MAY/JUNE 2017

# RCCL®

## REVIEW OF CORNEA & CONTACT LENSES

# ENHANCING Comfort

**It's our top priority for keeping contact lens wearers loyal and healthy. Inside, experts share their best tips on the influence of:**

- Contact Lens Materials
- Tear Film Dynamics
- Lens Care Regimens
- Allergy and Dry Eye

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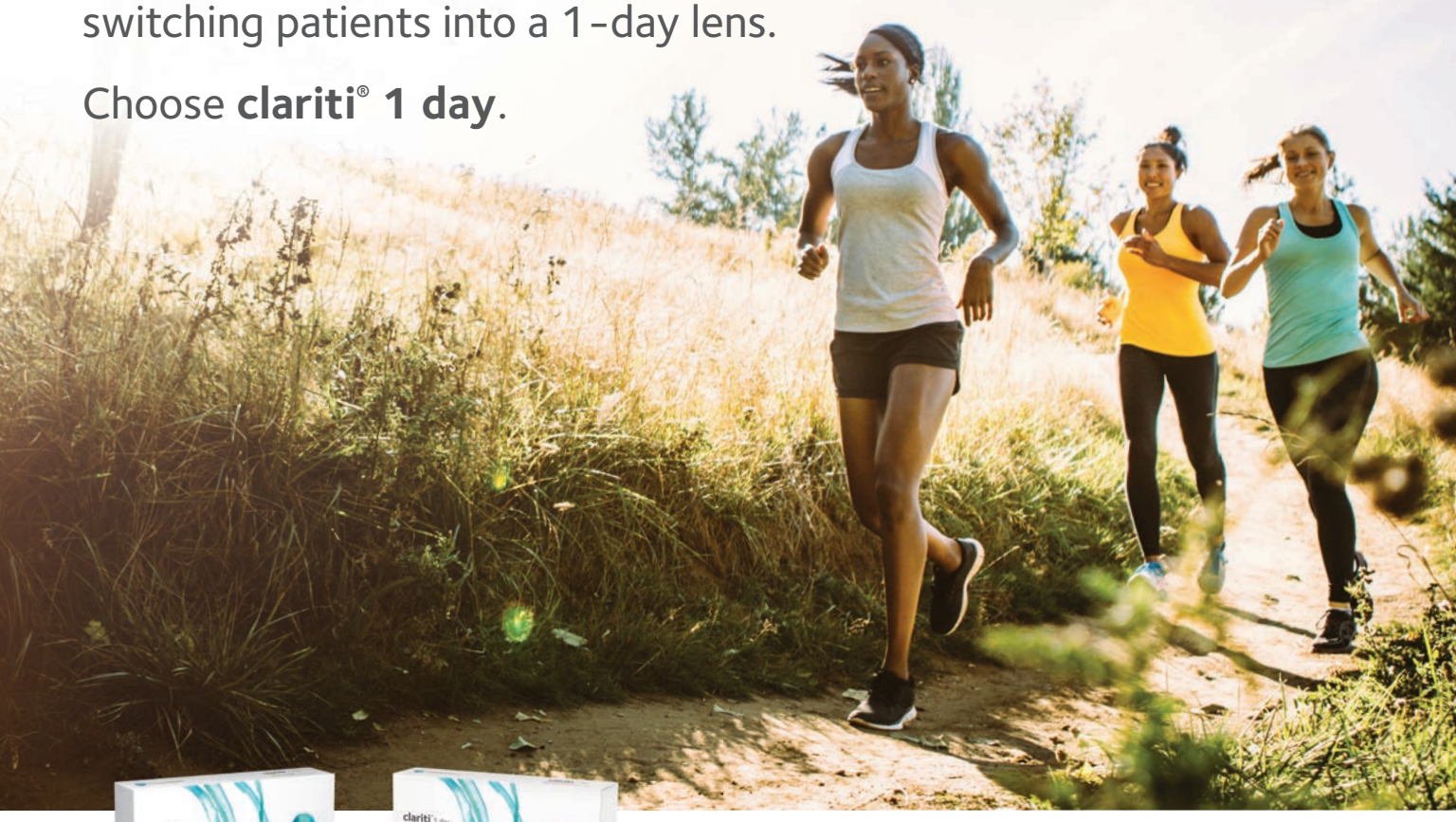


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## IN BRIEF

■ After following 500 patients post Descemet membrane endothelial keratoplasty (DMEK), researchers found outcomes remain excellent up to two years after the procedure. The study evaluated best-corrected visual acuity (BCVA), central endothelial cell density and central corneal thickness before and at six, 12 and 24 months after DMEK. At one year post-procedure, 81% of eyes recorded a BCVA of ≥20/25, 49% reached ≥20/20 and 15% achieved ≥20/18—and remained stable up to 24 months. Retransplantation was required in only 6.4% of eyes, and few participants had long-term complications such as secondary graft failure (1.4%) and allograft rejection (1.4%).

Peraza-Nieves J, Baydoun L, Dapena I, et al. Two-year clinical outcome of 500 consecutive cases undergoing Descemet membrane endothelial keratoplasty. Cornea. April 12, 2017. [epub ahead of print].

■ When studying tear neuropeptide levels in 20 contact lens wearers and 20 non-wearers, researchers uncovered a relationship between nerve density, calcitonin gene-related peptide concentration and corneal sensitivity. Lens wearers had higher Ocular Comfort Index scores and tear osmolarity compared with the non-wearers, but lower noninvasive tear break-up times. Tear neuropeptide concentrations, nerve morphology and ocular surface sensitivity were no different between the two groups. The authors conclude that contact lens wear does not seem to alter markers of corneal neurobiology and sensory function, despite worse tear function.

Golebiowski B, Chao C, Stapleton F, Jalbert I. Corneal nerve morphology, sensitivity, and tear neuropeptides in contact lens wear. Optom Vis Sci. 2017;94(4):534–42.

■ Researchers who recently looked into the *in vitro* extended drug reservoir function of human amniotic membranes (HAM) were able to achieve sustained release of moxifloxacin from HAM for up to seven weeks. The study, which involved a process of soaking HAM buttons of different thicknesses with moxifloxacin and closely assessing the release kinetics, may have revealed a new application for sustained drug delivery through a biological bandage system when dealing with bacterial keratitis. Results also showed significantly higher entrapment efficiency for moxifloxacin in thicker HAM compared with thinner.

Yelchuri ML, Bhagyashree M, Nilam G, et al. *In vitro* evaluation of the drug reservoir function of human amniotic membrane using moxifloxacin as a model drug. Cornea. 2017; 36(5):594–9.

# Back to Sleep for Dry Eye

A new study adds yet another facet to the already complicated conditions of dry eye disease (DED) and meibomian gland dysfunction (MGD): sleep position.

"Meibomian gland disease is often very asymmetric," says Hank D. Perry, MD, of Ophthalmic Consultants of Long Island in Rockville Centre, NY, and the Department of Ophthalmology, Nassau University Medical Center in East Meadow, NY. "When you question these patients, you frequently find they usually sleep on the side with the more severe meibomian gland disease. So there is a relationship between the way they sleep and presenting problems of meibomian gland disease, and dry eye disease in general."

To learn more about the possible association, Dr. Perry and colleagues asked 100 patients with DED symptoms and 25 controls to complete a sleep questionnaire and the Ocular Surface Disease Index (OSDI). While other studies have focused on nocturnal lagophthalmos, sleep apnea and floppy eyelid syndrome, this is the first to look at sleep position specifically, with more diagnostic parameters such as OSDI scoring, tear osmolarity, lissamine staining and Schirmer I testing, the authors said in the study.

In comparing the outcomes, they found a statistically significant difference with back sleeping compared to left side sleeping using lissamine green staining. They also found the OSDI scores were elevated in patients who slept on their sides compared with those who slept on their back. However, they found no statistically significant correlation between the sleep position and degree of MGD.

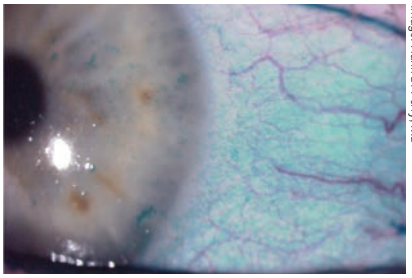

Image: Hank D. Perry, MD

**Sleeping on your back could help alleviate symptoms of dry eye.**

"We found that some patients got better just by changing their sleep patterns," Dr. Perry says. "Not the easiest thing to do, but it can be done." He also notes only 10% of the population sleeps on their backs, despite its benefits for those with MGD and dry eye.

"It's another step [in dry eye care] that can help in terms of treating very difficult, complicated patients," he says. "Something as simple as going from sleeping on their stomach to sleeping on their back can make a world of difference—and this is especially true for patients with severe meibomian gland disease, floppy eyelid syndrome" and other lid-involved conditions.

Eventually, Dr. Perry and his fellow researchers hope objective findings from a sleep center will further support the correlation uncovered by the patient questionnaires. Still, the current findings should lead many practitioners to add sleep patterns to their list of patient questions. "In some ways, it's easier than having the patient take artificial tears or have them do lid hygiene," Dr. Perry says. "It's at least worth mentioning that their sleep pattern can affect the disease. It just makes sense."

Alevi D, Perry HD, Wedel A, et al. Effect of sleep position on the ocular surface. Cornea. 2017;36:567-71.

# The SCOPE of Scleral Lenses

After looking at current scleral lens prescription and management practices, a recent survey-based study found a considerable amount of consensus among participating practitioners.[1] The Scleral Lenses in Current Ophthalmic Practice: an Evaluation (SCOPE) study surveyed 723 practitioners, all of whom had fit at least five patients with scleral lenses.

For instance, the survey showed 57% to 60% of respondents recommended using nonpreserved saline to fill the bowl of the lens prior to application. "To see such a large majority recommending preservative-free solutions for application of scleral lenses is a very strong recommendation," says Michael J. Lipson, OD, clinical assistant professor at University of Michigan's Kellogg Eye Center and vice president of the Scleral Lens Education Society. "Finding the right solution or 'cocktail' of solutions can be the difference between success and failure of a scleral lens fitting."

Dr. Lipson sees this as a possible area for future scleral research and product development. "It's a balance of cleansing, lubrication and overall biocompatibility that is required to make the patient comfortable and keep their vision and the cornea clear. We need to develop an application solution—sort of like 'Gatorade for scleral lenses'—that provides natural electrolytes and maintains a clean, wet lens surface."

The study also showed 73% of practitioners recommended mid-day lens removal on some, most or all days and 65% prescribed scleral lenses between 15mm and 17mm in diameter. According to Dr. Lipson, practitioners will find the most success when using various diameters to custom fit patients based on individual needs.

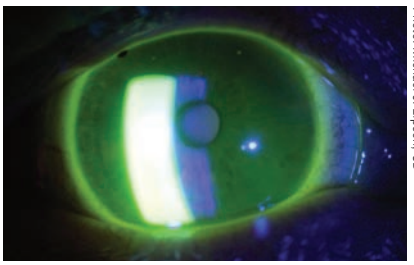

Photo: Michael J. Lipson, OD

**A good scleral lens fit depends on the right diameter and thickness.**

The authors believe more research is needed to develop evidence-based guidelines for scleral lens fitting; Dr. Lipson concurs. "The main issue is practitioner training and education," he says. "Practitioners taking on sclerals for the first time should attend fitting workshops, webinars and educational meetings to know whom to fit, how to fit and what to look for during fitting and follow-up care to assure ideal visual and eye health results."

Still, the SCOPE study could potentially serve as a starting point for practitioners new to sclerals. Also, the general agreement of those surveyed shows that practices are moving forward together in scleral fitting protocols. "As they are now, scleral lenses are generally very successful and can be life-changing for these challenging eyes," says Dr. Lipson. RCCL

1. Harthan J, Nau CB, Barr J, et al. Scleral lens prescription and management practices: the SCOPE study. Eye & Contact Lens. 2017;0:1–5.



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*Review of Cornea & Contact Lenses | May/June 2017*

## departments



## features

★★★ THE MAIN EVENT ★★★

# ZYLET®

**“A One-Two Combo”**

VS

**STEROID-RESPONSIVE INFLAMMATORY OCULAR CONDITIONS WITH RISK OF INFECTION**


# HELP PUT RELIEF IN YOUR CORNER

## INDICATIONS AND USAGE

ZYLET® (loteprednol etabonate 0.5% and tobramycin 0.3% ophthalmic suspension) is a topical anti-infective and corticosteroid combination for steroid-responsive inflammatory ocular conditions for which a corticosteroid is indicated and where superficial bacterial ocular infection or a risk of bacterial ocular infection exists.

Ocular steroids are indicated in inflammatory conditions of the palpebral and bulbar conjunctiva, cornea and anterior segment of the globe such as allergic conjunctivitis, acne rosacea, superficial punctate keratitis, herpes zoster keratitis, iritis, cyclitis, and where the inherent risk of steroid use in certain infective conjunctivitides is accepted to obtain a diminution in edema and inflammation. They are also indicated in chronic anterior uveitis and corneal injury from chemical, radiation or thermal burns, or penetration of foreign bodies.

The use of a combination drug with an anti-infective component is indicated where the risk of superficial ocular infection is high or where there is an expectation that potentially dangerous numbers of bacteria will be present in the eye.

The particular anti-infective drug in this product (tobramycin) is active against the following common bacterial eye pathogens: Staphylococci, including *S. aureus* and *S. epidermidis* (coagulase-positive and coagulase-negative), including penicillin-resistant strains. Streptococci, including some of the Group A-beta-hemolytic species, some nonhemolytic species, and some *Streptococcus pneumoniae, Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae, Enterobacter aerogenes, Proteus mirabilis, Morganella morganii,* most *Proteus vulgaris* strains, *Haemophilus influenzae,* and *H. aegyptius, Moraxella lacunata, Acinetobacter calcoaceticus* and some *Neisseria* species.

## IMPORTANT SAFETY INFORMATION

- ZYLET® is contraindicated in most viral diseases of the cornea and conjunctiva, including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, and also in mycobacterial infections of the eye and fungal diseases of ocular structures.

## IMPORTANT SAFETY INFORMATION (continued)

- Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, and defects in visual acuity and fields of vision. Steroids should be used with caution in the presence of glaucoma. If this product is used for 10 days or longer, intraocular pressure should be monitored.
- Use of corticosteroids may result in posterior subcapsular cataract formation.
- The use of steroids after cataract surgery may delay healing and increase the incidence of bleb formation. In those diseases causing thinning of the cornea or sclera, perforations have been known to occur with the use of topical steroids. The initial prescription and renewal of the medication order should be made by a physician only after examination of the patient with the aid of magnification such as a slit lamp biomicroscopy and, where appropriate, fluorescein staining.
- Prolonged use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In acute purulent conditions, steroids may mask infection or enhance existing infections. If signs and symptoms fail to improve after 2 days, the patient should be re-evaluated.
- Employment of corticosteroid medication in the treatment of patients with a history of herpes simplex requires great caution. Use of ocular steroids may prolong the course and exacerbate the severity of many viral infections of the eye (including herpes simplex).
- Fungal infections of the cornea are particularly prone to develop coincidentally with long-term, local steroid application. Fungus invasion must be considered in any persistent corneal ulceration where a steroid has been used or is in use.
- Most common adverse reactions reported in patients were injection and superficial punctate keratitis, increased intraocular pressure, and burning and stinging upon instillation.

**Please see Brief Summary of full Prescribing Information for ZYLET® on adjacent page.**

BAUSCH+LOMB

Zylet®

loteprednol etabonate 0.5% and tobramycin 0.3% ophthalmic suspension

**BRIEF SUMMARY OF PRESCRIBING INFORMATION**

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

# Zylet® (loteprednol etabonate 0.5% and tobramycin 0.3% ophthalmic suspension)

**Initial U.S. Approval: 2004**

## DOSAGE AND ADMINISTRATION

### 2.1 Recommended Dosing

Apply one or two drops of Zylet into the conjunctival sac of the affected eye every four to six hours. During the initial 24 to 48 hours, the dosing may be increased, to every one to two hours. Frequency should be decreased gradually as warranted by improvement in clinical signs. Care should be taken not to discontinue therapy prematurely.

### 2.2 Prescription Guideline

Not more than 20 mL should be prescribed initially and the prescription should not be refilled without further evaluation [*see Warnings and Precautions (5.3)*].

## CONTRAINDICATIONS

### 4.1 Nonbacterial Etiology

Zylet, as with other steroid anti-infective ophthalmic combination drugs, is contraindicated in most viral diseases of the cornea and conjunctiva including epithelial herpes simplex keratitis (dendritic keratitis), vaccinia, and varicella, and also in mycobacterial infection of the eye and fungal diseases of ocular structures.

## WARNINGS AND PRECAUTIONS

### 5.1 Intraocular Pressure (IOP) Increase

Prolonged use of corticosteroids may result in glaucoma with damage to the optic nerve, defects in visual acuity and fields of vision. Steroids should be used with caution in the presence of glaucoma.

If this product is used for 10 days or longer, intraocular pressure should be monitored.

### 5.2 Cataracts

Use of corticosteroids may result in posterior subcapsular cataract formation.

### 5.3 Delayed Healing

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

### 5.4 Bacterial Infections

Prolonged use of corticosteroids may suppress the host response and thus increase the hazard of secondary ocular infections. In acute purulent conditions of the eye, steroids may mask infection or enhance existing infection. If signs and symptoms fail to improve after 2 days, the patient should be re-evaluated.

### 5.5 Viral Infections

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

### 5.6 Fungal Infections

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

### 5.7 Aminoglycoside Hypersensitivity

Sensitivity to topically applied aminoglycosides may occur in some patients. If hypersensitivity develops with this product, discontinue use and institute appropriate therapy.

## ADVERSE REACTIONS

Adverse reactions have occurred with steroid/anti-infective combination drugs which can be attributed to the steroid component, the anti-infective component, or the combination.

*Zylet:*

In a 42 day safety study comparing Zylet to placebo, ocular adverse reactions included injection (approximately 20%) and superficial punctate keratitis (approximately 15%). Increased intraocular pressure was reported in 10% (Zylet) and 4% (placebo) of subjects. Nine percent (9%) of Zylet subjects reported burning and stinging upon instillation.

Ocular reactions reported with an incidence less than 4% include vision disorders, discharge, itching, lacrimation disorder, photophobia, corneal deposits, ocular discomfort, eyelid disorder, and other unspecified eye disorders.

The incidence of non-ocular reactions reported in approximately 14% of subjects was headache; all other non-ocular reactions had an incidence of less than 5%.

*Loteprednol etabonate ophthalmic suspension 0.2% - 0.5%:*

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

In a summation of controlled, randomized studies of individuals treated for 28 days or longer with loteprednol etabonate, the incidence of significant elevation of intraocular pressure (≥10 mm Hg) was 2% (15/901) among patients receiving loteprednol etabonate, 7% (11/164) among patients receiving 1% prednisolone acetate and 0.5% (3/583) among patients receiving placebo.

*Tobramycin ophthalmic solution 0.3%:*

The most frequent adverse reactions to topical tobramycin are hypersensitivity and localized ocular toxicity, including lid itching and swelling and conjunctival erythema. These reactions occur in less than 4% of patients. Similar reactions may occur with the topical use of other aminoglycoside antibiotics.

*Secondary Infection:*

The development of secondary infection has occurred after use of combinations containing steroids and antimicrobials. Fungal infections of the cornea are particularly prone to develop coincidentally with long-term applications of steroids.

The possibility of fungal invasion must be considered in any persistent corneal ulceration where steroid treatment has been used.

Secondary bacterial ocular infection following suppression of host responses also occurs.

## USE IN SPECIFIC POPULATIONS

### 8.1 Pregnancy

Teratogenic effects: Loteprednol etabonate has been shown to be embryotoxic (delayed ossification) and teratogenic (increased incidence of meningocele, abnormal left common carotid artery, and limb fixtures) when administered orally to rabbits during organogenesis at a dose of 3 mg/kg/day (35 times the maximum daily clinical dose), a dose which caused no maternal toxicity. The no-observed-effect-level (NOEL) for these effects was 0.5 mg/kg/day (6 times the maximum daily clinical dose). Oral treatment of rats during organogenesis resulted in teratogenicity (absent innominate artery at ≥5 mg/kg/day doses, and cleft palate and umbilical hernia at ≥50 mg/kg/day) and embryotoxicity (increased post-implantation losses at 100 mg/kg/day and decreased fetal body weight and skeletal ossification with ≥50 mg/kg/day). Treatment of rats at 0.5 mg/kg/day (6 times the maximum daily clinical dose) during organogenesis did not result in any reproductive toxicity. Loteprednol etabonate was maternally toxic (significantly reduced body weight gain during treatment) when administered to pregnant rats during organogenesis at doses of ≥5 mg/kg/day.

Oral exposure of female rats to 50 mg/kg/day of loteprednol etabonate from the start of the fetal period through the end of lactation, a maternally toxic treatment regimen (significantly decreased body weight gain), gave rise to decreased growth and survival and retarded development in the offspring during lactation; the NOEL for these effects was 5 mg/kg/day. Loteprednol etabonate had no effect on the duration of gestation or parturition when administered orally to pregnant rats at doses up to 50 mg/kg/day during the fetal period.

Reproductive studies have been performed in rats and rabbits with tobramycin at doses up to 100 mg/kg/day parenterally and have revealed no evidence of impaired fertility or harm to the fetus. There are no adequate and well controlled studies in pregnant women. Zylet should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

### 8.3 Nursing Mothers

It is not known whether topical ophthalmic administration of corticosteroids could result in sufficient systemic absorption to produce detectable quantities in human milk. Systemic steroids that appear in human milk could suppress growth, interfere with endogenous corticosteroid production, or cause other untoward effects. Caution should be exercised when Zylet is administered to a nursing woman.

### 8.4 Pediatric Use

Two trials were conducted to evaluate the safety and efficacy of Zylet® (loteprednol etabonate and tobramycin ophthalmic suspension) in pediatric subjects age zero to six years; one was in subjects with lid inflammation and the other was in subjects with blepharoconjunctivitis.

In the lid inflammation trial, Zylet with warm compresses did not demonstrate efficacy compared to vehicle with warm compresses. Patients received warm compress lid treatment plus Zylet or vehicle for 14 days. The majority of patients in both treatment groups showed reduced lid inflammation.

In the blepharoconjunctivitis trial, Zylet did not demonstrate efficacy compared to vehicle, loteprednol etabonate ophthalmic suspension, or tobramycin ophthalmic solution. There was no difference between treatment groups in mean change from baseline blepharoconjunctivitis score at Day 15.

There were no differences in safety assessments between the treatment groups in either trial.

### 8.5 Geriatric Use

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

## NONCLINICAL TOXICOLOGY

### 13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

Long-term animal studies have not been conducted to evaluate the carcinogenic potential of loteprednol etabonate or tobramycin.

Loteprednol etabonate was not genotoxic *in vitro* in the Ames test, the mouse lymphoma TK assay, a chromosome aberration test in human lymphocytes, or in an *in vivo* mouse micronucleus assay.

Oral treatment of male and female rats at 50 mg/kg/day and 25 mg/kg/day of loteprednol etabonate, respectively, (500 and 250 times the maximum clinical dose, respectively) prior to and during mating did not impair fertility in either gender. No impairment of fertility was noted in studies of subcutaneous tobramycin in rats at 100 mg/kg/day (1700 times the maximum daily clinical dose).

## PATIENT COUNSELING INFORMATION

This product is sterile when packaged. Patients should be advised not to allow the dropper tip to touch any surface, as this may contaminate the suspension. If pain develops, redness, itching or inflammation becomes aggravated, the patient should be advised to consult a physician. As with all ophthalmic preparations containing benzalkonium chloride, patients should be advised not to wear soft contact lenses when using Zylet.

## MANUFACTURER INFORMATION

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



Based on 9007706-9004406 Revised 08/2016 ZYL.0053.USA.16

# Passive Verification Doesn't Work

The Contact Lens Rule's current prescription verification system potentially could be putting patients at risk.

It's been over a decade since the Federal Trade Commission mandated the Contact Lens Rule. Its intent is to allow patients the right to purchase contact lenses from the seller of their choice, whether a health care provider or other source, including online.[1] The intentions are worthy.

However, most of us would agree that it just doesn't work in its current form. Most likely, you can easily cite abuses that have resulted from the Contact Lens Rule. At best, the current system of verification is onerous. Eye care providers must verify the patient's prescription through a "passive" process—and within eight regular business hours after a seller requests it. Should the prescriber's office not respond in time, the seller can (and will) consider the prescription verified (even though it has not been) and sell the patient lenses.

A 2015 survey found that approximately 25% of consumers who bought their lenses from a big-box or other retailer were given a different brand than was prescribed. The survey also found that nearly a third of consumers could order lenses with an expired prescription (often beyond one year).[2] Many consumers in the survey noted they were advised to purchase a non-prescribed product.

## HITTING CLOSE TO HOME

Let me share a recent first-hand experience with a close relative as an example. My relative called me up, saying: "I just got these lenses in the mail that were distributed from Taiwan—30 days' worth for free. Can I wear them? Apparently, I can order more if I like them!"

My response? "No, you can't, and how did they get the right prescription since no one has ever evaluated those lenses on you?"

He said, "I provided my prescription numbers online and they claim to have verified the accuracy with your office."

I called the company's "medical hotline," got a recorded message and left my number. While I have yet to hear back, my staff tracked down a different contact and I spoke to a very cordial person who stated that our office received a fax on a Sunday evening at 9:30pm to verify the prescription that doesn't exist; I don't have a fitting set to evaluate their lenses. My staff swears they didn't receive the fax. It's possible there was human error, but I don't think so. The important question remains: how can this company fill a prescription they know doesn't exist through this verification process? They know who has their fitting set and who doesn't.

This is beyond troubling for me.

## RULES, OR SUGGESTIONS?

Just for reference, here is a section from the Contact Lens Rule:[1]

"*No alteration of prescription.* A seller may not alter a contact lens prescription. Notwithstanding the preceding sentence, a seller may substitute for private label contact lenses specified on a prescription identical contact lenses that the same company manufactures and sells under different labels."

Beyond a disregard for the verification process, this company apparently assumes their product is a generic equivalent to almost anything a patient might be wearing.

I will concede that the material this company used, methafilcon A, is available in many different lens types and generally works well for most patients. Nevertheless, an on-the-eye assessment by a health care professional is required before a prescription is valid.

I know my outrage may appear self-serving to some. But, the experience with my relative would make any eye care practitioner tremble at the potential for disaster. Taking a patient's request for trials without proper evaluation, dispensing a month's worth of the trial lenses and ultimately prescribing lenses for the next full year with an extended delivery system is reckless. When would we see the patient to evaluate the lenses on the eye and the eye's response? A year later?

Let's work on a better system of verification for contact lens prescriptions. Short of that, we are living in a world of generic equivalents, and in my humble opinion, that's dangerous. After all, contact lenses are a medical device, the last time I checked. And for those who might be wondering: That close relative receiving lenses from a rogue source? My son.

Some of you have likely already received similar requests—if you haven't, get ready! RCCL

1. Contact lens rule. Federal Trade Commission. July 2, 2004. www.ftc.gov/enforcement/rules/rulemaking-regulatory-reform-proceedings/contact-lens-rule. Accessed March 27, 2017.

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By Mile Brujic, OD, and David Kading, OD

# A One-Two Punch to Beat Dry Eye

First, give the patient symptomatic relief, then focus on finding long-term solutions.

The ocular surface is a remarkable system. When it functions properly, an adequate quantity and quality of tears help the eye remain unnoticed by the person as the lids spread the tears across the surface, allowing light to enter the eye through a smooth refractive surface. And on this normal functioning ocular surface, contact lenses provide a remarkable option for vision correction. But, disrupting this delicate balance can cause increased awareness of the eyes, poor vision, desensitization of the cornea and anatomical alterations such as staining. Even with early stages of ocular surface disease (OSD), a contact lens can potentially compromise the comfort and visual performance the lens was designed to provide.

Although mild OSD can be treated immediately and rarely requires any discontinuation of lens wear, patients often do so on their own due to discomfort. This is where the clinician steps in to treat the ocular surface appropriately and get patients back to their contact lenses.

## DRY EYE AND CL WEAR

Dry eye is at the top of the list of ocular surface disruptions that can wreak havoc on contact lens wear. Luckily, a better understanding of its underlying etiology and newer diagnostic technologies allow us to diagnose the condition early and manage patients' response to treatment better than ever before.

Clinicians have a number of treatment options to help care for patients with OSD—a must for all patients, but especially to keep contact lens wearers happy in their lenses. Dry eye therapy can be a daunting task, but this two-step approach to optimizing the ocular surface—and thus the lens wearing experience—can help keep you on the path to success.

## STEP ONE: RELIEF

In this two-pronged strategy, clinicians must first provide relief of patient symptoms such as dry, irritated, itching or burning eyes or even blurred vision or fluctuating vision with blinks. Temporarily increasing the volume of tears on the eye with artificial tears is often the first move to alleviate discomfort. The improved function these artificial tears produce will also provide further relief.

For patients requiring significant supplementation of tears, clinicians can consider gels or ointments, always keeping in mind the blur profile these products produce. These typically work well in the evening for patients who have incomplete lid closure, for example. Another option to relieve dry eye symptoms over a longer period is Lacriserts (Bausch + Lomb)—small hydroxypropyl cellulose inserts placed in the lower fornix that slowly dissolve demulcents into the tear film over a 24-hour period.

## STEP TWO: FUNCTION

Improving function is just as important—if not more—than initially providing relief. Uncovering and treating the root cause of the condition will ultimately provide more relief to the eye by also improving the function of the ocular surface.

For one, clinicians should assess each dry eye patient's blink to ensure it is complete. They should also check lid elasticity by examining the lower palpebral conjunctiva and everting the upper eyelid to rule out floppy eyelid syndrome (FES). Individuals with FES may experience symptoms consistent with dry eye from unintended eye opening in the evening and, in some patients, eyelid eversion.[1]

There are two ways to improve function: mechanical means and chemical means. Only by providing both mechanical *and* chemical therapies will the functionality of the ocular surface improve. Better function will eradicate dry eye symptoms for many patients, and as rehabilitation progresses, supplemental lubrication can taper. However, some will still require the use of lubrication.

***Mechanical.*** To treat the ocular surface through mechanical means, clinicians must first be confident in the likely cause of the patient's symptoms. For example, the best treatment for a patient with anterior blepharitis is cleaning the eyelids of excessive debris (*Figure 1*). For this, clinicians can use the BlephEx (Rysurg) in office to mechanically

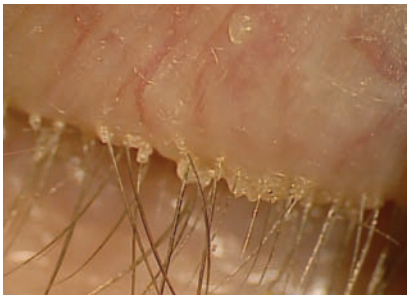

**Fig. 1. A patient with prominent anterior blepharitis.**

remove excessive debris at the base of the lashes.

For patients with meibomian gland dysfunction—whether obvious or non-obvious—debridement of the lid margin with a metal spud helps remove keratinized tissue that may be obstructing the meibomian glands (*Figure 2*). In addition, thermal application can decrease the viscosity of the meibum secreted from the meibomian glands. Patients can use a commercially available warm compress at home on a daily basis, or they can return to the office for an in office thermal therapy such as MiBoFlo (Mibo Medical Group) for the anterior surface of the eyelids or Lipiflow (TearScience) for the posterior surface of the eyelids. Lipiflow also produces pressure through an inflatable air bladder on the anterior portion of the lid to help evacuate meibum from the glands.

For individuals whose MMP-9 assessment by InflammaDry (RPS) testing is unfavorable and are currently being appropriately treated, consider adding punctal plugs. Punctal plugs help retain tears on the surface for longer periods of time by decreasing the rate they drain. However, using artificial tears on eyes with high levels of inflammation is not beneficial. Thus, InflammaDry is a good tool to assess contact lens wearers experiencing dry eye symptoms with low levels of ocular surface inflammation.

***Chemical.*** Clinicians have a number of strategies available to us to chemically improve the health of the ocular surface and adnexa. If, for example, an anterior blepharitis is present and the eyelids have been cleaned in office, having the patient perform lid hygiene on a daily basis with a commercially available preparation is appropriate.

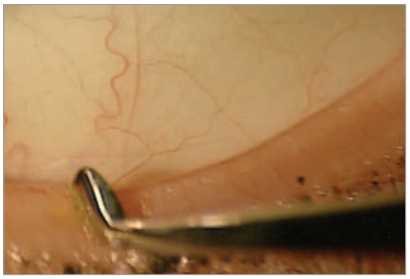

**Fig. 2. Lid margin debridement, as seen here, can significantly improve a patient's ocular surface function.**

For patients with significant inflammation, a temporary course of topical corticosteroids may be appropriate.

For individuals requiring long-term management of inflammation, Restasis (cyclosporine, Allergan) has been used for well over a decade, as it modifies T-cell interaction through immunomodulation.[2] Another recent addition, Xiidra (lifitegrast, Shire), is a topical lymphocyte functioning antigen antagonist that prevents the interaction of T-cells with intercellular adhesion molecules on the ocular surface, ultimately hindering T-cell activation and the release of inflammatory mediators.[3]

Oral agents can also help improve the ocular surface function. Omega-3 fatty acids, for example, have been long known to have anti-inflammatory activity.[4] In the body, this produces increased levels of prostaglandin-3, which has strong anti-inflammatory activity. Additionally, naturally occurring omega-6 fatty acids extracted from evening primrose oil have strong anti-inflammatory activity. Research shows formulas containing both omega-3 and omega-6 fatty acids can be beneficial for patients with dry eye.[5]

Another oral agent that works remarkably well to help improve ocular surface function through decreasing inflammation is doxycycline. This antibiotic, commonly used in dermatology for treating signs and symptoms of rosacea, has a non-specific anti-inflammatory activity. Thus, patients with ocular rosacea—which causes an inflammation of the meibomian glands and a visible alteration in the meibum secreted—often benefit from long-term doxycycline therapy, as it inhibits MMP-9.

Dry eye is often a remarkably complex condition and, if left untreated, can degrade comfortable contact lens wear. By actively identifying the underlying etiology of dry eye symptoms and appropriately treating it, clinicians can improve patients' chances of wearing lenses comfortably. A two-pronged approach—provide relief and improve function—is key to strategically caring for these patients. RCCL


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By Robert Ensley, OD, and Heidi Miller, OD

# Deterring Discomfort Dropouts

While contact lens discontinuation is as prevalent as ever, practitioners do have several effective methods to counteract it.

Eye care professionals battle contact lens discomfort (CLD) management on a daily basis. According to one survey about discontinuation of contact lens wear, 45% of those surveyed dropped out of wear within the first year, and 47% cited discomfort as the primary reason for dropping out.[1] Studies show that nearly 15% to 30% of contact lens wearers drop out each year.[1-3] One of the most significant factors in CLD is dry eye, as approximately 50% of contact lens wearers report experiencing dry eye symptoms at least occasionally.[4] This issue occurs with both soft and gas permeable lenses alike.

Due to its multifactorial nature, we have no cure-all for CLD, and even with today's technological advancements, CLD remains a leading cause of dropout in contact lens wearers. Ultimately, if CLD is not diagnosed and managed early, a patient may drop out of contact lenses permanently.

## WHAT IS CLD?

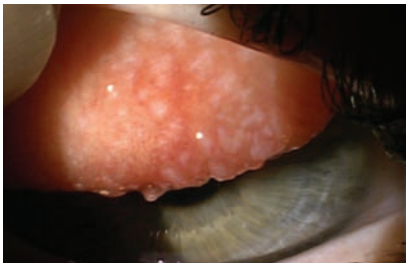
According to the Tear Film and Ocular Surface Society (TFOS), CLD is "a condition characterized by episodic or persistent adverse ocular sensations related to lens wear, either with or without visual disturbance, resulting from reduced compatibility between the contact lens and the ocular environment, which can lead to decreased wearing time and discontinuation of contact lens wear."[5] Clinically, CLD is usually determined by levels of end-of-day discomfort and dryness.[5]

TFOS further describes CLD as a distinctive five-step progression. It begins when patients start to struggle with symptoms such as physical awareness and visual disturbance. Consequently, patients reduce their comfortable wear time. As the lenses become more uncomfortable, patients begin reducing their total wear time. Next, patients may temporarily discontinue contact lens wear. For example, patients who used to wear contact lenses everyday for extended periods of time start to take breaks between wear. Finally, when comfort is no longer achievable, patients permanently discontinue lens wear. Given this progression, it is important to identify the factors that play a role in the earlier stages of discomfort to develop appropriate management strategies.

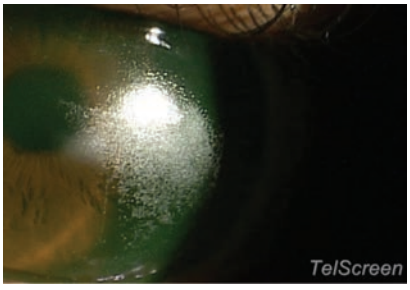
## CLD CAUSES

For gas permeable (GP) lenses, clinicians should consider factors such as environmental allergies, poor contact lens fit, poor contact lens edge profile, contact lens solutions, surface deposits and poor surface wettability when deciding how to manage and treat discomfort. Sometimes, the underlying problem is unclear, and several treatments may be warranted to eliminate CLD. Here is a brief overview of some common causes of GP lens discomfort and treatment methods:

***Environmental allergies.*** Giant papillary conjunctivitis (GPC) can occur with contact lens wear alone, but it can also be exacerbated with environmental allergies. If not treated, papillae can jeopardize success with contact lens wear. GPC can affect contact lens positioning due to lid interaction with the contact lens, creating a less-stable, high-riding contact lens.



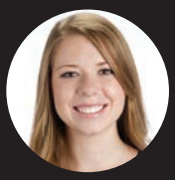
**Giant papillary conjunctivitis in a GP lens wearer.**




**Heavy lipid deposits on the scleral lens surface in an MGD patient.**

When treating allergies in contact lens wearers, first consider switching to a preservative-free, peroxide-based lens solution or an alcohol-based cleaner to help minimize allergens on lens surface. Also, consider prescribing an antihistamine/mast cell stabilizer to be used on a daily basis. Preservative-free artificial tears should be applied every few hours to reduce exposure to allergens. Cold compresses can also be used to reduce symptoms. In severe cases, a topical steroid may be necessary to treat the condition. The severity level varies among patients, so several treatments may be necessary to eliminate CLD entirely.

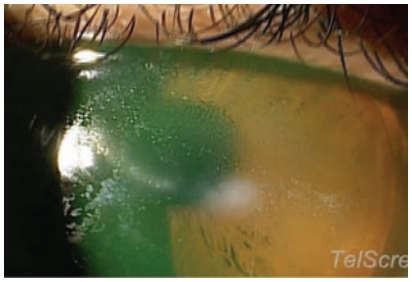
***Dry Eye.*** Researchers attribute dry eye symptoms in contact lens wearers to a diminished aqueous or

mucin layer of the tear film, changes in tear protein concentration and altered meibomian gland structure or function, to name only a few.[6] Studies show lens wear is associated with adverse changes in meibomian gland morphology as well as the condition of the lid margin and meibum.[6] Contact lens-related dry eye may also be explained by increased tear film thinning, leading to greater tear evaporation and increased tear film osmolality.[4] This suggests that contact lenses negatively affect meibomian glands and are partly responsible for dry eye symptoms.[6]

For patients with meibomian gland dysfunction (MGD), warm compresses and a more stringent eyelid hygiene regimen using a foam lid cleanser or hypochlorous acid are usually the first steps, along with omega supplements. A cycle of doxycycline or azithromycin may be used in more advanced cases of MGD due to their anti-inflammatory properties.[7] Occasionally, an antibiotic eye drop, a low-dose topical steroid drop or an antibiotic-steroid combination drop may be used in conjunction with an inflammatory modulator such as Restasis (cyclosporine 0.05%, Allergan) or Xiidra (lifitegrast 5%, Shire). Punctal plugs may be used in patients where treatment with supplements, artificial tears or prescription eye drops fails to relieve dry eye symptoms. Deciding whether to use dissolvable collagen plugs or semi-permanent silicone plugs is left to the discretion of the eye care provider.

But when the patient still complains of discomfort after treatment with antibiotics, topicals, artificial tears/ointments and punctal plugs, a scleral contact lens may be the ideal solution.




**More lipid deposits on the scleral lens surface in an MGD patient.**

Initially thought to be reserved for patients with irregular corneas or severe ocular surface disease, scleral lenses also can be a viable option for patients suffering from dry eye discomfort in their soft or corneal GP lenses. Scleral lenses can be more comfortable than soft lenses due to the fluid reservoir under the lens and the lack of lens surface dehydration.[8] They are essentially moisture chambers on the eye that also give superior rigid lens optics.

***Surface deposits and poor wettability.*** Often, a patient's GP lens will fit well and feel comfortable, but poor surface wettability or heavy lipid deposits still occur. Excessive lipids in the tear film create a foggy, hydrophobic surface, which in turn leads to poor visual comfort. Alcohol-based cleaners or intensive protein cleaners such as Progent (Menicon) can help eliminate surface deposits. For patients who have had no success with various lens solutions, have been prescribed an eyelid hygiene regimen and have been warned not to use hand lotions prior to insertion of GP lenses, practitioners can consider a new lens coating to meet each patient's needs.

According to Tangible Science, its new Hydra-PEG lens coating is designed to create a highly wettable and lubricious surface, with increased surface water retention due to its high water content (90%).[9] This polyethylene glycol-based polymer can be permanently bonded to the surfaces of both soft and GP lenses, and is currently available for Contamac materials provided by several GP lens manufacturers. It also helps to reduce protein and lipid deposits on lens surface.[9]

CLD is both common and difficult to manage, in part because of its multifactorial nature. Without a tried-and-true treatment, it is important to consider a step-wise approach in diagnosing, managing and treating CLD to provide continued success with contact lens wear.[5] RCCL

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# Highlights from ARVO 2017: ABSTRACT REVIEW

**Dive into some new cornea and contact lens care studies with the help of an expert.**

By Joseph P. Shovlin, OD

It's a fast-paced world, for sure. Health care is advancing daily, and we—and our patients—continue to enjoy the fruits of researchers' labors. Recently, investigators presented a full year's worth of findings at the Association for Research in Vision and Ophthalmology's (ARVO) meeting, held in Baltimore. Don't you wish you could sit down, stop the clock and take the time to devour all the new research presented there, boosting your knowledge and clinical skills?

To give you a taste, we selected what we consider important research and reviewed abstracts for you. Hopefully they can help improve your patient care—because what's presented today becomes practical clinical information for tomorrow. Ideas generated at this meeting spark additional research initiatives and serve to develop new strategies for diagnosing and treating a wide array of ocular disease. Take a look to see what investigators have uncovered so far:

## CORNEAL INFECTION GRAND ROUNDS

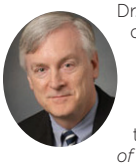
A recent Texas-based study evaluated the efficacy of **a multifaceted diagnostic approach for corneal infections.** Researchers compared the results of scrape cytology and corneal cultures from the corneal washings of 47 eyes to test which diagnostic tool detected the likely cause of corneal infection best. Of the 47 cases, 14 showed culture was superior to cytology, 23 showed cytology was superior, eight showed the two to be even, one was indeterminate and one had no detection of the virus in either. The researchers concluded that culture is better for detecting bacterial organisms, while cytology is better for detecting other corneal (non-bacterial) infection causes. Accordingly, they recommend using a multifaceted diagnostic approach to ensure more accurate results since not all organisms may necessarily be detected by one method alone.[1]

Offering a closer look at ocular **exposure to commensal organisms and their effect on immunity**, a Boston study found tonic signals from local commensal flora promote ocular mucosa surveillance, in turn limiting microbial presence on the ocular surface and strengthening protection during infection. The study identified commensal species in ocular swabs from mice, then treated them with topical antibiotics to ablate bacteria in the conjunctiva. Next, the mice were rested and colonized with other commensals such as coagulase-negative *Staphylococcus xylosus* and *Streptococcus oralis*. After three weeks, the commensal strains greatly aided immunity to *Pseudomonas aeruginosa*. These findings show potential for commensals to regulate bacterial keratitis susceptibility.[2]

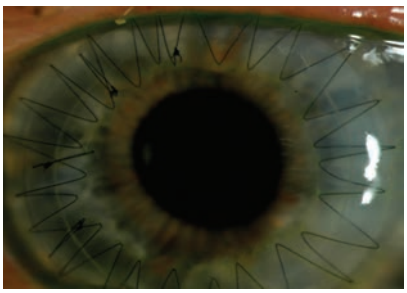
Another study investigated bilateral **corneal endothelial cell density** (ECD) and its connection to scar location and corneal nerve alterations **in patients with unilateral herpes zoster ophthalmicus** (HZO). Researchers compared 28 eyes with corneal scarring caused by HZO with 24 healthy eyes, using *in vivo* confocal microscopy (IVCM) and corneal sensation of the central cornea. Results showed significantly lower levels of ECD in scarred eyes and contralateral clinically unaffected eyes compared with healthy eyes. It also showed that location does make a difference, as central HZO scarring had notable loss of ECD compared with peripheral scars. Researchers also found a possible link between corneal innervation and corneal endothelial cell homeostasis, as results showed a positive correlation between the ECD and the subbasal nerve density in both total nerve length and corneal sensation.[3]

To better understand the pathophysiology of **ocular infections caused by the herpes simplex virus-1**

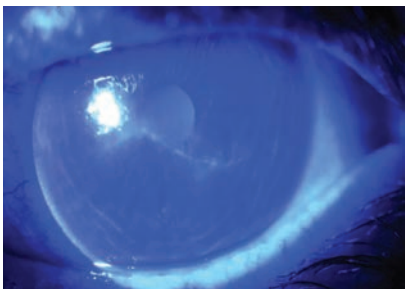
### ABOUT THE AUTHOR



Dr. Shovlin is the senior optometrist at Northeastern Eye Institute and a member of the adjunct faculty at the Pennsylvania College of Optometry. He is also the clinical editor for *Review of Cornea & Contact Lenses*, associate clinical editor for *Review of Optometry* and president of the American Academy of Optometry.



**Corneal transplants, such as this one, might benefit from a drug-eluting contact lens similar to the one researchers presented at ARVO.**



**Many ARVO presentations focused on *Acanthamoeba* keratitis, shown here with large dendriform lesion on the corneal surface.**

(HSV-1), researchers from the University of Illinois at Chicago explored the virus's degradation and its supportive role for autophagy, a normal physiological process dealing with the destruction of cells.

Autophagy maintains homeostasis by protein degradation and turnover of the destroyed cell organelles for new cell formation. During cellular stress, autophagy is increased. The study revealed that autophagy was necessary to support optimal virion growth over longer periods of time, and higher amounts of the virus were reported from cells with a normal ability to perform autophagy. In short, autophagy degrades incoming virions and then later provides support for optimal virion growth during infection. The researchers concluded that optineurin, an autophagy adapter protein of host origin, may effectively regulate the switch from virus degradation to virus support. This also marks the first substantial evidence of the dual role autophagy plays during HSV-1 infection.[4]

A recent study from the Yale University School of Medicine chronicled the clinical etiologies, microbial spectrum, antibiotic resistance and visual acuity **outcomes of acute endophthalmitis**. Tracking ICD-9 and ICD-10 codes for endophthalmitis over a six-year period revealed that the most frequent clinical etiologies were progression of corneal ulcer and postoperative infection after cataract extraction, accounting for 22% and 17% of cases, respectively.

The most likely pathogens causing endophthalmitis included coagulase-negative *Staphylococcus*, *Staphylococcus aureus* and *P. aeruginosa*. The vast majority of infections were deemed endogenous rather than environmental and likely relate to lid disease. Antibiotic susceptibilities were topped by vancomycin at 96.7%, closely followed by gentamicin and doxycycline, both at 96.6%. Concerning visual acuity, the majority of patients displayed improvement after treatment, but there was also a sizable portion of patients with a final visual acuity of no light perception.[5]

## A CLOSER LOOK AT *ACANTHAMOEBA* KERATITIS

A critical amount of **bacteria is required for the development of *Acanthamoeba* keratitis** (AK), according to a new study. Researchers instilled *Acanthamoeba castellanii* in rabbit corneas, then instilled the organism co-incubated with high and low density *P. aeruginosa*. Levofloxacin eye drops were administered following each inoculation. After a five-day observation period, *Acanthamoeba castellanii* alone did not cause AK. *Acanthamoeba castellanii* co-incubated with low-density *P. aeruginosa* induced a few infiltrates but the cornea remained relatively clear. However, *Acanthamoeba castellanii* co-incubated with high-density *P. aeruginosa* produced severe AK. The researchers also found a six-hour co-incubation caused a much more severe case of AK than a two-hour co-incubation. The study suggests bacteria count and time of coexistence both play an essential role in AK development and severity.[6]

Another study found that prompt anti-amoebic treatment (AAT) and age are **important factors in avoiding poor AK treatment outcomes**. The researchers defined poor outcomes as having one or more of the following: corneal perforation, keratoplasty, other ocular surgery (except biopsy), 10.5 months or more of AAT and final visual acuity of 20/80 or worse attributed to AK. Those with poor treatment outcomes tended to be older, with a median age of 38 compared with 31 for those with better outcomes. Patients with poor outcomes also had longer symptom duration and more doctor visits prior to AAT. While age is simply a factor to indicate possible issues, researchers concluded that AAT intervention should begin as early as possible to give patients a better opportunity for positive AK outcomes.[7]

Similarly, a Philadelphia study sought to identify **risk factors for AK treatment failure**. Researchers tracked 60 AK patients based on demographics, clinical details, treatment protocols and overall outcomes. They defined treatment failure as requiring penetrating keratoplasty or having best-corrected visual acuity (BCVA) worse than 20/100 at the last follow up. The researchers found that 25 eyes (42%) had treatment failure; contributing factors included older age, longer duration of symptoms prior to presentation, poorer presenting

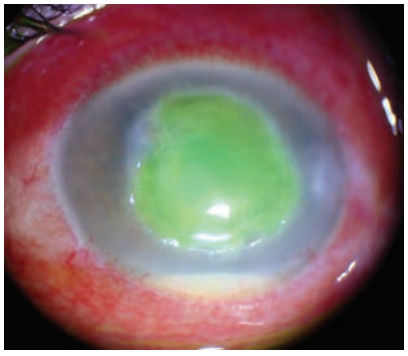
BCVA and positive diagnosis on pathology. Some of the findings, however, were unexpected. Despite better disease recognition today, the researchers found worse outcomes in cases treated from 2012 to 2015 compared with cases from 2009 to 2011. In fact, the percentage of failures was much higher compared with a group treated from 2004 to 2008. Researchers recommend doctors counsel older AK patients, those with longer duration of symptoms and those with poor initial BCVA about the possibility of poor outcomes.[8]

## AT THE FOREFRONT OF DRY EYE

To shed more light on the **natural history of dry eye disease** (DED), researchers studied 3,136 subjects—91% of whom were female—and found nearly 10% developed symptomatic DED within the two-year study timeframe. For those with symptomatic DED at baseline, up to 37% showed resolution of symptoms in two years. This closer look at the natural history of DED suggests symptomatic cases can be highly variable over time, according to researchers.

The researchers also found female sex, asthma, osteoarthritis, chronic pain syndromes, depression, higher copper intake, lower coffee intake and increased body mass index were all associated with symptomatic DED. Persistence was associated with osteoarthritis, increasing age and female sex, while resolution of symptoms was associated with stroke, use of contact lenses and higher coffee intake. A better understanding of DED's natural history may lead to more focused clinical care, the researchers conclude.[9]

Using IVCM, Boston researchers have discovered **patients with DED have significantly reduced nerve density** in the central and peripheral



**Progressing corneal ulcers, as seen here with hypopyon, account for 22% of acute endophthalmitis, according to new research.**

corneal quadrants. Investigators took IVCM images of the central cornea and four peripheral quadrants in 46 patients with DED and 20 age- and sex-matched controls. They found the main trunk, branch and total nerve densities of the central cornea and all peripheral quadrants of patients with DED were significantly lower compared with the control group.

When comparing nerve density between the central cornea and periphery in particular, they found total nerve density was significantly higher in the central cornea than in the nasal and inferior quadrants in DED patients, while the main trunk density in the central cornea was significantly lower than in the nasal and temporal quadrants. Because DED causes ocular surface discomfort, a better understanding of corneal nerve changes may help clinicians better manage patient symptoms.[10]

New findings from a Boston-based study suggest that clinicians should **add the evaluation of ocular pain to a comprehensive work up for dry eye** patients. In a cross-sectional study of 91 patients with DED, researchers asked subjects to rate their ocular pain on a scale from one to 10 and undergo a comprehensive ophthalmic examination that included an ocular surface disease index (OSDI) questionnaire. They found 44.9% of the study subjects said they had mild pain, 33.7% indicated moderate pain and 6.8% rated their pain as severe. When the researchers assessed the patients' pain scores in relation to their OSDI score and clinical signs, they found the ocular pain scores only correlated weakly with the OSDI scores and had no correlation at all with DED signs.[11] The neuropathic features of DED continue to receive much attention, especially as it relates to resultant clinical depression.

Although previous research shows a correlation between **bacterial burden and** signs of meibomian gland dysfunction, a new study suggests the same is not the case for **dry eye symptoms**. Researchers from the Brien Holden Vision Institute asked 186 participants with normal ocular and systemic history to complete the OSDI and McMonnies dry eye questionnaires, and have a swab taken from their left lower lid margin. The results of the swab cultures and questionnaires showed only a weak correlation between dry eye symptoms and bacterial burden. The OSDI indicated 114 participants were normal, 42 had mild dry eye, 21 had moderate and eight were severe, while the McMonnies questionnaire showed 98 were normal, 76 had marginal dry eye and 12 had pathological dry eye. The swabs revealed the most common species were *Propionibacterium sp.* (59%) and *Staphylococcus epidermidis* (36%). Ultimately, the data shows no consistent trend in bacterial burden vs. the questionnaire scores.[12]

A new study used an online survey of ophthalmologists to gather information about DED procedures to learn more about **evaluating dry eye patients for possible Sjögren's** syndrome (SS). The study found

that a majority of ophthalmologists surveyed prefer to use traditional DED tests such as corneal fluorescein staining as opposed to newer tests such as tear osmolarity assessment. The survey also uncovered an abundance of under-referral of DED patients for SS work ups, which researchers suspect may be a contributing factor to underdiagnosis of SS. Some common reasons for SS referral included positive review of systems, severe dry eye symptoms or signs and dry eye resistant to treatment. The survey found 83% of respondents felt an evidence-based standardized screening tool for SS evaluation referrals in DED patients is needed.[13]

**A new condition known as lid seal compromise** may have a significant impact on refractory dry eye patients, according to a study that sought to reveal its prevalence in this patient population. Researchers used the Korb–Blackie (KB) light test to assess lid seal compromise in 46 symptomatic patients and 50 asymptomatic patients with a zero-to-three scale—zero indicated no visible lid seal compromise and three indicated severe lid seal compromise. They found 61% of symptomatic refractory dry eye patients had moderate to severe compromise compared with only 14% of the asymptomatic group. The researchers conclude lid seal compromise may be a primary deleterious factor in the etiology of dry eye, causing chronic exposure to desiccating stress during sleep.[14]

Another recent study looked at **tear protein content following intranasal tear neurostimulation** (ITN) in DED patients. The post-ITN tear samples of 55 patients were analyzed for protein concentration, using a 20% margin of the pre-stimulation mean to evaluate the equivalence between pre- and post-stimulation. The 95% confidence interval fell within the equivalence margins for mean difference in total protein concentration, relative lysozyme levels and relative lactoferrin levels. This suggests sensory neural stimulation of the nasal cavity promotes release of proteins from secretory granules in the lacrimal gland following ITN stimulation. This is critical in the lacrimal gland's role in protection against environmental insult and the maintenance of ocular surface homeostasis, the researchers conclude.[15]

## CONTACT LENS INNOVATION

**Artificial tears can impact how well pathogens adhere to** conventional and silicone hydrogel **contact lenses**, but not all pathogens, one study found. Researchers from the University of Waterloo School of Optometry and Vision Science tested four bacterial strains—*P. aeruginosa*, *Achromobacter xylosoxidans*, *Delftia acidovorans* and *Stenotrophomonas maltophilia*—with both Acuvue 2 (etafilcon A, Johnson & Johnson Vision) and Acuvue Oasys (senofilcon A, Johnson & Johnson Vision) lenses.

In the control group, the total counts didn't differ between the two materials, although *A. xylosoxidans* and *P. aeruginosa* were significantly higher compared with *D. acidovorans*. After soaking the lenses in an artificial tear solution, the senofilcon A material showed no difference in the total counts for any strain. The total counts of *A. xylosoxidans* and *P. aeruginosa* on the etafilcon A material remained significantly higher compared with *D. acidovorans* and *S. maltophilia*. In addition, the etafilcon A lenses had lower total counts of *D. acidovorans* compared with the senofilcon A lenses; for the remaining three strains, the total counts did not vary significantly between the two materials.[16]

Another study looked at pathogens on contact lenses, this time focusing on the **bacterial biofilm** that can grow **in contact lens cases**. Although disinfecting contact lens cases can remove more than 99% of the bacterial biofilm, it doesn't necessarily keep contact lenses bacteria-free, according to researchers from the School of Optometry and Vision Science at the University of New South Wales.

After growing *P. aeruginosa* or *S. aureus* biofilms on cases, researchers added contact lenses and disinfected the cases with a multipurpose disinfecting solution or a rinsing solution for four hours. Cases following the disinfection cycle with the disinfecting solution had a significant reduction of biofilm, while the cases cleaned with the rinsing solution did not. For the cases cleaned with multipurpose solution, 26% of the remaining *P. aeruginosa* and 13% of remaining *S. aureus* were transferred to the lenses.

Although only 1% of the bacteria in the cases cleaned with rinsing solution was transferred to contact lenses, the contact lenses from storage cases disinfected with multipurpose disinfecting solution had significantly lower numbers of *P. aeruginosa* and *S. aureus* compared with lenses from storage cases filled with rinsing solution. The results emphasize the importance of properly caring for lens storage cases to prevent biofilm formation in the first place.[17]

Two **new contact lens designs** hold promise **for slowing myopia progression**, according to investigators at the Brien Holden Vision Institute. To test the designs—one that imposed myopic defocus across the central and peripheral retina and one that manipulated higher-order aberrations to provide retinal image quality that degraded in the direction of myopic eye growth—researchers enrolled 508 myopic

children and randomized them into five groups: a control group wearing single-vision silicone hydrogel (SH) lenses, two groups wearing SH lenses with varying powers and two groups wearing hydrogel lenses. At 12 months, three of the four test groups showed significantly reduced myopia progression compared with the control group. After adjusting for age, parental myopia and compliance, they found the reduction in myopia progression with the test lenses ranged from 21% to 29% for spherical equivalents and 31% to 42% for axial length, which increased to 27% to 33% and 38% to 56%, respectively, for those who were compliant.

These results suggest both of these new designs can reduce myopia progression, the researchers conclude. This is yet another study that shows that imposing myopic defocus across both central and peripheral retina or providing retinal image quality that degrades in the direction of eye growth can provide a signal to slow eye growth.[18]

Clinicians can consider using **wavefront-customized hydrogel contact lenses** in normal eyes, as well as to modulate and correct spherical aberration and coma, according to researchers. A new study used seven customized, lathe-cut hydrogel contact lenses that incorporated specific amounts of spherical aberration and coma. When fit on three normal subjects (three eyes total), the lenses modulated the aberration in a consistent fashion towards the same polarity of the aberration, ranging from roughly 60% to more than 200% of the intended change. In addition, the lenses that employed coma of the same sign as the subject's coma increased the coma of the eye-lens combination. Lenses with opposite coma decreased, or even reversed, the on-eye aberration coma. Custom lenses that can be personalized to each patient's specific needs can be useful in normal eyes with subtle higher-order aberrations, the authors conclude.[19]

Another study evaluated a novel **drug-eluting contact lens for** the treatment of experimentally induced **neovascularization**. Using a rabbit model, researchers compared the effects of contact lenses that eluted dexamethasone with a control group treated by topical dexamethasone sodium phosphate drops hourly. They assessed corneal inflammation on day seven by analyzing CD45 cell frequencies in tissue using flow cytology. The dexamethasone-eluting contact lenses effectively inhibited corneal neovascularization and inflammation similar to the hourly-administered eye drops. Contact lens drug delivery may be an option for ocular drug delivery and the prevention of many corneal responses, including post-keratoplasty rejection episodes, the researchers conclude.[20]

This is just a sampling of the many wonderful research projects presented at this year's conference. I encourage you to browse the full list to broaden your horizons beyond these select research projects. We look forward to another productive year of clinically relevant research from ARVO next year! RCCL

1. Nakatsuka A, Ortiz J, Chevez-Barrios J. A multifaceted diagnostic approach to pathological diagnosis of corneal infection. Program 3343. Association for Research in Vision and Ophthalmology (ARVO) Meeting 2017.

2. Gadjeva M. Impact of commensals on ocular immunity to infection. Program 5772. ARVO 2017.

3. Hamrah P, Sahin A, Chirapapaisan C, et al. In vivo confocal microscopy demonstrates bilateral corneal endothelial cell loss in patients with unilateral herpes zoster ophthalmicus. Program 1483. ARVO 2017.

4. Shukla D, Thakkar N, Jaishankar D. Dual role for autophagy in herpes simplex virus infection of the cornea. Program 3619. ARVO 2017.

5. Lu L, Adelman RA. Clinical etiologies, microbial spectrum, antibiotic susceptibilities, and visual acuity outcomes of acute endophthalmitis. Program 5519. ARVO 2017.

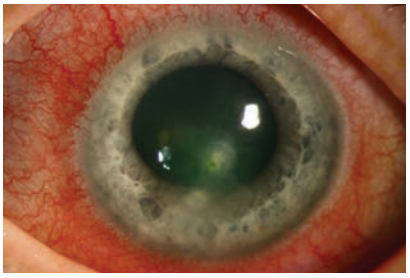


Photo: Christine W. Sindt, OD

**Research on HSV-1's degradation and its supportive role for autophagy may one day lead to a better understanding of ocular effects of the virus, such as this central corneal ulcer and HSV stromal keratitis.**

6. Nakagawa H. Number of bacteria and time of co-incubation with bacteria required for the development of Acanthamoeba keratitis. Program 5782. ARVO 2017.

7. Carnt NA, Robaei D, Minassian D, Dart JK. Acanthamoeba keratitis in 194 patients: risk factors for poor outcomes and severe inflammatory complications. Program 4796. ARVO 2017.

8. Siu S, Rapuano CJ, Nagra P, Hammersmith K. Acanthamoeba keratitis: are recent infections more severe? Program 3891. ARVO 2017.

9. Vehof J, Hammond CJ. Incidence, persistence and resolution of dry eye disease: new insights into the natural history. Program 2700. ARVO 2017.

10. Salem Z, Gabriela Dieckmann G, Tanaka A. Patients with dry eye disease demonstrate significant decrease in central and peripheral corneal nerve density. Program 2658. ARVO 2017.

11. Sun Z , Satitpitakul V, Kheirkhah A, et al. Ocular pain in patients with dry eye disease. Program 2659. ARVO 2017.

12. Flanagan J, Yeotikar N, Zhu H, et al. Ocular bacterial burden and dry eye symptoms in a normal population. Program 2690. ARVO 2017.

13. Fernandez K, Ying GS, Masssaro-Giordano G, et al. A survey of dry eye practice patterns. Program 2651. ARVO 2017.

14. Korb DR, Blackie CA, Nau AC. Prevalence of compromised lid seal in symptomatic refractory dry eye patients and asymptomatic patients. Program 2696. ARVO 2017.

15. Woodward A, Senchyna M, Franke M, et al. Effect of intranasal neurostimulation on tear protein content in patients with dry eye. Program 2673. ARVO 2017.

16. Dantam J, Subbaraman L, Jones LW. Adhesion of emerging pathogens to contact lenses under the influence of an artificial tear solution. Program 3079. ARVO 2017.

17. Vijay AK, de Jesus NG, Ong J, Willcox MD. Bacterial transmission to contact lenses following storage case disinfection. Program 3074. ARVO 2017.

18. Sankaridurg P, Bakaraju RC, Morgan J, et al. Novel contact lenses designed to slow progress of myopia: 12 month results. Program 2391. ARVO 2017.

19. Akers D, Asimellis G, Karageorgiadis L, et al. Wavefront-customized soft contact lenses for high-order aberration correction in normal eyes. Program 1276. ARVO 2017.

20. Kobashi H, Bengani L, Ross AE, et al. Inhibition of Corneal Neovascularization by Dexamethasone-Eluting Contact Lenses in a Rabbit Model. Program 1000. ARVO 2017.

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# Contact Lenses and Comfort: It's a Material World

**New materials, surface treatments, coatings and moisture networks mean one thing: better comfort for contact lens wearers.**

By Karen K. Yeung, OD, Nikita M. Sarwar, and Jessica Hu

Influenced by clinical feedback that discomfort is the number one cause of dropout, the latest contact lenses have evolved significantly to improve ocular comfort. This is especially true with silicone hydrogel (SiHy) contact lenses, which are supplanting soft hydrogel lenses in popularity. Whereas first-generation SiHy contact lenses emphasized higher oxygenation for extended wear, newer materials have improved comfort without sacrificing the high oxygen permeability of silicone.[1]

Researchers have been trying to improve comfort by increasing water content, decreasing the modulus, lowering contact angle hysteresis and adding surface coatings and plasma treatments. One study found that over a 10-year period, the water content of SiHy contact lenses has increased from 24% to 74%, and the modulus has decreased significantly from 1.4MPa to 0.3MPa.[2] Increased contact lens water content and surface coatings have also led to a notable decrease in contact lens hysteresis, from greater than 40° in lotrafilcon A to less than 10° in delefilcon A.[2]

Researchers are unsure if lubricity is the only variable that correlates well with *in vivo* contact lens comfort. So while new, more comfortable materials emerge (though older materials are not eliminated), patients are benefiting from newer, more comfortable silicone hydrogel contact lens materials.[3] With wider parameters and replacement modalities, more patients than ever are finding successful contact lens designs that fit their daily needs. This article discusses the latest SiHy contact lens materials and how they affect patient comfort.

## LOTRAFILCON B

As an upgrade to Air Optix Aqua (lotrafilcon B), Alcon launched its monthly disposable Air Optix with HydraGylde (lotrafilcon B) to the United States market in 2016. The lens has a 25µm permanent plasma surface treatment, which the company calls 'SmartShield.' The continuous hydrophilic layer is designed to help the lens resist lipid deposition. It also uses what the company calls a 'HydraGlyde moisture matrix,' which is a block copolymer (poly[oxyethylene]-poly[oxygutylene]) designed to envelop the contact lens in a thin film and create a uniform hydrophilic surface. Both of these technologies are designed to work together to increase the lubricity of the lens and improve contact lens comfort. One study, funded by the manufacturer, found that lotrafilcon B has a significantly lower absorption of cholesterol compared with other SiHy lens materials.[4]

## DELEFILCON A

In 2013, Alcon launched Dailies Total1 (delefilcon A), a one-day SiHy contact lens with what's described by the manufacturer as 'water gradient technology.' The lens has a silicone core with 33% water content. The silicone is enveloped in a 6µm thick water gradient created by covalently linked hydrophilic monomers that form a soft, hydrophilic surface gel. According to the company, the lens can achieve greater than 80% water content on the surface.[5] The comfort is attributed to the combination of the water gradient technology, low surface modulus of 0.025MPa

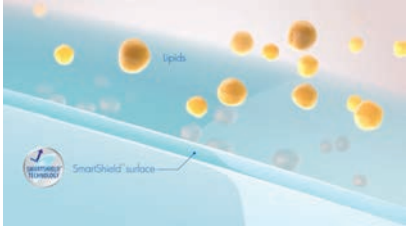


Image: Alcon

**Air Optix with HydraGlyde's SmartShield surface surrounds the contact lens and resists lipid deposition.**

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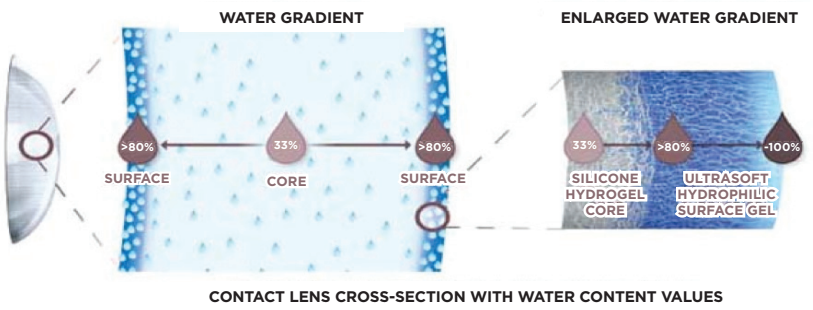


**This Dailies Total1 cross section illustrates the water gradient throughout the contact lens with water content values.**

(core of 0.76MPa), daily disposable modality and packaging in a phosphate-buffered saline solution containing 0.3% polymeric wetting agents (copolymers of polyamidoamine and poly[acrylamide-acrylic acid]).

One study compared the tear break-up time (TBUT), corneal and conjunctival staining and dry eye symptoms in patients randomly assigned to wear one of two different brands of contact lenses. They found that symptomatic dry eye patients who switched to Dailies Total1 had improved comfort by three hours of wear compared with those who switched to Alcon's Focus Dailies (nelfilcon A), who did not experience any significant comfort improvement.[6]

Another study compared the wettability and noninvasive TBUT for asymptomatic and symptomatic contact lens patients wearing three different types of daily disposable SiHy contact lenses. The researchers found that Dailies Total1 had reduced dehydration staining and that the ocular and clinical performance of the lenses was not significantly different between symptomatic and asymptomatic contact lens wearers.[7] In a cross-over clinical comparison with two other daily disposable SiHy lenses, Dailies Total1 had a longer TBUT, although comfort was similar between the three contact lenses.[7,8]

## SAMFILCON A

In 2014, Bausch + Lomb launched Ultra (samfilcon A), a lens designed with a high level of polyvinylpyrrolidone (PVP) on the lens surface, branded by the company as 'MoistureSeal Technology.' Electron microscopy shows silicone wrapped in PVP, and photoelectron spectroscopy reveals PVP on the surface of the lens, creating a hydrophilic surface. PVP is also distributed throughout the lens, allowing for water to be stored within the lens material. This results in a relatively high water content of 46% for a SiHy contact lens.[9]

According to the manufacturer, samfilcon A is a combination of three distinct types of silicone that contribute to the balance of high oxygen transmissibility and low modulus. The lens material undergoes two distinct polymerization phases. The first phase involves creating a matrix of long- and short-chained silicone molecules. This is followed by the polymerization of PVP throughout the silicone lattice framework in the second phase.

While no independent studies comparing comfort of Ultra with other contact lenses currently exist, an internal Bausch + Lomb study found that after four hours of lens wear, samfilcon A only dehydrated by 5.07%.[10] Another company study used atomic force microscopy and x-ray photoelectronic spectroscopy to evaluate four different contact lenses, each when new and after rub/rinse cycles simulating a month of wear.[11] They found little change in the morphology, roughness and composition of samfilcon A lenses compared with other SiHy lenses.[11]

## COMFILCON A

Cooper Vision launched Biofinity Energys in 2016 to address the visual discomfort patients may experience while using digital devices. Energys uses the same material as the company's Biofinity lens, comfilcon A, but has different optics—called Digital Zone Optics by CooperVision. The optics design is comprised of multiple front-surface aspheric curves across the entire optical zone. The low positive add power in the center of the lens is designed to decrease visual fatigue without sacrificing distance vision while using digital devices. This is to accommodate the increasing digital world, in which 69% of American adults use smartphones on a daily basis compared with only 26% in 2012.[12]

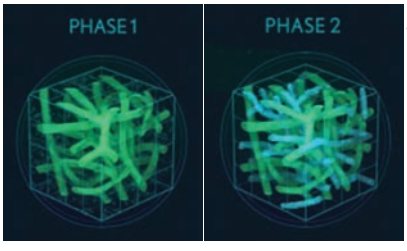


Image: Bausch + Lomb

**Phase one builds the silicone matrix (green), while Phase two polymerizes PVP (blue) during the production of samfilicon A.**

The Biofinity material uses two types of silicone-based macromers that differ based on molecular weight. These macromers are combined with hydrophilic monomers, resulting in a wettable lens that does not require additional internal wetting agents or surface treatments, according to the manufacturer.

In a clinical study, the original

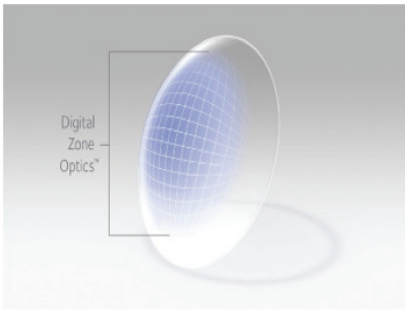


Image: Cooper Vision

**The Energys lens's Digital Zone Optics are illustrated as a low positive power in the center of the lens.**

Biofinity lens worn on an extended basis for 30 days over course of a year was compared with another extended wear lens. The researchers found the Biofinity lens was more comfortable, with better vision quality and less limbal redness, bulbar conjunctival hyperemia and conjunctival sodium fluorescein staining.[13] Another study showed that Biofinity lenses maintained a relatively low coefficient of friction, indicating greater comfort, even after 100 cycles of simulated wear.[14] Its original coefficient of friction value of 0.033 was lower than that of comparable lenses, but not as low as some others that reached values as low as 0.016.[14]

## STENFILCON A

Introduced in 2015, MyDay (stenfilcon A) is Cooper Vision's most recent one-day disposable contact lens. MyDay is made of covalently linked hydrophilic groups attached to long silicone chains, which the manufacturer calls 'Smart Silicone.' Stenfilcon A has a low quantity of silicone—just 4.4%—and this efficient use of the component allows for more space in the contact lens for hydrophilic materials while attaining a 100 Dk/t, a water content of 54% and a low modulus of 0.4MPa, Cooper Vision says.[15]

Few independent studies on the MyDay lens exists; however, one study found improved hydration performance in hydration profile relative to another SiHy lens, yet both had similar comfort after a 12-hour day.[16]

## SENOFILCON A

In 2016 Johnson & Johnson Vision launched Acuvue Oasys 1-Day (senofilcon A), a one-day disposable contact lens designed with 38% water and 62% senofilcon A. Though both the two-week disposable Oasys and Oasys 1-Day are made of senofilcon A, J&J says the one-day lens uses an enhanced moisture network that increases the crosslinking density of the silicone with a long chain, high molecular weight, internal wetting agent based on PVP—a process the manufacturer calls 'HydraLuxe

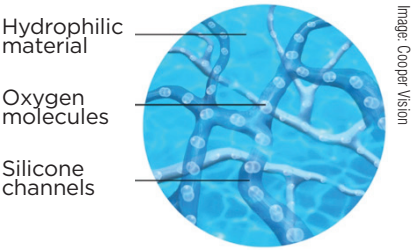


Image: Cooper Vision

**Cross section of MyDay's Smart Silicone illustrates the silicone channels filled with oxygen and large spaces between the silicone channels filled with hydrophilic materials.**

**Comparison of Silicone Hydrogel Contact Lenses and Their Comfort Technologies[18]**

| Contact Lens | Manufacturer | Material | Modality | Comfort Technology | Comfort Technology defined | Water content | Dk/t | Modulus (MPa) |
|---|---|---|---|---|---|---|---|---|
| Air Optix Aqua with Hydraglyde | Alcon | Lotrafilcon B | One month | Smart Shield Technology, Hydraglyde Moisture Matrix | Permanent, thin, continuous, hydrophilic plasma coating | 33% | 138 | 1.0 |
| Dailies Total1 | Alcon | Delefilcon A | Single use | Water Gradient Technology | 33% water core, with a water gradient to a hydrogel surface layer that exceeds 80% water at the surface | 33% at core, 80%+ at the surface | 156 | 0.76 |
| Ultra | Bausch + Lomb | Samfilcon A | One month | Moisture Seal Technology | Multiple layers of long-chain silicone integrated with PVP | 46% | 163 | 0.7 |
| Biofinity Energys | Cooper Vision | Comfilcon A | One month | Aquaform Technology | Hydrophilic monomers integrated with silicone; requires no internal wetting agents | 48% | 160 | 0.8 |
| MyDay | Cooper Vision | Stenfilcon A | Single use | Smart Silicone | Minimal efficient use of silicone to allow for a higher water content | 54% | 100 | 0.4 |
| Acuvue Oasys 1-Day | Johnson & Johnson Vision | Senofilcon A | Single use | HydraLuxe Technology | Long-chain, high-molecular weight, PVP internal wetting agent | 38% | 147 | 0.72 |
| Acuvue Vita | Johnson & Johnson Vision | Senofilcon C | One month | HydraMax Technology | Long-chain, high-molecular weight, PVP internal wetting agent | 41% | 147 | 0.77 |

Technology.'[17] The chain length and molecular weight PVP is added to a reactive monomer mix and is evenly distributed throughout the lens. The resulting contact lens matrix closely mimics the properties of mucin to improve the comfort as the lens interacts with the patient's tear film, according to the company. The lens is also packaged in an electrolyte-balanced packaging solution designed to mimic human tears.

Due to the recent launch of these contact lenses, no independent clinical research has been published comparing the comfort of Acuvue Oasys 1-Day with other lenses beyond the internal Johnson & Johnson Vision studies.

## SENOFILCON C

Johnson & Johnson Vision also launched Acuvue Vita (senofilcon C) in 2016. It is a monthly disposable contact lens that uses a non-coated silicone formulation of senofilcon C marketed as 'HydraMax Technology.' Senofilcon C is a combination of two types of silicone and has 30% more PVP compared with senofilcon A. The integrated PVP throughout the lens matrix helps with hydration and comfort, without the use of surface treatments. Natural lipid deposits from the tear film are distributed throughout the lens to increase its lubricity and decrease evaporation of the tear film. It also has what the company describes as 'an infinity edge,' which is a thin tapered edge designed to improve contact lens comfort.

Because these contact lenses are new, no independent clinical research has been published comparing the comfort of Acuvue Vita with other lenses.

The increasing water content and evolving surface and mechanical properties in these latest SiHy contact lenses show promise for more comfortable contact lens wear. Each company uses a different technology to increase contact lens lubricity—and, interestingly, some of it seems contradictory. For example, the Air Optix with HydraGlyde lens is designed to protect itself from tear lipids, while the Acuvue Vita integrates tear lipids into the lens. The Energys lens does not use internal wetting agents, but Ultra and Acuvue Oasys 1-Day have internal wetting agents based on PVP.

Without vigorous masked, randomized and controlled studies, it is difficult to determine the best contact lens and design feature. To find the right contact lens for each patient, clinicians should have the patient try different contact lens brands. When possible and given that both brands fit well without compromising ocular health, having patients try one brand of contact lenses in one eye and another brand in the other eye allows the patient to experience the comfort of lenses in the same environment. After all, given our current contact lens selection, our patients have many excellent choices to choose from. RCCL

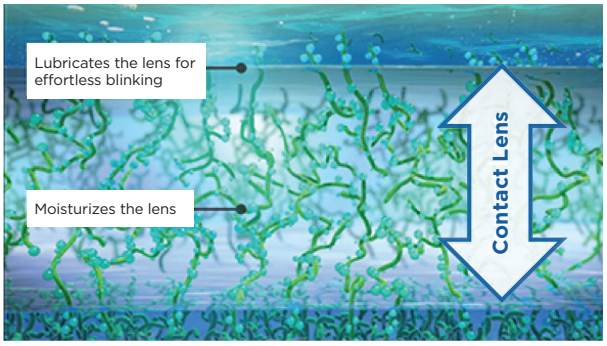


Image: Johnson & Johnson Vision

**Acuvue Oasys 1-Day with HydraLuxe Technology is comprised of a network of hydrated silicone and tear-like molecules that interact with the tear film.**

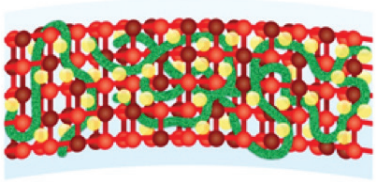

Image: Johnson & Johnson Vision

**HydraMax Technology is a network of hydrated, lipophilic silicones (dark red and red) with embedded long chains of pure PVP homopolymer (green). Natural tear lipids (yellow) are integrated into the lens for improved lubricity.**


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# It's All About the TEAR FILM

**When dealing with ocular dryness and contact lens discomfort, your first move should be to look at the tears.**

By Jennifer S. Harthan, OD, and Milton M. Hom, OD

We love our contact lenses. They improve our vision and looks while also helping us win on the athletic field. But we also hate our contact lenses, especially when they cause ocular irritation. Successful contact lens wear is multifactorial, and one of the leading factors is lens wettability. End-of-day discomfort and ocular dryness are the main causes of contact lens dropout, with up to one-third of contact lens wearers discontinuing wear secondary to these common complaints.[1,2]

The association of ocular dryness and contact lens discomfort has been frequently reported in the literature.[1,3,4] As the most common complaint in contact lens wearers, dryness affects between 50% and 70% of wearers—most likely due to the physical interaction between the ocular surface (the tear film specifically) and the contact lens.[5-7]

Research shows a dysfunctional tear film is associated with complaints of ocular discomfort and dryness in contact lens patients, which in turn leads to reduced wear time, increased chair time and, ultimately, contact lens discontinuation. When these symptoms arise, often our first move is to immediately switch a patient's contact lens modality or change contact lens solutions; however, addressing the ocular surface and unstable tear film first may improve contact lens retention and overall comfort. Let's take a closer look at the tear film, how contact lenses affect it and how to keep our contact lens patients comfortable in their lenses.

## KEEP THE TEAR FILM INTACT AND STABLE

Tear film stability and appropriate pre- and post-lens tear exchange characteristics are necessary for all contact lens wear, whether it is soft, gas permeable (GP) or specialty contact lenses.[8] Factors that contribute to how well the tear film spreads over the contact lens surface include: surface tension gradients, the tear film-contact lens surface interface, tear film quality, tear film stability, gravity and the presence of deposits on the lens surface.[9] Gradual surface deposition of proteins and lipids over time also contributes to decreased lens wettability and optical quality.

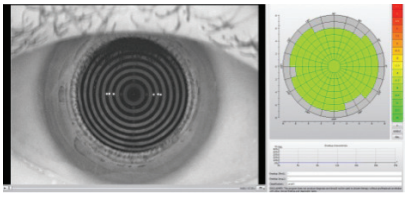
In particular, the stability of the tear film is related to the lipid layer's ability to prevent evaporation from the ocular surface. A thicker lipid layer decreases evaporation rates and increases the period between blinks.[10] For example, studies show patients with meibomian gland dysfunction have increased levels of cholesteryl esters (CE) and decreased levels of wax esters (WE) in their meibum, contributing to blocked glands and an unstable tear film.[11] Another study looked at the effects of these tear lipid parameters in contact lens wearers and found a higher proportion of WE to CE lipids is associated with improved tear film quality and stability after eight hours of contact lens wear.[12]

In addition, corneal glycocalyx, which is formed by mucins secreted by epithelial cells, provides a hydrophilic barrier to minimize friction from blinking and stabilize the tear film in both contact lens wearers and non-wearers.[13,14] However, contact lenses can also disrupt the corneal glycocalyx, as research shows hydrogel contact lenses gradually show a reduction in surface hydrophilicity over time, creating a hydrophobic surface.[15] Hydrophobic contact lens surfaces cause more spontaneous dewetting and break up of the tear film compared with hydrophilic contact lens surfaces, further contributing to discomfort and dryness.

## ABOUT THE AUTHORS


Dr. Harthan is an associate professor at the Illinois College of Optometry and chief of the Cornea Center for Clinical Excellence at the Illinois Eye Institute. She lectures, publishes and participates in research on OSD and contact lenses.

Dr. Hom practices in Southern California. He is an award-winning, internationally recognized expert and lecturer in dry eye, contact lenses and allergy. He has written four books and published over 200 papers and peer-reviewed abstracts.



**This Oculus Keratograph 5M tear film quality color map demonstrates an overall even tear film centrally, with an average noninvasive tear break-up time of over 17 seconds.**

According to the Tear Film and Ocular Surface Society's International Workshop on Contact Lens Discomfort, tear film stability is strongly associated with comfort and contact lens wear.[16] Research shows contact lens wearers with reduced tear break-up times and tear volumes are more susceptible to lens-wear discomfort and, ultimately, contact lens intolerance.[16,17]

## EVALUATE THE TEAR FILM

According to research, contact lens wear disrupts the lipid layer, decreases the tear break-up time and increases tear evaporation and tear film thinning compared with patients who do not wear lenses.[18-21] Thus, evaluating the tear film, its stability and how it interacts with the contact lens surface is essential to a contact lens practice.[18-21]

We should start by looking at contact lens surface wettability, which estimates the combined relationship of the soft contact lens surface dewetting and tear film spread.[22,23] Other commonly assessed tear film measures include tear break-up time, noninvasive tear break-up time, tear film thickness and stability, tear meniscus height, Schirmer's testing, phenol red thread testing, interferometry, on-eye contact angle, aberrometry, lipid layer interference patterns and optical coherence tomography.[22]

Although many clinicians use sodium fluorescein to measure tear break-up time, it is readily taken up within the matrix of the lens. Secondary to this, we can now use non-invasive measures of tear film break-up such as tear film reflection with placido disc images through corneal topography systems. New software systems, such as the Keratograph (Oculus) and the Tear Stability Analysis System (Tomey), can measure tear break-up time and quality, as well as tear film stability.

Another technique to assess tear film stability is interferometry, in which we can record the time between blinks and the first disruption in the lipid layer. For example, the LipiView (TearScience) system uses interferometry to measure the thickness of the lipid layer for half the tear film over the cornea at a time.

## CHOOSE THE RIGHT PRODUCTS

Once we have a clear picture of the patient's ocular surface and the factors contributing to contact lens discomfort, we can treat any underlying etiologies such as dry eye disease or allergy to improve comfort. Only then can we turn to different contact lens modalities and materials to ensure the most comfortable lens wearing experience.

***Care product solutions.*** The interaction of certain contact lens solutions with contact lens materials can play a significant role in ocular comfort and dryness.[24,25] As such, recommending the proper solution to minimize negative adverse events such as toxicity and microbial keratitis is extremely important. We should also remember to educate patients who tend to accumulate deposits on their contact lenses about the importance of rubbing and rinsing their lenses or instruct them to use a peroxide-based solution system. Keep in mind that hydrogel lenses attract more proteins while silicone hydrogel lenses attract more lipids.[26] A recommendation of more frequent lens replacement, which minimizes or even eliminates the need for solution, may also improve the patient's overall ocular comfort in this situation.

***Modalities.*** Replacing the lens more often is one way to combat contact lens discomfort and reduced wettability. Research shows contact lenses that are replaced more frequently, such as daily disposable lenses, enhance subjective comfort compared with those replaced less frequently.[23,27]

***Materials.*** Concerning contact lens materials, the newer silicone hydrogel materials allow more oxygen to pass through the lens, which should improve tear film and ocular surface stability compared with hydrogel materials, as a higher Dk/t decreases central corneal swelling and maintains normal corneal homeostasis.[28] Despite this, research has yet to show that silicone hydrogel lenses significantly improve ocular comfort or decrease incidence of microbial keratitis compared with hydrogel contact lenses.[29]

Manufacturers have attempted to address end-of-day discomfort and dryness in both soft and GP lenses by adding a moisture agent to the

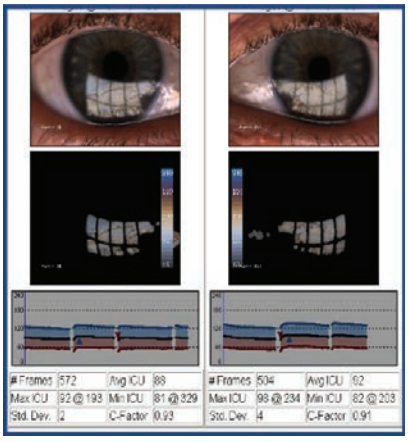
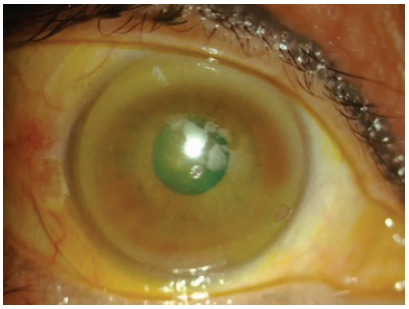
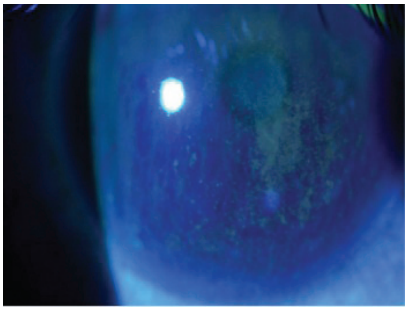


Photo: Scott Hauswirth, OD

**LipiView interferometry can provide objective measurement of lipid layer thickness, as well as real-time video of blink mechanics.**



**This image shows poor surface wetting of a contact lens due to unstable lipid layer and incomplete blink.**



**Clinical findings of poor tear film stability and corneal staining caused by severe dry eye and meibomian dysfunction.**

lens matrix or a coating to the lens surface. However, results have varied based on the lenses used and patients' individual ocular surface characteristics. For example, patients who experience dryness or discomfort associated with lens wear or moderate-to-heavy lens deposition may benefit from the recently FDA-approved Tangible Hydra-PEG (Contamac), a 90% water polyethylene glycol-based polymer mixture that is permanently bonded to both surfaces of the contact lens. This may be applied to soft, GP, scleral and hybrid lenses.

Even when fitting patients in a silicone hydrogel lens, we have much to consider, as the lens material can differ significantly from one manufacturer to another. In one study, three different silicone hydrogel lenses were evaluated for clinical performance over the course of a 16-hour day.[17] Results showed Dailies Total1 (delefilcon A, Alcon) lenses had a longer noninvasive tear break-up time than Clariti (falcon II-3, CooperVision) and 1-Day Acuvue TruEye (narafilcon A, Johnson & Johnson Vision) lenses. This may play a significant role in protecting the ocular surface for patients presenting with signs and symptoms of dry eye. Dailies Total1 lenses also demonstrated less corneal staining after 16 hours of wear than the other two lenses.[17]

All three lenses demonstrated similar comfort, vision, contrast visual acuity, quality of vision and limbal redness, although all of these factors decreased throughout the day.[17] With all of the great lens options available, it is important to listen to patient feedback as well as look at the ocular surface to make the appropriate lens recommendation.

Evaluating and managing the tear film is not a new concept in clinical practice. However, improving the tear film will lead to increased contact lens wear time and retention, reduced chair time and increased referral network. We can always change a patient's contact lens solution, their lens material or their lens modality. But above all else, consider the tear film and ocular surface wetting. RCCL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# Five Ways to Connect LENS CARE with *Comfort*

*By Michael Iannucci, Associate Editor*

Finding a lens care system that fits your patients' needs while maintaining comfort can be tricky, but these tips can help.

Whether you're working with a first-time contact lens patient or an existing wearer who is having difficulties, you need to play every card you hold if you want to win them over to long-term lens wear. During the contact lens fitting process, the influence of case systems on comfort is often sidelined for a proper fit and correction, and with a 24% contact lens dropout rate directly due to discomfort, it can feel like a no-win scenario.[1] However, choosing the right lens care system can help minimize discomfort. Here are some of the most important things to keep in mind when recommending an effective and comfortable lens care system for your patients.

## 1 CONSIDER THE LENSES

Choosing the right contact lens solution to keep your patient comfortable starts with choosing a contact lens that meets their needs best; that decision will then dictate much of the care system selection process. Clinicians must consider how the lens dehydrates throughout the day, how stable the lens is on the patient's eye and much more. "If you had somebody with dry eye, you would want to choose a lens that has a very hydrophilic surface," says Christine Sindt, OD, director of contact lens service and clinical professor at the University of Iowa. "Something that has a lot of surfactant or polymer or phospholipids to prevent dehydration of the lens material itself."

While GP lenses take some getting used to for soft lens wearers, they have several valuable benefits.[2] GP lenses are more resistant to deposits and bacteria, which could prove beneficial in minimizing long-term comfort decline for patients with eye hygiene issues.[3] "Unquestionably, GP lenses are initially less comfortable than soft," says Daniel G. Fuller, OD, of Southern College of Optometry. "This difference dissipates with adaptation over approximately a two-week period to where it is often clinically insignificant." One study shows using a topical anesthetic prior to lens insertion during diagnostic fitting and dispensing visits is effective at easing the adaptation process for patients.[2]

"GP wearers are, by far, more faithful to their solution than the soft lens wearers," says Dr. Sindt. "They feel like that's how their contact lenses are supposed to feel vs. other products that say they wet better but don't have the same gooey feeling to them."

After deciding on the best lens option, clinicians should turn their attention to the best lens care solution, and its interaction with the lens will be a significant factor in the decision. For example, a lens with high silicone content requires extra attention, as the hydrophobic nature of silicone may create a bond between solution properties and the surface of the lens.[4] "You can have the uptake and release of biocides back to the surface of the lens, and that can cause some end-of-the-day drying," says Dr. Sindt. "If you have a high-silicone lens, you may want to choose to use a peroxide-based solution so that you won't have the silicone reacting to the solution."

Sometimes, the lens type necessitates more than a simple multipurpose solution. Patients prone to heavy deposits on their lenses or who wear lenses approved for three months or more may need to use a daily enzymatic cleaner, says Susan Gromacki, OD, MS, director of contact lens service at Washington Eye Physicians & Surgeons.

## 2 KNOW YOUR PATIENTS

Patient lifestyle often weighs heavily on contact lens comfort. Here are some important factors to consider when finding a lens care system to maximize comfort:

***Sleep.*** If a patient is not getting enough sleep at night, their lens comfort can suffer. "Just like our bodies in general, we need time to repair and we're going to need time with our eyes shut for our eyes to repair," says Dr. Sindt. Ask your patients about their sleep habits—if they are not getting enough sleep or experience nocturnal lagophthalmos (look for the telltale signs of exposure keratopathy), you

may have found the cause of their discomfort.[5,6] In these cases, using preservative-free artificial tear at least four times a day may provide relief.[7] Ointments and moisture goggles may also be necessary.[7]

***Screen time.*** The daily amount of hours a patient spends with their eyes focused on a computer, TV, tablet or phone is an increasingly prevalent cause of discomfort.[8] It reduces the blink rate, which impairs proper tear film replenishment from lipid release, causing symptoms of dryness.[9] Again, preservative-free tears should be among the first lines of defense here to provide relief, but reducing screen time can minimize risk of further irritation.[10] For more severe cases, methods that may provide aid include conserving tears through punctal occlusion or cautery, increasing tear production with prescription eye drops and omega-3 fatty acids, or directly treating the inflammation with ointments, warm compresses and lid massage, or daily cleaners.[11]

***Compliance.*** Noncompliance causes problems with every facet of eye care, so it's no surprise that it promotes discomfort as well.[11,12] Knowing a patient's noncompliance tendencies can steer you toward specific care systems. "If a patient is going to wear their lenses overnight and remove them one time a week, I want to provide them the solution that will kill the most bacteria during that one night of cleaning," says Jason Miller, OD, of EyeCare Professionals of Powell, Ohio. For many, a daily disposable option often helps reduce the risk of compliance-related microbial issues and improve comfort.[12]

***Age.*** The older we get, the greater our propensity for inflammation, and that includes in our eyes.[13] Our circulating hormones decrease as we age, and as a result, our ability to control inflammation decreases.[13] In

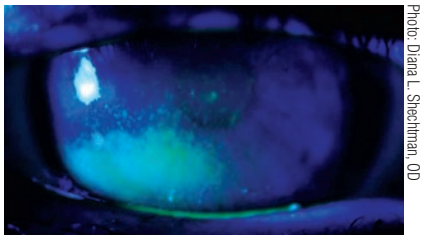


Photo: Diana L. Shechtman, OD

**A telltale sign of nocturnal lagophthalmos is inferior cornea staining corresponding to exposure.**

cases where age-related inflammation is a problem, practitioners first need to decide whether the inflammation warrants a new form of control in the absence of hormones. Some options for this include topical inflammatory mediators such as cyclosporine, lifitegrast or even steroids.[14]

Dry eye disease (DED) is also prevalent in patients older than 65, most of whom experience at least some dry eye symptoms.[15,9] "A contact lens splits the tear film, so if it is thin or unhealthy, a patient will experience discomfort over time," says Dr. Gromacki. Research shows DED is a major contributor to the contact dropout rate.[1] "Those who continue to wear contact lenses successfully beyond this point require special attention to visual acuity needs and dryness," says Dr. Fuller. For dry eye sufferers, "lenses with lower wetting angles created by surface treatments or the incorporation of hydrophilic and amphiphilic agents into the lens matrix may help. They attract moisture and mimic the natural tear film."

In younger patients, hygiene and compliance are potentially problem areas, too. Teens and college students in particular can have an invincibility complex that encourages outright disdain for lens care. As such, these patients may require extra attention and coaching.[16]

Knowing your patients and all the factors that could affect their contact lens wear will allow you to bring up potential issues before they occur. This is a good way to gain their trust and ensure issues are addressed right from the start. "If the patient does end up having problems, they're going to think, 'Wow, you knew that! How did you know that?'" says Dr. Sindt. "And then, because you alerted them to it ahead of time, they'll go back to you to make sure that it gets managed."

## 3 MATCH LENS CASES WITH SOLUTION

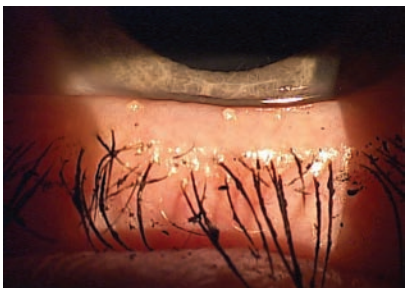
The importance of compatibility between lenses and solutions is well known; what gets less attention, however, is the need to match *cases* and care systems. Contact lens cases are specifically designed to go with their solution counterparts, and as such, mixing them up could be problematic, Dr. Sindt says. Some plastics used for lens cases bind preservatives tightly to their surface. If a foreign solution is used and binding occurs, that preservative will no longer be present in the solution.

"The worst cases out there that patients have the most problems with are actually those flat packs that doctors buy with their names imprinted on them," says Dr. Sindt. "Those are going to have the most uptake and release of solutions, as well as binding of the preservative out of the solution." The key here is to have patients replace the solution in the case each night and the case itself with each new bottle purchase.

## 4 BE CAREFUL WITH DISINFECTANTS

Disinfectants are designed to destroy cell membranes.[17] That works to an OD's advantage to reduce microbial populations, but against them on the ocular surface itself, as exposure to disinfectants can cause irritation. Disinfectants can bind to the lens and break down tears when the lens is on the eye,

Photo: Paul M. Karpecki, OD



**Dry eye disease is a major contributor to contact lens dropout.**

leading to discomfort.[18] For sensitive patients, the presence of disinfectant on the surface or within the matrix of a lens may cause toxic reactions. "It's always this very fine balance between having a disinfectant that is efficacious enough to kill the bacteria that's in the well, but isn't so strong that it's going to kill the surface of your eye," says Dr. Sindt.

As with disinfectants, preservatives can bind to the lens, and they are also prone to uptake into the lens material and subsequent release into the tear film, which sometimes causes corneal staining.[18]

Hydrogen peroxide-based disinfection systems and preservative-free tears can be helpful alternatives.[19] For example, Dr. Gromacki recommends hydrogen peroxide for patients with allergies. "But, if the patient wears their lenses less than once per week, then they'll have to re-disinfect the lenses prior to wearing them," she says. Hydrogen peroxide solutions also must be neutralized, which can take anywhere from four to six hours, so patient lifestyle will need to allow time for this.[20] As a result, practitioners and patients will have to make a decision based on the magnitude of allergies and level of compliance.

## 5 AVOID GENERICS

While your patients may be attracted to the lower price tags of generic solutions, the notion that you get what you pay for may apply here. A major issue with generics is the consistency of their contents—or lack thereof, specifically.

About once a year, retailers take bids from solution companies to produce and package their private-label solution.[21] The contracts won in the bids generally expire in 18 to 36 months, so the formulation of that generic brand solution may change.[21] As a result, there could potentially be two of the same bottle but each could have different chemical formulations.[21] Also, "since the contract goes to the lowest bidder, manufacturers are highly unlikely to place their premium lens solutions into privately labeled bottles," says Dr. Gromacki. "Many of the generic brands, for example, were developed prior to the advent of silicone hydrogels (1999) and as such cause significant solution-induced corneal staining in combination with some of these materials."

To combat generics, practitioners should address the risks with patients and strongly recommend avoiding them. "Doctors generally delegate training to technicians, but we need to use the 'power of the white coat' to prescribe an appropriate care system," says Dr. Fuller. "If we don't take the time to explain our decision-making, the patient assumes there is no difference."

Many factors affect the lens care system you ultimately recommend for your patients, and comfort is just one of them. Despite significant advances in contact lens materials and lens care systems, contact lens dropout rates have not changed significantly in decades.[22-25] No one should hold their breath for a technological breakthrough that will solve the many problems that can arise with contact lens wear.[22-25] However, if you take the time to balance all your lens care options, ultimate comfort will no longer need to sit on the sidelines. RCCL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# A WAR ON TWO FRONTS: Combat Dry Eye and Allergy in Contact Lens Wearers

As optometrists, we spend a great deal of our time trying to keep our contact lens wearers happy and comfortable. No matter how much effort we put into this, preventing dropout is often a struggle. While there are many reasons for dropout, two of the most common are dry eye and allergic eye disease.[1] When both are present, it creates a significant clinical challenge.

## IDENTIFYING THE PROBLEM

To keep contact lens patients comfortable, practitioners should consider potential dry eye and allergic eye diseases at the beginning of the fitting process. While this may seem trite, many clinicians approach soft contact lens fitting by arbitrarily choosing a lens, slapping it on and seeing how the patient does. However, prior to initiating the fitting process, a careful history regarding pre-existing symptomatology and clinical evaluation of the ocular surface are key to increasing your success rate, particularly in dry eye and allergy sufferers.

## DRY EYE

Many practitioners, especially those with an older patient demographic, have taken to including dry eye questionnaires in a patient's intake, and the Dry Eye Ocular Surface Disease Index (OSDI) in particular.[2] The OSDI has been validated in clinical studies to assess quality of life in patients as their condition improves.[3] Many practitioners, however, feel their patients already have enough paperwork to fill out, and high OSDI patients are likely poor candidates for contact lens wear anyway.

I find that simply asking a patient if they have dry eye symptoms when not wearing lenses is sufficient to indicate that the patient will have excessive dryness with contact lens wear. If the patient reports symptoms on a regular basis in the absence of contact lens wear, I treat the dry eye aggressively to get it under control prior to initiating wear. I ask established lens wearers how many hours of wear it takes before they experience (1) any dryness and (2) sufficient dryness to force them to remove their lenses. If the former is less than six hours and the latter is less than 10 hours, there is likely an underlying etiology that can be identified and addressed.

Many of these patients are on edge of the proverbial dry eye "cliff," and contact lens wear is enough to push them over. To pull them back to safety, I draw on a limited number of dry eye tests that are likely to yield positive results. In particular, I focus on tear film stability and the (nearly) ubiquitously present evaporative component. This means a thorough evaluation for blepharitis, with particular attention to the meibomian glands and their dysfunction.

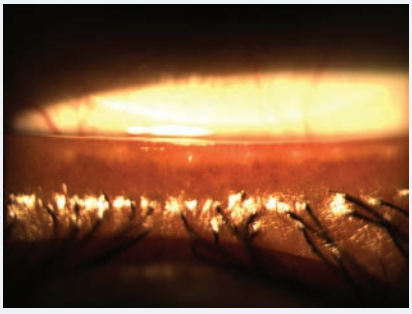
Meibomitis is an extremely common condition that presents with a wide variety of symptoms, both in type and severity.[4] It is the result of chronic inflammation secondary to *Staphylococcal* species that are commonly part of the established skin flora. The bacteria slough off exotoxins that incite inflammation within the gland, thereby changing the chemical composition of the meibum. The result is an increase in the melting temperature, which slows the flow of meibum from glands. A very common, and under-recognized, feature of meibomitis is meibomian gland obstruction (MGO), which is characterized by a plug of epithelial cells that physically block the gland opening.[5] MGO is not necessarily evident in white light exams; if the gland openings appear


### ABOUT THE AUTHOR

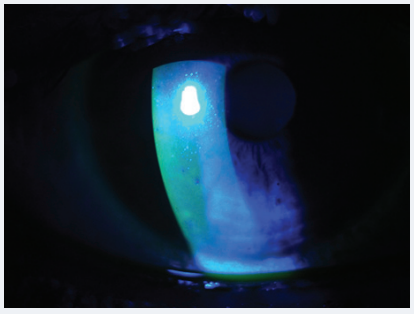
Dr. Green is an assistant clinical professor at the UC Berkeley School of Optometry and did his PhD work in immunology at the California Institute of Technology. He is currently the director of UC Berkeley Digital and director of Berkeley Optometry Online Education.

Preventing contact lens dropout in patients with multiple complications can be challenging, but these tips and tricks can help.

*By Harry M. Green, OD, PhD*



**Although these meibomian glands do not appear inspissated, they are completely obstructed.**



**Perform your tear break-up time before trying to gently express the meibomian glands.**

normal in a white light exam, it is necessary to physically express the glands gently to determine if they are obstructed.

Tear break-up time should be performed prior to any type of gland expression, as the physical expression itself will influence the result. To determine if the glands are completely obstructed, apply gentle pressure along the lid margin, with opposing pressure against the globe. Normally functioning meibomian glands will express with only slight pressure, and the appearance of the expressed meibum should be clear and flow easily. If it takes more than gentle pressure to get the glands to express, or if they do not express at all, then treatment of the lid disease should significantly reduce symptoms.

## ALLERGY

From an allergy perspective, the review of systems (ROS) on our intake paperwork should provide us with the first clue. However, my experience is that patients with allergies often downplay their significance. Many of my patients report not having allergies and do not list over-the-counter (OTC) allergy medicines on the ROS because their allergies "aren't that bad" and are controlled with the OTC systemic antihistamines. I find that it is more reliable to directly ask current or potential contact lens wearers if they have allergies, regardless of what they report on their ROS. Ask more pointed questions regarding the presence of atopy, and specifically atopic dermatitis of the face or lids. Very often, atopic dermatitis of the lids has palpebral conjunctival involvement as a comorbidity. Remember, allergic eye disease only rarely occurs in isolation. Inquire about other affected organ systems due to allergic rhinitis, asthma and food allergy.

Identifying ocular allergy on clinical examination can be done by looking for signs of low-level, chronic allergic eye disease on the ocular surface. These include

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**Expiration Date:** May 15, 2020

**Goal Statement:** Preventing contact lens dropout consumes much of an optometrist's time, and there are many methods for ensuring contact lens wearers remain happy in their lenses. Two of the most common culprits for contact lens discomfort, and thus dropout, are dry eye disease and ocular allergy. Although treating one of these issues is challenging enough, patients often present with both dry eye and allergy, further complicating their management. This article will help optometrists understand the conditions, how to treat them and what to do when both are present.

**Faculty/Editorial Board:** Harry M. Green, OD, PhD

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signs of atopic dermatitis on the lids and face, hyperemia of the palpebral conjunctiva, a mixed papillary and follicular response on the tarsal conjunctiva and conjunctivochalasis.

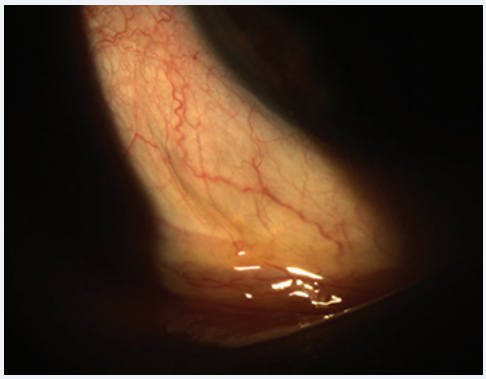
Lastly, it is absolutely essential to flip the upper lid and examine the upper tarsus of current or potential contact lens wearers. I'm often surprised by what I find, including fibrosis from chronic allergic inflammation with recurrent exacerbations. Many patients with a constellation of these subtle signs will not report allergic symptoms until asked; often, patients will report no symptoms at all, even after a direct inquiry.

## TREATING DED

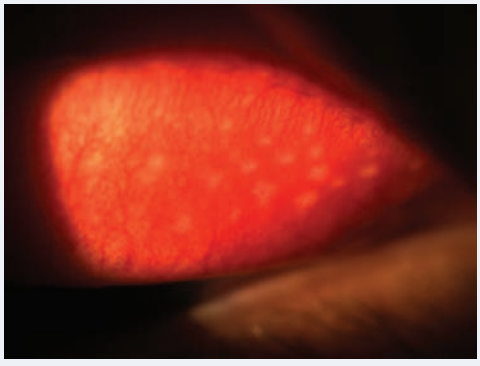
Initial treatment for dry eye disease is usually twice-a-day warm compresses and lid hygiene. I also recommend that the patient begin taking daily omega-3 supplements. Research shows omega-3 fatty acids increase the secretion and quality of the meibum from the meibomian glands in patients that take them on a daily basis for six weeks.[6] My general recommendation is a supplement high in EPA and DHA (fish or krill oil-based) because of the increased bioavailability over linoleic acid (flax-seed oil) and dosing at three capsules per day.

The greatest challenge with treating dry eye patients is compliance. Getting patients to follow recommendations that take 20 to 30 minutes out of their daily routine is a daunting task. However, many commercially available warm compresses not only hold a sufficient amount of heat for the entire session, but also absorb ambient humidity when the compress is not in use, and release water vapor when in use. A plethora of commercially available lid soaps and soap products are formulated to provide effective lid hygiene without causing significant ocular surface discomfort.

Another great option for effective symptomatic relief is the use of rewetting drops. There are many different options available OTC, and they can be very effective when used properly. Clinicians should avoid prescribing them "as needed," as consistent use throughout the patient's normal contact lens wear time is key. Dosing at regular intervals throughout the day often extends wear-time significantly. However, make sure the patient understands that the maximum usage should be four times a day.



**Redundant conjunctiva from chronic bouts of allergic inflammation.**



**Whitish fibrosis from chronic allergic inflammation on the upper tarsal conjunctiva.**

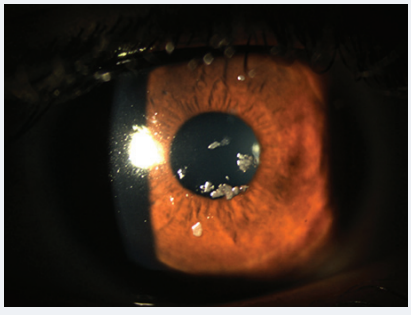
Although antibiotics can be useful for some dry eye patients, antibiotic resistance has become a significant concern across the entire health care field, and it is our duty as clinicians to use them as sparingly as possible.[7] In addition, other potential side effects of long-term use of systemic antibiotics include the development of severe systemic allergy, pharmacologically-induced intracranial hypertension and the augmentation of gut flora, which can lead to colonization by aggressive bacterial strains, such as *Clostridium difficile*. In females, there is also the added increased risk of vaginal moniliasis with chronic use of antibiotics.

Demodicosis has been recognized more and more as a significant contributor to dry eye symptomatology, and clinically significant infestations should be treated aggressively to minimize the mite population. Treatment can include in-office procedures such as a 10-minute warm compress followed by cleaning and debridement of the lid margins with a spatula or cotton swab to remove mite-derived debris at the base of the lashes. Tea tree oil ointment 50% or ivermectin cream 1% can then be applied to the lid margins. Be aware, however, that these products are not particularly compatible with the ocular surface and tend to be uncomfortable for the patient. Tea tree oil also has a pungent odor. Much of the work to control this chronic condition needs to be done at home, and clinicians can prescribe the same methodology used for controlling MGD, but specifically using ocular soaps that contain tea tree oil.

## WHEN ALLERGIES HIT

For patients with overt signs and symptoms of simple allergic conjunctivitis, contact lens intolerance can pose a significant clinical challenge. This is particularly true for seasonal allergy sufferers or perennial sufferers with seasonal exacerbations. The latter are the most challenging because their allergies usually stem from multiple sources. These patients tend to do very well with consistent use of topical mast cell stabilizers. Stand-alone mast cell stabilizers, such as cromolyn, are extremely safe and effective with long-term use.[8] However, this class of topical medications frequently has QID dosing to reach therapeutic levels in the eye, and dosing over contact lenses should be avoided. Thankfully, multimodal anti-allergy drugs, such as ketotifen, are widely available and have excellent safety records.[8] They typically have QD to BID dosing, which allows contact lens wearers to dose prior to insertion and after removal. These drugs have both OTC and prescription options.

Lastly, there are many daily disposable soft contact lens options for both spherical and astigmatic fits. The main advantage for allergy sufferers is that frequent replacement eliminates proteinaceous deposit formation on the surface of the lens and the associated reduced comfort. These deposits can bind exogenous allergens and inflammatory mediators and can exacerbate the allergic inflammation.[9] One-day replacement lenses simply do not allow enough time for these deposits to establish themselves.



**Avoid deposits like these by fitting your allergy patients in daily replacement contact lenses.**

## THE DOUBLE WHAMMY

There will invariably be some contact lens wearers who suffer from a combination of ocular allergy and dry eye disease, leading to intolerance and dropout. The clinical problem with this is that warm compresses, the main treatment for evaporative dry eye due to MGD, can worsen an allergic response.

One of the key pathophysiologic mechanisms in an allergic response is histamine release by mast cell degranulation.[8] This causes vasodilation and vascular leakage of serum components, as well as pruritis. The application of heat will increase mast cell degranulation, thus increasing itching symptoms. Heat by itself causes vasodilation and increased vascular permeability, making swelling of the surrounding tissues even worse. In fact, one of the supportive therapies for allergy is *cold* compress. The decrease in temperature causes vasoconstriction and stabilizes mast cells so that fewer are triggered to degranulate.

I take a step-by-step approach to treating these patients, and always start with getting the allergic eye disease under control first. If necessary, I pulse with a topical steroid to rapidly control the ocular surface inflammation. I concomitantly start the patient on a multimodal anti-allergy drop, because I know that mast cell stabilization will take four to six weeks for to reach maximum therapeutic effect.[8] Follow-up timing will depend on the individualized treatment plan, but I generally wait six weeks before instituting dry eye therapy. Often, good allergic control in these patients will create enough symptomatic relief that dry eye therapy does not have to be as aggressive. A good starting point is the use of rewetting drops (preferably refrigerated) throughout the day. This not only keeps the ocular surface moist and comfortable, but also acts as a periodic lavage of the ocular surface, physically flushing out allergens.

No matter how you approach treating these patients, keep in mind that contact lens wear is a luxury that is simply not appropriate for some patients. With good clinical thinking and use of the many treatments at our disposal, most of these patients can achieve comfortable, full-time contact lens wear. But I always warn patients that contact lens wear may have to be limited or abandoned entirely if reasonable therapy is ineffective. RCCL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# COMBAT DRY EYE AND ALLERGY IN CONTACT LENS WEARERS

## CE TEST ~ MAY 2017

1. **When taking a history from current or potential contact lens wearers:**
   a. A validated questionnaire is an efficient way to determine clinical impact of dryness symptoms.
   b. Dryness symptoms without contact lens wear is a red flag.
   c. Simply asking total wearing time is sufficient to determine if intervention is needed.
   d. High scorers on the OSDI are good candidates for contact lens wear in general.
2. **All of the following about meibomitis are true, except:**
   a. Meibomian gland obstruction is a common feature.
   b. It results in a decreased melting temperature of the meibum.
   c. It is caused by staphylococcal species that live on the skin.
   d. Exotoxins from the skin flora act as inflammatory mediators in the meibomian gland.
3. **Allergy sufferers:**
   a. Usually have only one affected organ system.
   b. Who have facial atopic dermatitis are unlikely to have involvement of the palpebral conjunctiva.
   c. Often downplay the presence of allergy and its severity.
   d. Tend to reliably report use of over-the-counter allergy medications.
4. **Meibomian gland obstruction:**
   a. Is a rare feature of meibomitis.
   b. Is not present if meibomian gland orifices appear normal on white light exam.
   c. Will result in an increased tear break-up time.
   d. Represents an epithelial plug that causes a physical block the of meibomian gland orifice.
5. **Which of the following regarding rewetting drops is false?**
   a. The use of rewetting drops can flush out allergens.
   b. Refrigerating rewetting drops can enhance their soothing effect in allergy sufferers.
   c. They are most effective when used PRN.
   d. Rewetting drops are specially formulated for use with contact lens wear.
6. **Antibiotics:**
   a. Should be used to treat DED to prevent patients from contact lens dropout.
   b. Are not associated with possible secondary complications.
   c. Are effective in reducing and controlling *Demodex* infestation.
   d. Need to be used responsibly to minimize the probability of resistance formation.
7. **Which of the following is true about *Demodex* infestation?**
   a. Products with tea tree oil are available for in-office and home use.
   b. It rarely contributes to dry eye symptoms.
   c. In office treatment is the only effective management to control infestations.
   d. It can be completely eradicated with aggressive treatment.
8. **With regard to mast cell stabilizers:**
   a. They should only be used for short-term treatment of allergic conjunctivitis.
   b. They have excellent safety profiles.
   c. Stand-alone mast cell stabilizers are ideal for use with contact lens wear because of QID dosing.
   d. Dosing over contact lenses is not problematic due to their limited long-term side effects.
9. **When both DED and allergy are present:**
   a. Warm compresses are a reliable first-line therapy.
   b. Therapy is more effective if the dry eye component is treated first.
   c. Rewetting drops treat dryness symptoms and flush allergens from the ocular surface.
   d. Topical corticosteroids should be avoided in the therapeutic regimen.
10. **Which of the following about contact lens wear and DED/allergy is false?**
    a. The clinician should always consider whether or not the patient's ocular surface disease contraindicates contact lens wear.
    b. One-day contact lenses are an excellent modality for minimizing the development of contact lens deposits.
    c. There are many effective and safe therapies to control DED and allergy and keep patients in their contact lenses.
    d. The fitting process should begin with an arbitrary lens choice, and allergy and DED should only be considered once symptoms develop.

## EXAMINATION ANSWER SHEET

**A War on Two Fronts: Combat Dry Eye and Allergy in Contact Lens Wearers**

*Valid for credit through May 15, 2020*

**Online:** This exam can also be taken online at www.reviewofoptometry.com/ce. Upon passing the exam, you can view your results immediately. You can also view your test history at any time from the website.

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**Answers to CE exam:**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 4. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 8. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 2. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 5. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 9. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 3. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 6. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 10. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| | | | | | 7. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | | | | | |

**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*

| | | | | | |
|---|---|---|---|---|---|
| 11. Better understand the pathophysiology and clinical impact of meibomitis and meibomian gland obstruction. | ① | ② | ③ | ④ | ⑤ |
| 12. Better identify the signs and symptoms of dry eye and allergy before fitting contact lenses. | ① | ② | ③ | ④ | ⑤ |
| 13. Increase skill in treating dry eye, allergy or both in contact lens wearers. | ① | ② | ③ | ④ | ⑤ |
| 14. Improved my ability to reduce contact lens dropout in my patients. | ① | ② | ③ | ④ | ⑤ |
| 15. Increase my knowledge of dry eye and allergy's effect on contact lens wear. | ① | ② | ③ | ④ | ⑤ |
| 16. Improve my ability to communicate with patients about diseases that may interfere with their contact lens wear. | 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*

| | | | | | |
|---|---|---|---|---|---|
| 17. The content was evidence-based. | ① | ② | ③ | ④ | ⑤ |
| 18. The content was balanced and free of bias. | ① | ② | ③ | ④ | ⑤ |
| 19. The presentation was clear and effective. | ① | ② | ③ | ④ | ⑤ |

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By Elyse L. Chaglasian, OD, and Tammy Than, MS, OD

# Allergy and CLs: The Seasonal Battle

With springtime upon us, know the solutions for your patients' allergy issues.

Spring always comes with the good—warm weather and outdoor activities—and the bad—ocular allergies. Our offices see a noticeable uptick in complaints of itchy, watery, red eyes and an inability to wear contact lenses comfortably, if at all.

## THE PROBLEM

Ocular allergies are a growing problem, especially in cities with more air pollution, including hydrocarbons and automotive exhaust.[1,2] One study found the rhinoconjunctival tissue of susceptible patients is quite sensitive to irritant stimuli during allergic inflammation, and susceptibility to irritants may increase in areas with more air pollutants.[3]

Up to 40% of the US population experiences symptoms from ocular allergy: conjunctival chemosis, injection and papillae.[4] With up to 51% of patients discontinuing contact lens wear every year, it's no surprise patients with ocular allergies will drop out of contact lens wear, flooding our practices with unhappy patients and less contact-lens related revenue.[5] In fact, the TFOS study proved the conjunctiva to be more closely linked to the development of contact lens discomfort than the cornea.[5] The study also suggests alterations of the tear film caused by contact lens wear can cause discomfort.[6] A stable and healthy tear film is vital in the defense against allergens, and an allergic eye with an altered tear film allows greater contact time between offending agents and the ocular surface.

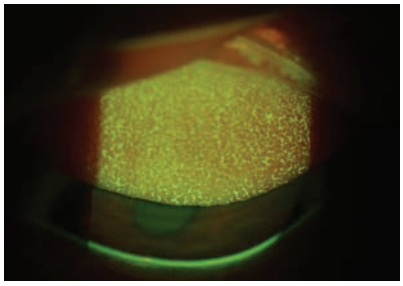

Photo: Jennifer Harthan, OD

**Allergic conjunctivitis can cause significant contact lens discomfort, and must be treated promptly to avoid contact lens dropout.**

Untreated, or undertreated, allergic conjunctivitis can be a direct cause of contact lens discomfort and dropout, and it is our responsibility to identify and treat it quickly.

## THE SOLUTIONS

The first step is ruling out other comorbidities such as systemic, corneal, conjunctival or ocular surface diseases, and then alleviating the symptoms of ocular allergy.

Avoiding known allergens is obvious, though not always realistic if the offender is a family pet or home or work environment. Palliative therapies such as cool compresses, artificial tears and fully protective, wraparound eyewear while outdoors all reduce exposure to offending allergens.[6] Artificial tears in particular can diffuse or drain away the offending allergen.[7] Other therapies include hair washing before bed, avoiding eye rubbing, using HEPA filters and replacing allergen-hosting materials such as pillows and carpeting.[6]

For patients who require further relief, there are a number of effective over-the-counter (OTC) and prescriptive topical options: decongestants, antihistamines, mast cell stabilizers, combination antihistamine/mast cell stabilizers and "soft" steroids drops. The once-daily dosage offered by some Rx drops is preferable to the four times required by some OTC drops. Topical cyclosporine has also shown promise in the treatment of allergic conjunctivitis.[8] Oral allergy agents tend not to be as effective or expedient at alleviating ocular symptoms as topical agents, and can lead to ocular surface drying and the retention of allergens in the tear film.[9]

For patients who still find contact lens wear challenging, we recommend switching to daily disposables. If this is not feasible, suggest a peroxide-based care system. Daily lenses do not allow offending allergens to bind to the surface of the lens, minimizing likelihood of symptoms. Although a seasonal solution, often monthly disposable wearers opt to continue the daily use modality indefinitely. RCCL

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# Don't Let HSK Heterogeneity Fool You

Its highly variable nature often thwarts diagnosis and complicates treatment.

Although it's estimated that roughly 20% of patients with herpes simplex virus (HSV) keratitis will develop herpes stromal keratitis (HSK), I'd estimate 50% of HSV patients referred to our cornea clinic from ODs have HSK.[1] This suggests we are more comfortable identifying and treating dendritic keratitis than we are with HSK. And it's not surprising, given just how repeatable the presentation of the dendrite is, compared with the extremely variable nature of HSK. Let's take a look at HSK and discuss the diagnostic clues different cases offer us.

## HSK PATHOLOGY

HSK is a widely studied yet poorly understood pathology. Viral replication within the stroma probably isn't taking place, and viral proteins haven't been isolated in eyes with experimental HSK.[2] This intuitively makes sense when we consider viral pathophysiology: viruses are obligate intracellular pathogens, and the sparsely distributed keratocytes would present a poor target for infection, as cell-to-cell propagation would be limited by distance and lack of accessible blood or lymph channels. Rather than actual viral infection, more likely mechanisms of HSK inflammation are either an immune response to shed viral antigens or perhaps a form of autoimmunity to corneal autoantigens "turned on" by the original HSV infection.[2] Regardless of the precise mechanism, the subsequent immune response—while involving multiple classes of immune cells—is primarily mediated by T-lymphocytes.

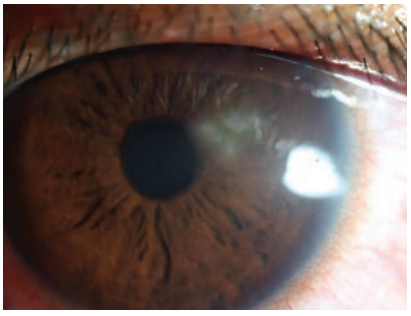

**Fig. 1. Typical sub-dendritic HSK lesions, as seen here, sometimes occur following dendritic keratitis.**

Clinically, for all HSV keratitides, a positive previous HSV history is strongly suggestive that any active stromal keratitis is linked to the virus. However, lack of a *known* HSV history doesn't eliminate the possibility of HSK, as it may occur spontaneously without identifiable risk factors or serendipitously in an eye with risk factors for more acutely severe corneal diseases such as microbial keratitis. If the clinical picture doesn't support a microbial form, consider HSV.

The most common, easiest to identify type of HSK is the sub-dendritic form. Its timing may immediately follow the active dendrite or occur months later, but as it is immediately below a dendrite or dendriform scar, it's not challenging to diagnose. Its active form has zones of irregular corneal inflammation and migrating white blood cells that will give the anterior cornea a grainy or powdery appearance. Though this form of HSK is relatively easy to diagnose, many other types are not so clear cut (*Figure 1*).

## CASE REPORT

A previously healthy 24-year-old with no interesting ocular history developed the pathology that led to an atypical lesion three weeks prior to being seen (*Figure 2*). The infiltrate is particularly deep, involves the paracentral cornea and has density consistent with microbial keratitis. While its shape is somewhat irregular for a microbial source (which tends to be round or oval), they can't be ruled out. A closer look at the clinical presentation and history will help reveal the true pathology, however.

First, the patient has no risk factors or history. Risk factors, such as contact lens use, trauma and severe ocular surface disease, are practically required for HSK, so while a microbial source is not impossible, it is unlikely.

Next, the vascular leash on the infiltrate is a classic sign of HSV keratitis. Though not all HSK cases vascularize, it is the most common connecting diagnosis between non-peripheral keratitis and vascularization. Any active, non-limbal keratitis with vascularization should suggest HSV, and any anterior scar with vascularization should point to previous HSV as a possible cause.

Corneal neovascularization (CN) is not unique to HSV keratitis, but HSV keratitis is the most common cause of CN in the United States.[3] Although the specific source of CN in HSV is vague, all inflammatory cells involved in HSK directly upregulate, or produce cytokines that upregulate VEGF isoforms. In mouse models, mice without a thymus and thus without T-cells don't develop HSK or subsequent CN, suggesting a primary role of T-cells and their derivatives in these processes.[4] Keeping all this in mind,

when you see an isolated infiltrate with vascularization that isn't at the limbus, HSV is the chief differential.

However, an infiltrate such as this, given its location and the associated risk for vision loss, should prompt cautious management. Given this ulcer's appearance and location, clinicians should consider a superinfection with microbial etiology over an HSV lesion. In this case, the eye was cultured and placed on topical antibiotic for coverage as well as the more therapeutic oral antiviral. When cultures returned negative, corticosteroid was added, antibiotic was discontinued and the patient responded well.

## TREATMENT

For HSK, antiviral and anti-inflammatory therapy is conventional, and according to the Herpetic Eye Disease study, long-term use of acyclovir for stromal keratitis is helpful in reducing recurrence.[5] Unfortunately, treatment failure occurs in a percentage of patients due to either worsening HSK or HSK-related CN and its sequela, such as lipid exudate and corneal opacification. Luckily, other medical options can help.

Research shows low concentration cyclosporine—an inhibitor of T-cells, which seem to be the primary force behind HSK—can be effective in non-responsive HSK in both animal studies and clinical case series.[6,7] Further, we may be able to indirectly reduce development of HSK-associated CN using cyclosporine. Treating HSK is one of the few non-dry-eye medical applications for Restasis (cyclosporine ophthalmic emulsion, Allergan), as its 0.05%

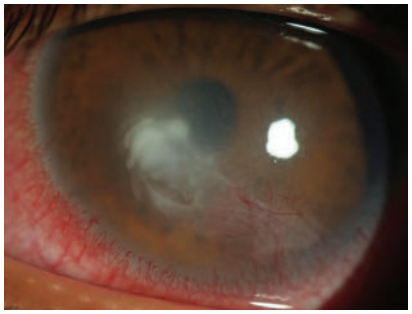

**Fig. 2. Although this atypical infiltrate suggests microbial keratitis, a closer look reveals HSK.**

concentration seems to be sufficiently high, compared with other medical applications of topical cyclosporine that require compounded drops at 0.5% to 2%.[6,7] However, clinicians should be cautious when using Restasis here, as it's specifically cautioned against in the package insert.[8] Patients should be appropriately counseled and maintained on a suppression dose of oral antiviral throughout treatment.

A newer treatment option, Xiidra (lifitegrast, Shire Pharmaceuticals), is involved in downregulating T-cell activity and may prove its worth over time as well. However, no studies yet show its effect for HSK.

Matrix metalloproteinases (MMPs) assist in the development of CN by degrading corneal connective tissue and allowing space for formation of blood vessels. In HSK cases with early CN, a two-to-three month course of doxycycline to reduce MMP is a reasonable, noninvasive option to attempt to reduce development of CN. As with cyclosporine, this application makes the most sense as a preventative therapy rather than a treatment of existing CN.

Finally, when large vessels are established but the process is still relatively early, the CN may be susceptible to intrastromal or subconjunctival dosing of Avastin (bevacizumab, Genentech), which we used to terrific effect with our patient. This approach works best early in the process because chronically established CN is less susceptible to complete resolution with anti-VEGF therapy. As with Restasis, this would be considered an off-label use of the medication and requires appropriate patient consent.

HSK can be quite difficult to treat. Compared with dendritic keratitis, HSK treatments are longer and more likely to lead to permanently compromised vision. Additionally, the lesions can masquerade as any number of stromal keratitides, making diagnosis challenging. But keeping HSV near the top of your differential for any unusual unilateral keratitis can help you prepare for the possibility of dealing with a viral etiology and initiate appropriate treatment in a timely manner. RCCL


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By Vivian P. Shibayama, OD

# Building a Better Bandage Lens

Patients in need of pain relief deserve the comfort and protection that customization can provide.

After a Boston keratoprosthesis (KPro) implantation, many patients are prescribed extended-wear soft contact lenses to protect the cornea and minimize complications such as infections, epithelial defects and stromal melt.[1] However, these lenses are usually standard for every patient, and clinicians do not evaluate the fit. One study found that merely five out of 16 patients actually fit the standardized bandage lens size (9.6mm/16.0mm diameter) typically used for patients following surgery.[2] We at UCLA use traditional silicone hydrogel contact lenses to minimize hypoxia for patients who need bandage lenses. But sometimes, we need a customized lens to achieve the best fit.

## CASE

An 81-year-old female presents for a contact lens fitting, referred by her ophthalmologist. She had a history of bullous keratopathy in both eyes after cataract surgery 15 years ago. She also suffered from limbal stem cell deficiency, which led to multiple failed corneal transplants, ultimately resulting in Boston KPro surgery for the right eye in 2013 and in the left eye in 2016. She had complaints of extreme photophobia, tearing and pain. She suffered from persistent epithelial defects in the left eye after her surgery. To treat the epithelial defects, a bandage contact lens was placed on her left eye. Although this bandage lens alleviated her pain, it was difficult to insert and popped out of her eyes constantly. She was not able to put them in herself and would have to travel several hours to come into the clinic to replace the lenses. She suffered severe pain when the lens dislodged, and she was unable to keep her eye open when the lens was out.

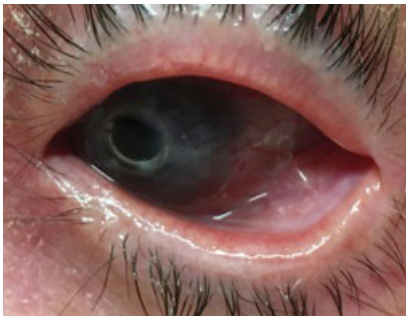

**Fig. 1. The patient's inferior symblepharon in the left eye made a standard bandage lens dislodge.**

Current ocular medications were Vigamox (Novartis) TID OU and prednisolone acetate BID OS. Presenting uncorrected visual acuity was 20/200 OD, 20/200 OS. Manifest refraction was plano OD and -2.50 VA: 20/100 OS. She had +5.00 add J3 OU.

Slit lamp exam revealed blepharitis in both eyes, slight medial and lateral tarsorrhaphy OS, superior and lateral symblepharon in both eyes with trace injection OS (*Figure 1*). The KPro in both eyes had vascularization and scarring of the donor cornea, no current epithelial defect in either eye with 16 sutures per eye. Anterior chambers were deep and quiet, and the iris was normal with posterior chamber intraocular lenses in both eyes. Intraocular pressure was soft and equal by palpation in both eyes.

## CONTACT LENS FITTING

The cornea division first tried an Acuvue Oasys (Johnson & Johnson Vision) 8.4 base curve/14.0 diameter bandage lens. It was apparent that the limiting factors in finding the right lens were the size of the patient's eye and the symblepharon. An Air Optix Night and Day (Alcon) 8.4 base curve/13.8 diameter was tried on the eye which was a slightly smaller diameter than the Acuvue lens. The lens was difficult to insert and promptly ejected when the patient gazed medially—the symblepharon was pulled taut, which lifted the lens straight off of the eye. We decided a custom diameter soft lens was necessary to properly fit the eye. Keratometry readings could not be obtained for a Boston KPro. Thinking outside the box, we used a 13.0mm color-coded diagnostic soft lens fitting set that is normally used to fit children (*Figure 2*). An 8.4mm/13.0mm diameter lens, although still too

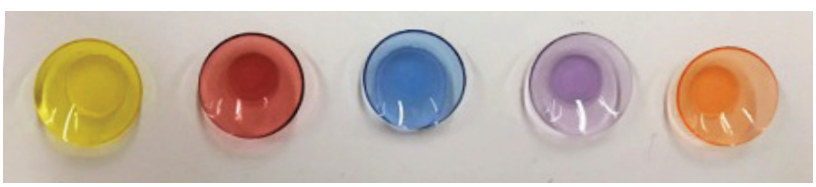

**Fig. 2. This color-coded soft lens diagnostic 13.0mm fitting set helped us custom-fit a better lens option for our patient.**

large, was the best fit.

We ordered a 8.3/-2.50/12.5 diameter soft lens in Definitive (Contamac) material with a slightly steeper base curve to compensate for the 0.5mm change in diameter.

## ONE WEEK LATER

The patient presented for the bandage lens dispense. She had spent most of the week with her eyes closed due to the pain, for which she was taking Tylenol (Johnson & Johnson). Unlike the previous attempts, the lens was easily placed on the eye and evaluated. The lens was centered and fit the KPro nicely (*Figure 3*). The edge of the lens rested next to, but not over, the symblepharon, which was ideal to improve the stability of the fit. The patient was sent home with instructions to return if the lens fell out.

## TWO WEEKS LATER

The patient returned for a follow up. She was unaware if the lens was still in her eye, but said she had less pain in the past few weeks. She reported a slight foreign body sensation on lateral gaze that was tolerable. On examination the lens was in place. The lens fit was finalized and more lenses were ordered as spares. Since the patient was unable to insert and remove the lenses on her own and had no one to help her, she returned monthly for bandage lens replacement and corneal evaluation.

## SIX MONTHS LATER

At six months, the patient was still doing well. Only one lens was lost in that span of time, which was a significant improvement for her.

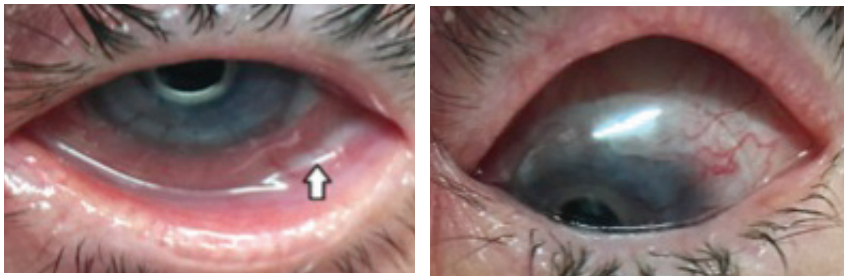

**Fig. 3. The custom bandage lens in place. The arrow in the left image indicates the lens edge. The right image provides a superior view of the lens.**

## DISCUSSION

KPro is a treatment option for patients with corneal disorders who have failed multiple corneal transplants. Ideal candidates are those who have had repeat corneal graft failures and do not have severe inflammation, as it increases the risk for necrosis and infection.[3-7]

Clinicians must pay particular attention to patients with corneal transplants to reduce neovascularization that could lead to a corneal graft rejection or failure, especially when fitting contact lenses. According to one study, extended wear for the normal cornea requires a Dk/t of 87, and not meeting that threshold can lead to corneal hypoxia in the form of corneal edema or neovascularization.[8-11]

However, this is not a concern for KPro recipients.[12] The donor tissue of the KPro is vascularized, negating the concern for oxygen delivery. Nonetheless, the hypoxic environment can increase the chance of microbial infection, which is why most patients with a KPro implant are on preventative long-term antibiotic therapy, antifungal therapy and close observation.

When traditional bandage lenses fail to fit the patient, clinicians should consider customizing silicone hydrogel lenses using Definitive material, which has the highest Dk available—60Dk—for this type of lens. Such customization can help improve the patient's experience while also minimizing hypoxia. RCCL


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By Christine W. Sindt, OD

# Too Much of a Good Thing

Extreme overwear of a bandage contact lens let this opportunistic inection flourish.

A 74-year-old female with a >20-year history of Sjögren's syndrome, epithelial basement membrane dystrophy and repeated episodes of recurrent erosions of the left cornea presented with a three-month history of decreased vision, foreign body sensation with discomfort, irritation and photophobia OS. She reported using cyclosporine 0.05% BID.

She had previously tried a bandage contact lens to help with the discomfort of erosions. Over the previous 10 days, her pain, irritation, visual blur and redness had increased. She saw her primary care doctor for "sinus issues" and was given an oral antibiotic and nasal spray, which aggravated her ocular symptoms. She was told her "eye looks dry."

On presentation, it was noted that she still had a bandage contact lens in her left eye, of unknown but long duration. The lens was removed, and both it and her ocular surface were cultured. She was empirically started on vancomycin and tobramycin every hour while awake and two times overnight, plus preservative-free artificial tears, pending culture results.

On day seven, her cultures grew positive for *Aeromonas* species susceptible to the topical medications she was currently taking. Viral and anerobic cultures were negative. Fungal cultures are still pending.

*Aeromonas*, a gram-negative bacillus known to populate environmental sources, is sometimes found in contaminated hospital water supplies, from which it can lead to nosocomical infections.[1] Researchers have cultured it from the intestinal tract of asymptomatic subjects, but it is not part of the normal ocular flora.[1] When present, it can lead to opportunistic infection, particularly in immunocompromised individuals.

As this presentation was in her better-seeing eye (the other had severe neurotrophic scarring) and she is a poor candidate for keratoplasty, treatment compliance will be essential to a successful outcome. RCCL

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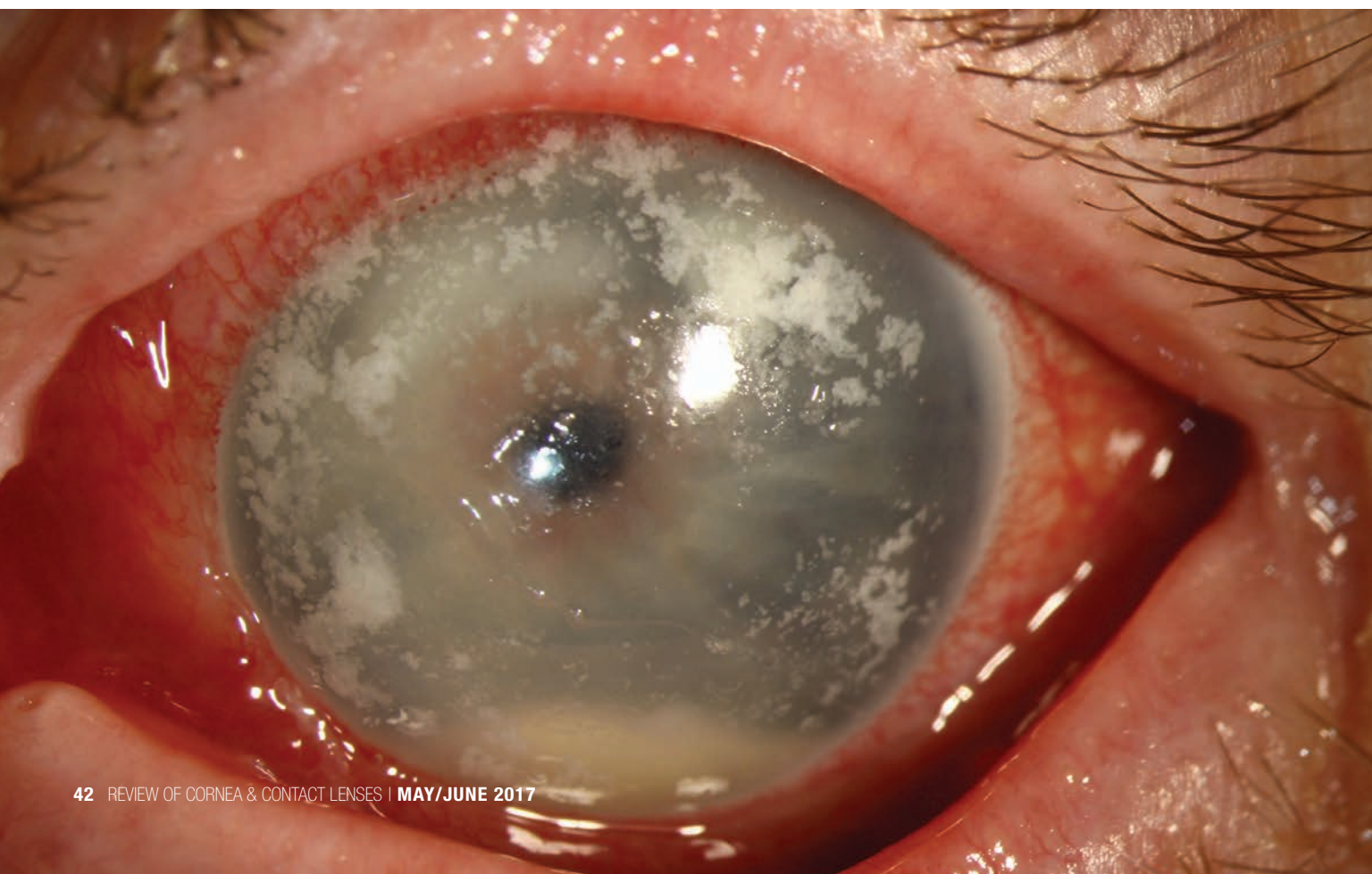

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**References: 1.** Gabriel M, Bartell, J, Walters R, et al. Biocidal efficacy of a new hydrogen peroxide contact lens care system against bacteria, fungi, and Acanthamoeba species. *Optom Vis Sci.* 2014;91:E-abstract 145192. **2.** Alcon data on file, 2014. **3.** Alcon data on file, 2015.



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