse, firm adhesion of the conjunctiva to the corneal surface is possible, which can create a synechia between the cornea and conjunctiva.¹⁴

To prevent this complication, patients should be well educated on proper insertion and removal, as well as the importance of an appropriate wearing schedule to avoid over-wearing their contact lenses.

Practitioners should also design a lens with an appropriate vault and landing zone to prevent adhesion between the cornea and conjunctiva. Ensuring proper lens centration can reduce the risk of conjunctival prolapse. To improve centration, practi-

tioners can adjust peripheral curves or incorporate prism ballasts or double slab-off technology. In well-centered lenses with conjunctival prolapse, reducing the overall diameter of the contact lens or reducing the vault over the limbus can help prevent conjunctival prolapse.

In cases where the base curve, vault or edge design cannot prevent conjunctival prolapse, frequent follow-up and monitoring is recommended. Contact lenses should be removed at each visit to allow for manual manipulation of redundant conjunctiva to ensure no adhesion.

If a redundancy of conjunctiva is causing dryness and tearing, artificial tear drops and gels can help manage symptoms. Increasing the vault in the midperipheral or limbal zone can help prevent any prolapsed conjunctiva from adhering to the limbus or corneal surface. In advanced cases that impede safe and comfortable lens wear, referral to an anterior segment specialist for surgical excision of conjunctivochalasis may be necessary.¹⁵

Most conjunctival complications can be managed with lens design, good wearing habits and communication with an anterior segment specialist when surgical or advanced medical management is indicated.

A Central Problem

Scleral lens wear can introduce several complications specific to the cornea as well. Here is a look at many of the common issues and how to avoid them.

Corneal epithelial staining. This is a complication that should not be seen in healthy scleral

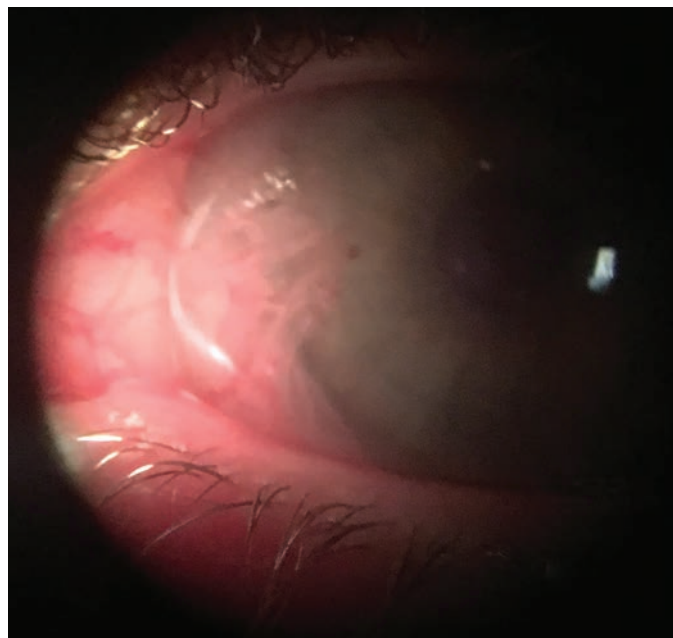


Fig. 2. The edge of this scleral contact lens is landing on a pterygium, causing compression and irritation of the elevated conjunctival tissue.

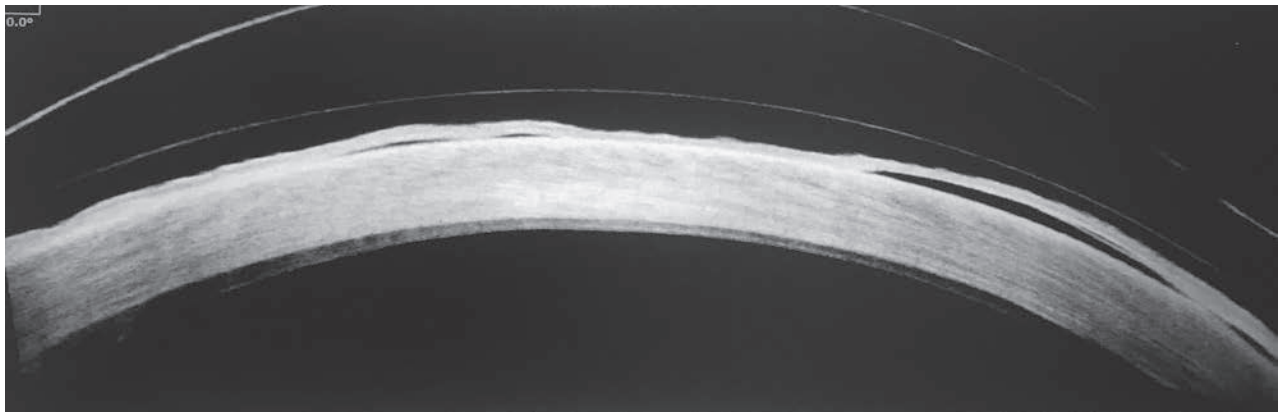


Fig. 3. This OCT evaluation of a scleral contact lens in a patient reveals a significant epithelial defect.

contact lens wear because lenses are designed to vault over the cornea without any touch or bearing, but may be seen if lenses are fit with insufficient corneal or limbal vault or if excessive settling takes place. Such a complication can lead to further corneal damage.

Compromised epithelial cells can cause pain and predispose an eye to sight-threatening infection, whereas intact, smooth corneal epithelium protects and defends against microbial keratitis.¹⁶ Thus, practitioners should always ensure adequate corneal vault in scleral lenses by assessing the lens fit after complete settling has taken place. Optical coherence tomography (OCT) is a useful tool to accurately assess corneal vault in areas of questionable bearing or touch.¹⁷ If there is any bearing seen over the cornea or limbus, the lens should be altered to increase sagittal depth.

Other causes of corneal staining include poorly fit lens edges that cause lens seal-off or lens edge lift, both of which can lead to corneal desiccation. Allergy or sensitivity to the solutions used to clean, store or fill contact lenses can also cause cornea staining.¹⁸ Clinicians should carefully educate patients on proper insertion and removal, as corneal abrasion can occur with improper insertion or removal techniques.

Epithelial defects should be well documented and treated until resolution, while non-healing epithelial defects should be referred to a corneal specialist for culturing and evaluation (*Figure 3*).

Hypoxic corneal changes. In scleral contact lens wear, these are not common; however, complications resulting from hypoxia may be seen with increased frequency as a greater number of patients are fit in scleral contact lenses, and as existing wearers continue to successfully wear their lenses over time. Most hypoxic changes are likely subclinical and benign.⁵

Bullae, striae and endothelial cell death are not typically associated with contact lens-induced edema, but research is still lacking on the effects of chronic edema over prolonged periods of time.

Acute corneal hypoxia causes corneal edema, which can affect any layer of the cornea. Epithelial edema may be subclinical and result in compromised epithelial integrity and increased risk of microbial infection. Stromal edema causes increased corneal thickness, haze and associated blurry vision. In severe cases, these symptoms can be accompanied by full-thickness edema, hypopyon or frank epithelial defects.¹⁹ These changes are uncommon in scleral contact lens wear due

to the highly gas-permeable materials used today, but can present in cases of contact lens over-wear, such as overnight wear.²⁰

In cases of extreme corneal hypoxia, lens wear should be discontinued, and symptoms should be treated with prophylactic antibiotics and cycloplegia.²⁰ While lens wear can resume once resolved, clinicians should stress to patients the importance of contact lens compliance, including adhering to the determined wearing schedule.

Chronic corneal hypoxia is also uncommon, but can have serious potential consequences. It can cause changes such as redness, decreased lens tolerance, endothelial cell polymegethism and corneal neovascularization.²⁰ These are more likely to occur in high-powered lenses, which have increased lens thickness, as well as in lower Dk lenses, highly vaulted lenses and with the extended wear modality.

Researchers who have looked at the long-term effects of scleral contact lenses on ocular physiology suggest fitting guidelines to reduce hypoxia: lenses should be designed with highest Dk, least lens thickness and minimal clearance to reduce risk of hypoxia.^{21,22}

Although today's scleral lenses use highly gas permeable materials and hypoxic complications are rare,

tear stagnation in the tear-lens reservoir can lead to epithelial toxicity. One study looked at the permeability of corneal epithelium and found that tear stagnation in overnight contact lens wear decreases the barrier function of the epithelium.⁶

Limiting wear time and optimizing scleral lens edge designs can prevent tear stagnation and corneal hypoxia, reduce epithelial toxicity and promote healthy scleral contact lens wear.

Keep the Bugs at Bay

Microbial keratitis is a rare, but potentially devastating, complication of scleral contact lens wear. While uncommon, it could become a more widespread problem as scleral contact lenses become more popular, as contact lens wear is the most common predisposing factor for microbial keratitis.²³ Other risk factors for microbial keratitis include ocular surface disease, prolonged steroid use and decreased corneal sensation.²³

Corneal infections should be detected early and treated promptly with appropriate medication to prevent permanent vision loss. Referral to a cornea specialist should be considered for management, including obtaining microbial culture and treatment with antibiotics.¹⁶

Contact lens hygiene is an easily modifiable risk factor, and adherence to healthy habits and use of appropriate solutions can reduce the risk of infection. The best way to prevent permanent vision loss from bacterial keratitis is to avoid contact lens over-wear and to educate patients regarding the importance of good contact lens hygiene.²⁴

Ocular surface disease is one of the most common indications for scleral contact lens wear, further promoting the modality's popularity. Patients with ocular surface disease can experience improved

vision, as well as resolution of keratopathy with the use of scleral lenses.² However, in treating ocular surface disease with scleral contact lenses, practitioners should be aware of the risks of infection in patients with keratopathy, thoroughly assess for signs of early infection even in the absence of symptoms, and consult a cornea specialist when needed.

Many patients require long-term steroid use as part of their disease or postoperative management and are therefore at increased risk for microbial keratitis. Decreased corneal sensation may be common in patients who have undergone corneal surgery, or who have previous history of corneal herpetic infection. These patients often require scleral contact lenses for ocular surface protection, as well as for visual correction, but are at higher risk for infection due to hypoesthesia. Increased monitoring and exceptional patient education can reduce the risk of ocular infection in these patient populations.

To prevent a surge in microbial

keratitis, practitioners should prioritize patient education to encourage safe and hygienic behavior from their patients.^{25,26}

After the Cut

The most common indication for fitting scleral contact lenses is keratoconus.²⁷ Corneal transplantation, specifically penetrating keratoplasty (PKP), is a full-thickness corneal transplant that is often the best treatment to restore vision in advanced keratoconus. This surgery has been considered a safe and effective treatment for corneal ectasia and scarring for more than one hundred years.²⁸

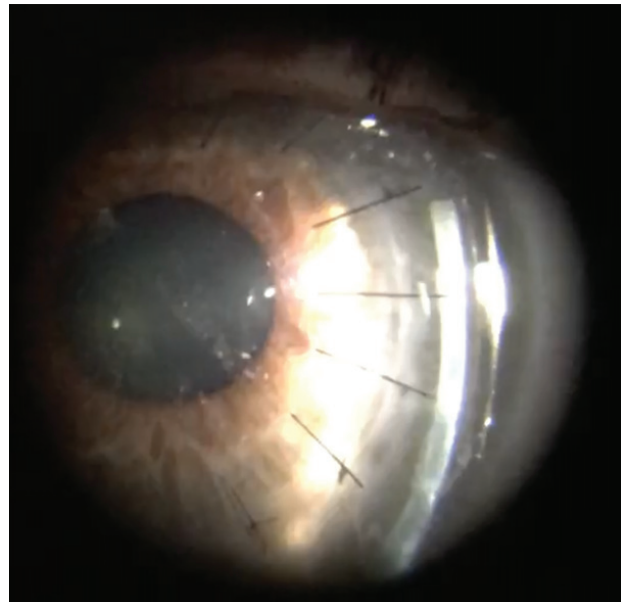


Fig. 4. Evaluation of a scleral contact lens with optic section reveals variation in elevation over the graft-host junction with sutures intact.

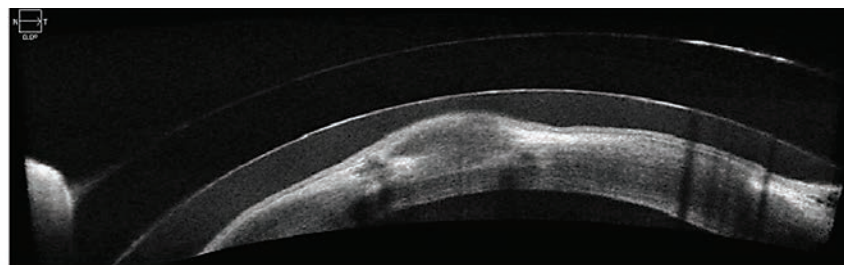


Fig. 5. Evaluating a scleral contact lens fit with OCT reveals clearance over the edematous graft-host junction.

PKP frequently results in significant amounts of astigmatism, which makes it difficult to achieve satisfactory visual acuity even once the eye has healed. Despite optimal surgical outcomes, many patients are left with poor vision due to high corneal toricity. When fit correctly, scleral contact lenses can provide safe and non-invasive treatment for refractive error and post-keratoplasty astigmatism and can prevent the need for additional ocular surgery.

In fitting scleral contact lenses post-PKP, the goals are the same as in any other successful fit: clearing the cornea and the limbus without excessive vault and landing in alignment with the conjunctival surface. However, transplanted corneas present more challenges due to significant differences in elevation between the donor and host graft. Edema at the graft-host junction presents an additional challenge because of increased elevation and irregularity. Another fitting challenge is the complex topography and variation in corneal graft shapes, with some being prolate, some oblate and some a unique combination.¹ Practitioners should avoid an excessively thick tear reservoir to allow for adequate oxygen permeability, as this is necessary for graft survival.

Failure to achieve an adequate fit can cause corneal hypoxia, edema, neovascularization and infection, and can lead to graft rejection. When sutures remain in place, the graft-host junction requires extra evaluation for loose or broken sutures, overlying epithelial staining or subepithelial infiltrates (*Figures 4 and 5*). If any signs of suture abscess or infection are seen, lens wear should be discontinued, and the patient should be referred back to the surgeon.

To prevent a surge in complications in patients who have undergone corneal transplantation, an

optimal fit should be achieved, followed by close monitoring. It is important to educate the patient extensively about signs and symptoms of corneal graft infection and rejection. Practitioners should look for signs of corneal graft rejection at every visit and ensure the contact lenses are not causing any corneal insult that could lead to rejection.

In comanaging post-PKP patients, practitioners should be vigilant in assessing for complications such as infectious crystalline keratopathy, herpetic epithelial disease, glaucoma, cataract and suture abscess.²⁸ It is important to identify signs of rejection early and treat aggressively by discontinuing lens wear, adjusting necessary parameters, initiating steroid treatment and referring back to the surgeon as needed.

Scleral contact lenses have extensive indications for visual correction and management of complex ocular diseases, making them an excellent option, for both practitioners and patients. Often the ocular pathology requires comanagement with an anterior segment specialist to prevent complications or worsening of disease. As contact lens practitioners, it is important to understand the ocular pathology being treated, the risk factors for complications and the signs to evaluate for at each follow-up visit.

By fitting scleral contact lenses with appropriate clearance over the entire cornea and limbus and proper alignment with conjunctiva, we can prevent complications such as corneal staining and hypoxia. Practitioners have a responsibility to educate patients on lens hygiene, appropriate solutions and potential symptoms of complications. Each of these strategies can go a long way to prevent any potential surge of complications with the increase in popularity of scleral contact lenses. ■

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- Scleral contact lenses can be worn by which of the following patient populations?
 - Patients with a refractive error.
 - Patients with corneal ectasia.
 - Patients with ocular surface disease.
 - All of the above.
- Which of the following causes an irregular landing zone for a scleral contact lens?
 - Ocular surface disease.
 - Irregular astigmatism.
 - Pinguecula.
 - Microbial keratitis.
- Which is true of conjunctival blanching?
 - It occurs when lens edges fit too tightly.
 - It is a normal variation of properly fitting lenses.
 - It is acceptable to see blanching, unless it causes pain or is not tolerated by the patient.
 - It causes the pre-corneal fluid-reservoir to seep out.
- Lens fogging is caused by:
 - Daily scleral lens wear.
 - The pre-corneal fluid reservoir seeping out

- throughout the day.
- The edge of the lens landing too steeply on the conjunctival surface.
- Contact lens decentration.

- Which of the following is not an appropriate adjustment to improve conjunctival blanching?
 - Increase the diameter.
 - Increase the base curve.
 - Steeper the peripheral base curves.
 - Reduce sagittal depth.

- Pterygia most commonly occur:
 - Nasally.
 - Temporally.
 - Inferiorly.
 - Infero-temporally.

- Which of the following is true regarding a pterygium?
 - It is elevated, causing an uneven landing zone for scleral contact lenses.
 - It can encroach onto the cornea, causing irregular astigmatism.
 - It can be exacerbated by scleral contact lenses when not fit properly.
 - All of the above.

- Conjunctival prolapse is most commonly seen in patients who have:
 - Pingueculae.
 - Pterygium.
 - Conjunctivochalasis.
 - Bleb.

- Which is an appropriate adjustment to reduce conjunctival prolapse?
 - Decrease the lens diameter.
 - Incorporate double slab-off technology to decenter lens inferiorly.
 - Increase central vault.
 - Steeper the landing zone.

- Which of the following is true of corneal epithelial staining in scleral contact lens wear?
 - It is a common complication, even in healthy contact lens wearers.
 - It is caused by sufficient corneal or limbal vault.

- Patients with staining should be referred to a cornea specialist if defects are non-healing.
- It can be prevented by encouraging patients to use preserved saline solution.

- Which of the following is true regarding corneal hypoxic changes seen in scleral contact lens wear?
 - It commonly leads to bullous keratopathy after extended wear.
 - It causes increased endothelial cell death in many patients.
 - It can lead to neovascularization and corneal edema.
 - Resulting corneal edema affects only the epithelial cell layer, having little effect on pachymetry values.

- According to studies, corneal hypoxia can be exacerbated by:
 - High Dk.
 - Reduced central lens thickness.
 - Minimal limbal clearance.
 - High corneal vault.

- Scleral contact lenses should not be worn by patients who have:
 - Irregular astigmatism.
 - Corneal ectasia.
 - Microbial keratitis.
 - Ocular surface disease.

- Which is not a risk factor for microbial keratitis?
 - Ocular surface disease.
 - Prolonged steroid use.
 - Conjunctival prolapse.
 - Decreased corneal sensation.

- Clinicians can reduce the risk of microbial keratitis in scleral lens wearers by:
 - Stressing the importance of contact lens hygiene.
 - Fitting the lens tightly.
 - Prescribing a long-term steroid.
 - Avoiding comanagement with a cornea specialist.

- Patients with ocular surface disease can experience the following benefits from

OSC QUIZ

scleral contact lenses:

- a. Improved vision.
- b. Fewer symptoms.
- c. Reduced dependency on other treatment modalities.
- d. All of the above.

17. Penetrating keratoplasty frequently results in significant amounts of:

- a. Astigmatism.
- b. Edema.
- c. Scarring.
- d. Ocular surface disease.

18. When fitting scleral contact lenses after keratoplasty, clinicians should keep in mind that:

- a. Bearing over the donor graft is acceptable as long as the host cornea remains adequately vaulted.
- b. Achieving optimal clearance over graft-host junction often creates a challenge.
- c. Scleral contact lenses are contraindicated as long as sutures remain in place.
- d. These patients require an oblate design to match the contour of the corneal graft.

19. Scleral contact lenses can be used safely in patients with:

- a. Acute full-thickness corneal edema.
- b. Subepithelial infiltrates and overlying epithelial defects.
- c. Corneal transplantation and graft-host junction edema.
- d. Corneal transplantation and early signs of rejection.

20. Which of the following strategies can help patients remain safe in scleral lens wear post-keratoplasty?

- a. Patient education on the risks of infection and rejection.
- b. Careful assessment for signs of corneal graft rejection at every follow-up visit.
- c. Communicate with comanaging surgeon should complications arise.
- d. All of the above.



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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. Improve my understanding of scleral lens designs for irregular conjunctival and scleral surfaces. (1) (2) (3) (4) (5)

22. Increase my knowledge of many common corneal complications and how to avoid them. (1) (2) (3) (4) (5)

23. Help me identify important aspects of every clinical exam to ensure healthy and safe scleral lens wear. (1) (2) (3) (4) (5)

24. Better understand the risks of microbial keratitis in scleral lens wear. (1) (2) (3) (4) (5)

25. Improve my knowledge of the role of scleral contact lenses after keratoplasty. (1) (2) (3) (4) (5)

26. Help me better understand how to safely overcome the fitting challenges in complex corneas. (1) (2) (3) (4) (5)

Rate the quality of the material provided:

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

27. The content was evidence-based. (1) (2) (3) (4) (5)

28. The content was balanced and free of bias. (1) (2) (3) (4) (5)

29. The presentation was clear and effective. (1) (2) (3) (4) (5)

30. Additional comments on this course:

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Play a Part in Postoperative Glaucoma Care

For every procedure our patients undergo, optometrists must develop a follow-up routine. Here's how to get started. **By Michael Cymbor, OD**

Glaucoma is the leading cause of irreversible blindness in the world.¹ And, while researchers are still speculating about the precise etiology and mechanism of the disease and the damage it causes to the optic nerve, one modifiable risk factor is known—intraocular pressure (IOP). Ocular hypotensive topical medications, laser procedures and numerous surgeries all aim to lower IOP and, ideally, stem any new damage.

While all optometrists can diagnose glaucoma and most have the legal privilege to treat glaucoma with drops, the number of ODs who participate in postoperative care of glaucoma patients is still growing. Within the last five years alone, we have seen an explosion of new surgical procedures available. This article reviews glaucoma-related procedures along with the postoperative care and the vital role optometrists can embrace.

Laser Peripheral Iridotomy

This procedure creates a hole in the iris that ideally causes an equalization of pressure between the anterior and posterior chambers. The laser peripheral iridotomy (LPI) procedure is performed with either an Nd:YAG laser, argon laser or a combination of the two. At one point, LPIs were done superiorly.² A 2014 study challenged that idea and many clinicians moved the placement to the temporal iris to reduce the chance of linear dysphotopsia.² However, a recent study is challenging that idea by concluding that linear dysphotopsia is independent of LPI location.³

One of the most underused techniques in our diagnostic toolkit is angle assessment. This is typically achieved by gonioscopy. Angle imaging such as angle

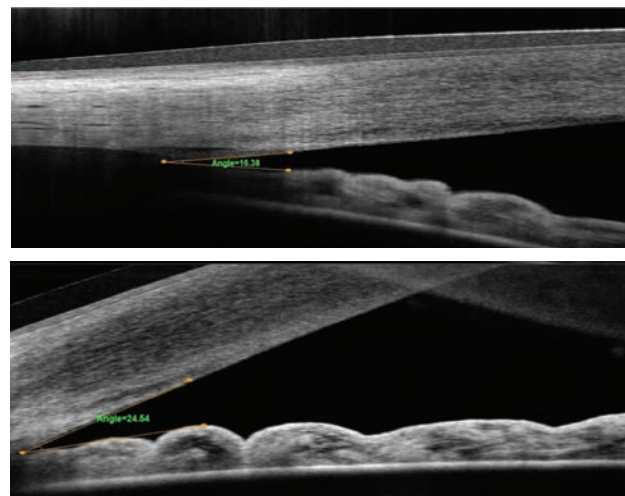
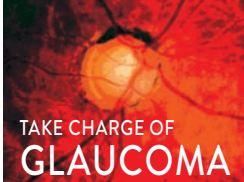


Fig. 1. These OCT images compare the angle pre- and post-LPI.

OCT or B-scan is complementary to gonioscopy and becoming more common. All referrals should include angle assessment. Take care not to erroneously label chronic narrow angle glaucoma cases as primary open angle glaucoma (POAG) cases. Always assess the angles prior to any type of laser or surgical intervention, whether you're comanaging with an ophthalmologist or you're in a state where optometrists can perform an LPI themselves.

Narrow angle is a difficult concept for most patients to understand. Convincing an asymptomatic patient to have a laser procedure can be challenging. One helpful tool is to show patients their actual angle. In our practice, we show them the OCT angle pre- and post-LPI (*Figure 1*). In the patients whose angles open with LPI,



Part 4: Surgery

Table 1. Setting a Schedule

Procedure	IOP reduction	Follow-up	Typical Regimen	Complications
LPI	variable	1-2 weeks	Pred Forte QID x 4 days	IOP spike, hyphema, A/C inflammation
SLT	20-25%	1-2 weeks then 2-4 months	Pred Forte or NSAID QID x 4 days vs. no drops	IOP spike, corneal abrasion, A/C inflammation
ECP	10%	1 day, 1 week, 1 month	Steroid + NSAID with tapering schedule, first week	IOP spike, hyphema, A/C inflammation
iStent	10%	1 day, 1 week, 1 month	Same as above	IOP spike, hyphema, A/C inflammation, CME
KDB	25%	1 day, 1 week, 1 month	Same as above but with 1% pilocarpine on taper	IOP spike, hyphema, A/C inflammation
Trabectome	30%	1 day, 1 week, 1 month	Same as above but with 1% pilocarpine on taper	IOP spike, hyphema, A/C inflammation, cyclodialysis
Cypass	30%	1 day, 1 week, 1 month	Same as above but with 1% pilocarpine on taper	IOP spike, hyphema, A/C inflammation, myopic shift
Xen	30%	1 day, q2-3 days, weekly	Steroid first week then adjusting steroid	IOP spike, hyphema, A/C inflammation, malposition, hypotony
Trabeculectomy	30-50%	1 day, q2-3 days for 2 weeks, q1-2 weeks until month 3	Same as above	IOP spike, hyphema, A/C inflammation, malposition, hypotony
Tube	30-50%	1 day, weekly for 1 month then every 2 weeks until bleb fills	Same as above	IOP spike, hyphema, A/C inflammation, malposition, fibrosis, hypotony, diplopia

we explain that this is a temporary fix and that the angle will continue to narrow as the natural lens becomes thicker. We help them understand that cataract surgery may eventually be needed to open the angle.

Should we consider clear lens extraction as first-line treatment for the treatment of primary angle closure or primary angle closure glaucoma if the patient did not have a cataract? At one time, the standard of care was LPI followed only by clear lens extraction if the angle remained closed. The EAGLE study challenges that idea, saying “clear lens extraction showed greater efficacy and was more cost-effective than laser peripheral iridotomy, and should be considered as first line treatment.”⁴

The postoperative LPI patient typically uses 1% prednisolone acetate for four days. The optometrist should evaluate the patient approximately two weeks afterwards to assess the anterior chamber, IOP and angle via gonioscopy or angle imaging, or both. Complications can include a temporary rise in IOP, hyphema and inflammation.

SLT Procedure

This laser targets the pigmented cells of the trabecular meshwork (TM) to promote aqueous outflow. Using it can also reduce the IOP by approximately 25% after three years.⁵

Research shows the use of topical glaucoma drops can reduce a patient’s quality of life.⁶ Eye drop compliance may also hinder therapeutic IOP reduction.⁷ There is currently no way of knowing whether a patient is taking their drops properly. Selective laser trabeculoplasty (SLT) is designed to reduce that medication burden while maintaining adequate IOP reduction.⁸ SLT may also be considered a first-line therapy.⁹

The postoperative SLT patient may be on topical steroids, topical NSAIDs or nothing, as the literature is inconclusive on which option is the most effective. In our practice, patients typically are on no drops afterwards. Early results from the SALT (Steroids After Laser Trabeculoplasty) trial show a short-term IOP-lowering effect with topical NSAIDs compared with placebo.¹⁰ We’re currently evaluating whether to modify our postoperative SLT regimen.

The patient should be evaluated approximately one to two weeks after SLT to monitor IOP. Spikes may occur more frequently in pigmentary glaucoma and exfoliation glaucoma.^{11,12} The anterior chamber should also be carefully inspected for any sign of inflammation. As SLT may take two to four months to reach peak effect, the next visit should fall around the two to four month time-frame. Success rates of SLT are between 75% to 97% at six months to a year.^{9,13,14}

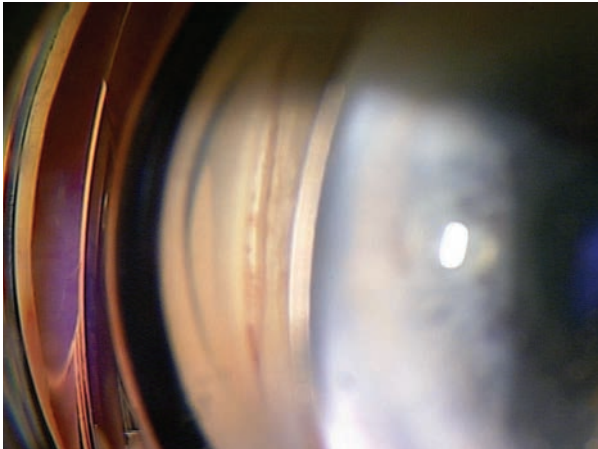


Fig. 2. This photo shows a patient's angle following the Kahook Dual Blade (KDB) procedure. Note the white KDB cleft.

Other side effects of SLT include conjunctival injection, discomfort, headache, photophobia, corneal abrasion and subconjunctival hemorrhage.¹⁵

Minimally Invasive Glaucoma Surgeries

This class of procedures is an option for mild-to-moderate glaucoma patients that both lowers the medication burden, as most can reduce the number of drops they are taking, and lowers IOP.¹⁶ A large meta-analysis shows minimally invasive glaucoma surgeries (MIGS) have a good safety profile, with IOP spikes being the most frequent complication.¹⁶ Clinicians who perform postoperative care for MIGS patients should be aware that as many as 90% of POAG patients will have an ocular hypertensive response to topical steroids.¹⁷ It is important for the clinician to be vigilant about IOP spikes and be prepared to mitigate steroid responders as early as the one-week postoperative visit. Many of these procedures involve cataract surgery, and glaucoma is a strong risk factor for developing elevated IOP after cataract surgery.¹⁸

MIGS procedures include:

1. Internally-applied laser (e.g., endocyclophotocoagulation).
2. Trabecular surgery (e.g., Kahook Dual-Blade, Trabectome, iStent).
3. Suprachoroidal shunts (e.g., Cypass).
4. Microtrabeculectomies (e.g., Xen).

Endocyclophotocoagulation (ECP) (Beaver-Visitec International). This procedure employs a microprobe laser to coagulate necrotic damage to the ciliary body epithelium, while sparing the ciliary muscle and vasculature. Ciliary body damage reduces aqueous flow.¹⁹



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ECP can be combined with phacoemulsification or can be performed in aphakia. The ECP laser is typically performed with 360 degrees of treatment. ECP reduces the IOP around 10% when combined with cataract surgery.²⁰

The postoperative care is similar to standard cataract surgery with a topical antibiotic used for one week and a topical steroid and NSAID used for one week while tapering out to four weeks.

Postoperative complications can include IOP spikes, hyphema and uveitis. IOP spikes are common as early as the one-day postoperative visit. Uveitis may resolve quickly but may sometimes be persistent. Care must be taken when managing a longer-lasting uveitis as prolonged steroid use may trigger a steroid response. The complication rate is similar between cataract surgery and ECP vs. cataract surgery alone.²¹

ECP is one of the few glaucoma procedures that can be repeated and titrated without leaving any conjunctival scars, nor does it alter the outflow pathway anatomy in any way that would preclude any future glaucoma surgical options.

The iStent (Glaukos) is a non-magnetic titanium shunt implanted into Schlemm's canal to bypass the TM, in an effort to increase aqueous drainage. Cataract surgery combined with iStent reduces IOP around 10% and can reduce the need for topical medications.²² The FDA has approved the use of one stent, but recent studies show that applying two implants to the same eye may be superior.^{23,24} Currently, the iStent is always combined with cataract surgery and the postoperative care is the same as cataract surgery alone. Potential complications are similar to cataract surgery too and include corneal edema, anterior chamber inflammation, IOP spikes, hyphema and macular edema.²⁵

The Kabook Dual-Blade (KDB) (New World Medical) device removes a portion of the trabecular meshwork and exposes Schlemm's canal. The surgically created cleft increases aqueous outflow which leads to more sustained IOP control (Figure 2). KDB combined with cataract surgery reduces the IOP around 24%.²⁶

The KDB can be performed with or without cataract surgery. The postoperative care is the same as cataract surgery alone with a topical antibiotic applied for one week and a topical steroid and NSAID used for one week while tapering out to four weeks.



Fig. 3. The Xen gel stent regulates the flow of aqueous from the anterior chamber into a bleb in the subconjunctival space.

Postoperative complications may include hyphema on the first postoperative day and IOP spikes which typically occur beginning at the one week visit and may persist until discontinuation of the topical steroid. In our clinic, we apply 1% pilocarpine a few minutes after the steroid drop and follow the same steroid taper. This helps to blunt the IOP spikes.

Trabectome is an energy-delivering electrode probe that causes plasma-mediated TM ablation increasing aqueous outflow. Trabectome can be used with or without cataract surgery. Trabectome com-

combined with cataract surgery reduces IOP around 30% and may be higher in exfoliation patients.²⁷

The postoperative care is the same as cataract surgery alone. As with KDB, pilocarpine can be used to minimize postoperative IOP spikes.

Postoperative complications include hyphema, IOP spikes and, rarely, cyclodialysis.²⁸

The Cypass Micro-Stent (Alcon) is a 6mm long, biocompatible, fenestrated tube implant that creates an alternate outflow chamber into the supraciliary and suprachoroidal space increasing aqueous outflow. Cypass combined with cataract surgery reduces IOP by around 30%.²⁹

Currently, the Cypass Micro-Stent is always combined with cataract surgery and the postoperative care is the same as cataract surgery alone. A topical antibiotic applied for one week and a topical steroid and NSAID used for one week while tapering out to four weeks.

Postoperative complications are similar to cataract surgery alone and include hyphema, IOP spikes, iritis, myopic shifts and corneal edema. In the COMPASS trial, 2.9% developed hypotony but all resolved.²⁹

The Xen gel stent (Allergan) is 6mm-long, consisting of gelatin cross-linked with glutaraldehyde. The implant is stiff when dehydrated but becomes flexible and conforms to the appropriate space when hydrated by the aqueous humor.³⁰ The gel stent regulates the flow of aqueous from the anterior chamber into a bleb in the subconjunctival space (Figure 3). The Xen procedure combined with cataract surgery reduces the IOP around 30%.³¹

The bleb is typically lower and more diffuse than with a trabeculectomy. The Xen procedure may be performed with or without cataract surgery.

Comanagement with Care

For much of my optometric career, I served on the front lines of glaucoma care and made referrals to glaucoma specialists when surgical intervention was appropriate. Two years ago, our practice partnered with a glaucoma surgeon. Part of my practice is now a referral-based glaucoma service. Seeing referrals from other eye care physicians has allowed me to better appreciate the importance of effective comanagement.

One of the best ways to improve your relationship with a glaucoma referral center or glaucoma specialist is to improve the quality of your referral letter. One publication assessed that the quality of glaucoma referral letters found 34% of referral letters substandard.¹ The five most important pieces of information omitted from the letters were:

1. Serial visual fields.
2. Current glaucoma therapy.
3. Current intraocular pressure.
4. Maximum intraocular pressure.
5. Serial disc imaging.

When sharing serial disc imaging, black and white faxes or copies of OCTs are difficult to read and interpret. Sending color OCT printouts will improve patient care.

Ask your glaucoma specialist how they wish to be contacted when an urgent issue arises. Is the IOP higher than expected? Is the anterior chamber reaction greater than expected? Is the acuity reduced more than expected? Some may prefer you call the main office number, and others may prefer you call, or text, their cellphones directly. Communicating a potential problem early in the process may prevent a small issue from becoming a large one.

Non-urgent communication is also important. Why does that iStent placement look different than usual? Why was a goniotomy performed when it seemed as though an SLT would suffice? Find out how your glaucoma surgeon wishes to be contacted to discuss these items. Some may prefer emails while others prefer phone calls or even periodic lunches.

Conversely, a glaucoma specialist's letter should clearly show their findings, management plan and precisely when the patient will be returned to your care. There should be no ambiguity. Let the specialist know if their letters are not providing you with the information needed to effectively manage the postoperative care.

Communication with your glaucoma surgeon is always a two-way street. Effective communication between the referring optometrist and the glaucoma surgeon leads to a trusted relationship and exceptional patient care.

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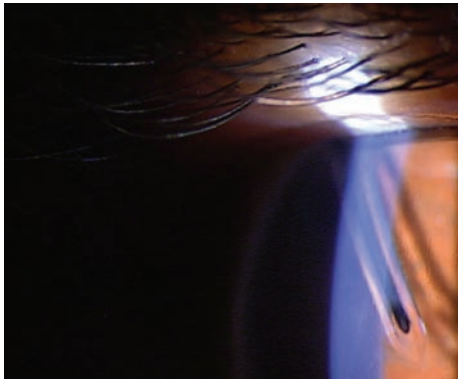
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Fig. 4.
Baerveldt
tube with
rip-cord
suture still in
place. Note
the tube's
proximity
to the
endothelium.



Post-op complications include hyphema, malposition, conjunctival perforation, hypotony and erosion. One drawback of the Xen is that a high percentage of patients may require a needling procedure.³²

Trabeculectomy

This involves bypassing the resistance of the trabecular meshwork and Schlemm's canal by moving aqueous directly to the subconjunctival space, creating a filtering bleb. This is very effective at reducing IOP but carries a higher risk of complications. Trabeculectomy will reduce IOP from approximately 30% to 50%.³³ This procedure is commonly used with the antimetabolite mitomycin C.

After a trabeculectomy, patients should be seen at one day and then every two to three days for approximately two weeks. The patient can then be followed every one to two weeks until two to three months after the procedure. The topical steroid needs to be adjusted throughout this process depending on inflammation and IOP.

Postoperative complications include hypotony, flat anterior chamber, choroidal effusion, choroidal hemorrhage, maculopathy, endophthalmitis and blebitis.³⁴ Inadequate tension in the scleral sutures may be responsible for many of the short-term complications such as hypotony and a releasable suture technique may result in better outcomes.³⁵ A longer-term complication is early cataract development. The overall failure rate is close to 50% at five years post-surgery.³⁵

Tubes

Tube shunts divert aqueous from the anterior chamber to the subconjunctival space. Like a trabeculectomy, this creates a filtering bleb and the effectiveness and risks are similar to trabeculectomies. Three main types of tubes are available. They are the Ahmed, Molteno and Baerveldt (Figure 4). The Ahmed tube has a valve while the Baerveldt and Molteno are non-valved. Tubes will reduce the IOP between 30% to 50%.³⁶

After a tube procedure, the patient should be followed at day one and then weekly for one month. The patient can then be followed every two weeks until the tube opens and the bleb fills. This typically occurs when the suture dissolves. One possible advantage of a Baerveldt or Molteno is that the bleb does not open right away. Thus, any inflammatory-related cytokines are usually greatly reduced by the time the bleb opens, thus reducing fibrosis and scarring. One disadvantage is that the IOP does not typically drop to its full potential until the bleb opens.

Postoperative complications include hyphema, hypotony, choroidal effusion, bullous keratopathy and double vision. Diplopia may occur because of extraocular muscle involvement of the tube. This often is temporary and can be managed with prisms until resolution. Long-term tube complications include increased IOP due to fibrosis.³⁷

If the bleb is excessively high, this might indicate scar tissue formation around the plate. If the bleb is low, that might indicate a blockage in the tube.

During the early postoperative period, a Molteno bleb will often be flat as a vicryl dissolvable suture is used around the shaft of the tube. Once the suture dissolves, then aqueous flows into the bleb and fills it. The tube may be blocked by vitreous, fibrin, or iris tissue. Sometimes the blockage can be lasered open using a YAG or argon. If the tube is blocked by a blood clot, an injection of a tissue plasminogen activator may be helpful.

Optometrists have an essential role to play in managing today's glaucoma patients. As the profession takes on a more prominent role in the comanagement space, we must make ourselves familiar with all of the options to our patients so we can be prepared to render the best postoperative care possible. ■

Dr. Cymbor is a partner at Nittany Eye Associates in State College, PA. He is also the co-director of the Glaucoma Institute of State College and a member of the Optometric Glaucoma Society.

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Here's how to up your game when treating even the most severe dry eye patient.

By Justin Kwan, OD

Eye care is a vast field, and optometrists can't be expected to be experts in everything. Many ODs choose to specialize in a certain type of care, such as pediatrics or anterior segment, while shying away from others, such as scleral lens fitting and myopia control. The same can be true in managing ocular disease states such as glaucoma and retina.

But dry eye shouldn't be one of them. According to The Tear Film and Ocular Surface Society's Dry Eye Workshop II (TFOS DEWS II), signs of dry eye can occur in up to 75% of some populations, and its prevalence only increases with age.¹ Severe dry eye—disease that has a major impact on quality of life—can affect as much as 10% of the population older than age 50.¹ Faced with such numbers and patient impact, we should all be prepared to care for dry eye patients at all stages of the disease, especially when it becomes detrimental to our patient's quality of life. A solid understanding of dry eye is the foundation of care, but knowing how to navigate the

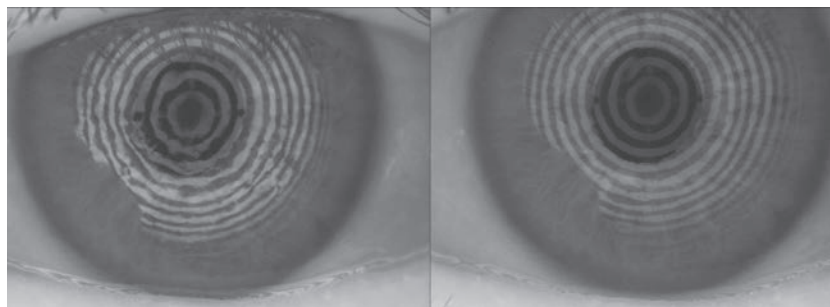


Fig. 1. The restoration of a smooth corneal and refractive surface can be seen in these before, at left, and after placido ring reflections after amniotic membrane therapy.

complex treatment options is just as important. This article will help you better understand the many dry eye treatment regimens that go beyond the basics.

Where to Start

Severe dry eye is a large umbrella term for ocular surface conditions that are difficult to manage and are unresponsive to traditional first-line therapies such as artificial tears and at-home warm compresses. TFOS DEWS II came to a consensus on classifying dry eye subtypes and a diagnostic test battery—both of which can help you better under-

stand this complex disease and how to proceed with advanced therapies when necessary.² As an example, patients with a mixture of evaporative and aqueous deficient signs are often simultaneously flagged as abnormal or borderline during dry eye testing. These patients may also have *Demodex* blepharitis and allergic conjunctivitis, worsening the symptoms and inflammatory environment on the ocular surface.

For all patients presenting with suspicious signs or symptoms, a logical place to start is a validated symptom survey or questionnaire. DEWS II emphasizes the utility of

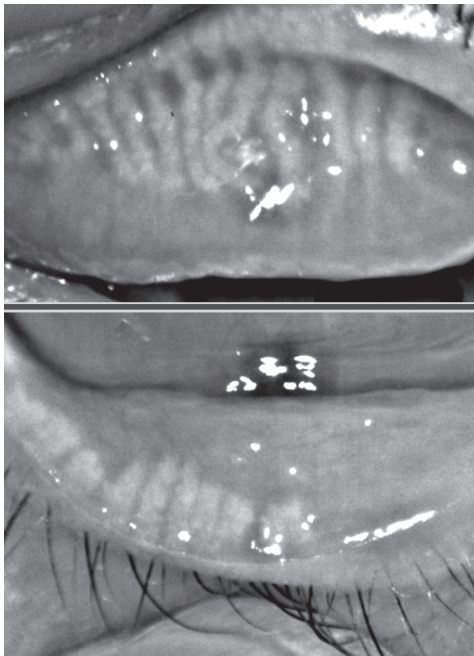


Fig. 2. This patient with 75% meibomian gland atrophy may benefit from in-office MG expression.

the Ocular Surface Disease Index (OSDI) and the 5-Item Dry Eye Questionnaire 5 (DEQ-5). A highly cited study suggests an OSDI score of 33 to 100 indicates severe disease, while a minimal clinically important difference, whether better or worse, is 7.3 to 13.4 for severe disease.¹ When using the DEQ-5, researchers suggest a cutoff point of ≥ 6 for keratoconjunctivitis sicca and ≥ 12 as suspicious for Sjögren's syndrome (SS).³ Once the patients are flagged for severe dry eye using either questionnaire, the management can then be tailored based on the severity, response or non-response to past interventions, comorbidities and the patient's visual goals.

Healing, One Step at a Time

Many options now exist to restore homeostasis to the tear film composition in severe dry eye—and initiate ocular surface healing. For many patients, clinicians should consider a

step-wise approach to therapy, beginning with immediate relief with topical artificial tears, and escalating as the case deems necessary.

Artificial tears. These over-the-counter drops remain the first-line treatment, even for severe dry eye. Myriad options offer a wide array of active and inactive ingredients—all of which with the ultimate goal of supplementing the natural tear film and diluting it to reduce the osmolarity, known to cause ocular surface damage. Some newer options on the market may provide more tailored relief for patients with severe symptoms.

The recently released Systane Complete (Alcon) has twice the concentration of propylene glycol (0.6% vs. 0.3%) compared with the com-

pany's Systane Ultra and contains the micro-emulsions of mineral oil from its Systane Balance. This product uses nano-droplet technology designed for longer retention time and thus prolonged and uniform protection of the ocular surface.⁴

Trehalose—a sugar present in some plants that gives them the ability to survive in harsh environments without water—is incorporated as an osmoprotectant into both Refresh Optive Mega-3 (Allergan) and Thera Tears Extra (Akorn). In a study of various artificial tears with stressed human corneal epithelial cells, trehalose-based eye drops showed the highest efficiency in prevention of cell death from desiccation.⁵

Retaine MGD (OcuSoft) owes much of its success to its cationic nanoemulsion properties, taking advantage of the inherent negative charge of the ocular surface for spreading and retention.⁶

Clinicians must keep in mind

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Fig. 3. This patient, seen here before (at left) and after treatment, experienced significant improvement in signs and symptoms of *Demodex* infestation with four months of tea tree oil foam cleanser QHS.

that dosing any artificial tear too frequently can strip the ocular surface of its naturally occurring beneficial components (i.e., lactoferrin and lysozyme) and worsen the condition.⁷ The use of artificial tears should be thought of as a preventative measure prior to the onset of symptoms and prior to activities that challenge the fragile tear film.

Punctal plugs. For severe dry eye patients whose symptoms are exacerbated by excessive tear drainage, punctal plugs may help. Lacrimal occlusion, whether temporary, semi-permanent or permanent, can increase tear volume and contact time of natural tears on the ocular

surface. Studies show this treatment method can improve patient-reported symptoms of dry eye, and the procedure is considered both safe and effective compared with artificial tear use alone. However, clinicians should be careful to only use this intervention for patients with drainage system dysfunction; if that is not a contributing factor, occlusion may do more harm than good.⁸⁻¹⁰

Autologous serum. Derived from the patient's own blood, this lab-created drop provides ingredients and properties, such as pH and osmolarity, biochemically similar to that of healthy tears.¹¹ The serum contains

New Drops in the Pipeline

Despite their clinical utility, topical drops come with considerable barriers. Instillation is dependent on the dexterity and skillfulness of the patient, and drops usually wash away within 30 seconds, allowing less than 5% to reach the intraocular tissues.²² Luckily, advances are helping improve this treatment modality. Nanomicelles are excellent pharmaceutical carriers because of their ability to minimize drug degradation, lower adverse side effects and improve drug permeation through the ocular epithelium with minimal or no irritation, ultimately leading to enhanced ocular bioavailability.²¹ Much of this activity stems from the nanomicelles having both hydrophilic and hydrophobic properties. A Phase III confirmatory study of a preservative-free aqueous formulation of cyclosporine A 0.09% that uses nanomicelles was performed in 744 dry eye patients with promising results. After 12 weeks of therapy, the drug provided statistically significant improvement in Schirmer's score compared with vehicle alone.²⁸

Another novel eye drop molecule is perfluorohexyloctane, which research shows has a cumulative effect of thickening the lipid layer 13.36% over four weeks compared with a minimal 3.21% of saline. Current investigations suggest its benefits derive from semifluorinated alkanes' ability to rapidly spread on the ocular surface, creating a significantly larger volume-adjusted spread area than saline with a contact angle of almost 0°.²⁹

several epithelial and nerve growth factors, including vitamin A, epidermal growth factor and fibronectin—all of which can be helpful in nerve regeneration.¹² To offer this management strategy, eye care providers need to have a local laboratory that partners with a compounding pharmacy. Patients have approximately 30 vials of blood drawn, tested for disease and then diluted to the appropriate concentration. Due to its sterile and unpreserved nature, bottles yet to be used must be stored frozen and thawed one at a time. While one review was inconclusive, a retrospective cohort study of 63 patients using autologous serum for three to 48 months found improvements in corneal fluorescein staining, Schirmer scores and symptoms.^{13,14}

Amniotic membranes. When chronic insult to the ocular surface results in persistent corneal epithelial defects, amniotic membranes can protect and quickly restore these areas. Research shows complete or partial success in the vast majority of various ocular surface disorders.¹⁵ It is important to dose a prophylactic topical antibiotic to minimize the risk of a secondary bacterial infection because these patients are spending two or more nights in a closed-eye state (*Figure 1*).

Amniotic eye drops. These are another advanced therapy that contains the beneficial properties of autologous serum and amniotic membranes. While dosing and efficacy have not been well studied, amniotic eye drops are thought to deliver their healing effects in a more patient-accessible medium compared with an amniotic membrane.

Scleral lenses. As an efficacious treatment strategy for severe dry eye, these lenses constantly bathe the ocular surface with sterile saline and protect it from the external environment.¹⁶ They should be employed

EXAMINATION STAND



Fig. 4. This 85-year-old female has end-stage Demodex, cylindrical dandruff and madarosis.

when the patient's tear film volume is low or the quality is poor to the point of instant evaporation and exposure. Clinicians should select a larger diameter (i.e., $\geq 16.0\text{mm}$) to cover more of the exposed cornea and conjunctiva. Because doing so will likely encounter more scleral toricity, toric scleral landing curves or further customization can help to promote good centration and minimize post-lens fogging.

Intranasal tear neurostimulation.

This new therapy option, recently introduced as TrueTear (Allergan), works on the principle that neurostimulation will help the patient make more tears. A 180-day study in 40 subjects revealed that the device improved corneal staining by roughly one grade level and conjunctival staining by about two grade

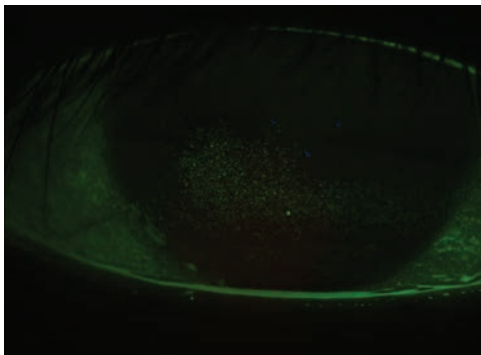


Fig. 5. This a post-LASIK cornea has grade 3.5 coalesced superficial punctate keratitis.

levels on the modified Oxford Scale.¹⁷ While tear break-up time did not change, Schirmer increased from 13mm to 20mm compared with unstimulated patients at day 180. Symptoms by OSDI decreased 53%, and each stimulation had an average duration of symptom relief of three hours with a time interval of six hours between each stimulation in a given day.

Another study found neurostimulation can lead to degranulation of goblet cells in the conjunctiva, which releases the natural complex substance and may directly improve the mucin layer.¹⁸

In-office meibomian gland (MG) expression. Either manually with a Mastrota paddle or with a device such as Lipiflow (TearScience) or the recently approved iLux (Tear Film Innovations), this is an advanced option clinicians can employ to help treat severe dry eye from meibomian gland dysfunction (MGD). Clearing blocked MGs can help promote normal blink patterns and facilitate spread of a lower viscosity and healthier meibum (Figure 2).

When MGD stems from an inflammatory dermatological condition such as ocular rosacea, intense pulsed light (IPL) may help to reduce signs and symptoms. IPL's accidental discovery for MGD was due to patients reporting fewer dry eye symptoms after upper cheek treatment for acne, rosacea and abnormal blood vessels.¹⁹ One study found tear break-up time improvement and patient-reported satisfaction after a series of IPL treatments.²⁰

Specialty Cases

Often, severe dry eye can be linked to a comorbidity that



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exacerbates symptoms. Clinicians should include these in their differentials when honing the dry eye diagnosis, and tailor therapy accordingly when they arise:

Demodex continues to be underdiagnosed, despite its prevalence of 17.7% in young adults and up to 100% in older adults.^{17,19} From the initial diagnosis, photographing the entire upper eyelash area will not only drive patient compliance but also help monitor the treatment results (Figure 3).

Reducing *Demodex* counts can be accomplished with a variety of methods, the basis of which is tea tree oil. Eye care providers can prescribe a daily tea tree oil foam cleanser or

single use packet lid wipe.

A recent study found similar efficacy between three treatments; the 86 subjects were randomly assigned tea tree face wash, OcuSoft Lid Scrub Plus and in-office debridement with the BlephEx lid cleaning device, and symptoms and number of *Demodex* folliculorum from one epilated lash all improved similarly.²¹

Severe cases may manifest with pervasive cylindrical dandruff that can be thick and sticky, potentially blocking the penetration of tea tree oil into the eyelash follicle (Figure 4). These cases may require a softening of the cylindrical dandruff with a foam cleanser or oil followed by manual removal of the stubborn and

large accumulation of keratinization and lipids with forceps. In-office use of commercially available 50% tea tree oil may be necessary.²² Clinicians should use a topical anesthetic on the ocular surface prior to treating or even apply a silicone hydrogel contact lens prior to treatment to protect the cornea and soak up any residual tea tree oil on the front surface. Patients with punctal plugs may require an extra rinse to minimize the contact time between residual tea tree oil and the ocular surface epithelium.

Systemic diseases can also complicate a dry eye diagnosis and warrant significant follow up and continued communication with other care providers such as primary care doctors and rheumatologists. If you have a patient with severe dry eye symptoms, it's important to rule out Sjögren's syndrome and other autoimmune diseases such as systemic lupus erythematosus and rheumatoid arthritis. SS dry eye typically presents with significant and coalesced corneal (Figure 5) and conjunctival staining with sodium fluorescein and lissamine green.

Other autoimmune diseases such as fibromyalgia can exacerbate dry eye as well. A retrospective cohort study found that patients with fibromyalgia 49 years of age or older had an 80% elevated risk of dry eye syndrome compared with the non-fibromyalgia group.¹⁸ If a patient with fibromyalgia had a comorbidity of irritable bowel syndrome or sleep disturbance, the risk of dry eye increased even more.¹⁸

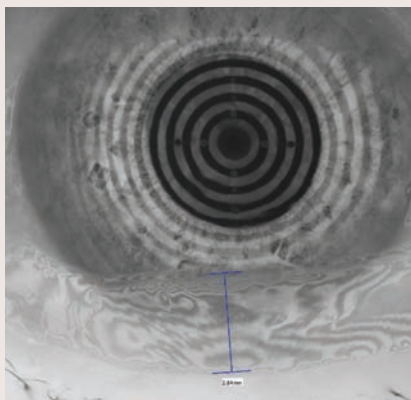
Another potential manifestation of fibromyalgia is neuropathic eye pain, a subtype of the TFOS DEWS II clinical decision algorithm that describes when a patient has dry eye symptoms without signs.² One study found dry eye symptoms correlate with both neuropathic pain com-

Masqueraders

Superior limbic keratoconjunctivitis may often be missed because this region is not examined as closely as the eyelashes, eyelids, MGs and the exposed interpalpebral conjunctiva and cornea. Microtrauma definitely occurs at this interface, described as frictional events in the TFOS DEWS II.²⁰ This area, if compromised, will pick up vital dye staining and even appear hyperemic and overall inflamed. Therapies to reduce this inflammation as well lubricate these tissues against the blinking eyelid will ensure an expedient resolution of signs and symptoms. One should also rule out any thyroid dysfunction when coming across this specific ocular finding.¹⁹

Conjunctivochalasis is also a highly prevalent—greater than 90% in the fifth decade of life and onwards—and underdiagnosed condition that often presents with dry eye symptoms.²⁵ Severe conjunctivochalasis may initially appear as an elevated tear meniscus height when in fact it is all conjunctival tissue contacting the inferior cornea. Tears may stagnate in the folds, worsen tear film stability and overall drain more slowly. Thus, the folds may also harbor inflammatory mediators as these frictional events perpetuate more symptoms and more inflammation.²⁶ Initial therapies include strategies to reduce inflammation and promote lubrication across these micro or macro folds.²⁶

Surgical treatment includes conjunctival cauterization or surgical excision with or without tissue graft. Radiofrequency cautery, similar to electrocoagulation, shortens conjunctiva by burning excessive conjunctiva at sites about 5mm from the limbus following topical anesthesia. These procedures are relatively short (less than 10 minutes) and can be performed in an outpatient clinic setting.²⁷ The goal is to get the vast majority of the redundant conjunctiva to lay flat against the sclera and restore a smooth interpalpebral surface again, unimpeded by the blink.



Severe conjunctivochalasis, 2.84mm tall, extending onto and irritating the cornea.

plaints, particularly the symptom of ocular burning, and the Patient Health Questionnaire-9, which is a measure of depression. In these cases, clinicians should refer to a pain specialist for treatment.^{13,14}

Filamentary keratitis can also cause many symptoms secondary to frictional events and corneal nerve stimulation as the upper eyelid blinks and moves these filaments. Researchers found that filaments appeared in the exposed interpalpebral zone for dry eye and exposure keratitis, but were more likely at the corneal limbus for autoimmune and ocular inflammatory conditions.²³ Filaments may present early as a single 0.25mm mucus collection on the corneal epithelium.⁷ After topical anesthesia, removing the filaments with a cotton-tipped applicator or forceps and applying a bandage soft contact lens dramatically improves symptoms. Continued daily wear of soft contact lenses also minimizes future formation of new filaments. Other treatments include nonpreserved lubricants, topical steroidal and nonsteroidal anti-inflammatory agents, hypertonic saline and mucolytic agents.²⁴

Severe dry eye patients require frequent monitoring and treatment adjustments to ensure they achieve much-needed relief and corneal healing. While eye care providers should remain positive, they must also set realistic expectations to maintain, maximize what's left and restore as much homeostasis as possible. ■

Dr. Kwan is an assistant professor at Southern California College of Optometry at Marshall B. Ketchum University. He is the current chief of the Stein Family Cornea and Contact Lens Center, University Eye Center, Ketchum Health. He is also director of the Dry Eye Institute for patient care and participates in dry eye and contact lens research.

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The Cut After Colonization

When patients have resistant organisms, should clinicians be resistant to LASIK?

Edited by Joseph P. Shovlin, OD

Q I have a 27-year-old patient who is interested in having LASIK but had a methicillin-resistant *Staphylococcus aureus* (MRSA) skin infection six months ago. She responded well to treatment and has had no new episodes. Do I have her wait for surgery or discourage her entirely from undergoing LASIK?

A “Today more than ever, the optometrist and ophthalmologist must carefully screen for and manage a number of conditions that place patients at elevated risk for sight-threatening postoperative infections,” says Eric Donnenfeld, MD, a Long Island ophthalmologist and previous president of ASCRS who specializes in refractive, corneal and cataract surgery. One of the most significant risk factors is the colonization of MRSA or methicillin-resistant *Staph. epidermidis* (MRSE), notes Dr. Donnenfeld.

Higher Stakes

Colonization is becoming more common and may be present in 50% of patients who have cataract surgery.¹ Patients who have been on long-term antibiotics or have had prior infections are more prone to colonization by these resistant organisms, says Dr. Donnenfeld.

Clinicians must consider the higher possibility of post-op infection in these patients. “LASIK is a reasonable procedure as long as the patient is treated aggressively with lid hygiene, disinfectants and the appropriate prophylactic antibiotic,” Dr. Donnenfeld says.

Reviewing the Choices

“Several surgical options should be considered for patients with higher risk of infection,” says Dr. Donnenfeld. Studies show LASIK has a lower risk of post-op infection than photorefractive keratectomy procedures because patients heal faster.²

Patients with known colonization and signs of blepharitis who are considering LASIK should have a culture taken of their lid margins and undergo treatment based on drug-susceptibility testing results, Dr. Donnenfeld says.

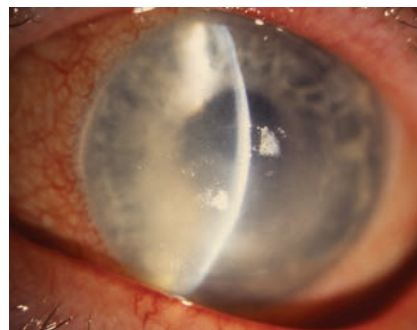
He also recommends using hot compresses, increasing lid hygiene, sterilizing with topical disinfectants like hypochlorous acid, treating with antibiotic ointments that have good activity against MRSA and aggressively supporting the ocular surface to prevent epithelial defects. These measures should be taken during the screening visit, and a follow-up should be scheduled before surgery to ensure the blepharitis has resolved, notes Dr. Donnenfeld.

Prophylaxis of Patients at Risk

Dr. Donnenfeld developed a protocol to reduce infection in patients with a history of MRSA or MRSE:

Pre-op. Dr. Donnenfeld recommends aggressively treating blepharitis to reduce *Staph.* colonization on the lid by using hot compresses and increasing lid hygiene. He also encourages the use of a hypochlorous acid and a fourth-generation fluoroquinolone QID for five days.

Post-op. Dr. Donnenfeld says a



This patient developed an early MRSA infection under their LASIK flap.

fourth-generation fluoroquinolone QID and an antibiotic drop QID effective against methicillin-resistant organisms should be used for five to seven days for additional prophylaxis against MRSA and MRSE.

If a patient with a history of MRSA develops an infiltrate after LASIK, the infection is likely resistant to the fluoroquinolone unless a culture sample proves otherwise, Dr. Donnenfeld says. He adds that the patient should be referred back to the surgeon for treatment.

Dr. Donnenfeld says high-risk patients require close post-op monitoring, “with return visits every few days until healing is evident.”

In the current microbiologic environment, clinicians should presume that every patient is colonized by MRSA or MRSE when deciding how to proceed with treatment, according to Dr. Donnenfeld. ■

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A Knuckle Sandwich in the Eye

A patient reports blurry vision after a blow to the eye. What was the damage?

By Eric Dillinger, OD, and Mark T. Dunbar, OD

A 32-year-old male presented with sudden-onset blurry vision in his left eye after being punched about 12 hours earlier. He reported that, while walking to his car after leaving a restaurant, he was assaulted by an unknown man who punched him in the head and his eye. He reports “graying” of his central vision that extends inferior toward his nose. He also has a black eye and hemorrhaging on the outside of the eye. His past medical and ocular history is unremarkable.

On examination, visual acuities were 20/20 OD and 4/200 OS, eccentrically viewing. Confrontation visual fields were full-to-careful finger counting in both eyes, but there was a central scotoma in the left. His pupils were equally round and reactive. We observed no afferent pupillary defect. Ocular motility was full. The anterior segment of the right eye was normal. The left eye showed significant periorbital swelling and ecchymosis. He had a subconjunctival hemorrhage in the left eye. The cornea was clear. The anterior chamber was 4+ deep and quiet. The iris and lens were normal. Tensions by applanation were 12mm Hg OU.

A dilated fundus exam of the right eye was normal, but left eye imaging revealed hemorrhage (*Figure 1*). An SD-OCT of the left eye is also available for review (*Figure 2*).

Take the Retina Quiz

- How would you characterize the hemorrhage in the left eye?
 - Subhyaloid.

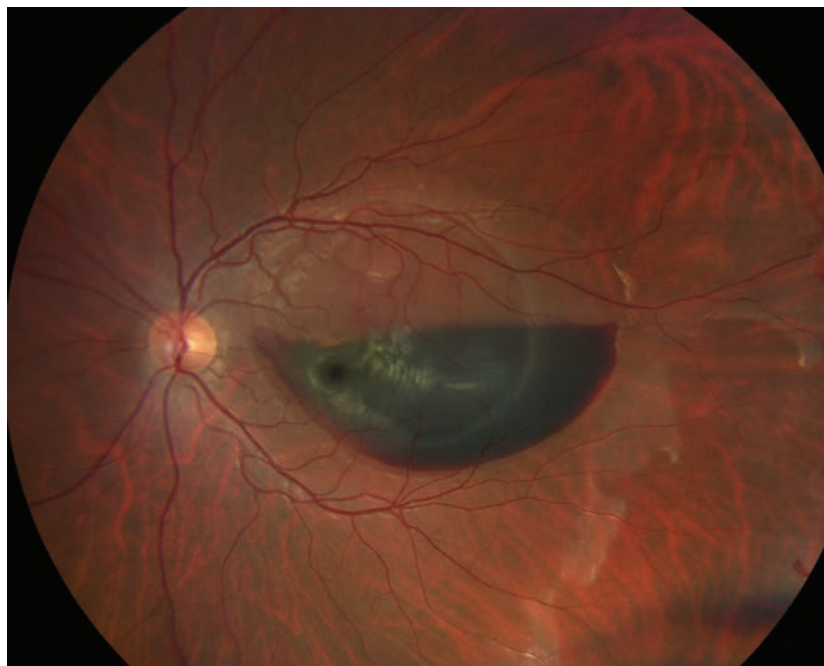


Fig. 1. A view of the macula and posterior pole of the left eye of our patient. How would you characterize the hemorrhage?

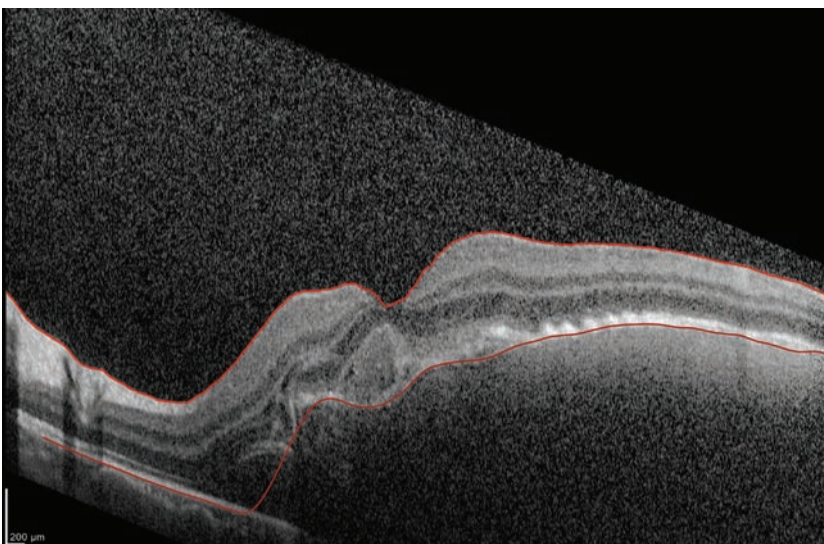


Fig. 2. What can this OCT image tell you about the patient's macula?

- b. Preretinal.
 - c. Intraretinal.
 - d. Subretinal.
2. What is the likely etiology of the hemorrhage?
- a. Hemorrhagic retinal detachment.
 - b. Retinal macroarterial aneurysm.
 - c. Choroidal rupture.
 - d. Valsalva retinopathy.
3. How should this patient be managed?
- a. Careful observation.
 - b. Pars plana vitrectomy and evacuation of the hemorrhage.
 - c. PPV and scleral buckle.
 - d. Intravitreal anti-VEGF medication.
4. What is the prognosis for this eye?
- a. Resolution and return to normal visual function.
 - b. Chorioretinal scarring and loss of central vision.
 - c. Possible development of choroidal neovascularization.
 - d. Too early to tell.

For answers, see page 90.

Diagnosis

Our patient has a large subretinal hemorrhage that involves the macula. It is difficult to tell what else is going on because of all the hemorrhaging. The images clearly show elevation of the retina in the macula from the hemorrhage and possible subretinal fluid on the temporal side of the hemorrhage that extends superiorly. It appears there is a detachment of the posterior hyaloid of the vitreous surrounding the macula. We observed no retinal detachment.

An SD-OCT was performed and

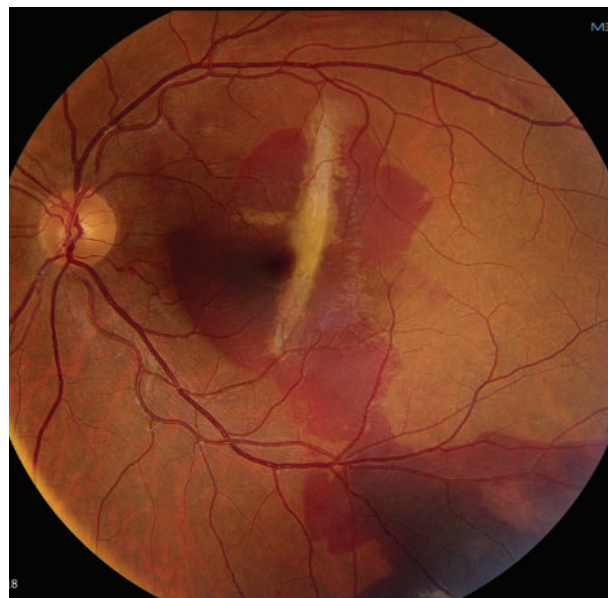


Fig. 3. This fundus photo shows our patient two weeks later. What do you see now?

clearly shows elevation of the retina and significant subretinal hemorrhage. There was poor visualization of the posterior segment due to the dense hemorrhaging.

So, what is going on with our patient? The presence of the subretinal hemorrhage in the macula should be a clue. He likely developed a choroidal rupture as a result of the punch. The choroidal rupture develops from mechanical compression to the globe (from the blunt trauma), followed by sudden hyperextension of the globe. The sclera can often resist the mechanical forces that occur from blunt trauma, but the middle layers do not have the strength or the elasticity to resist these compressive forces. As a result, a rupture of the choroid, Bruch's membrane and retinal pigment epithelium (RPE) can occur. The presence of a subretinal hemorrhage in the setting of blunt trauma should arouse suspicion of a choroidal rupture. Commotio retina or Berlin's edema, or both, can occur if the trauma is severe.

Discussion

Choroidal ruptures develop in approximately 5% to 10% of patients who present with blunt trauma.¹ These lesions appear as radial cracks or defects in Bruch's membrane and RPE and are often located temporal to the macula, but can develop anywhere in the posterior pole. They can be difficult to observe in the acute phase due to the subretinal hemorrhage and the acute nature of the event. But as the hemorrhage resolves, scarring and fibrosis will occur, making it easier to see.

Our patient was

closely observed without treatment and the subretinal hemorrhage began to resolve. Indeed, within a few weeks, the characteristic white radial choroidal rupture was apparent but, unfortunately, it appeared to involve his central fixation (*Figure 3*). His acuity was 20/80 OS eccentrically viewing and there was a suspicion of an early choroidal neovascularization (CNV).

CNV is a common secondary complication of choroidal ruptures. New vessels can grow through cracks or defects within Bruch's membrane. If left untreated, they will leak and bleed, resulting in further scarring. We plan to continue closely monitoring this patient, without any intravitreal anti-VEGF injections. If his condition worsens or the presence of a CNV is confirmed, intravitreal anti-VEGF injections will be the next step. ■

Dr. Dillinger is a resident at Bascom Palmer Eye Institute.

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Keep an Eye on NAION

A promising new study is enrolling. Here's how you can be a part of it.

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

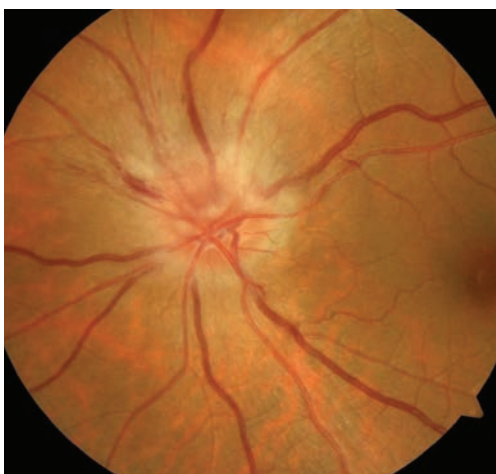
A 58-year-old man presented urgently after noticing a painless visual change in his left eye when he awoke the previous morning. He knew that something was off, but initially wasn't too concerned because he still had good central vision. He didn't become concerned until the next day when the visual sensation didn't improve.

He had a history of treated hypertension. His visual acuity was 20/25 OS, but there was a relative afferent pupil defect (RAPD) in that eye. He had an inferiorly located defect on confrontation visual fields, and threshold perimetry revealed a significant inferior arcuate defect. A dilated retinal examination revealed an edematous, hyperemic optic disc in the left eye and a small optic disc in the right with virtually no optic cup.

Diagnosis

Based upon the history of abrupt painless vision loss, an inferiorly located visual field defect, a hyperemic edematous optic disc and a classic "disc at risk" in the fellow eye, he was diagnosed with non-arteritic anterior ischemic optic neuropathy (NAION).

NAION typically presents as a painless, unilateral disturbance of vision. Patients are generally 55 to 65 years old; however, the onset of NAION may occur as early as the patient's late 30s.¹ Men and women are affected equally, and the disease



A patient with NAION. Researchers are hunting for a treatment.

Photo: Neil R. Miller, MD

reveals an RAPD in the involved eye. They generally experience little pain or other associated symptoms, a feature that helps to distinguish this condition from other optic neuropathies. The involved optic disc will be edematous and hyperemic.^{1,5}

A key diagnostic characteristic of NAION involves a small, crowded optic disc with minimal cupping in the contralateral eye. This "disc at risk," as some have called it, is recognized as a significant risk factor for the development of NAION in predisposed individuals.^{1,6,7} NAION represents an infarction of the

anterior portion of the optic nerve, typically involving the paraoptic branches of the short posterior ciliary arteries.^{7,8}

While no specific laboratory studies can confirm a diagnosis of NAION, an erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) should be ordered for any older patient for whom the diagnosis is uncertain and the possibility of giant cell arteritis exists.

Treatment Options

No universally accepted treatment for NAION yet exists. NAION eyes can spontaneously recover some visual function.⁹ Optic nerve sheath fenestration was investigated in the early 1990s, but abandoned as a therapy because of poor efficacy and high risk.⁹ Daily aspirin therapy has been recommended as prophylactic therapy, but the five-year cumulative

is most prevalent in Caucasians.^{1,2} Many patients with NAION have some underlying systemic disease, although they may not be aware of any health problems at the time of presentation.³ Most often, vascular disorders such as hypertension, diabetes, atherosclerosis or a combination are present.³

Vision loss is not always abrupt. Some patients report a rapid decline in acuity over several days, while 45% of patients worsen over two weeks, with another 29% reporting visual deterioration over 30 days.⁴ Visual acuity may be moderate to poor; about half of patients present with 20/60 or better, while roughly a third have entering acuity of less than 20/200.² Visual field defects most commonly include inferior altitudinal, inferior arcuate, inferior nasal and cecocentral scotomas.¹

Examination of these patients

benefit was less than 3%, according to researchers.¹⁰

Intravitreal injections of ranibizumab and erythropoietin individually have been noted to increase visual function in eyes with NAION, but again these were very small case series without controls.^{11,12} Research shows intravitreal injections of triamcinolone acetonide (IVTA) can improve visual function in eyes with NAION.¹³⁻¹⁶ However, most of that research was from case reports with no control group. Larger, controlled studies are needed before IVTA can be considered an effective therapy.

Topical brimonidine tartrate 0.2% has been anecdotally used based upon presumed neuroprotection and ease and availability of use. A double-masked, placebo-controlled, randomized multicenter trial involving brimonidine showed that visual acuity did not change to a statistically significant degree with treatment, though some non-significant trends for better visual field results were seen in the brimonidine group. While safe, a statistically significant advantage for the patients receiving brimonidine tartrate could not be shown.¹⁷ Systemic steroids have also been well demonstrated to have no recognizable benefit for visual function in NAION and, at high doses, have caused significant systemic adverse effects.¹⁷⁻²⁰

All May Not Be Lost

Though traditional and non-traditional approaches show little to no benefit for patients with NAION, a study is currently enrolling patients in an effort to bring an effective treatment to market. Quark Pharmaceuticals, in concert with the Neuro-Ophthalmology Research Disease Investigator Consortium (NORDIC), is conducting a randomized, double-masked, sham-controlled trial of QPI-1007 delivered

by single or multi-dose intravitreal injection(s) to patients with acute NAION. This efficacy and safety study will enroll approximately 800 subjects with recent-onset NAION. Subjects will be randomized into one of three groups in a 1:1:1 ratio, and assigned to receive QPI-1007, a sham procedure or both. Subjects will have a 66% chance of receiving active treatment and a 33% chance of receiving a sham placebo procedure. Total study time involvement will be approximately 12 months. This study will determine the effect of QPI-1007 on visual function in subjects with recent-onset NAION and assess the safety and tolerability of intravitreal injections of QPI-1007 in this population. This study will also evaluate the structural changes in the retina following administration of QPI-1007. Criteria assessed from day one through month 12 will be final mean change in best-corrected visual acuity and visual field.

Study enrollment criteria involves males and females ages 50 to 80 years old, and a positive diagnosis of first episode of NAION in the study eye with symptom onset within 14 days. Key exclusion criteria include any treatment for the current episode of NAION, including systemic steroids or brimonidine, use of drugs known to cause optic nerve or retinal toxicity such as chloroquine, hydroxychloroquine, ethambutol or vigabatrin, as well as clinical evidence of temporal arteritis.

Optometrists can help these patients by referring potential patient-subjects to a clinical study site across the United States. If you suspect your patient has NAION, consider referring as soon as possible. Early referral is critical, as study enrollment is limited to 14 days from onset of symptoms. Study sites will complete full diagnosis,

determine eligibility and provide all study details. You can identify and contact a study site by visiting www.eyectnow.com for study information and to locate a study site. You can also visit www.clinicaltrials.gov for more information and to identify current sites. Your involvement may shed light on a possible treatment for a condition that has eluded management. ■

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The Dry Eye Misalignment

If dry eye comes with headaches, neck/shoulder pain and eyestrain, it may be trigeminal dysphoria. **By Paul M. Karpecki, OD**

A patient complains of burning, irritated eyes, especially late in the day after working at the computer. Sounds like classic dry eye disease, doesn't it?

Every week I see patients like this who were diagnosed with dry eye and treated with artificial tears, therapeutics and omega fatty acids—all to no avail. After a year or two, they continue to have the same symptoms with little to no improvement. Furthermore, early diagnostic testing typically reveals common dry eye signs such as mild inferior staining, meibomian gland dysfunction and even a rapid tear film break-up time. These signs may improve with treatment, but the symptoms do not.

While their lack of improvement with traditional dry eye treatments may already have most clinicians suspicious, osmolarity testing can provide another clue. These patients will often have normal osmolarity readings in the range of 280mOsm/L to 295mOsm/L, making it extremely unlikely that they truly have dry eye.

A complicated clinical picture such as this warrants a closer look at the nervous system, because some patients who complain of dry eye with concurrent headaches, neck/shoulder pain and eyestrain when using digital devices, reading or doing near work, may be experiencing symptoms of trigeminal dysphoria. While these patients can be treated with traditional base-in prism, they now have a new treatment option with specialized contoured prism spectacle lenses.

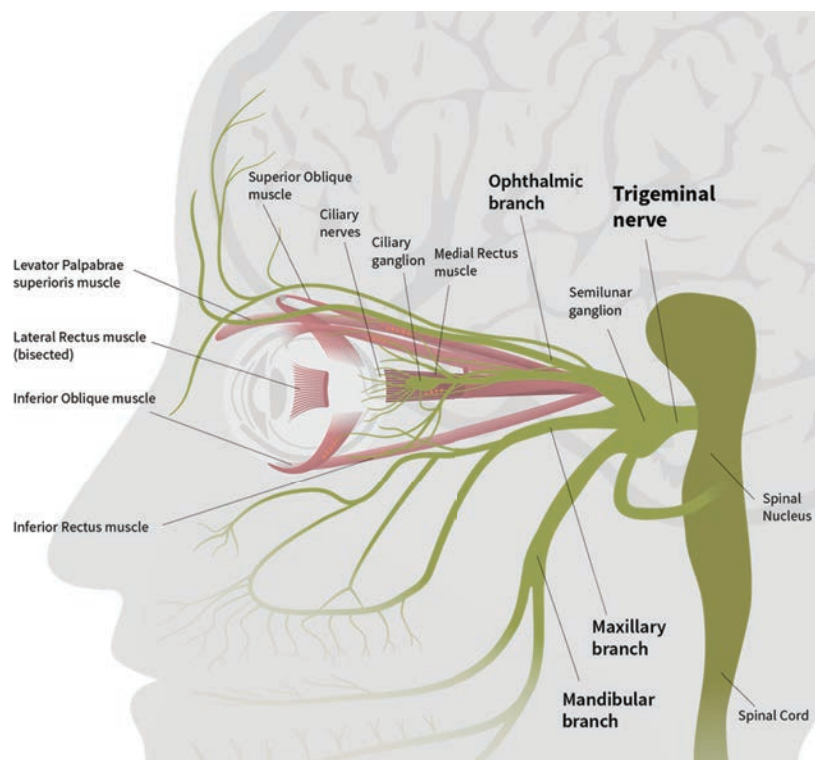


Image: eyebrian

Research now suggests specialized lenses can help patients overcome symptoms of dysfunction of the ophthalmic branch of the trigeminal nerve, trigeminal dysphoria.

The Nerve Disconnect

The trigeminal nerve is the largest and most complex nerve connected to the brain. It splits into three branches as it leaves the brain to innervate the eyes, nose and mouth; it also provides head and neck sensation.

Its involvement with the eye has spurred growing interest in both research and industry. Recently, for example, we have seen the introduction of nasal neurostimulation for dry eye, in which a device is used to stimulate the trigeminal nerve and increase tear production.¹ Researchers

are also expanding our understanding of the commonalities between neuropathic migraine and ocular pain.² A series of clinical studies on patients with chronic headache revealed that symptomatic patients shared a common trait: a misalignment in their synchronization of peripheral and central visual tracking systems.³ Investigators have termed this condition—with its related symptoms—*visually induced trigeminal dysphoria*.

Researchers have long known proprioceptive fibers innervating the extraocular muscles provide affer-

ent feedback to the brain around the location of each eye—feedback required to avoid binocular misalignments. These signals are transmitted through the ophthalmic branch of the trigeminal nerve, which is responsible for detecting sensation and reporting pain. Research now suggests these signals play a large role in the stimulation of the trigeminal nerve, resulting in symptoms such as headache, neck and shoulder pain, light sensitivity, eyestrain and dry eye.^{4,5}

In addition, both mild exophoria at distance and convergence insufficiency are associated with trigeminal dysphoria. The degree of misalignment is much less than what is commonly classified as strabismus and often goes unnoticed precisely because it does not lead to loss of binocularity. However, the more subtle degree of misalignment greatly increases the compensatory demands on the visual system during near work, overstimulating the trigeminal nerve and causing symptoms.

Similar symptoms have been described in the ophthalmic literature for years.⁵⁻⁷ They haven't been thoroughly explored until recently, likely because our highly visual, digital device-dependent world now exacerbates the condition. American adults spend more than nine hours per day on digital devices, requiring prolonged near focus and reducing the blink rate.⁸

Uncovering the Truth

To get to the heart of a patient's suspicious dry eye complaints, clinicians need to be more diligent history-takers. Because headaches and neck strain are so common in trigeminal dysphoria, I have added these symptoms to my patient questionnaire, which already includes questions about near vision problems and end-of-day eyestrain. Patients often don't connect the head and neck symptoms

to their eyes and might not mention them during an eye exam without direct questioning.

In patients with symptoms that lead to a suspected trigeminal dysphoria, I begin with a cover test. I have the patient look at a distant object or letter, move a paddle from eye to eye and tell me if the object moved. If it moved with the paddle, I suspect exophoria, the most common presentation leading to trigeminal dysphoria. If it's also present at near, I have my technicians screen for this condition with SightSync (eyeBrain Medical), the neurolens measurement device. This provides a customized measurement of misalignment from 50cm to a non-accommodative distance. The device also incorporates other ocular fusion analyses, including heterophoria, vergence conditioning, fixation disparity, accommodative convergence response and alternating monocular central fixation. Clinical research shows more than 90% of patients have a larger misalignment at near than at distance.⁹

In my referral clinic, when examining patients with unresolved dry eye symptoms despite treatment, we find that about 50% have three or more symptoms that could be related to eye misalignment.

Calm Some Nerves

Luckily, this new diagnosis comes with a new treatment option: neurolenses. SightSync provides precise measurements to 0.01D of prism, giving clinicians a prescription for neurolenses (eyeBrain Medical).¹⁰ These prescription lenses incorporate a contoured prism to bring the eyes into alignment. Unlike standard prism lenses, they are designed to relieve binocular misalignment at distance, intermediate and near in a single lens, in addition to correcting the patient's refractive prescription.

In my personal experience,

patients' late-day dry eye symptoms disappear when given spectacles with neurolenses, and patients often report improvements in headache and neck strain as well. In a survey conducted by the manufacturer, 93% of patients who had previously been diagnosed with computer vision syndrome reported a reduction in symptoms, including 86% who said their symptoms were substantially reduced or "basically gone" after 90 days of wearing neurolenses.¹¹

Patients should be counseled that it can take a few weeks for neuroadaptation, similar to what we expect when prescribing any new progressive or prism lens. Wearing the glasses all day will speed up the neuroadaptation process.

This exciting new development is twofold: the new diagnosis can help clinicians better distinguish dry eye from other masquerading conditions and the accompanying treatment can bring relief to those who have continued to struggle with these unresolved symptoms. ■

Dr. Karpecki is a consultant for eyeBrain Medical.

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A Little of This, A Little of That

A new patient presents with two findings associated with optic nerve disease. Well, maybe two. **By James L. Fanelli, OD**

A 65-year-old Caucasian male presents as a new patient to establish care in May 2018 with complaints of gradual, yet painless, blurry vision in his left eye over several months. His last reported visit to an eye doctor was approximately five years earlier. Current medications included Tenormin (atenolol, AstraZeneca), omeprazole, Zocor (simvastatin, Merck) and multivitamins. He reported no known allergies to medications.

Diagnostic Data

At this initial visit, entering visual acuities were 20/30 OD and 20/60 OS, best corrected to 20/20 OD and 20/50+ OS. There was no frank afferent pupillary defect (APD) noted, and his extraocular muscles were full in all positions of gaze. Confrontation fields were full in both eyes.

A slit lamp examination of his anterior segments was unremarkable, with open anterior chamber angles and clear corneas. Applanation tensions were 14mm Hg OD and 13mm Hg OS at 10:45am. Pachymetry readings were 511µm OD and 513µm OS.

Through dilated pupils his crystalline lenses were clear, with

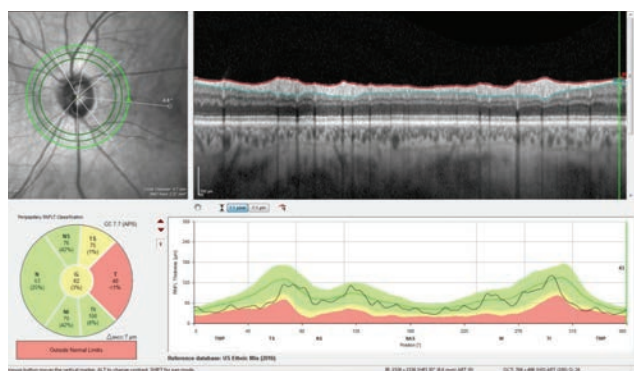


Fig. 1. These readouts demonstrate the global reduction in the temporal neuroretinal rim BMO complex consistent with a previous episode of unspecified non-glaucomatous optic neuropathy.

perhaps some incipient nuclear changes OU, but not significant enough to affect vision. The anterior vitreous OU was clear.

Findings

The posterior segment was characterized by clear maculae, and retina vasculature characterized by moderate arteriolar sclerosis, consistent with his medical history of hypercholesterolemia. The cup-to-disc ratios were 0.35 x 0.45 OD and 0.45 x 0.65 OS, with a somewhat thinned neuroretinal rim from 1 o'clock to 5 o'clock. I noted some mild pallor of the temporal aspect of the left optic nerve, and margins in both eyes were distinct. His peripheral retinal evaluation was normal.

Following the posterior pole examination, and the optic nerves in particular, I reviewed with him his history and, although it was

not the most detailed, there appeared to be no distinct, acute onset of decreased vision consistent with a non-glaucomatous optic neuropathy, such as non-arteritic ischemic optic neuropathy. He attributed the change in his vision to both age and a lapse in routine eye care for several years. He denied any phosphodiesterase type 5 (PDE-5) inhibitor use. Essentially, a review of this aspect of

the history was not forthcoming in details suggestive of acute optic neuropathy.

Diagnosis

Accordingly, the patient was initially diagnosed as a normal tension glaucoma suspect, more so in the left eye than the right, with the possibility of an old ischemic optic neuropathy in the left. He was prescribed glasses to get him to best-corrected visual acuity levels, and he was asked to return in a few weeks for optic nerve imaging and threshold visual field studies.

At that follow-up visit, close examination of his pupillary reactions yielded an equivocal APD on the left side. Neutral density filters were missing in the office, so no sensitivity pupillary testing could be done.

Applanation tensions were 12mm Hg OD and 13mm Hg

OS. Threshold flicker-defined form (FDF) visual field testing of his right eye demonstrated an essentially normal field. The left eye was consistent with a relatively small central defect, along with pericentral areas consistent with the thin inferotemporal neuroretinal rim, suggestive of early glaucomatous loss, but this area was contiguous with the central defect.

Heidelberg retina tomography (HRT 3) and optical coherence tomography (OCT) imaging of the optic nerves were obtained. The HRT 3 imaging confirmed the initial estimate of the neuroretinal rim contours with the left eye, showing thinning of the temporal rim. The OCT evaluation—using the glaucoma premium edition (GMPE) software analysis—demonstrated normal peripapillary retinal nerve fiber layer scans in the right eye, and, for the most part, similar findings in the left. Bruch’s membrane opening (BMO) measurements in the right were not suspicious, whereas those of the left demonstrated a thinned temporal neuroretinal rim in the area of the papillomacular bundle, and a relatively normal BMO in the superior temporal and inferior temporal sectors (*Figure 1*). The macular thickness scans were suspect in the left eye for early loss in the inferior arcuate region (*Figure 2*).

Discussion

In glaucoma, even in advanced cases, the remaining neuroretinal rim, though thin and excavated, is not usually pale and atrophic. In cases of non-glaucomatous optic neuropathies, there is pallor to the neuroretinal rim and rim thinning

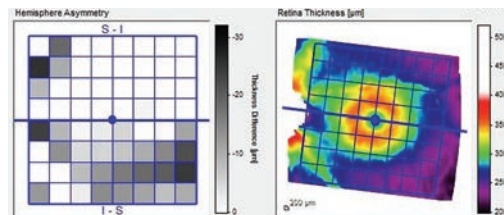


Fig. 2. This image demonstrates the hemispheric asymmetry of the left macular scan between the hemisphere above and below the horizontal raphe.

usually does not occur.

In our case, the patient has a bit of thinning of the neuroretinal rim in the left eye and pallor of the neuroretinal rim. With two diagnoses—normal tension glaucoma and a previous infarct affecting the optic nerve—two patient management plans must be created.

Let’s tackle the optic nerve infarct first. What we don’t have is a complete history of acute vision loss. But we do have three important findings, two of which are a visual field defect and optic nerve pallor. The field study in the left eye is consistent with a previous infarct, as non-glaucomatous optic neuropathies do present with a central or a cecentral field defect. Following the initial infarct, the damaged tissue becomes pale and atrophic, and observation of the nerve clearly shows temporal pallor. The third, and probably most important, piece is the OCT image, which shows thinning of the temporal sector of the optic nerve, specifically in the area of the papillomacular bundle. Glaucomatous thinning usually occurs infero- and superotemporally, rather than in the papillomacular bundle. Given these findings, it does appear that the patient did, at some point, experience an optic nerve infarct.

The question as to whether or not the patient has normal tension glaucoma is not as clear cut. The thin appearance of the neuroreti-

nal rim of the left eye from 1 to 5 is consistent with glaucomatous damage. While the visual field is suggestive of early glaucomatous damage, it is not diagnostic, as the questionable areas are contiguous with the central field defect (which is attributable to the ischemic event). But one cannot argue with the thin neuroretinal rim findings.

Management

So ultimately, the question moves to patient management. Once again, the infarction end of the diagnosis is straightforward: the damage has been done, and there’s nothing that needs to be done in this regard, other than continued monitoring. The glaucomatous end of the diagnosis is not as straightforward. But the question is that if the patient does in fact have normotensive glaucoma, how “at risk” is that left disc for progressive damage? And the answer to that specific question is simply, “no more than any other normotensive glaucoma patient.”

At this point, we have two valid options to manage this patient: intervene with medications or passively monitor the patient. But given that we’re not 100% certain the patient has glaucoma, as well as the absence of increased risk of more rapid progression than any other glaucoma patient, I chose to monitor the patient. I’ve only had the opportunity to see him twice over the course of a month. In other words, I don’t have longitudinal data to base a decision on, so I chose to monitor him, with the intention of watching him closely. If he does have normotensive glaucoma, changes will be visible to either the neuroretinal rim or the visual field, or both, over time, and he would then go on medication for glaucoma. ■

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Trauma Drama

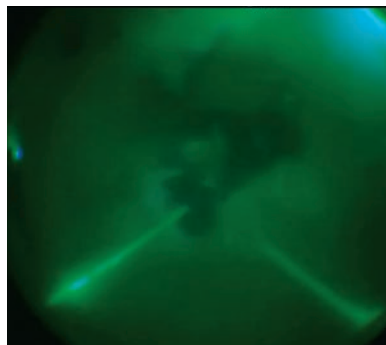
Ocular injuries can sometimes come with a host of complications. Here's how to handle them in four steps. **By Alan Franklin, MD, PhD**

With ocular trauma, a relatively innocuous presentation can be associated with a significant injury, and symptoms can often be more pronounced than the actual injury itself. When evaluating a traumatic ocular injury, quickly discerning whether it is penetrating or non-penetrating is critical, as the former requires prompt intervention to reduce the risk of endophthalmitis. This four-step approach can help ensure patients get prompt care:

Step One: History and Exam

This is key to rule out significant trauma. The patient pictured here was hammering metal on metal, which creates a small, high-velocity projectile that can easily penetrate the globe. Although sharp trauma is generally associated with a higher incidence of globe penetration, blunt trauma can also cause globe rupture around surgical incisions or where the sclera is most thin, near insertion of the rectus muscles. Thus, either form of trauma to a previously operated eye increases the index of suspicion for a ruptured globe.

Risk factors for open globe include: (1) vision worse than 20/200; (2) relative afferent pupillary defect; (3) hemorrhagic chemosis; (4) vitreous hemorrhage; and (5) relative hypotony. For this patient, we ordered a computed tomography



Using a digital red-free filter to see through the vitreous blood, the surgeon was able to tamponade the blood and create a better view of posterior segment damage, including the IOFB.

scan to confirm an intraocular foreign body (IOFB).

Step Two: Alert the Team

An IOFB constitutes a true emergency because of the risk of traumatic endophthalmitis and requires an immediate referral to the surgeon and a local retina specialist. If the patient develops an infection associated with a traumatic injury, the bacteria can be virulent and cause severe damage. Therefore, foreign body injuries require prompt treatment to avoid a potentially disastrous outcome.

Step Three: Surgery

Management of significant trauma can be challenging. In this case, the patient had many complications: corneoscleral laceration, dense hyphema and vitreous hemorrhage, traumatic cataract, IOFB and traumatic retinal detachment (RD) with two retinal impact sites. We chose a

two-stage surgical approach. In the first surgery, we repaired the laceration, removed the lens and injected intravitreal and subconjunctival antibiotics. During the second repair, we washed out the anterior segment blood, removed the vitreous hemorrhage, repaired the RD, stabilized the posterior impact sites, removed the IOFB and reinjected antibiotics.

Often, visualization during the primary repair is significantly compromised, and a fresh wound may not be able to hold the pressure required for vitrectomy surgery and foreign body removal. High-resolution digitally assisted vitreoretinal surgery was critical in this case, as the digital filters suppressed the vitreous blood, enabling a better view and permitting more precise and less traumatic IOFB and bloody vitreous removal. Moreover, the enhanced depth of field helped us achieve a relatively atraumatic foreign body removal.

Step Four: Follow up

Over the first post-op week, managing clinicians must ensure the globe remains formed and free of infection. Typically, frequent antibiotic drops and anti-inflammatory steroids are prescribed in addition to oral antibiotics. After the first week, patients are monitored for recurrent hemorrhage, RD and abnormal intraocular pressure.

Newer technologies and techniques have refined our approach to severe trauma, and today's patients can achieve a functional outcome despite significant injuries. ■



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

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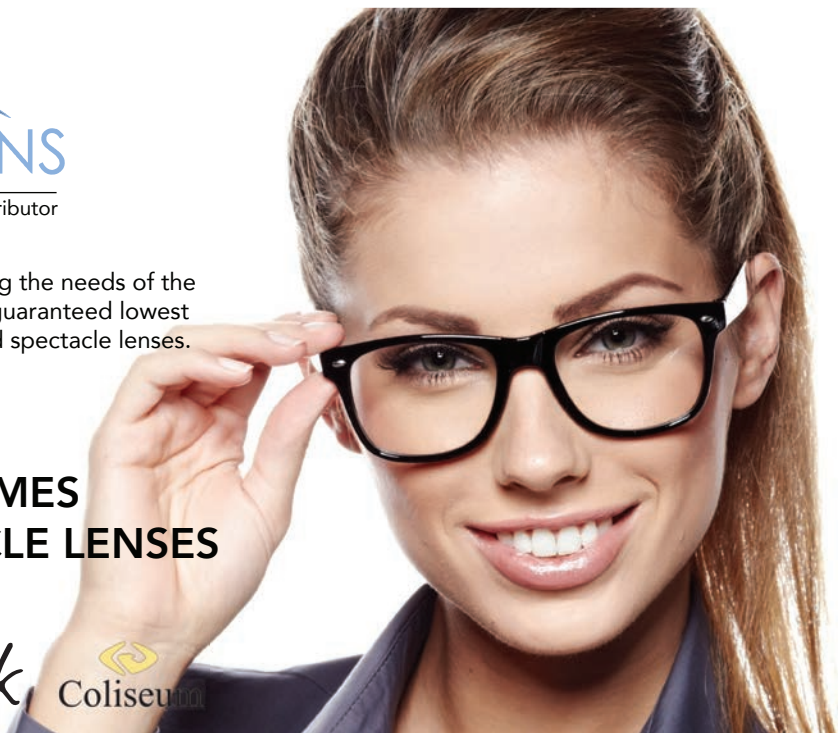


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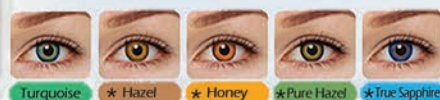
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a) Teaching

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- Precepting students on clinical rotation at the Midwestern University Eye Institute where applicable;

b) Service

- Helping to maintain and grow the state of the art optometry program with a strong interdisciplinary focus that meets the needs of patients in the surrounding community; is efficient, patient friendly, and cost-effective;
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- Participating in leadership roles in

state, regional, and national optometry organizations;

c) Scholarly activity

Engaging in research and scholarly activity, including presentations at scientific meetings, research, and publication in peer reviewed journals sufficient to qualify for academic advancement in a non-tenure or tenure track position.

Qualifications: Primary care candidates must possess a Doctor of Optometry degree from an ACOE-accredited institution, must have completed an ACOE-accredited residency, and must be eligible for an optometric state license in the state in which the college is located. Primary eye care clinical expertise is also required.

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■ 21-22. East Coast Optometric Glaucoma Symposium.

Rittenhouse Hotel, Philadelphia, PA. Hosted by: *Review of Optometry*. Key faculty: Murray Fingeret, Robert N. Weinreb. CE hours: Up to 12 (COPE approval pending). For more information, email reviewmeetings@jhihealth.com, call (877) 451-6514 or go to www.reviewofoptometry.com/events.

■ 26-29. *International Vision Expo & Conference West*. The Sands Expo & Convention Center, Las Vegas, NV. Hosted by: Reed Exhibitions and The Vision Council. Key faculty: I. Ben Gaddie, Mark Dunbar, Kirk Smick, Jack Schaeffer, Dave Ziegler, Douglas Devries. CE hours: 291 total, 30 per OD. For more information, go to west.visionexpo.com.

■ 27-30. *2018 Wisconsin Optometric Association Convention and Annual Meeting*. Kalahari Resort & Conference Center, Wisconsin Dells, WI. Hosted by: Wisconsin Optometric Association. Key faculty: Tony Litwak, Nate Lighthizer, Jay Haynie. CE hours: 22. For more information, email Joleen Breunig at joleen@woa-eyes.org, call (608) 824-2200 or go to www.woa-eyes.org.

October 2018

■ 4-6. *EastWest Eye Conference 2018*. Huntington Bank Cleveland Convention Center, Cleveland, OH. Hosted by: Ohio Optometric Association. Key faculty: Paul Ajamian, Brad Sutton, Stuart Richer, Danica Marrelli, Steve Ferrucci, Milton Hom. CE hours: 250 total, 26 per OD. For more information, email Jordan Quickel at jquickel@ooa.org or go to www.eastwesteye.org.

■ 4-6. *Idaho Optometric Physicians Annual Congress*. Coeur d'Alene Resort, Coeur d'Alene, ID. Hosted by: Idaho Optometric Physicians. CE hours: 32 total, 19 per OD. For more information, email Randy Andregg at execdir@iopinc.org or go to idaho.aoa.org.

■ 6-7. *Symposium on Ocular Disease*. Swan and Dolphin Hotel, Orlando, FL. Hosted by: PSS EyeCare. Key faculty: Stuart Kaplan, Richard Castillo, David Masihdas, Deepak Gupta, Michael Tolentino, Pinakin Davey. CE hours: 18. For more information, email Sonia Kumari at education@psseyecare.com or go to www.psseyecare.com.

■ 20-21. *Georgia Optometric Association Fall Education Conference*. University of Georgia Center for Continuing Education and Hotel, Athens, GA. Hosted by: Georgia Optometric Association. CE hours: 18. For more information, email Vanessa Grosso at vanessa@goaeyes.com or go to www.goaeyes.com.

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Starting From Scratch

By Andrew S. Gurwood, OD

History

A 27-year-old Caucasian female reported to the office urgently with a chief complaint of pain and vision changes in her right eye throughout the previous week. She explained that she had scratched her right eye following aggressive rubbing when her seasonal allergies caused irritation during an outing, four weeks earlier. She recounted that she did not seek care at the time of the incident and opted to treat it herself with over-the-counter lubricants.

She believed her remedy was working until about a week prior to the office visit when she noticed her eye was red, feeling scratchy and that her vision “was off.” Her previous ocular and systemic history was unremarkable, she was not a contact lens wearer and she denied allergies of any kind.



This 27-year-old woman reported pain after scratching her right eye.

Diagnostic Data

Her best uncorrected entering visual acuities were 20/50 OD and 20/20 OS at distance and near with no improvement upon pin-hole. Her external examination was normal with no evidence of afferent pupil defect. The biomicroscopic examination of the right eye’s anterior segment is shown in the photo; mild sodium fluorescein

corneal staining overlying a 3mm x 1mm area of mild subepithelial and stromal corneal edema with subepithelial infiltrate, local limbal conjunctival injection and trace cell and flare in the anterior chamber, OD. The fellow eye was normal. Goldmann applanation tonometry measured 13mm Hg OD and 15mm Hg OS. The dilated fundus exam was normal with no posterior pole or peripheral pathologies in either eye.

Your Diagnosis

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

Retina Quiz Answers (from page 75): 1) d; 2) c; 3) a; 4) d.

Next Month in the Mag

Review of Optometry will present its Annual Technology Report. Topics include:

- *The Promise and Peril of Virtual Reality and Augmented Reality Technologies*
- *What OCT-A Could Offer Patients with AMD, Diabetes and More*
- *Get More Out of EHR and New Diagnostic Devices: Retool Your Practice to Boost Efficiency*

Also in this issue:

- *Understanding the Symptomatology of Giant Cell Arteritis* (Earn 2 CE credits)
- *Fitting Glasses for Kids: The Latest Guidelines on Pediatric Practice*
- *Optometry’s Role in Substance Abuse*
- *Add a Specialty to Stand Out from the Crowd: Dry Eye, Contact Lenses, Vision Therapy, Low Vision, TBI and More*

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