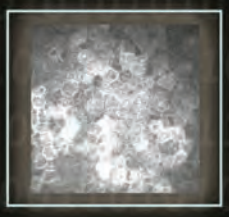
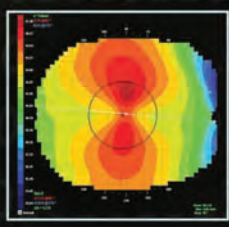
jmi

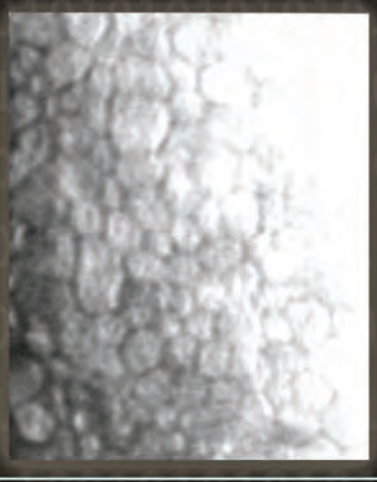
Review of Cornea & Contact Lenses

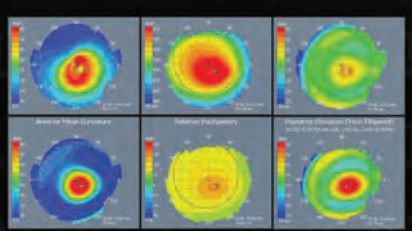
OCTOBER 2009

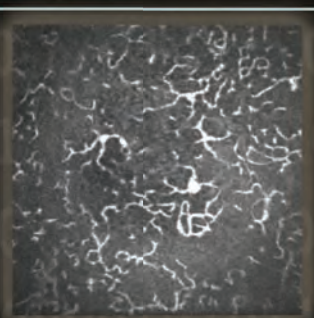
The Technology Issue











ALSO INSIDE :

- More Than Meets the Naked Eye
- Topography FAQs
- Sjögren's Solutions
- The Role of Compliance

Supplement to
REVIEW OF OPTOMETRY
October 2009

By Joseph P. Shovlin, O.D., F.A.A.O.

The Mystique of Late-Onset DLK

Recognize the signs and symptoms and initiate timely treatment for ocular complications associated with cosmetic enhancement.

Late-onset diffuse lamellar keratitis (DLK) is a complication seen in patients with a corneal interface following an epithelial disruption, which is often a result of trauma or chemical insult. I have had two LASIK patients this year who developed this complication following cosmetic procedures. The first patient provided a history of having had Botox injections (botulinum toxin type A, Allergan) in the glabellar region and getting the "prep" in her eye. She experienced pain and noticed a change in vision a few days later. The second patient had CO^2 laser resurfacing of her face and eyelids and described a similar experience of "hazy vision" that presented much later.

Early research described DLK as a peculiar complication following interface surgery.[1,2] Since then, much has been written concerning the etiology, expected course and attending complications, and treatment of DLK. Early-onset DLK is characterized by a diffuse white, granular infiltrate in the interface that occurs within a few days after LASIK. Proposed causes of DLK immediately following initial surgery include metallic deposits or lubricants from the microkeratome blades, particles from the eye drape or betadine prep, use of improper detergents or impure balanced saline solutions, epithelial defects, meibomian gland secretions and other tear film components, surgical glove talc, debris from surgical sponges, bacterial cell wall hypersensitivity, and contamination of reservoir sterilizers by bacterial endotoxins.[1,2] But, many of these proposed causes are based on speculation and have no supporting data.

Several classification systems have been proposed but consistently four different stages appear to be operant. On post-op day one, white blood cells encroach the flap peripherally, and the visual axis is spared. If this is unchecked, by day two the infiltration moves toward the center of the cornea. With further progression, the cellular reaction will advance, causing a central clumping effect. Because it is a threshold disease, DLK should be treated immediately with topical corticosteroids. If the disease progresses, oral corticosteroids can be used; but, in these cases, surgical intervention with a flap lift and irrigation is necessary to prevent permanent scarring, irregular astigmatism and a hyperopic shift from topographic flattening of the cornea.[2] More advanced cases can progress to flap melts with stromal necrosis and associated vision loss.

Unlike early-onset DLK, late-onset DLK can take place any time following the initial surgery whenever a significant epithelial defect occurs. The insult must be significant enough to create an epithelial defect that triggers the production of epithelial derived factors that are chemotactic for inflammatory cells via an interleukin-1 release. These epithelial derived cytokines stimulate keratocytes to produce chemokines that are chemotactic to inflammatory cells.[2] The association of late-DLK with epithelial defects implies the release of inflammatory stimulants from a site other than the interface.[1] Regardless, steroids are necessary to blunt the release of cytokines and quiet the injury.

Although late-onset DLK is most often a result of direct trauma or chemical insult, it has been reported following foreign body, viral keratitis, bacterial keratitis and many other forms of insult to the cornea.[2]

But, be careful not to be confused by a masquerade syndrome. An interface reaction resembling early DLK can happen when there is an increased intraocular pressure after topical steroid use.[3] A reduced resistance at the interface from fluid can give a false low pressure reading, complicating the clinical picture in the early postoperative course. The true reading lies outside of the flap area and can accurately be obtained with a tonopen.

The very same group that sought freedom and the cosmetic benefits from spectacles may show up in your office with complications that are a result of additional cosmetic procedures. Early, appropriate measures must be taken to assure a favorable outcome. RCCL

1. Jeng BH, Stewart DG, McLeod SD, Hwang DG. Relapsing diffuse lamellar keratitis after laser in situ keratomileusis associated with recurrent corneal erosion. Arch Ophthalmol. 2004 Mar;122(3):396-8.
2. Chang-Godinich A, Steninert RF, Wu HK. Late occurrence of diffuse lamellar keratitis after laser in situ keratomileusis. Arch Ophthalmol. 2001 Jul;119(7):1074-6.
3. Parekh J. Grossly false applanation tonometry associated with interface fluid in susceptible LASIK patients. J Cataract Refract Surg. 2001 Aug;27(8):1143-4.

Joseph P. Shovlin, O.D., F.A.A.O., Clinical Editor

VOL. 146, NO. 7

In The News

• **Abbott** has reached an agreement **to acquire Visiogen, Inc.**, the manufacturer of a next-generation accommodating intraocular lens (IOL) technology to address presbyopia for cataract patients. Visiogen is an ophthalmic medical device company that specializes in the development of new vision alternatives for patients with cataracts. **Synchrony**, its **accommodating IOL**, is designed to deliver improved vision at all distances, potentially eliminating the need for glasses or contact lenses, reducing glare and nighttime halos, and improving contrast sensitivity, the company says.

• **ClearKone** from **SynergEyes** is a hybrid contact lens that is designed to **vault** the predominant **irregularities** of the **keratoconic cornea**. The ClearKone lens utilizes hybrid technology to give keratoconus patients the visual clarity of a high-oxygen rigid gas-permeable contact lens and the comfort and convenience of a soft lens. What makes this lens different from other SynergEyes lenses is the design and the technique used to fit it. SynergEyes lenses are the only FDA-approved hybrid contact lenses specifically designed for keratoconus vision correction.

• The **U.S. Food and Drug Administration** has **approved Bepreve** (bepotastine besilate ophthalmic solution 1.5%, ISTA Pharmaceuticals) as a twice-daily prescription eye drop treatment for **ocular itching associated with allergic conjunctivitis** in patients two years of age and older. Bepreve is a non-sedating, highly selective antagonist of the histamine (H1) receptor. It has a stabilizing effect on mast cells, and it suppresses the migration of eosinophils into inflamed tissues, the company says.

Decorative Lens Safety

With Halloween just around the corner and the raging popularity of Twilight characters, some enthusiasts may be looking to enhance their "Edward" costumes with a pair of decorative contact lenses. Unfortunately, many don't plan their costumes in advance. And, instead of visiting their eye doctor to determine which lens would be ideal for them, they purchase their colored contact lenses last minute without much consideration for safety.

Although the FDA has banned the distribution of these specialty lenses by anyone other than a licensed practitioner, they can be purchased without an eye exam or proper education. Some daring individuals may even reuse someone else's lenses. So, what are some potential risks of decorative contact lenses? What can you do to prevent undesirable outcomes?

"One major concern is the use of a lens that has not been properly fitted or dispensed with adequate instruction on proper maintenance and care," says Dr. Joseph Shovlin, Clinical Editor of *Review of Cornea & Contact Lenses*. "Acquiring lenses from alternate sources like the example of lenses being sold at the Bloomsburg Fair next to the livestock exhibit is another key concern."

If patients experience an adverse response, such as redness, discomfort, light sensitivity or decreased acuity, they should seek immediate attention. "Remind patients to clean (rub and rinse) with an approved disinfection system prior to wearing lenses and never overwear them," adds Dr. Shovlin.

All members of the eye care community should take it upon themselves to raise awareness about colored contact lens safety, especially around this time of the year. If everyone does their part, hopefully patients' eyes won't be a frightful sight the morning after Halloween.

Lenses for Presbyopia

According to a survey conducted by Walker Communications for *Working Mother Magazine* and ACUVUE OASYS Brand Contact Lenses for Presbyopia, nearly nine out of 10 (86%) women over the age of 35 are concerned that their vision is getting worse as they age, and 74% say they have problems with near vision. Nearly half (46%) say that having good near vision is most important to get them through their daily activities, but cite problems with everyday tasks, such as reading (66%), working on a computer (63%), using a cell phone/PDA (49%), seeing things in low light (45%), or trying to read a menu (44%). Nearly three out of 10 (27%) working mothers who participated in the survey agree that problems with near vision bothers them most while multitasking at work.

Review of Cornea & Contact Lenses

JOBSON MEDICAL INFORMATION LLC
11 Campus Blvd., Suite 100
Newtown Square, PA 19073
Telephone (610) 492-1000
Fax (610) 492-1049

Editorial inquiries (610) 492-1003
Advertising inquiries (610) 492-1011
E-mail rcl@jobson.com

EDITORIAL STAFF

EDITOR-IN-CHIEF
Amy Hellem *ahellem@jobson.com*

CLINICAL EDITOR
Joseph P. Shovlin, O.D., F.A.A.O. *jpshovlin@gmail.com*

EXECUTIVE EDITOR
Arthur B. Epstein, O.D., F.A.A.O.
artepstein@artepstein.com

ASSOCIATE CLINICAL EDITOR
Ernie Bowling, O.D., F.A.A.O. *bowling@roman.net*

ASSOCIATE CLINICAL EDITOR
Alan G. Kabat, O.D., F.A.A.O. *kabat@nova.edu*

ASSOCIATE CLINICAL EDITOR
Christine W. Sindt, O.D., F.A.A.O.
christine-sindt@uiowa.edu

ASSOCIATE EDITOR
Izabella Alpert *ialpert@jobson.com*

ASSOCIATE EDITOR
Leah Addis *laddis@jobson.com*

CONSULTING EDITOR
Milton M. Hom, O.D., F.A.A.O. *eyemage@mminternet.com*

CONSULTING EDITOR
Stephen M. Cohen, O.D., F.A.A.O.
stephen.cohen@doctormyeyes.net

ART/PRODUCTION DIRECTOR
Joe Morris *jmorris@jobson.com*

ART/PRODUCTION
Alicia Cairns *acairns@jobson.com*

AD PRODUCTION MANAGER
Pete McMenamin *pmcmenamin@jobson.com*

BUSINESS STAFF

PRESIDENT/PUBLISHER
Richard D. Bay *rbay@jobson.com*

SALES MANAGER, NORTHEAST, MID ATLANTIC, OHIO
James Henne *jhenne@jobson.com*

SALES MANAGER, SOUTHEAST, WEST
Michele Barrett *mbarrett@jobson.com*

REGIONAL SALES MANAGER
Kimberly McCarthy *kmccarthy@jobson.com*

EDITORIAL BOARD
Mark B. Abelson, M.D.
James V. Aquavella, M.D.
Edward S. Bennett, O.D., M.S.Ed.
Brian Chou, O.D.
Gary Gerber, O.D.
Brien Holden, Ph.D.
Bruce Koffler, M.D.
Jeffrey Charles Krohn, O.D.
Kenneth A. Lebow, O.D.
Robert Ryan, O.D.
Christine W. Sindt, O.D.

REVIEW BOARD
Peter Bergenske, O.D.
Robert C. Campbell, M.D.
Kenneth Daniels, O.D.
Michael DePaolis, O.D.
Desmond Fonn, Dip. Optom. M. Optom.
Gary N. Foulks, M.D.
Robert M. Grohe, O.D.
Patricia Keech, O.D.
Jerry Legerton, O.D.
Craig Norman, F.C.L.S.A.
Robert A. Ryan, O.D.
Charles B. Slonim, M.D.
Mary Jo Stiegemeier, O.D.
Loretta B. Szczotka, O.D.
Michael A. Ward, F.C.L.S.A.
Barry M. Weiner, O.D.

Early Vision Screening

According to Prevent Blindness America (http://preventblindness.org), one in four school-age children have a vision problem significant enough to affect learning. For this reason, PediaVision urges parents to have their children's vision evaluated before they are able to talk. Most vision issues can be corrected if detected and treated early. Here are some fact to remember:

- 80% of what children learn is visually acquired.
- 2.4 million children younger than four are affected.
- 86% don't have eyes examined before first grade.
- Only 14% have their eyes examined before age 18.

A recent national report by the Vision Council (www.thevisioncouncil.org) indicated that:

- Nine states do not require children to receive a vision assessment before starting school.
- Thirty-nine states (including Washington, D.C.) require a vision screening for children entering school; however, 32 of these states do not mandate any follow-up care for children who fail the screening.
- Three states require all children to receive a comprehensive eye exam by an eye care professional before entering elementary school.

By comparison, hearing tests for children are mandatory, yet hearing issues affect a much smaller percentage of the population—about 0.003%.

Parameter Expansion

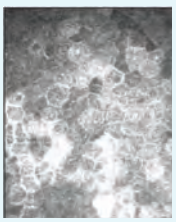
Avaira two-week replacement silicone hydrogel lenses from CooperVision now come with new plus sphere powers of +0.25D to +8.00D on a new 8.4mm base curve. Avaira's parameter range now extends from -12.00D to +8.00D. Avaira features a naturally wettable material that keeps the lens moist without the need for surface treatments, additives or wetting agents, the company says. Avaira is available in a base curve of 8.4mm and 8.5mm, a diameter of 14.2mm, a Dk of 100, and a Dk/t of 125. The water content is 46%. Currently approved for daily wear throughout the United States, Avaira is available in a six-lens pack or a three-lens trial carton.

Advertiser Index

contents

Review of Cornea & Contact Lenses | October 2009

The Technology Issue



Departments

By Mark B Abelson, M.D., C.M., F.R.C.S.C.

Feeding the Eyes

How can proper nutrition help protect patients against various ocular conditions?

Recent research sheds light as to just how much nutrition impacts the eye, with deficiencies in poly-unsaturated fatty acids (PUFAs) being tied to everything from dry eye to age-related macular degeneration (AMD). Luckily, it has also suggested that increased intake of PUFAs does slow or prevent the progression of these conditions. In most circumstances, changes in diet or the use of dietary supplements can safely augment the effects of more traditional, medicinal approaches to therapy.

Dr. Jeffrey Gilbard, whose work in tear hyperosmolarity was integral to dry eye research, passed away on August 12, 2009. Dr. Gilbard was the founder and CEO of Advanced Vision Research. He developed HypoTears and TheraTears, and he pioneered nutritional supplements for ocular health. Having lost an inquisitive scientist and beloved colleague, the ophthalmic community will long remember Dr. Gilbard, and patients will continue to benefit from his contributions. On behalf of the Ora team, I wish to impart our deepest sympathy to his loved ones.

Our Dietary Muddle

There are two primary families of PUFAs: omega-3 and omega-6 fatty acids. Both regulate metabolism, stimulate skin and hair growth and maintain healthy bones, joints, brain and vision, but over-consumption of fried and processed foods (high in omega-6s), combined with low consumption of fatty fish (high in omega-3s) result in an skewed ratio of omega-6 to -3. This ratio is recommended to be 2:1 to 5:1, but in Western diets, it's commonly as high as 10:1 to 25:1.[1,2]

Nutrition and the Eye

Dry eye is a multifarious condition characterized by gritty, uncomfortable eyes, and it is often insufficiently treated by the current selection of artificial tears. Topical and systemic PUFAs, however, are being investigated for treating and preventing dry eye. Topical application of alpha-linolenic acid (the precursor to omega-3) significantly decreased fluorescein staining in comparison to linoleic acid (the precursor to omega-6), the combination ALA+LA, or vehicle in a mouse model.[3] Ora, Inc. has also evaluated a proprietary, anti-inflammatory formulation of vitamins, minerals, antioxidants, phytonutrients and fatty acids in dry eye subjects exposed to the controlled adverse environment (CAE). Results demonstrated that, after 10 weeks of dosing, the oral supplement was more effective than placebo at reducing ocular discomfort.[4] Such supplements could be taken in conjunction with artificial tears.

Age-related vision loss results from a lifetime of environmental stresses, including dietary deficiencies. Using a dietary composite scoring system and a food frequency questionnaire, researchers at Tufts University in Boston found interesting trends in patients wit h advanced age-related macular degeneration (AMD). Those with diets rich in omega-3s (low in LA) demonstrated a strong association with a reduced risk of disease progression.[5] Similar results have been reported for glaucoma, with dietary omega-3s decreasing intraocular pressure (IOP) with age in rats.[6] This effect has not, however, been noted in humans.

Evidence-Based Practices

Multiple uncontrollable dietary, genetic and environmental variables complicate research as to the impact of diet on specific conditions. This is especially true in multi-faceted conditions, such as dry eye and glaucoma. Although a single nutrient cannot prevent or treat a given ocular condition, a balanced diet may increase patients' ocular comfort and preserve their sight. At the same time, clinicians must be careful to use nutritional supplements for the right reasons and with the right expectations. Recommendations must be based on appropriate review of scientific studies—not unsubstantiated hope. RCCL

1. Tokudome S, Ichikawa Y, Okuyama H, et al. The Mediterranean vs. the Japanese diet. Eur J Clin Nutr. 2004 Sep;58(9):1323.
2. Simopoulos AP. Human requirement for N-3 polyunsaturated fatty acids. Poult Sci. 2000 Jul;79(7):961-70.
3. Rashid A, Jin Y, Ecoiffier T, et al. Topical omega-3 and omega-6 fatty acids for treatment of dry eye. Arch Ophthalmol. 2008 Feb;126(2):219-25.
4. Pratt S, Ousler GW III, Schindelar M, et al. Evaluation of a dry eye oral supplement for the treatment of the signs and symptoms of dry eye in a controlled adverse environment (CAE) model. Invest Ophthalmol Vis Sci. 2005 46:E-Abstract 2047.
5. Chiu CJ, Klein R, Milton RC, et al. Does eating particular diets alter risk of age-related macular degeneration in users of the age-related eye disease study supplements? Br J Ophthalmol. 2009 Sep;93(9):1241-6.
6. Nguyen CTO, Bui BV, Sinclair AJ, Vingrys AJ. Dietary omega-3 fatty acids decrease intraocular pressure with age by increasing aqueous outflow. Invest Ophthalmol Vis Sci. 2007 Feb;48(2):756-62.

By John M. Rinehart, O.D., F.A.A.O.

Empirical vs. Diagnostic Lens Fitting

Know when to use each GP lens fitting method for optimal vision, comfort and ocular health.

Last October, I wrote about the use of diagnostic lenses when fitting patients with GP lenses. This month, I will discuss the methods I use when fitting these lenses empirically.

There are very distinct advantages to both systems. Most of the time, I use the diagnostic lens method when fitting multifocal and toric lenses and when fitting irregular corneas. Empirical fitting is very practical for most "normal" corneas that do not require specialty lenses to meet patient needs. As we know, the goals with any fitting method are:

- To provide good vision.
- To provide good lens comfort.
- To avoid compromising the health of the cornea.

These goals can be achieved by fitting a clean, wet, moving lens on a clean, wet eye. This is simple in theory, but not always simple to implement.

Lens Diameter

The overall lens diameter is between 2.0mm and 2.5mm smaller than the horizontal visible iris diameter (HVID) of the cornea. As an example, an eye with an HVID of 11.8mm would have an overall lens diameter between 9.8mm and 9.3mm. Personally, I tend to use the larger diameters. Today's hyper-permeable materials allow larger lenses to be placed on the eye without the risk of hypoxia.

Base Curve

If topography is available, determine the radius of the cornea 3.5mm to 4.0mm to the temporal side of the cornea. This radius is used for the base curve. The goal is to have the lens lightly touch in three places: nasal cornea, temporal cornea and central cornea. This light touch in the horizontal meridian controls lateral centration. This same curve must also allow for unobstructed vertical movement of the lens, as it enhances tear circulation beneath the lens. The cornea with 1.00D to 2.00D of with-the-rule astigmatism is ideal to achieve these desired fitting characteristics.

But, when topography is not available, select the base curve based on the amount of corneal cylinder.

Corneal Cylinder	Base Curve Radius
0.00D to 1.00D	On flat K
1.12D to 2.25D	0.25 steeper than flat K
Less than 2.50 D	Consider toric base curve

Lens Power

Adjust the spherical portion of the subjective refraction (minus cylinder) for the vertex distance. Calculate the power of the "tear lens." This is the difference between the lens base curve and the flattest central keratometer reading. Then, add these two (vertexed refraction and tear lens power) together. If the base curve is steeper than the flat K, add minus power; if the base curve is flatter than flat K, add plus power.

Optical Zone Diameter

As a general guideline, the diameter of the optical zone will equal the radius of the base curve. For instance, if the base curve is 7.67mm, the diameter of the optical zone would be 7.7mm.

Intermediate and Peripheral Curves

Lenses can have two to four different curves outside the optical zone. These curves are designed to facilitate tear circulation beneath the lenses. In general, the first intermediate curve will have a radius 1.0mm to 1.5mm flatter than that of the base curve, and the peripheral curve will have a radius of 3.0mm to 4.0mm flatter than that of the base curve. Additional intermediate curves may be added with radii between these two curves. The widths of these curves are determined to achieve the desired optical zone diameter.

Vision, Comfort and Health

In cases of low amounts of with-the-rule corneal astigmatism and no pathology, empirical fitting will have a very high rate of first-fit success. More complicated corneas, such as those with against-the-rule astigmatism and distorted corneas have best first-fit results with diagnostic lenses.

The ultimate goals of good vision, good comfort and no compromise in corneal health are accomplished with a lens that lightly touches in the mid-periphery of the cornea and has unobstructed vertical movement. This balance can be accomplished with both diagnostic and empirical fitting techniques. But, to optimize outcomes, use the method that will provide you the highest rate of first-fit success. RCCL

By Gary Gerber, O.D.

If at First You Don't Succeed

Learn about the power of message reinforcement and consistency in practice branding.

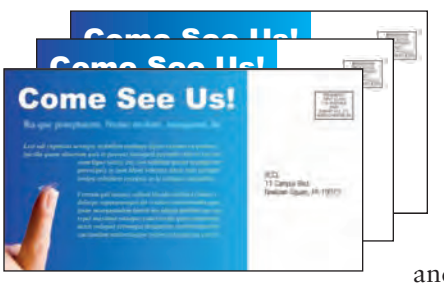
We had a client who called us and asked for help with his marketing. To all of the questions I asked, his answers were, "I tried that. It didn't work. Nope. Tried that too. That didn't work either. No, no luck there either. No, only did each one once. Why try them again if they didn't work?"

My questions regarded direct mail, e-mail and newspaper ads. He responded that he tried them all and none of these strategies produced results. But, the most telling response he gave was his last: He had tried (and failed) with each medium and never repeated his attempts.

Repeated Exposure

If you were looking to buy a new car and wanted a big luxury SUV but had never heard of either Mercedes Benz or the G550, would you spend over $100,000 on one? Unlikely!

How about if you were familiar with Mercedes' reputation, had admired many of these SUVs on the road, were exposed to multiple commercials and visited the website? Do you think there is a better chance? Price tag aside, probably. The point here is that marketing to prospective patients rarely works with one single attempt—especially when we are talking about health care, rather than SUVs or pizza.



The Value of Trust

A certain level of trust and familiarity must be established first. Unless your prospective patients are having trouble with their contact lenses at the exact instant they open up your first mailing (if they even open it and read it), the odds of them responding are miniscule. There are lots of variables at play. First of course, is the offer itself. Assuming it's a good one and properly packaged, if patients are already wearing lenses, they already have a practitioner. Is your offer geared toward disrupting that bond, or does it talk more about new lenses? Or, is your offer aimed at acquiring new patients who have yet to try lenses? Once you've nailed down all of those "moving target" variables, only then can you work on the issue at hand, which is repetition and frequency.

One key to building trust and getting prospects to notice your marketing is repetition, and this was the main ingredient my caller neglected. It's unreasonable to assume that a prospective patient who has never met you will fall in love with your offering and respond after only one exposure. It can take months until patients cross the "trust threshold" and are willing to consider calling your practice. And, as mentioned before, even after they do cross that threshold, all the other variables must align with that particular prospect.

Try, Try Again

A great way to start is to send the same information to the same prospects. Just seeing your message repeatedly starts to establish the notion that you are a viable business and are here to stay. This concept is related to branding your practice, and it's one of the reasons that both the media you choose and how your message is delivered are crucial to your success.

Take this example of repetition, but with bad branding. You compose a direct-mail piece and mail it once a month to the same 1,000 prospects. Each month, you change the color of the envelope, paper and the font of the letter. You move your logo to different locations and send it with a different color scheme each month. In effect, you are sending a new letter each month to the same person, not accumulating any marketing points for previous attempts. With each mailing, the prospect is back to square one on the board game of trust.

Contrast the above example with sending the exact same letter four times to the same person and you'll start to appreciate the importance of consistency and repetition. Sustaining a concentrated marketing effort that builds trust can certainly be difficult and expensive, but it is essential to success. RCCL

By Ernie Bowling, O.D., M.S., F.A.A.O., Dipl.

A New Fluoroquinolone

Will this formulation prove to effectively kill antibiotic-resistant pathogens in the eye?

When fluoroquinolones were initially introduced, the health care community didn't expect resistance to develop, but as we now know, resistance to earlier- and even the newer-generation fluoroquinolones is increasing, and there is a clear need for new antibiotics with improved activity against these microbes.[1]

Besivance (besifloxacin 0.6%, Bausch & Lomb) is a new fluoroquinolone that was recently approved by the FDA for the treatment of bacterial conjunctivitis. It has excellent in vitro activity against a wide range of ocular pathogens, such as *H. influenza*, *S. pneumonia*, *S. aureus*, and *S. epidermidis*. This includes activity against fluoroquinolone-resistant and multi-drug resistant strains.[2] Besivance is a topical formulation designed as a long-acting ophthalmic antibiotic for the treatment of bacterial conjunctivitis. Its formulation includes the patented DuraSite delivery system, which is intended to extend residence time on the ocular surface.

This drug is administered less frequently than most topical fluoroquinolones, which may improve patient compliance.[3] The medication dosage is 1gtt t.i.d., four to 12 hours apart for seven days.[5] The antibiotic is approved for use in children over one year of age. Besivance is supplied as a sterile ophthalmic suspension in a white low-density polyethylene (LDPE) bottle with a controlled dropper tip. There is 5ml of suspension in the 7.5ml volume bottle. The manufacturer recommends that the bottle should be inverted while closed and shaken once before the drug is dispensed. The most frequently reported adverse event with Besivance use was conjunctival redness, reported in approximately 2% of patients.[5] Besivance is a pregnancy category C drug and should be used during pregnancy only if the potential benefit justifies the potential fetal risk. Another potential benefit of this suspension is that it has been developed exclusively for ophthalmic use and has not been used systemically, which theoretically should reduce resistance, which tends to result from prior systemic use.

Clinical Data

Results from a randomized, study of 957 patients demonstrated the superiority of besifloxacin, which was dosed three times a day, over vehicle in the treatment of bacterial conjunctivitis.[6] Overall, both clinical resolution and microbial eradication were significantly higher for besifloxacin-treated eyes vs. vehicle-treated eyes. Clinical resolution rates were significantly higher at day five for gram-positive organisms, and microbial eradication rates were significantly higher at day five and day eight for gram-positive organisms. This was also the case on day eight as far as gram-negative organisms were concerned.

The clinical resolution and microbial eradication rates observed with besifloxacin in a Phase III study were similar to those reported for other fluoroquinolone ophthalmic preparations used to treat bacterial conjunctivitis.[6,7] Another besifloxacin study reported similar findings; clinical resolution and microbial eradication of the infection at day four and day eight were greater in patients who were treated with besifloxacin than with vehicle.[8]

Eradicate Pathogens

Although most patients with bacterial conjunctivitis recover without treatment in one to two weeks, Besivance may be an important new therapeutic alternative in patients who are at risk for complications or those who require faster clinical resolution in order to return to school or work.[9] We are always seeking better treatment options for our patients. I'm certainly looking forward to using this new medication in my practice. RCCL

1. Goldstein MH, Kowalski RP, Gordon YJ. Emerging fluoroquinolone resistance in bacterial keratitis: a 5-year review. Ophthalmology. 1999 Jul;106(7):1313-8.
2. Brunner LS, Norton SE, Blondeau JM. In vitro activity of SS73A, a novel fluoroquinolone, against pathogens associated with bacterial conjunctivitis. Clin Microbiol Infect 2007;13(Suppl 1): S475-S476.
3. Bartlett JD. Ophthalmic Drug Facts. 19th ed. St. Louis, MO. Wolters Kluwer Health, 2008.
4. Bausch & Lomb. Besivance product insert. Rochester, NY.
5. Tepedino ME, Heller WH, Usner DW, et al. Phase III efficacy and safety study of besifloxacin ophthalmic suspension 0.06% in the treatment of bacterial conjunctivitis. Curr Med Res Opin. 2009 May;25(5):1159-69.
6. Hwang G, Schanzlin DJ, Rotberg MH, et al. A phase III, placebo-controlled clinical trial of 0.5% levofloxacin ophthalmic solution for the treatment of bacterial conjunctivitis. Br J Ophthalmol. 2003 Aug;87(8):1004-9.
7. Yee RW, Tepedino M, Bernstein P, et al. A randomized, investigator-masked clinical trial comparing the efficacy and safety of gatifloxacin 0.3% administered BID versus QID for the treatment of acute bacterial conjunctivitis. Curr Med Res Opin. 2005 Mar;21(3):425-31.
8. Karpecki P, DePaolis M, Hunter JA, et al. Besifloxacin ophthalmic suspension 0.6% in patients with bacterial conjunctivitis: A multicenter, prospective, randomized, double-masked, vehicle-controlled, 5-day efficacy and safety study. Clin Ther. 2009 Mar;31(3):514-26.
9. Rose PW, Harnden A, Brueggeman AB, et al. Chloramphenicol treatment for acute infective conjunctivitis in children in primary care: a randomized double-blind placebo-controlled trial. Lancet. 2005 Jul 2-8;366(9479):37-43.

Improve and Maintain Patients' Comfort and Ocular Health

Managing comfort in lens wear is important to preserving patients' eye health. Solution recommendation and reinforcement of compliance made by eye care practitioners can make all the difference. Let's review what experts have said about the key ingredient to keeping patients happy in lenses.

Susan Resnick, O.D., F.A.A.O.

Cleaning, an important variable in lens wear comfort, maybe accomplished by components that chemically decrease the attraction and aid in the removal of debris and protein from the lens surface. Promoting and maintaining contact lens wettability is achieved through the incorporation of specific surface acting agents (surfactants), which lower the wetting angle and recondition the lens surface.

At each visit, I ask all patients specifically what brand of solution they are using. If the reply is "OPTI-FREE® RepleniSH® solution," the multipurpose solution I prescribe to the majority of my patients, I remind them to use it as instructed and to be sure to replace their lens case every three months. If patients cannot recall which solution they are using or have switched to another "green box" or store brand, I provide them with a written prescription for OPTI-FREE® RepleniSH® MPDS and review the reasons for my recommendation. I emphasize both the lens reconditioning as well as biocompatibility benefits. I believe that product differentiation, rather than price differentiation, goes a long way toward keeping my patients on the right track.

Michael Slusky, O.D.

Our patients' eyes and their contacts go through a great deal of wear and tear throughout the day. For some, contact lens wear may be as dry and difficult as an excursion through the Sahara, with deposits accumulating on the surface that alter the natural physiologic state of the eye. At night, these folks remove their lenses with the assumption that their lenses will feel fresh and new the next morning. Such is the trust our patients have in the solutions we recommend to maintain their safe and comfortable contact lens wearing experience.

By managing the cleanliness of the surface, we are enhancing the comfort of the lens wearing experience for our patients. Although peroxide systems have a place in some of today's lens care regimens, I choose OPTI-FREE® RepleniSH® MPDS as my "big gun" solution. I prefer the convenience of a multipurpose disinfecting solution that has high-level performance attributes. "For its ability to kill microorganisms, remove surface deposits and maintain a comfortable wear experience, I prescribe OPTI-FREE® RepleniSH® for all of my contact lens patients."

Kelly Kerksick, O.D.

It is important to prescribe a lens care regimen that will benefit my patients. A multipurpose solution, such as OPTI-FREE® RepleniSH® MPDS, will provide patients with the flexibility to leave their lenses in the solution safely for more than just a few nights. If you think about it, even our daily wearers will occasionally decide to wear their glasses; but most of the time, this decision is made in an instant—rather than planned in advance. Typically, this can be the result of a late night out, the start of a common cold, a long night with little sleep, etc. It is for these instances, I feel that it is so important to recommend a high level disinfecting solution like OPTI-FREE® RepleniSH® MPDS.

I encourage all of you to very carefully evaluate and educate each of your patients on the importance of solution compliance. In addition, remember that contact lens solutions should be chosen and prescribed with the same care and time spent on choosing the ideal contact lens for each patient.

By Mile Brujic, O.D., and Jason Miller, O.D.

Optimize the Patient Experience

When you regularly incorporate technology into contact lens evaluations, the benefits are immeasurable to both your patients and your practice.

We all know that contact lenses can serve as a revenue stabilizer or even a revenue booster for many eye care practices—even in a sluggish economy. Making sure that lens wearers remain in lenses can drive the profit margin even further. But, challenges in managing a contact lens practice do exist; these include competing Internet contact lens sales, justifying contact lens fees and educating patients on the importance of compliance with their contact lens wear and care.

A good way to begin addressing these issues is to let your patients know that their ocular health is your primary concern. In doing so, you focus all efforts on high-quality contact lens care. This will inevitably maximize the wearing experience of existing wearers, and through referrals, the number of contact lens patients in your practice.

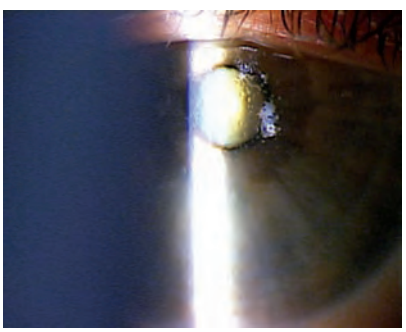
In order to cultivate a trusting relationship between patients and your practice, use the time during routine examination to educate patients regarding their contact lens care and the additional services that you offer. Explain that many factors are taken into consideration when setting fees for contact lens evaluations. Remember: the same lens assessment fee may seem extremely high to some but relatively low to others. The goal is to adjust patients' attitudes toward your fees by creating a perception of value in your services. So, how do we ensure that patients are satisfied that they are "getting their money's worth?"

Worth the Price

As practitioners, we are constantly looking for ways to maximize patient lens wearing success. We do this by attempting to enhance the final outcome, which is what they use to judge the experience. Patients' perception of the final product is based on many factors, such as:

- Are lenses comfortable upon insertion?
- Are they comfortable all day?
- How convenient are they?
- How easy is the handling and care?
- How clear is my vision with these contact lenses?

There are certainly ways to optimize the experience by many of the things that we do and say in the office. For example, when fitting or refitting a patient, I usually say the following, "I value my contact lens wearers, and it is very difficult to predict contact lens comfort. I can maximize your fit and vision, but comfort is something you have to experience. I want you to wear these diagnostic lenses, and when I see you back for a follow-up, we will determine if your comfort in them is adequate."



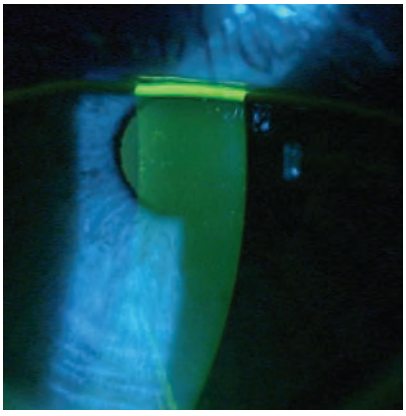
1. A photo of the surface of the patient's right contact lens (while being worn by the patient) shows significant deposits.

By doing this, we can emphasize the value of the contact lens evaluation as a part of maximizing the fit and vision. We also demonstrate that we are sensitive to what is often most important to the patient: comfort.

The Value of Technology

A thorough contact lens examination often involves the use of technology. Technology allows us to elevate the value of the contact lens services by adding precision to the contact lens fit. From a patient's perspective, the presence of technology justifies the additional costs for examinations and contact lens evalua tions. When patients can visualize and understand why a decision has been made regarding their ocular health, they understand the importance of the test. For each high-tech test that you perform, make sure your patients know the answers to the following questions: Why was the test necessary? What do the results mean? Lastly, when and why will the test be performed again, if necessary?

Corneal topographers can improve precision with many contact lens fittings by providing the exact measurement of a patient's corneal curvature. They can also reduce chair time by minimizing the number of follow-up appointments



2. Note the mild staining present on the patient's left cornea when the lens is removed.

needed. Topography allows a more accurate fit, especially when dealing with specialty design contact lenses. The 8,000 to 10,000 specific points across the corneal surface provide a corneal map that becomes useful in many contact lens fits, including gas-permeable (GP) lens wearers and post-refractive surgery patients. In regard to GP fits, many topographers can even simulate fluorescein patterns and aid in the design of these lenses.[1] This information is invaluable with corneal reshaping and is even required for some manufacturers. Lastly, corneal topography is also very useful in diagnosing anterior segment diseases, such as keratoconus, and determining proper treatment.

The utilization of an autorefraction over patients' current contact lenses will offer additional information about their refractive status. Before even entering the exam room, you will have significant insight regarding whether an adjustment in prescription is warranted. What's even more interesting is that newer-generation autorefractors take into account higher-order aberrations. Practitioners can use this technology to gain insight into some of the complaints from patients with significant higher-order aberrations. Attempting alternative contact lenses that may minimize these higher-order aberrations can help with these complaints.

Some of the most useful technological tools the clinician can use in educating patients are imaging systems. Fundus and anterior segment imaging and digital photography have certainly evolved significantly and are a valuable means of documenting unique contact lens fits as well as helping patients to understand how their contact lenses are performing on the eye. Demonstrating lens deposits or conjunctival injection may also aid in raising awareness of lens wear and care compliance.

We even have the ability to conveniently record a video of the contact lens fit from the slit lamp. Incorporating this feature into your contact lens fitting and using the technology to educate patients on how their contact lenses fit on their eyes and how they interact with the ocular surface will help them better understand their visual correction options and add value to your contact lens evaluation.

A Case in Point

"Lila," a 60-year-old female, came into our office for the first time for a contact lens evaluation. At the time, she was wearing a hydrogel toric lens in her right eye and a silicone hydrogel toric lens in her left eye. She was using a store brand contact lens solution to care for her contact lenses and reported not replacing the solution in the case "until the solution seemed dirty." Her chief complaints were discomfort while wearing contact lenses and blurry vision at both distance and near.

Lila's right contact lens had significant deposits on it (*figure 1*). Her left contact lens was relatively clean, but when the contact lens was removed, staining was seen on the cornea (*figure 2*). It was not clear whether the staining was secondary to a contact lens/solution interaction or from non-compliant habits. We showed Lila a video of the examination, which demonstrated the deposits on the lens, and we educated her on the importance of proper care of her contact lenses. This was enough to make Lila a more compliant contact lens wearer. Her right eye was refit into a silicone hydrogel toric contact lens, so that the same type of lens was worn in both eyes, and she was instructed to use a branded multipurpose disinfecting solution, which resulted in a complete resolution of symptoms. RCCL

1. Sowka J, Gurwood A, Kabat A. Understanding Corneal Topography. In: The Handbook of Ocular Disease Management. Available at: www.revoptom.com/handbook/oct02_sec3_6.htm. (Accessed September 2009).

More Than Meets the Naked Eye

How can confocal microscopy imaging improve your diagnostic abilities and aid in disease management?

By Christine Sindt, O.D., M.S., F.A.A.O.

Dr. Sindt is director of Contact Lens Service at the University of Iowa Hospitals and Clinics, Iowa City, Iowa.

The first scanning confocal microscope was proposed in 1968.[1] Since then, confocal microscopy has expanded our knowledge of both the physiological and pathological states of the cornea. The evolution of what started out as an experimental research tool and became clinical diagnostic equipment is reflected in the amount of peer-reviewed publications that highlight this technology—it has nearly doubled in the last five years.

Confocal microscopy allows for high-resolution, reliable, real-time imaging of the living corneal microstructure, including normal corneal morphology, pathogen invasion, dystrophies and degenerations, post-surgical management, dry eyes, drug toxicities, endothelial monitoring and contact lens related changes.

Prior to corneal confocal microscopy, ex vivo histology provided the only cellular view of the cornea. But, ex vivo histology requires tissue excision, and the tissue tends to degrade during processing—in such cases, change cannot be measured over time without further tissue removal. On the other hand, scanning laser confocal microscopy

Technical Specifications—HRT-RCM	
Probe	63x
Image acquisition speed	2-D: 24 milliseconds 3-D: 1 second (2mm scan depth)
Image size	2-D: 384 x 384 pixels 3-D: 384 x 384 x 64 pixels
Inspected field	400µm
Light source	670nm diode laser (class 1 laser, no ocular safety hazard)
Resolution	1µm
Scan intervals	2µm
Depth of scan	1.0mm to 4.0mm
Acquired sections	Up to 80 per scan
Working distance	Corneal applanation
Internal fixation	No

Author's Review:

Pros: The increased magnification and reduction of scatter with the scanning laser offer clear, easily readable images. This instrument reliably scans at 2µm intervals through the z axis. Replaceable probe covers ensures sterility between patients. If you already own a Heidelberg Retinal tomographer, this is just an add-on attachment.

Cons: This instrument does not scan the entire depth of the cornea at once, requiring several passes through the cornea at various depths to scan from epithelium to endothelium. The semi-automated endothelial cell count feature can be tedious. There is a significant learning curve to using HRT-RCM mechanics and can be awkward to handle at first.

Technical Specifications—Confoscan 4		
Probe	40x	20x
Image acquisition speed	Below 15 seconds	
Image size	768 x 576 pixel	384 x 576 pixel
Inspected field	460 x 345 µm	460µm x 690µm (Up to 1000 endothelial cells per scan)
Light source	Quartz halogen light source 12V/100W	
Lateral resolution	0.6 µm/pixel	1.2µm/pixel
Scan intervals	4µm	
Depth of scan	Full cornea or manually set depth	
Acquired sections	Up to 350 per scan	
Working distance	1.98mm with gel immersion	12mm
Internal fixation	9 targets	

Author's Review:

Pros: The Confoscan 4 module scans epithelium to endothelium in one pass and is easy to operate. It offers fully automated endothelial cell counts for quick analysis.

Cons: This module sometimes skips a portion of the cornea (endothelium or epithelium.) The 4µm scan intervals in the z axis are not ideal for research purposes. Resulting images are not quite as clear as those of the HRT-RCM module.

provides instantaneous, non-invasive imaging of living tissue.

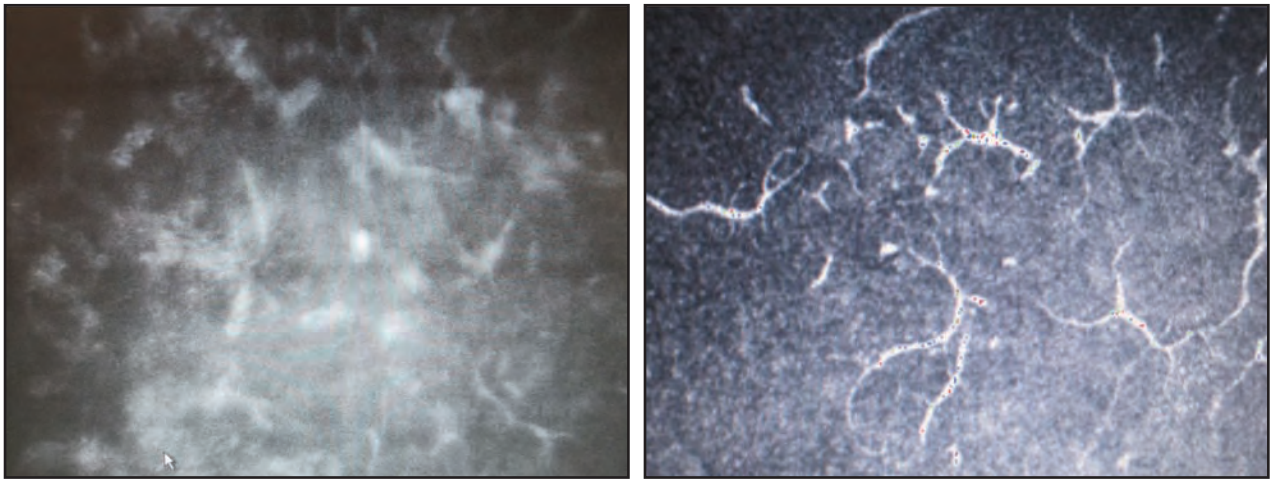
For a heavily cornea-based practice, confocal microscopy is indispensible in the diagnosis and monitoring of treatment response. However, it is also important for the general practitioner to be aware of this diagnostic tool and where confocal microscopes are located in the referral community. As we look toward the future, we must develop a basic understanding of the principles and anatomy from the confocal view.

How It Works

The corneal confocal microscope works by measuring light reflected within the corneal tissues, which may be clear or opaque. A light beam passes through the source aperture and is focused by an objective lens into the cornea, and reflected light from the illuminated spot is then recollected by the objective lens. Then, the light passes through a beam splitter and a pinhole before entering the photodetection apparatus. The detector aperture blocks scattered light, resulting in sharper images than those from conventional light microscopy techniques. The photodetection device transforms the light signal into an electrical one, creating a digital image.[2]

The Instruments

There are two commercially available confocal microscopes: the Confoscan 4 (Nidek), a scanning slit confocal micrsoscope and the Heidelberg Retina Tomographer Rostock Cornea Module (HRT-RCM) (Heidelberg Engineering), a laser scanning confocal microscope.[3,4] A scanning slit confocal microscope uses white light and two optically conjugate slits for illumination and detection of reflected light. This allows for many points to be scanned in parallel, resulting in reduced scan time vs. spot illumination. A scanning laser uses a single wavelength of coherent



Confoscan 4 image of Langerhans cells (left). HRT confocal images of Langerhans cells of the same patient (right).

light as the illumination light source, which scans sequentially over the examination area, offering high-depth resolution. The scanning laser technique can also evaluate the conjunctiva, sclera, limbus, lid, lacrimal gland and tear film.[2]

Corneal Anatomy

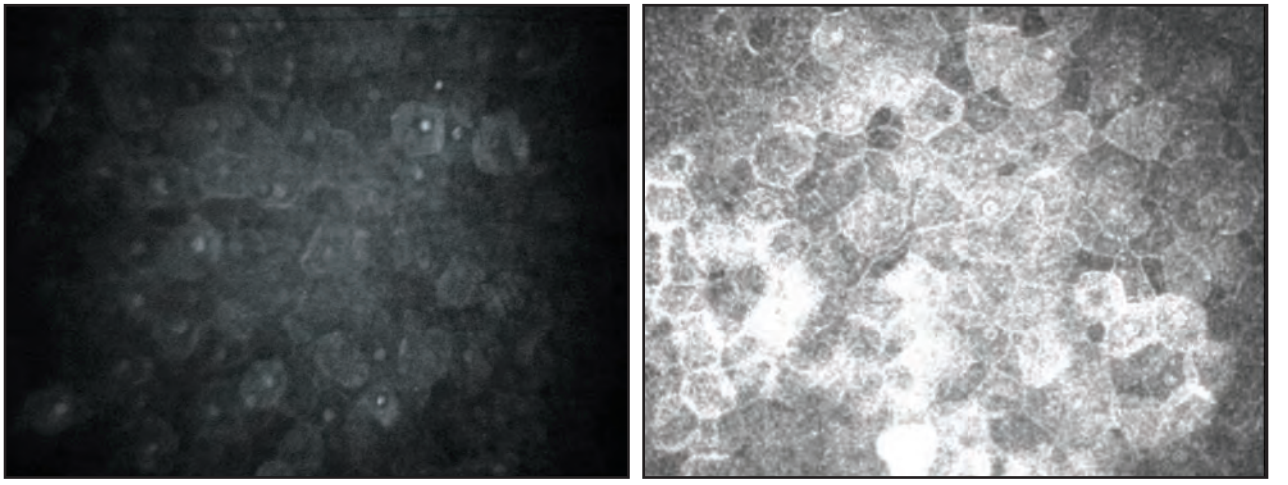
A healthy cornea is made up of five layers; epithelium, Bowman's layer, stroma, Descemet's membrane and endothelium.

The corneal epithelium has several distinct layers. Surface epithelial cells are characterized by a polygonal pattern, bright illuminated cytoplasm, a reflective nucleus and a perinuclear dark halo. As cells die, the entire cytoplasm becomes hyper-reflective. These superficial cells are up to 50µm in diameter and about 5µm thick. They are least dense in the corneal center, at around 624 cells/mm^2, and most dense in the periphery, at around 1,213 cells/mm^2.[5,6]

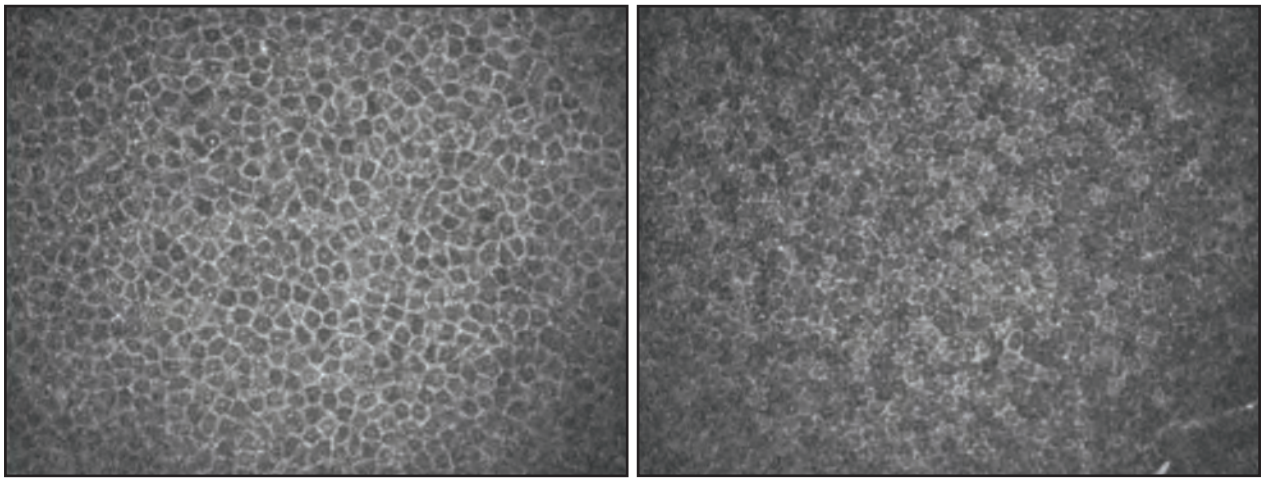
Immediately under the superficial cells are the wing cells, two to three cells deep. They can be divided into upper (larger) and lower (smaller) but are generally around 20µm in size and form a regular mosaic pattern. The average density is 5,000 cells/mm^2 in the corneal center and 5,500 cells/mm^2 in the periphery.[7]

The innermost portion of epithelial cells is the basal epithelium. These are the smallest of the epithelial cells, averaging around 8µm to10µm. They appear as a dense mosaic with highly reflective borders (tight junctions). The average density varies from 6000 regular mosaic pattern. The average density is 5,000 cells/mm^2 in the corneal center and 5,500 cells/mm^2 in the periphery.[7]

The innermost portion of epithelial cells is the basal epithelium. These are the smallest of the epithelial cells, averaging around 8µm to10µm. They appear as a dense mosaic with highly reflective borders (tight junctions). The average density varies from 6000



Healthy superficial epithelium (left). Epithelium with staining (right). Hyper-reflectivity represents various stages of cell death.



In this representatiion of wing cells, bright borders represent tight cell junctions (left). The basal cell layer is densely compact, and cell nuclei are not visible (right).

cells/mm^2 to 9000 cells/mm2 in the center and greater than 10,000 cells/mm^2 in the periphery.[7]

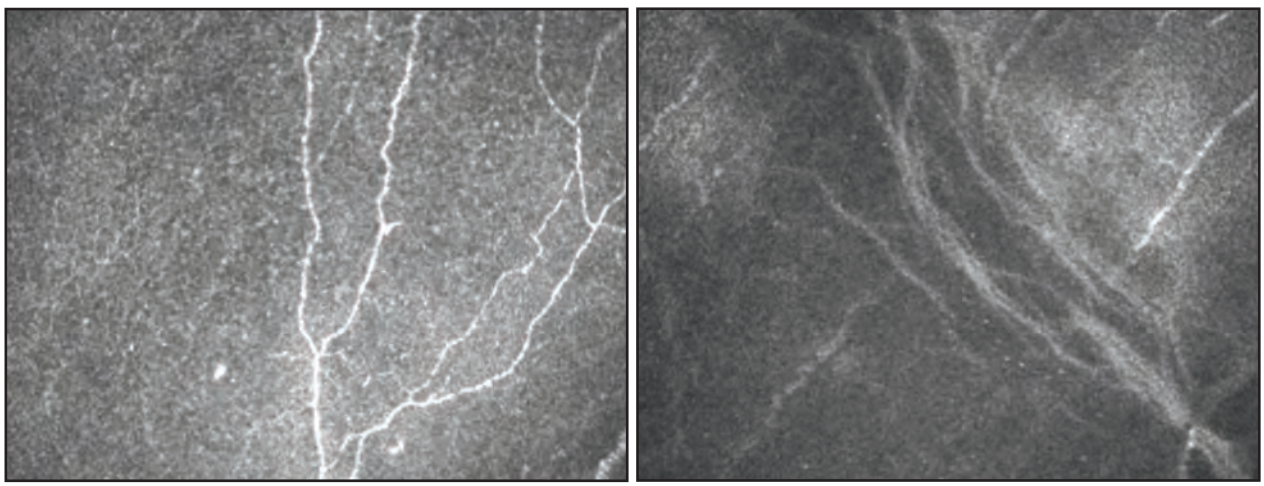
The sub-basal nerve plexus is immediately next to the basal epithelial cells. The nerve plexus is seen as a relatively cell-free layer with parallel linear hyper-reflective fibers.[8] The nerves are characterized by local axon enlargements, which are accumulations of mitochondria and glycogen particles. The fibers are organized into a vortex pattern and therefore, will run in different directions, depending on the scan location.[6,9]

Bowman's layer is 8µm to 10µm thick and consists of randomly arranged collagen fibrils that are located between the basal cell layer and the stroma.[6] This layer often appears hazy and dysmorphic.

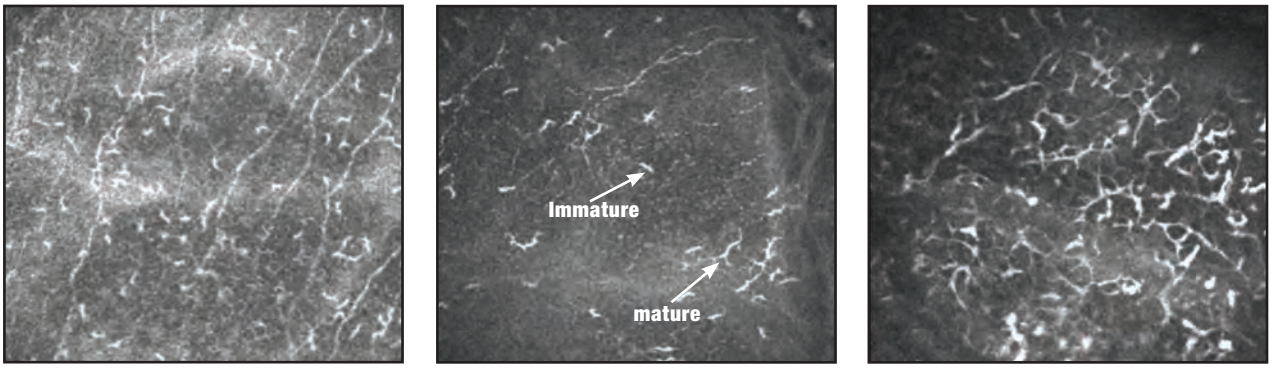
The stroma takes up 80% to 90% of the whole corneal volume. It consists of cellular, acellular and neurosensory structures.[2] The cellular components, or keratocytes, have reflective nuclei, whereas the acellular components, or collagen lamellae, appear black or optically transparent.[6] Keratocyte density is highest in the anterior stroma; it declines in the mid-stroma and increases slightly again toward the posterior stroma. Stromal nerve fibers are thicker than subepithelial nerve fibers.

The endothelium is a single layer of cells that form a hexagonal mosaic pattern. A healthy epithelium consists of 2500 cells/mm^2 to 3000 cells/mm^2, but this number decreases with age, disease and low-oxygen transmissible contact lens wear.

Finally, Descemet's membrane is not visible on confocal microscopy.



Nerves can run in any direction depending on the location within the cornea. The subbasal nerves form a vortex pattern (left). Collagen fibrils are randomly arranged in Bowman's layer (right).



Langerhans cells are immune cells within the cornea (left). It is thought that immune cells of the cornea take on a dendritic pattern as they mature (center). An intense immune response will form a "mesh network" (right).

Identifying Pathology

After normal cellular confocal microscope presentation is understood, pathology is easily recognizable. Two main cells types seen during corneal infiltration include leukocytes and Langerhans cells.

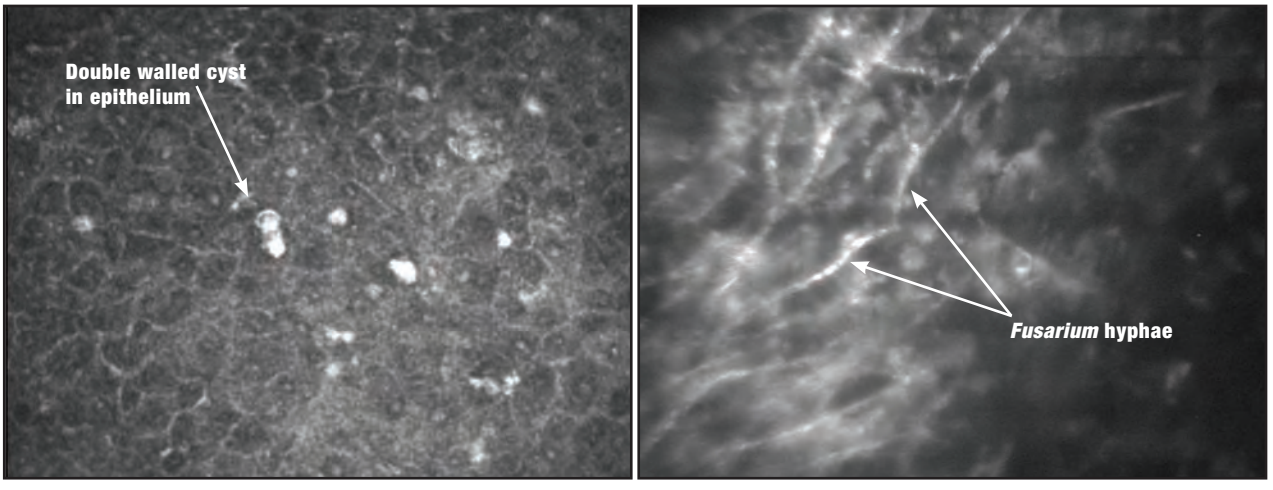
Leukocytes protect against foreign invaders, and the main categories of leuocytes include granular (neutrophils [50-70%], basophils [5%] and eosinophils [1%]), non-granular monocytes (3-9%) and lymphocytes (25-35%).[2] Granulocytes are very small (less than 10µm in diameter) and highly motile; they readily invade the cornea during inflammation in response to chemotaxic factors from microbes and injured cells.[2,10] Monocytes (up to 20µm in diameter) are the precursors to macrophages and are typically found in the corneal blood vessels and conjunctiva. Macrophages (12µm to15µm in diameter) are typically present at the ulcer site and may remain for many months within the tissue. Lymphocytes are found in the palpebral and tarsal conjunctiva.[2]

Leukocytes are located on the same level as the basal or wing cells. They cannot be differentiated by confocal microscopy; however, location and size may aid in identification.

Dendritic cells, or Langerhans cells, are important antigen-presenting cells in the cornea and conjunctiva.[11] They present at the level of the basal epithelial cells and sub-basal nerve plexus. They migrate into the cornea from the limbus, which means that they are more densely populated in the limbal region—34±3 centrally and 98±—in the periphery.

Immature Langerhans cells present as individual cell bodies, while mature Langerhans cells are seen with numerous processes (dendrite). Over time, these cells interdigitate and form networks. Immature cells are thought to be motile, while mature cells/networks are fairly stationary and only seen in unhealthy corneas.[11]

Langerhans cell density has been shown to increase not only with



A double-walled cyst in the epithelium of a patient with *Acanthamoeba* keratitis (left). Hyphae branching in a patient with *Fusarium* keratitis (right).

infection, but also with contact lens wear and dry eye.[12] The primary function of Langerhans cells is antigen capture by immature cells and sensitizing naïve T-cells and secretion of signaling molecules by mature Langerhans cells.

Bacterial vs. Viral Keratitis

There is insufficient resolution to identify individual bacterial morphology. Bacterial infections have a general haze of bacteria, inflammatory cells and cellular debris. Confocal microscopy may be helpful, but only in monitoring healing.[10]

The size of viruses prevents direct detection with confocal microscopy; however, the associated immunological response is detected. Post-herpetic changes in the cornea may be visualized with confocal microscopy. In corneal areas with herpetic involvement, epithelial cells are comparatively large, there is fibrosis in the anterior stroma, and the sub-epithelial nerve plexus is missing.[13]

Adenovirus has a characteristic pattern of resolution. Initially, hyper-reflective epithelial cells are seen along with numerous dendritic cells in the sub-basal nerve plexus at the level of Bowman's layer, often forming mesh networks. But over time, the density of Langerhans cells decreases.[12] Clusters of hyper-reflective keratocytes that are initially seen in the anterior stroma become visible in the mid-stroma. Hyper-reflectivity of the mid-stroma may be characteristic of adenovirus infection.[14]

Fungal Infections

Fungal infections are infrequent, but when present, they are generally easily diagnosed upon confocal microscopy. Filamentous keratitis is observed as thin, branching hyper-reflective hyphae 3µm to 5µm wide and of variable lengths in the anterior stroma. Stromal nerves are much wider and deeper in the stromal layer.

Candida albicans is a yeast that consists of ovoid bodies that may develop pseudohyphae. They are approximately 10 µm to 40µm long and 5µm to 10µm wide, located in the anterior stroma.[15]

Acanthamoeba

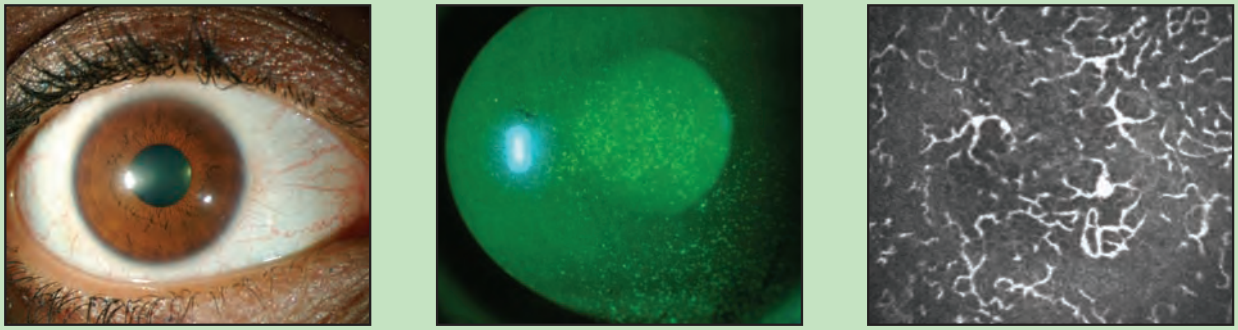
Confocal microscopy has become the clinical standard for initial diagnosis and treatment initiation for *Acanthamoeba* keratitis, although definitive diagnosis requires culture, corneal scraping and subsequent organism identification, or identification by *Acanthamoeba* DNA or by

Chronic Keratitis

"Alice," a 45-year-old female, presented to the clinic with a two-month history of bilateral hyperemia, photophobia and foreign body sensation. She tried to wear soft disposable bifocal contact lenses, and her previous doctor had tried several different brands of contact lenses and solutions. But, every time Alice wore her contact lenses, her symptoms would flare, so she discontinued lens wear. Otherwise, she was healthy, and she denied any significant medical history.

Her best-corrected entering visual acuity was 20/20 O.U. Slit lamp examination reveal numerous, round punctate erosions and trace conjunctival injection. Her anterior chambers were quiet, and dilated exam was unremarkable. But, confocal microscopy showed a dense meshwork of Langerhans cells, indicating a strong antigen presence.

I diagnosed Alice with a chronic viral keratitis and told her to lubricate with non-preserved artificial tears. She was to discontinue lens wear until her immunogenic response resolved. She was able to successfully resume contact lens wear within six months.



The patient presented with a two-month history of mild irritation and redness that flares with contact lens wear (left). Chronic corneal staining was observed with fluorescein and Wratten filter (center). The mesh network of Langerhans cells is indicative of chronic viral infection (right).

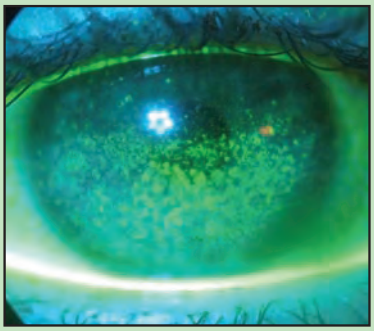
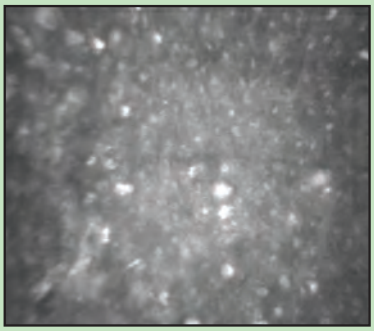
Acanthamoeba Keratitis

"Anna," a 20-year-old female, presented to the clinic with a two-month history of hyperemia, photophobia and foreign body sensation in her right eye. Generally, she was comfortable while wearing contact lenses, but on the day of presentation, her symptoms became quite exacerbated, and she experienced frank pain. Anna had no history of using lubrication or ocular medications.

Her entering visual acuity was 20/25 O.D. and 20/20 O.S. Slit lamp examination showed multiple, dense epithelial staining lesions. Her anterior chamber was quiet, but confocal microscopy revealed multiple cysts in the epithelium without infiltration below Bowman's membrane.

She was diagnosed with bacterial keratitis associated with presumed *Acanthamoeba* keratitis and started on 0.2% chlorhexadine q2h and Vigamox (moxifloxacin, Alcon) q.i.d. Cultures were taken. Within four weeks, she demonstrated complete resolution of *Acanthamoeba* cysts on confocal scan, and the chlorhexadine regimen was tapered. Anna was able to successfully resume contact lens wear.

Acanthamoeba are found grazing upon bacteria on the cornea.[19] Confocal microscopy is extremely helpful to establishing appropriate early treatment. Prognosis for *Acanthamoeba* keratitis is quite good if the amoeba have not penetrated Bowman's membrane.[16]

Note the relatively quiet eye in this patient with *Acanthamoeba* keratitis (left). Corneal staining in *Acanthamoeba* keratitis (center). *Acanthamoeba* cysts in epithelium (right).

polymerase chain reaction (PCR).[11] On confocal microscopy, *Acanthamoeba* cysts appear as round or oval hyper-reflective double-walled structures between 10µm and 26µm in diameter. Cysts may appear anywhere in the epithelium or stroma.[16] In some cases, the stromal nerves may appear thickened with associated round structures nearby. This may represent radial neuritis with trophozoite infiltration.[15]

Dry Eye

Confocal microscopy is a promising tool for not only dry eye research, but also for developing therapeutic treatments. Research on neuron innervations, the tear film and limbal stem cells production in patients with severe dry eye is currently underway.[17-19] In several recent studies, confocal scanning laser microscopy proved to be an efficient and non-invasive tool for quantifing conjunctival inflammation and epithelial cells densities.[12,18] One study showed an increased presence of inflammatory cells densities correlated with decreased tear film stability and tear quantity. In the future, this may prove to be an objective way to monitor dry eye patients.

Changes Observed in Lens Wearers

There are many changes observed with confocal microscopy during contact lens wear:

- Superficial epithelial cells increase in diameter, which is thought to be a result of decreased cell turnover.
- There is a near-doubling of Langerhans cells in some contact lens wearers, suggesting alteration of the immune state. (This does not hold true for patients who have worn contact lenses for longer than 10 years.)
- Corneal edema begins to manifest. And, dark lines appear in the posterior stroma when the edema exceeds 5% to 7%.
- Basal cells become more distinct.
- Keratocytes in the anterior stroma decrease and become less distinct.
- The endothelial mosaic becomes less distinct.
- Keratocytes decrease over time, which is indicative of overall corneal thinning.

Billing Logistics

It goes without saying that the ability to bill drives the market for

clinical applications. There are three codes that may be used for confocal microscopy: endothelial cell counts (CPT 92286), external ocular photography (CPT 92285) and optical corneal pachymetry (CPT 92499).[20]

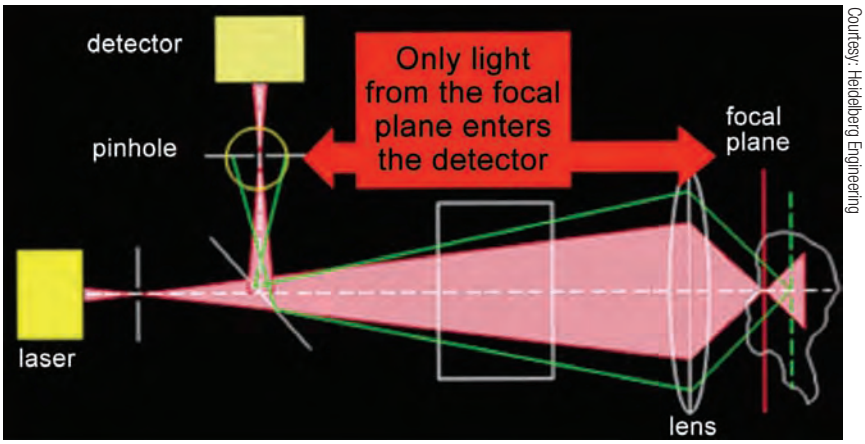
Endothelial photography is reimbursable when it is reasonable and necessary. The patient must meet one of the follow criteria. He or she must:

- Show evidence of endothelial dystrophy (guttata).
- Have corneal edema.
- Be about to undergo a secondary IOL implantation.
- Have had intraocular surgery and now requires cataract surgery.
- Be about to undergo surgery with a high-risk endothelium.
- Show evidence of posterior polymorphous dystrophy or iridocorneal-endothelium (ICE) syndrome.
- Be about to be fitted with an extended-wear contact lens after intraocular surgery.[21]

External photography is billable to insurance if the patient presents with a complaint that requires documentation or is undergoing treatment for a known disease. Confocal microscopy cannot be billed for documentation of a healthy eye.

Pachymetry for glaucoma is generally only covered by insurance once per lifetime; however, pachymetry associated with corneal pathology—such as keratoconus, endothelial disease or corneal transplantation—may be covered based on medical necessity.

Appropriate documentation is vital for billing confocal microscopy. The image(s) must be stored in a secure, referenceable database. The chart note should include an order for the test with medical rationale. It should also include documentation of test findings, diagnosis and the impact on treatment and management of the disease.



Courtesy: Heidelberg Engineering

This diagram demonstrates optical principles of scanning laser confocal microscopy.

A New Frontier

High-tech corneal imaging devices are finding their way into eye care practices. Once thought to be the domain of corneal surgeons, confocal microscopy and anterior segment ocular coherence tomography are considered indispensable by many disease based or specialty cornea contact lens practitioners. Conditions that were once medical mysteries are now diagnosable, thanks to high-resolution, real-time, in vivo histology. Treatments and outcomes are impacted by such early intervention. As image quality goes up and costs come down, these high-tech tools provide a platform for diagnosis, management and monitoring of corneal disease, surgical comanagement and patient education. RCCL

1. Reinhard T, Larkin DFP. In Vivo Micro Morphology of the Cornea; Confocal Microscopy Principles and Clinical Applications. In: Cornea and External Eye Disease. Springer.173-205.
2. Guthoff, Zhivov, Stachs O. In vivo confocal microscopy, an inner vision of the cornea—a major review. Clin Experiment Ophthalmol. 2009 Jan;37(1):100-17.
3. Manufacturer website. Nidek. Available at: www.Nidek.com. (Accessed August 2009).
4. Manufacturer website. Heidelberg Engineering. Available at: www.heidelbergengineering.com. (Accessed August 2009).
5. Mustonen, RK McDonald, MB, et al. Normal human corneal cell populations evaluated by in vivo scanning slit confocal microscopy. Cornea. 1998 Sep;17(5):485-92.
6. Patel D, McGhee C. Contemporary in vivo confocal microscopy of the living human cornea using white light and laser scanning techniques: a major review. Clin Exp Ophthalmol. 2007 Jan-Feb;35(1):71-88.
7. Eckard A, Stave J, Guthoff RF. In vivo investigations of the corneal epithelium with confocal Rostock laser scanning microscope (RLSM). Cornea. 2006 Feb;25(2):127-31
8. Midena E, Cortese M, Miotto S, et al. Confocal microscopy of corneal sub-basal nerve plexus: a quantitative and qualitative analysis in healthy and pathologic eyes. J Refract Surg. 2009 Jan;25(1 Suppl):S125-30.
9. Patel DV, McGhee CN. Mapping the corneal sub-basal nerve plexus in keratoconus by in vivo laser scanning confocal microscopy. Invest Ophthalmol Vis Sci. 2006 Apr;47(4):1348-51.
10. Labbe A, Khammari C, Dupas B et al. Contribution of in vivo microscopy to the diagnosis and management of infectious keratitis. Ocul Surf. 2009 Jan;7(1):41-52.
11. Zhivov A, Stave J, Vollmar B, Guthoff R. In vivo confocal microscopic evaluation of Langerhans cell density and distribution in the corneal epithelium of healthy volunteers and contact lens wearers. Cornea. 2007 Jan;26(1):47-54.
12. Lin H, Li W, Dong N, et al. Changes in corneal epithelial layer inflammatory cells in aqueous tear-deficient dry eye. Invest Ophthalmol Vis Sci. 2009 Jul 23. [Epub ahead of print]
13. Cavanagh HD, Petroll WM, Alizadeh H, et al. Clinical diagnostic use of in vivo confocal microscopy in patients with corneal disease. Ophthalmology. 1993 Oct;100(10):1444-54.
14. Dosso A, Rungger-Brandle E. Clinical course of epidemic keratoconjunctivitis: evaluation by in vivo confocal microscopy. Cornea. 2008 Apr;27(3):263-8.
15. Brasnu E, Bourcier T, Dupas B,et al. In vivo confocal microscopy in fungal keratitis. Br J Ophthalmology 2007; 91:588-591.
16. De Moraes J, Alfieri SC. Growth, encystment and survival of *Acanthamoeba* castellanii grazing on different bacteria. FEMS Microbiol Ecol. 2008 Nov;66(2):221-9.
17. Tuisku IS, Konttinen YT, Konttinen LM, Tervo TM. Alterations in corneal sensitivity and nerve morphology in patients with primary Sjögren's syndrome. Exp Eye Res. 2008 Jun;86(6):879-85.
18. Dart JK, Saw VP, Kilvington S. *Acanthamoeba* keratitis: diagnosis and treatment update 2009. Am J Ophthalmol. 2009 Aug 4. [Epub ahead of print].
19. Villani E, Galimberti D, Viola F, et al. The cornea in Sjogren's syndrome: an in vivo confocal study. Invest Ophthalmol Vis Sci. 2007 May;48(5):2017-22.
20. Wakamatsu TH, Sato EA, Matsumoto Y, et al. Conjunctival in vivo confocal scanning laser microscopy in patients with Sjögren's syndrome (SS). Invest Ophthalmol Vis Sci. 2009 Aug 20. [Epub ahead of print].
21. Medicare National Coverage Determinations Manual. Available at: www.cms.hhs.gov/manuals/downloads/ncd103c1_part1.pdf. (Accessed August 2009).

Topography FAQs

Understanding and applying corneal topography is as much of an art as it is a science.

By Dianne M. Anderson O.D., F.A.A.O.

Dr. Anderson maintains a specialty contact lens and anterior segment disease practice within two ophthalmology groups in suburban Chicago. Her major area of interest lies in keratoconus and post-surgical contact lens fits such as corneal transplants.

Corneal topography is one of the most underutilized pieces of diagnostic equipment by eye care practitioners. Many of us do not own or have access to topography, but of those who do, many are not familiar with the various functions and applications of their topographers. This article is focused on addressing practitioners' most frequently asked questions about corneal topography and its function in the everyday eye care practice. Though differences do exist between topographers, the answers are universally applicable to general topography. The following questions and answers are designed to serve as a reference guide to further readers' understanding of corneal topography and stimulate more advanced training. If you embrace the challenge of understanding corneal topography and follow these guidelines, you will soon realize the many benefits the tool can offer you and your patients.

What differences exist between corneal topographers?

There are two main types of topographers: those that directly measure curvature and those that directly measure elevation. Placido disc systems are curvature-based and directly measure the curvature of the anterior corneal surface by projecting a series of concentric light rings on the cornea, capturing an image of the reflected rings and analyzing the thousands of data points along the rings. By measuring the distances between the rings and their relationships with each other, the system reconstructs the corneal surface with a high degree of precision and identifies even micro irregularities. The larger the distance between the rings, the flatter the cornea and the less dioptric power it has. The opposite is true with a steeper cornea, which shows smaller distances between the rings and a higher corneal power.

Placido disc topographers can be further classified into small-cone or large-cone systems. Small-cone placido disc topographers have a shorter working distance and project a greater number of rings onto the cornea. Examples of small-cone models include the Medmont E300 (Medmont), Scout and Keratron (EyeQuip) and MagellanMapper (Nidek). Large-cone placido disc topographers use a longer working distance and project fewer rings onto the cornea than small-cone topographers. Examples of large-cone models available today include the ATLAS 9000 (Carl Zeiss-Meditec), and ReSeeVit (Veatch Ophthalmic Instruments).

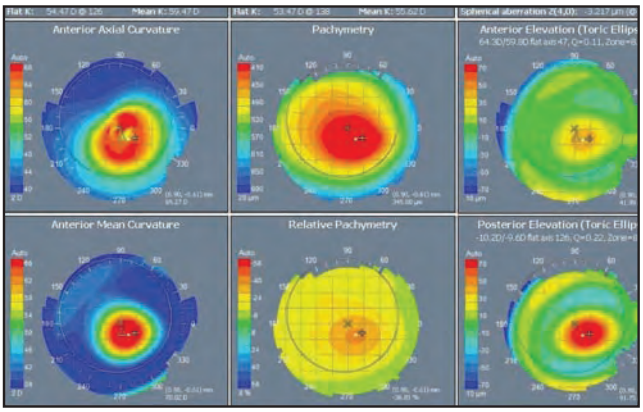
Elevation systems use light rays or ultrasound to scan the entire cornea; this directly measures the elevation

of both the anterior and posterior surfaces and generates corneal thickness data. The curvature data is then derived from the elevation data via sophisticated algorithms. This technology includes slit scanning and high-speed anterior segment optical coherence tomography (OCT). Orbscan (Bausch & Lomb), Scheimpflug imaging, Pentacam (Oculus) and Galilei (Zeimer) are used in slit scanning, and Visante omni (Carl Zeiss Meditec) and SL-OCT (Heidelberg) are used in OCT imaging.[1] Slit scanning and OCT devices display the elevation of the front and back surfaces of the cornea as anterior and posterior float maps. The term "float" refers to the fact that the best-fit sphere has no fixed center, but rather floats. The distance between cornea and reference body is optimized to be as small as possible and as equal as possible (*figure 1 and 2*).[2]

Other than curvature and elevation, what information does a corneal topographer provide?

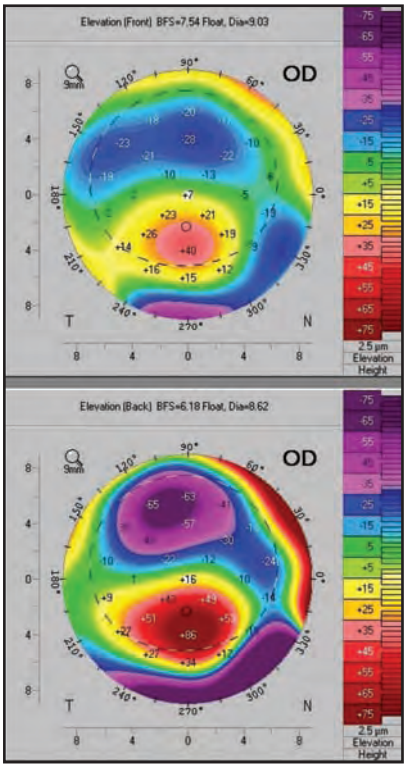
Some topographers also have the ability to measure wavefront data. This is accomplished through detailed ray tracing algorithms that illustrate the higher-order aberrations of the cornea (corneal wavefront) or the entire eye, including pupil size, as well as the lens and accommodation (optical wavefront).[3] Corneal wavefront data is helpful in explaining the quality of a patient's vision. For instance, a patient may be complaining of blurred distance vision, especially at night. Are these symptoms correctable with spectacles or will the patient still complain of haloes and glare? With spectacles, lower-order aberrations (defocus and astigmatism) will be corrected; however, higher-order aberrations such as spherical aberration will not.[3]

And, certain higher-order aberrations are associated with specific corneal conditions (e.g., coma is associated with keratoconus, and trefoil is associated with pellucid marginal degeneration).[4] Topographers with wavefront capabilities illustrate these higher-order aberrations in several displays: Zernike tables, image simulation, point-spread function or modulation transfer function. Each of these displays represents a different way to view higher-order aberrations. Knowing this will help you get a better grasp on your patients' complaints.



1. Visante omni (Carl Zeiss Meditec) Comprehensive Topography maps combine anterior curvature data from ATLAS topography with the thickness data from Visante global pachymetry to generate posterior corneal topography data.

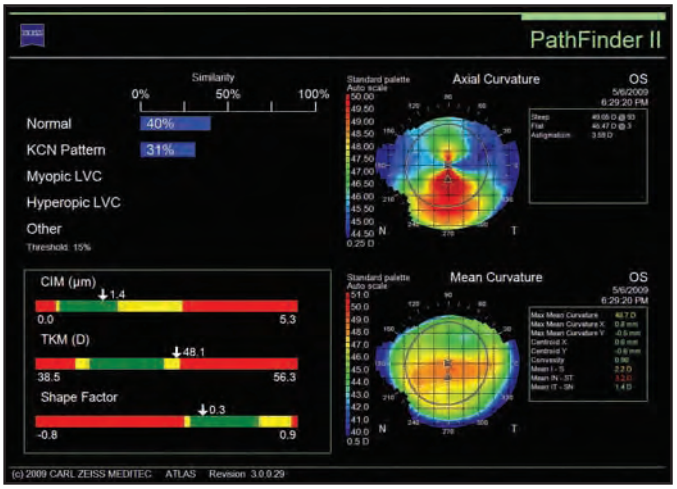
Pathology detection software is also available on many topographers. These programs analyze corneal topographic indices and identify those that fall out of the range identified as normal. PathFinder and PathFinder II, available on the ATLAS model topographers (Carl Zeiss Meditec), are commonly used pathology detection programs. These PathFinder programs analyze shape factor (SF), corneal irregularity measurement (CIM) and toric keratometric mean (TKM) and identify these values as normal (green), suspect (yellow) or abnormal (red). Pathfinder II analyzes an additional nine indices, including mean curvature, I-S value and convexity. And, it is trained to classify the cornea into one of five categories: normal, suspect keratoconus, myopic laser correction, hyperopic laser correction or other (*figure 3*).[5] Pentacam has a detailed keratoconus screening display that graphs out corneal thickness and rates it based on standard



2. Anterior and posterior elevation float maps from Pentacam (Oculus). The red area represents the corneal apex, which is decentered inferiorly, and indicates pathology based on the increased elevation values.

deviations above and below normal (*figure 4*).[6] These programs take the guesswork out of searching for the appropriate indices to evaluate in suspicious cases.

Contact lens designing software is available with most topographers, but it may be sold separately. Such programs are helpful in determining the best type of rigid gas-permeable contact lens to fit on a given cornea. Simulated NaFl patterns help to visualize the tear film clearance beneath an lens and modify the parameters to optimize the fit. Even though these simulated patterns don't take into consideration lens movement due to lid tension and/or decentered corneal apex, they are a time saver when you are designing custom lenses or choosing the best diagnostic lens for an irregular cornea.



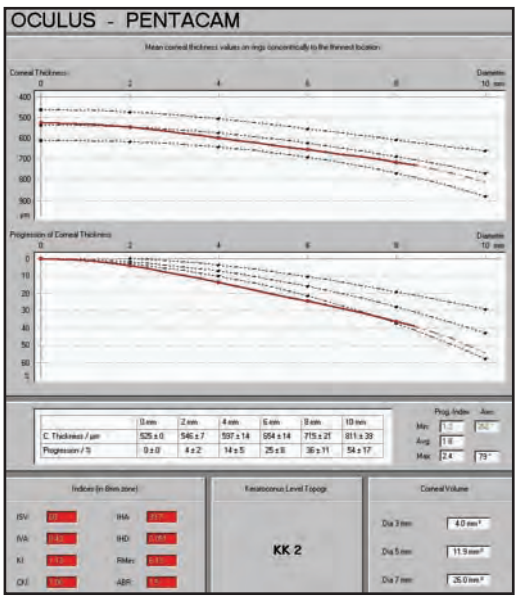
3. PathFinder II (ATLAS, Carl Zeiss Meditec) analyzes three main corneal indices (CIM, TKM and Shape Factor) and determines the probability within five trained categories (normal, keratoconus, myopic laser vision correction, hyperopic laser vision correction).

How can topography help me in my daily practice?

Topographers supply you with corneal curvature data out to about 10mm, which is well beyond the central 3mm, measured with standard keratometry. They also measure the horizontal visible iris diameter (HVID). This information allows you to streamline your basic contact lens fits by optimizing the base curve and diameter.[7] This is critical with toric soft lens fits because it helps to minimize rotation and ensure stability.

Topographers also generate a pupil diameter measurement. Patients with large pupils will experience haloes and glare with distance-centered multifocal lens designs as the peripheral near addition induces spherical aberration. Multifocal lenses that have a center near addition create simultaneous vision. Patients with large pupils will experience less aberration from simultaneous-vision lenses, as the periphery is all distance correction. So, a topography map prior to fitting multifocals is helpful in determining the patient's pupil size. And, a topography map over the multifocal lens will show you where the lens sits in relation to the patient's pupil. If the pupils are very small or the lens decenters, the patient will not be capable of experiencing the multifocal properties and should be fit with monovision rather than multifocal lenses.

Also, a topographer is indispensible if you fit overnight corneal reshaping lenses and if you comanage LASIK patients. A placido disc system is ideal for monitoring baseline curvature and refractive changes with corneal reshaping lenses. Elevation or slit-scanning devices are the preferred systems for precise pre-LASIK evaluations because they offer pachymetry and posterior curvature as well as elevation data.

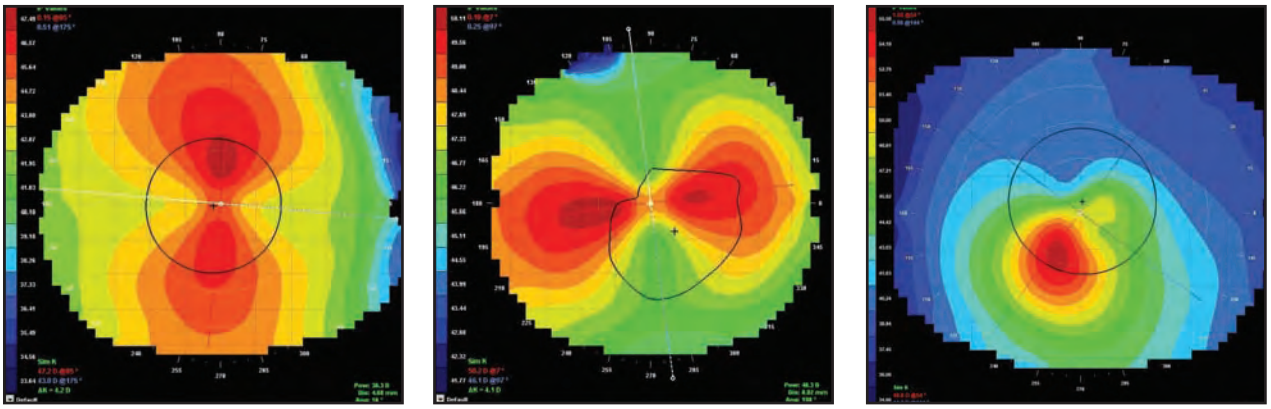


4. Pentacam's (Oculus) keratoconus detection software determines the probability of keratoconus based on to corneal thickness profiles.

What maps should I send to my contact lens lab for gas-permeable designing?

The most comprehensive maps for contact lens fitting are the axial and elevation maps. The axial map provides an overall view of the anterior corneal curvature and clearly defines the amount and type of astigmatism present—apical vs. limbal-to-limbal, with-the-rule (WTR) vs. against-the-rule (ATR), oblique vs. irregular (*figure 5*). Your lab can offer guidance with diagnostic lens fittings for keratoconus, post-PKP and post-refractive surgery.

The elevation map provides height information that is helpful in



5. These corneas show the same amount of astigmatism in very different presentations—with-the-rule (left), against-the-rule (center) and keratoconus (right). Without corneal topography, this type of identification is often missed.

determining the optimal peripheral curves for a gas-permeable lens. For example, a cornea with 2.00D of WTR limbal astigmatism will be fit well with a spherical lens with toric peripheral curves. Toric peripheral curves will stabilize the fit along the vertical meridian and prevent 3 o'clock and 9 o'clock staining. In addition to the above maps, the HVID measurement will help your lab determine the best lens diameter for your patient.

How do I bill for corneal topography?

As of January 1 2007, corneal topography is identified by CPT code 92025, as "computerized corneal topography, unilateral or bilateral, with interpretation and report."[8] Corneal topography is not bundled by Medicare with eye exams or other tests.

Medicare covers diagnostic tests that are medically necessary according to Medicare guidelines. Commonly covered diagnoses include irregular astigmatism (367.22), keratoconus (371.60) and com-plication of corneal graft (996.51). Check your local coverage determination (LCD) policy for additional indications. When performed for one of the diagnoses noted above, there should be no problem with coverage. For other corneal conditions, you should explain that there is a chance of non-coverage, ask the patient to sign an Advance Beneficiary Notice (ABN) and submit your claim with modifier GA.[8]

Prior to cataract surgery, Medicare administrative contractors will consider claims if there is a diagnosis—in addition to cataract—that support medical necessity. More often than not, testing with corneal topography prior to cataract surgery is associated with planning for concurrent limbal relaxing incisions, or toric IOL measurements, and as such is not covered.[8]

Corneal topography associated with elective refractive surgery is not covered by Medicare, nor is the surgery. The patient is financially responsible for the service, either as a separate charge or as part of the refractive surgery package. Inform patients of their financial responsibility and get a signed Notice of Exclusion from Medicare Benefits (NEMB). If the Medicare beneficiary requests that a claim be filed, append modifier GY to the CPT code to indicate an excluded service.[8]

How can I learn more about corneal topography?

There are many continuing education courses available on topography and advanced contact lens fitting at both the local and national levels. Additionally, you can take advantage of Internet resources, such as articles, web seminars and online courses. Many gas-permeable contact lens manufacturers, such as Art Optical, Blanchard Contact Lens, BE Retainer, Paragon CRT and SynergEyes, offer basic topography training as part of specialty lens design tutorials on their websites. These companies have expert consultants who can help you interpret topography maps and even schedule in-office fitting sessions. This type of hands-on experience is by far the best way to correlate topography interpretation with optimal contact lens fitting. RCCL

1. Swartz T, Marten L, Wang M. Measuring the cornea: the latest developments in corneal topography. Curr Opin Ophthalmol. 2007 Jul;18(4):325-33.
2. Oculus Pentacam HR Instruction Manual; Measurement for the anterior eye segment. 4.2.2.5.2 Reference bodies. 2007:50.
3. Wilson SE, Ambrosio R. Computerized corneal topography and its importance to wavefront technology. Cornea. 2001 Jul;20(5):441-54.
4. Oie Y, Maeda N, Kosaki R, et al. Characteristics of ocular higher-order aberrations in patients with pellucid marginal corneal degeneration. J Cataract Refract Surg. 2008 Nov;34(11):1928-34.
5. Bagherinia H, Chen X, Flachenecker C, et al. Support vector machine (SVM)-based classification of corneal topography. Poster presented at: Association for Research in Vision and Ophthalmology (ARVO) Annual Meeting. 2008 Ft. Lauderdale, Fla.
6. Oculus Pentacam HR Instruction Manual; Measurement for the anterior eye segment. 4.2.6.1 Corneal thickness progression. 2007:82.
7. Bergenske P. Prescribing soft toric contact lenses: prescribing soft torics is easier than you might think and is a skill that benefits many of your astigmatic patients. Available at: www.contactlensspectrum.com/article.aspx?article= &loc=archive\ 2005\February\0205033.htm (Accessed July 2009).
8. Corcoran, S. Corneal Topography Coding Pointers. Ophthalmology Management. Available at: www.ophmanagement.com/article.aspx?article=101783\2008\June (Accessed July 2009).

Sjögren's Solutions

Learn how to diagnose, manage and provide much needed guidance to patients with this all-encompassing condition.

By James V. Aquavella, M.D.

Dr. Aquavella practices in Rochester, N.Y. He specializes in medical and surgical diseases of the cornea and has directed a corneal research program for many years. He is professor of ophthalmology at the University of Rochester.

Sjögren's syndrome (SS) is the chronic inflammatory expression of an autoimmune disease that is characterized by exocrine gland dysfunction (primary) or with the addition of variable systemic involvement (secondary). From the ophthalmic perspective, the resultant dry eye and keratoconjunctivitis sicca (KCS) is caused by lymphocytic infiltration of the lacrimal gland. This "sicca complex" includes dry mouth (xerostomia) from similar salivary gland pathology. Widespread exocrine dysfunction results in dryness of skin, nose, throat or vagina. Systemic complzications can involve heart, liver, lungs, kidneys, joints,and nervous system as well as an increase in the incidence of lymphoma.[1] Chronic fatigue and rheumatoid arthritis are among the most frequent associations.[2]

Disease Development

The pathogenesis of Sjögren's is most likely related to an inflammatory trigger that affects glandular epithelial cells with secondary release of auto-antigens, which, in a susceptible subject, can cause the immunological reaction against self. Ultimately, the release of pro-inflammatory cytokines and b-cell stimulation lead to organ specific antibody production.

The classical presentation to the eye care practitioner's office is one of an aqueous-deficient dry eye in a post-menopausal female, although much recent work has implicated a strong evaporative component, and the age range is a broad 20 to 70.[2-4] The history is consistent with typical dry eye symptoms, such as itching, burning, foreign body sensation, lid irritation, ocular fatigue and mucous discharge.[2] These patients often present with a series of ocular "infections," which are misdiagnosed recurrent inflammatory episodes associated with the sicca.[5] While the serological diagnosis can take years to establish, the absence of a nasal stimulated reflex tearing and the presence of ocular surface staining help to pinpoint this condition. Filamentary, exposure, neurotrophic and punctate keratopathy are often present as related findings. Positive serology can include ANA, RF, anti-SSA/Ro and anti-SSA/La. Some patients may have had salivary or lacrimal gland biopsies, but remember—a negative biopsy does not rule out the disease because the specimen location may have missed a pathognomonic lymphocyte infiltration present in other areas.

In a similar fashion, it is thought that negative serology does not rule out incipient disease, since it

may require years to diagnose. A dilemma for immunology is when to start systemic immunosuppressive therapy in a serology-negative individual with significant symptoms.

The Role of Practitioners

So, what can eye care practitioners do to assist patients whose ocular manifestations are the cause of such distress? We must ensure that we have a good understanding of this multifaceted condition and that we are in contact with an appropriate medical team of immunologists, OB/GYNs, dental practitioners, rheumatologists, primary care physicians and others. We must also have a thorough understanding of the environmental and lifestyle implications of dry eye disease.

Non-preserved lubricants instilled several times a day are the mainstay of all dry eye therapy, Sjögren's included. Patients can be taught to associate avoidance of dry and evaporative environments with amelioration of their symptoms. Airline travel is an example of a controlled adverse environment that begs for extra lubricants. Dry and windy environments should be avoided when possible in favor of warm, moist geographical locations. Instruct patients to increase humidification at home or at the workplace and place computer terminals and television screens away from air ducts. These minor lifestyle adjustments can translate into significant improvement in functional capacity.

Minor intervention, such as punctal occlusion or bandage contact lens, may be helpful in selected patients. But in severe cases, fluid-ventilated semiscleral lenses can be utilized. Topical anti-inflammatory agents, such as steroids or cyclosporine, can be helpful in appropriate doses in the short term.[6] Steroids have the capacity to be beneficial but are prone to complication and must be used judiciously while being monitored carefully. The one approved commercial cyclosporine product is probably not suited for control of the level of inflammation associated with Sjögren's disease, but may be tried. In severe chronic cases, immunologist administration and supervision of systemic immunosuppressive agents can be helpful. Frequently, there is disconnect between subjective symptoms and objective findings. For this reason, many individuals may be relatively comfortable despite significant amounts of cornea and conjunctiva staining.[4]

One of the simplest and most effective solutions is to guide the patient to the selection of appropriate eye wear, both to minimize ocular fatigue as well as to construct a moist chamber effect to minimize evaporation from the ocular surface. A dry and irregular ocular surface has adverse effects on visual acuity and ocular fatigue, particularly in near vision. Moist chamber goggles are now becoming more readily available in cosmetically pleasing formats. This is an inexpensive modality but one that can be effective for many subjects. While it may require several days or weeks for the patient to become aware of the effects of a new therapeutic modality, the benefits of a moist chamber can be readily appreciated in a matter of days.

Geography plays a strong role in dry eye disease, but in most areas of the lower 48 states, seasonal variations are equally important. The frequency and timing of examinations can be coordinated with these projected environmental changes.

While some have ascribed an immunological basis for autologous serum therapy, the evidence is lacking. It would seem that an immunologically neutral environment is present and that the serum acts as a well-tolorated and non-irritating surface lubricant. The logistical difficulties involved in the use of serum are the major impedement to this therapy, except when there is evidence of improvement or when all else fails.

A Pragmatic Approach

What is a practical way to diagnose, manage and treat the Sjögren's patient? We need to recognize that the eye exam is significantly different from routine. These cases require much more chair time, so this should be scheduled as a visit that will involve 50% to100% more of your time than usual. Most of the patients have several physicians and a long medication list. There may be referral letters and copies of medical records as well. This information should be readily available to the physician and will require still more time for the staff to process.

You will want to ask the patient if they are taking immunosuppressive drugs, and in the absence of a report from the immunologist, how they are doing on the particular drug. We need to reinforce the importance of routine immunology follow up. While the relationship between systemic immunosuppressive therapy and the ocular surface disease is not a direct one, I feel that these systemic medications are important to overall health of the ocular surface. One such drug was evaluated in a

recent phase II NIH trial. Dehydroepiandrosterone (DHEA) was found not to have a statistically proven relationship with the amelioration of Sjögren's symptoms. The subjects however responded in a survey that their symptoms had improved in 75% of cases.[7]

Patient's expectations will also be different. We are viewed as experts in the disease, and they will seek information and encouragement during their eye exam. This expectation can only be met if we are able to assume the role of adviser.

The patient's dental hygiene is also a factor. While there is no direct relationship between the severity of the xerostomia and kerititis sicca, our patients may be more comfortable on a regimen that includes frequent sips of water, as well as Salagen (pilocarpine, MGI Pharma Inc) by mouth.[8] Additional agents for dry mouth are Evoxac (cevimeline HCL, Daiichi Pharmaceuticals) and Numolsyn lozenges (Align Pharmaceuticals).

More frequent appointments with dental hygienists are required to rid the teeth of the discoloring and tenacious debris associated with dry mouth. But, the ability to maintain well-rooted and functioning teeth in the long term is compromised in Sjögren's patients.

We are used to dealing with eye fatigue, and it is true that as a result of compromised acuity secondary to ocular surface drying, concentration on written material is not facile. But, Sjögren's is also associated with chronic fatigue.[9] The relationship between blinking, adequate illumination, lubrication and appropriate eye wear must be stressed.

Pulmonary and gynocological aspects may be more difficult for eye care practitioners to deal with, but an awareness of the magnitude of the problems our patients are facing is helpful.

Examining the Sjögren's Patient

During the examination, noting the condition of the lids is a good place to start. Blepharitis is treated in a standard fashion with warm compresses, mild topical antibiotics and good hygiene. I tend not to use long-term doxycycline or tetracycline in these patients unless the condition is severe. The potential benefit is relatively modest, and these individuals have a host of medications with which to contend.

The ocular surface deserves most of our attention, as in all instances of dry eye. I tend to treat the symptoms rather than the pathology. If the patient is relatively comfortable, I rely on lubricants and eyewear. Most will have some staining and conjunctival injection, but I withhold the specific anti-inflammatory therapy unless there is an exacerbation of symptoms that are causing distress. I always stress lifestyle modification and environmental factors at every visit. Patients often forget, and a gentle reminder of the advisability of adjusting the airflow or wearing their goggles even while indoors can result in improved comfort. Increased inflammation may require steroids, bandage lenses and cyclosporine, but these measures should be tapered or removed as soon as the condition stabilizes.

The question of measurement of the intraocular pressure always presents a problem because the topical anesthetic agent will have adverse effects on the epithelium. I prefer to always measure the tension but at the end of the exam. This should never be performed by an inexperienced technician. A delicate approach is essential, and lubrication should be instilled following the test. Patients can and should be dilated as indicated, and periodic retinal exams need to be conducted on schedule.

If patients are stable, examinations can be conducted at six-month intervals. Practicing in a cold and windy climate, I always suggest examinations in the fall and in the winter when symptoms are likely to be worse, while spring and summer are usually trouble free.

Make a Difference

Sjögren's patients require our special attention, and we must be sensitive to all the systemic issues they are going though. But, despite the demands associated with treating this condition, we can all benefit from the knowledge that the advice and care we provide will have a significantly positive effect on the functional capacity of our patients. RCCL

1. Ekstrom Smedby K, Vajdic CM, Falster M, et al. Autoimmune disorders and risk of non-hodgkin lymphoma subtypes: A pooled analysis within the InterLymph consortium. Blood. 2008 Apr 15;111(8):4029-38.
2. Akpek EK, Klimava A, Thorne JE, et al. Evaluation of patients with dry eye for presence of underlying Sjögren's syndrome. Cornea. 2009 Jun;28(5):493-7.
3. Nguyen CQ, Peck AB. Unraveling the pathophysiology of Sjögren's syndrome-associated dry eye disease. Ocul Surf. 2009 Jan;7(1):11-27.
4. Sumida T. Diagnosis and therapy for Sjögren's syndrome. Nippon Naika Gakkai Zasshi. 2007 Oct 10;96(10):2201-5.
5. Oguz H. Noninvasive tear meniscometry in dry eye patients with Sjögren's syndrome. Am J Ophthalmol. 2008 Jan;145(1):184; author reply 184-5.
6. Manna R, Verrecchia E, Fonnesu C, et al. Cyclosporine A: Good response for patients affected by autoimmune disorders and HCV infection? Eur Rev Med Pharmacol Sci. 2009 Mar;13 Suppl 1:63-9.
7. Fox R. Report to American College of Rheumatology. Annual Meeting. New Orleans.
8. Jorkjend L, Bergenholtz A, Johansson AK, Johansson A. Effect of pilocarpine on impaired salivary secretion in patients with Sjögren's syndrome. Swed Dent J. 2008;32:49-56.
9. Dass S, Bowman SJ, Vital EM, et al. Reduction of fatigue in Sjögren's syndrome with rituximab: Results of a randomised, double-blind, placebo-controlled pilot study. Ann Rheum Dis. 2008 Nov;67(11):1541-4.

The Role of Compliance

Eye care practitioners reduce the risk of infection and other complications with contact lens wear one patient at a time.

By Vinita Allee Henry, O.D., F.A.A.O.

Many contact lens patients wear their lenses successfully for most of their lives. Reasons for contact lens drop out include solution sensitivity, dry eyes, overwear, infection, comfort, convenience and inadequate vision. Infections with soft daily contact lens wear are four per 10,000 wearers.[1-3] The ultimate goal of the practitioner is to provide healthy, sustainable contact lens wear. And, by using high oxygen-permeable lens materials, proper lens care and wear and educating the patient about their contact lenses, the risk of infection can be minimized.

Lens Types

Past lens modalities such as polymethylmethacrylate (PMMA) rigid lenses, low-Dk gas-permeable (GP) and soft hydrogel lenses were the standard lenses fit for many years. Although many patients wore them fairly successfully for a period of time, most of these patients eventually began to show signs of corneal hypoxia. A hypoxic cornea becomes edematous and loses its integrity, putting it at risk for corneal compromise, which includes infection. Today, there are medium- and high-Dk fluoro-silicone acrylate GP lenses and silicone hydrogel soft lenses that provide oxygen to the cornea at levels similar or equal to not having the lens on the eye at all. Although lens wearers may still experience complications with these lens materials, the oxygen permeability of the lenses creates a much healthier environment. PMMA lenses have a Dk of 0 vs. GP lens materials with Dk values of 25 to greater than 100. Silicone hydrogel lenses provide up to eight times more oxygen to the cornea than conventional hydrogel lenses.[4] Even wearers who remove their lenses daily will benefit from the oxygen permeability of these materials. With these advances, the older lens materials with limited Dk values have little to no use *(figure 1)*.

Contact Lens Care

Practitioners, staff and contact lens wearers often do not take lens care seriously; however, lens care can be a large factor in determining the success of contact lens wear. Sources of contamination for the lens are the hands, the environment, tear film, case and solutions. Hand washing prior to handling lenses is important to prevent bacteria from

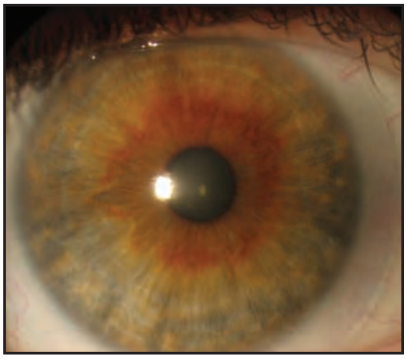
Dr. Henry is a Clinical Professor, Director of Residency Programs, Co-chief of the Contact Lens Service and co-instructor in the Contact Lens courses at the College of Optometry University of Missouri-St. Louis. She is a Fellow in the American Academy of Optometry and a Diplomate in the Cornea and Contact Lens Section.

contaminating the lens. I prefer to use antibacterial soap that is free of lotions, so as not to transfer oils or lanolin to the lens surface.

Contact lenses should be disinfected every time lenses are removed from the eye. Handling a lens and wearing it without disinfection increases both bacterial contamination and the risk of infection. In addition, wearers may disrupt the corneal epithelium when removing or inserting a lens, which offers bacteria an entry point. The proper care regimen for a GP lens is to remove the lens, clean and rub it to remove deposits and disinfect it prior to wear. Most disinfection regimens take four to six hours to complete. This includes most GP and soft lens solutions. Generally contact lens wearers disinfect lenses overnight.

For shorter periods of disinfection, AQuify (CIBA Vision) takes five minutes to disinfect a lens. Storing a GP lens in hydrogen peroxide solution, such as ClearCare (CIBA Vision) or Oxysept (Abbott Medical Optics) for 10 minutes in a typical flat pack is a way to rapidly disinfect a GP lens. After disinfection, patients must rinse the lens and reinsert it with a wetting or conditioning solution. Either method can be helpful if a lens wearer is seen in-office, and the lenses need to be disinfected prior to reinsertion. When fitting patients with diagnostic lenses, the use of single-use soft lenses or disinfecting diagnostic GP lenses in hydrogen peroxide will aid in prevention of infection.

Many solutions, especially multipurpose solutions—which clean, disinfect and wet the lens—have been marketed as "no-rub" solutions. In order to properly clean the lens, patients must use copious amounts of solutions. Most contact lens wearers have interpreted



1. This healthy eye is wearing a silicone hydrogel contact lens that demonstrates good centration and fit.

this "no-rub" phrase to mean no rubbing or rinsing, which may have resulted in increased infections among contact lens wearers. Rubbing and rinsing a lens alone without disinfection is helpful in removing debris and bacteria from a lens.[5] The lens should be rubbed for 10 to 20 seconds on both sides. This is especially beneficial with silicone hydrogel lens materials, which can be more prone to deposits due to the silicone component of the lens. Patients should be educated to rub and rinse their lenses upon lens removal, despite labeling that specifies "no-rub." Simply ask them to imagine a dirty dish that is rubbed with soap and rinsed as opposed to simply rinsed with water; this scenario should help the lens wearer understand the benefits of rubbing the contact lens.

Contact lens wearers are often confused by the many different types of solutions that are available to them. Ideally, wearers will continue using the solution prescribed for them, but when shopping, they may see what appears to be a generic equivalent of their product or another solution on sale and switch without realizing that the new product is not optimal for them. By switching products, the wearer may be using a different preservative, not properly disinfecting, not cleaning or not properly conditioning the lens. All of these outcomes may produce complications for the wearer, either by contamination or reduced comfort. By properly and consistently educating the wearer on the purpose of the solution and the importance of sticking to that solution, the wearer will understand the role of the solution in successful wear. Contact lens wearers tend to think that the solutions are interchangeable and have little to do with comfortable lens wear. When the practitioner spends a little additional time on patient education, patients can make wiser decisions regarding their lens care products. An additional tip in educating the patient is to use other patients' experiences to reinforce serious and thoughtful lens care. Examples of this would be a patient who cut down on lens wear due to discomfort, which improved when he returned to his originally prescribed solutions or a patient who developed a solution sensitivity to a preservative in a generic solution.

Acanthamoeba Keratitis

Some lens wearers use tap water to rinse the cleaner from a GP lens. I prefer to discourage tap water use, but if tap water is used, remind patients that tap water should only be used prior to disinfection. Many GP patients eventually begin to use tap water to rinse a lens prior to reinsertion or occasionally to rinse off the wetting solution. This puts the patient at risk for an infection and *Acanthamoeba* keratitis. I recommend using saline rather than tap water to rinse the cleaner from the lens. Tap water should never be used on soft lenses, because it puts the patient at risk for *Acanthamoeba* keratitis. The water-borne protozoa that cause *Acanthamoeba*

infection can exist in a trophozoite form or can change to a cyst form if threatened. Once it changes into a cyst, it is more difficult to eradicate. Besides using tap water on the lens, practices such as showering and swimming in contact lenses also put a patient at risk for *Acanthamoeba* keratitis. Some outbreaks more recently have been attributed to changes in water purification systems.[6,7]

Patients who are afflicted with *Acanthamoeba* keratitis present with symptoms of pain, photophobia and tearing that appear to be more severe than the typical clinical signs. A stromal ring of infiltrates or an epithelial lesion that looks dendritic begins to appear as the infection increases. Treatment for *Acanthamoeba* consists of two to three medication combinations, such as antifungals (fluconazole or clotrimazole), cationic antiseptics (polyhexamethylene biguanide or chlorahexidine), diamides (propamidine) and aminoglycosides (neomycin or paromomycin).[8] If the infection is left untreated, corneal perforation can occur, which requires a corneal transplant. Fortunately, proper disinfection, rubbing and rinsing the contact lenses, avoiding tap water contact with lenses and avoiding swimming with lenses will greatly minimize the risk of infection. For this reason, proper patient education is the key.

Solution Intolerance

Some contact lens wearers may have a sensitivity to the preservatives in contact lens solutions. When you are performing a case history and patients mention sensitivities—notably to cosmetic and facial products—it is beneficial to have them use non-preserved solutions. Although it may affect GP wearers, it is typically more of an issue with soft lens wearers. Hydrogen peroxide care systems, such as Oxysept, ClearCare and AOSept (CIBA Vision) provide disinfection without preservatives. When using multipurpose solutions for lens care, you could try a different solution if patients exhibit solution sensitivity.

Switching to a different preservative may relieve the symptoms. It is important for the practitioner to know the preservatives used in solutions, so patients with sensitivity may be switched to a different preservative *(table 1)*.

Symptoms of solution sensitivity may be dryness, grittiness, burning, reduced wearing time, itching, injection and corneal staining; symptoms can range from vague complaints to significant irritation. When a patient presents with these symptoms, eye care practitioners can take one of two actions: recommend changing the solution or prescribe daily disposable soft contact lenses that require no solution use at all. The latter option is ideal for those patients with significant or multiple sensitivities.

Deposits

Lens deposits provide a mechanism for bacteria to adhere to the surface of the contact lens, thereby increasing the risk for infection. In addition, lens deposits decrease comfort and visual acuity *(figure 2)*. Thorough lens cleaning upon removal of the lens decreases deposits as does frequent replacement of the lens. GP lenses should generally be replaced about every two years, as opposed to most soft lenses, which should be replaced

Table 1. Common Gas-Permeable and Soft Lens Solutions and Preservatives

Solution	Manufacturer	GP or Soft	Preservative
Complete Multi-Purpose	Abbott/AMO	Soft	Polyhexamethylene biguanide
Opti-Free Express	Alcon	Soft	Polyquad & Aldox
Opti-Free RepleniSH	Alcon	Soft	Polyquad & Aldox
ReNu MultiPlus	Bausch & Lomb	Soft	Dymed
AQuify	CIBA Vision	Soft	Polyhexanide
Opti-One & Opti-Free	Alcon	Soft	Polyquad
Opti-Free GP	Alcon	GP	Polyquad
Boston Simplus Multi-Action & Boston Advance Comfort Formula Conditioning Solution	Bausch & Lomb	GP	Chlorhexidine gluconate & Polyaminopropyl biguanide
Boston Original Conditioning Solution	Bausch & Lomb	GP	Chlorhexidine
Optimum	Lobob	GP	Benzyl alcohol, disodium edetate, sorbic acid
MeniCare	Menicon	GP	Benzyl alcohol, disodium edetate

every two weeks to every month. But, there are still a few specialty soft lenses that are replaced quarterly or annually. Lens deposits are patient-dependent as some patients are more prone to deposits than others. This can depend upon the quality and quantity of the tear film, blink rate, blink quality (full or partial), wear time (daily vs. extended wear), replacement schedule and the patient environment. Rubbing and rinsing the lens upon removal vs. waiting until lens insertion, aids in removing deposits before they become more adherent to the lens. For particularly heavy depositors, daily disposable lenses are a good option.

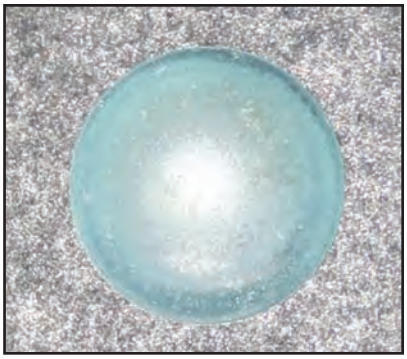
Case by Case

Eye care practitioners know how crucial lens case hygiene is to safe and healthy lens wear. We educate patients on the importance of routine cleaning and replacement of cases. Still, some contact lens wearers can be particularly lax in caring and replacing their case. More often than not, cases presented at routine eye examinations are dirty, broken, discolored or have build-up *(figure 3)*. Their owners do not appear to recognize the importance of keeping their cases clean and in good shape. Build-up on the case, especially a biofilm inside the case, can be a perfect environment for bacteria to flourish, resulting in a source of ocular contamination. Studies have found that 70% to 80% of cases have been contaminated with bacteria, fungi, yeasts and amoebae.[9,10] We must stress the magnitude of this issue and remind our patients that cases should be replaced, at maximum, every three months. Many care systems now include a case in the solution package; providing a case at examinations may encourage case cleanliness. When a dirty case is used during an examination, the patient should be educated about the complications associated with dirty cases. Discarding the dirty case in front of the patient after issuing a new case may aid in reinforcing case cleanliness.

When cleaning the case, the patient should discard any residual care solution from the case. The case should be rinsed with disinfection solution and allowed to air dry. Cases may be sterilized in boiling water or microwaved for three minutes.[11] ProGuard (CIBA Vision) is a case that incorporates silver, an inorganic antibacterial agent, to enhance protection against bacteria.

Topical Interferences

Cosmetic products, such as aftershave lotions, acne medications and other topical facial preparations, can be a source of lens contamination. This results when ingredients in the product used are not compatible with the lens or the corneal surface or there is bacterial growth in the product container. Cosmetic products should be discarded every three to six months to eliminate the risk of bacterial contamination. Cosmetics should not be shared, as this is a mechanism of spreading infection. In addition, eye liners, mascara and waterproof cosmetic products can block the meibomian glands and introduce bacteria when applied on the lid margin. Products used on the lid margins also increase the risk of corneal injury or contact lens contamination when the application wands or cosmetic particles inadvertently come in contact with the eye. Water-soluble and hypoallergenic products are preferred for contact lens wearers. Instruct patients to apply cosmetics after the contact lens is inserted to aid in eliminating contact of the lens with the cosmetic product.



2. This heavily coated lens was worn by a patient that had failed to properly clean or replace its GP lens.

Replacement and Wearing Schedules

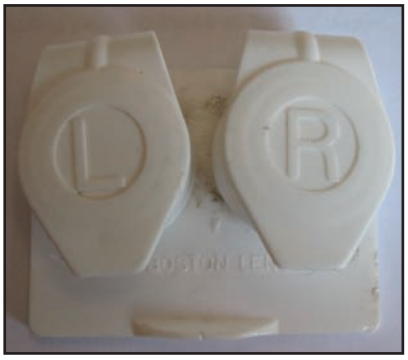
Wearing and replacing contact lenses for the prescribed period of time also plays a role in minimizing infections and complications. Although many soft hydrogel lenses have been approved for six nights of extended wear, with the introduction of silicone hydrogel lenses and the increase in oxygen transmission (Dk/t) with these materials, it is no longer in the patient's best interest to fit hydrogel lenses for more than daily wear usage. Depending on the recommended wearing time, silicone hydrogel lenses can be worn for six nights of extended wear (EW) or 30 days of continuous wear (CW). Patients vary in their corneal oxygen demands, and some patients cannot successfully wear any lens overnight. These patients still benefit from the Dk of silicone hydrogel lens materials even on a daily wear basis. This is also the case with GP lenses. Although when handled daily, the durability of super-permeable GP materials can be decreased, the same moderate-to-high Dk GP lens materials can be used interchangeably for daily wear and extended wear patients. This provides the

necessary oxygen to the eye, providing a safeguard for those patients who overwear their lenses. It is not uncommon for patients to decide to start sleeping in a lens that has not been prescribed for overnight use. When the eye does not react in an adverse manner, the wearer becomes confident and pushes the limits, a decision that often results in complications.

Contact lens wearers may often exceed the recommended lens replacement period. Daily and monthly lens replacements are easiest for the patient to remember. You can help patients remember to replace two-week lenses by recommending that they do it on the first and the 15th of the month. While extreme cases of noncompliance are the minority, most lens wearers do not strictly follow their recommended wearing schedule. Make sure your patients realize the advantages of following a recommended replacement schedule, which are comfort, vision, convenience, fewer lens deposits, increased lens wear satisfaction and fewer ocular complications. Deposited lenses increase the likelihood of bacterial adherence to the lens, thus increasing the risk of infection. This is also true of GP lenses, which although typically are not replaced more often than annually, do have recommended replacement schedules of every two years.

Education is paramount in helping the patient understand the importance of their wearing and replacement schedules. Participants of one study reported that if they knew that proper replacement schedules would affect their comfort and vision, they would be more compliant.[12]

Practitioners and staff must educate the patient and reinforce patient education at each visit. Written materials, newsletters, e-mail and text message reminders can be



3. This dirty case was brought in by a patient. Note the debris and dirt collected on the lens case, which could have resulted in lens contamination.

beneficial in increasing patient compliance. Additionally, spare lenses benefit the patient in case of lens loss or lens damage. Complications and infections may be the result of damaged lenses that patients continue to wear because they need the vision correction and don't have access to new lenses. Remind patients to have spare lenses on hand at all times.

Additional Compliance Issues

Practitioners must be aware of all noncompliant patient behaviors, so that they can effectively cover each one during the exam. Issues such as topping off solutions, using expired solutions and keeping solution bottles capped between uses must be addressed. Topping off the solution means to add solution to a case already partially filled with solution, rather than discarding it. This practice fails to disinfect because the solution in the case is already depleted of its disinfecting characteristics and a small amount of fresh solution cannot adequately disinfect lenses. In addition, the case is not being cleaned daily, which increases the risk of bacterial contamination and biofilm growth. A real-life example that may make this concept more meaningful to the patient is the example of a pet-watering dish. If water is merely added and not replaced, a noticeable biofilm can be found in the dish with stagnant water. Using examples such as this may encourage the patient to be more careful with their lens and case care.

As noted previously, tap water use is a source of *Acanthamoeba* with contact lenses. Myopic patients do not like to swim and not be fully corrected. Swimming pools, hot tubs, lakes, streams and even showers can be other sources of *Acanthamoeba*. Not wearing contact lenses is the only way to minimize the complication of *Acanthamoeba* keratitis; however, some wearers do use goggles with daily disposable contact lenses that are removed and discarded immediately after. Avid swimmers may benefit from overnight orthokeratology or goggles with visual correction to prevent the use of contact lenses while swimming. Many wearers are not properly educated on swimming with contact lenses, and they proceed to wear lenses, reuse the lenses and even sleep in lenses after swimming in them, greatly increasing their risk for complications.

Back-up Spectacles

All contact lens patients would benefit from some type of spectacle correction that can be used to supplement contact lenses. Too many patients continue lens wear—even when there is a complication. They do this for one of several reasons: their spectacles that are out of fashion, they are the wrong prescription, or the patient does not have any spectacles. The severity of the complication increases with the contact lens wear, and these patients end up having to discontinue contact

Table 2. Guidelines for Managing Contact Lens-Induced Complications [8]

Condition	Suggested treatment
Bacterial conjuctivitis	Aminoglycoside or fluoroquinolone.
Bacterial keratitis	Fluoroquinolone drops with ointment at night.
Acanthamoeba keratitis	Antifungals, cationic antiseptics, diamides, aminoglycosides.
Fungal infection	Natamycin or amphotericin B.
Corneal abrasion	Fluoroquinolone or aminoglycoside drops with ointment at night, non-steroidal anti-inflammatory drug (NSAID) for pain, cycloplegic agent.
Vascularized limbal keratitis	Antibiotic/Steroid combination such as Zylet or TobraDex.
Giant Papillary Conjunctivitis or contact lens-induced papillary conjunctivitis	Antihistamine/Mast cell stabilizer combination.
CLARE	Antibiotic/Steroid combination such as Zylet or TobraDex.
Dry eyes	Artificial tears, punctal plugs, Omega-3 fatty acid supplementation, anti-inflammatory therapy with Lotemax and Restasis.

lens wear for several days. For this reason, contact lens wearers should be encouraged to have current back-up spectacles. You can encourage back-up spectacles by providing programs or discounts that include spectacles for the contact lens wearer.

You could also present patients with a pamphlet or informational sheet with their contact lens prescription. Title it something along the lines of "The Recipe to Lens Wear Success," and include the following items:

- Back-up spectacles.
- Hand washing.
- Case hygiene and replacement.
- Recommended lens replacement.
- Rubbing the lens.
- Disinfection.
- Proper solution use.
- Not topping off.
- Caution during water activities.
- Proper wearing schedules.

Managing Contact Lens Induced Complications

Many contact lens induced complications will be eliminated by careful follow-up examinations and improved patient compliance. But, some complications require the use of therapeutic medications *(table 2)*. Additionally, researchers are looking into providing surface treatments to contact lenses that may successfully reduce or eliminate bacterial contamination of contact lenses. Time will tell whether this will be another method of minimizing the risk of infection.

Share the Knowledge

The greatest weapon eye care practitioners have to minimize the risk of infections in contact lens wearers is to provide serious and consistent patient education, encouraging good patient compliance. The use of real-world examples to help drive home the message may aid in patient understanding. Educated patients understand the relationship between compliance and comfortable contact lens wear. Thorough documentation of patient education and the use of patient informational materials are also beneficial. But, remember—patients who show a total disregard for contact lens safety guidelines should not be fit with contact lenses. Eye care practitioners must know when lens wear is contraindicated, and this too becomes a way to prevent lens-related infections risks and complications. RCCL

1. Poggio EC, Glynn RJ, Schein OD, et al. The incidence of ulcerative keratitis among users of daily-wear and extended-wear soft contact lenses. N Engl J Med. 1989 Sep 21;321(12):779-83.
2. Schein OD, Glynn RJ, Poggio EC, et al. The relative risk of ulcerative keratitis among users of daily-wear and extended-wear soft contact lenses. A case-control study. Microbial Keratitis Study Group. N Engl J Med. 1989 Sep 21;321(12):773-8.
3. Cheng KH, Leung SL, Hoekman HW, et al. Incidence of contact-lens-associated microbial keratitis and its related morbidity. Lancet. 1999 Jul 17;354(9174):181-5.
4. Sweeney D, Fonn D, Evans K. Silicone hydrogels: the evolution of a revolution. Contact Lens Spect. 2006;Special Edition:14-9.
5. Penley CA, Willis SW, Sickler SG. Comparative antimicrobial efficacy of soft and rigid gas permeable contact lens solutions against *Acanthamoeba*. CLAO J. 1989 Oct-Dec;15(4):257-60.
6. Joslin CE, Tu EY, McMahon TT, et al. Epidemiological characteristics of a Chicago-area *Acanthamoeba* Keratitis outbreak. Am J Ophthalmol. 2006 Aug;142(2):212-7.
7. Gutman C. *Acanthamoeba* Keratitis increasing at alarming rate. Ophthalmol Times. 2006 Jan 1.
8. Melton R, Thomas R. Management of contact lens-associated or lens-induced pathology. In Bennett ES, Henry VA eds. Clinical Manual of Contact Lenses, 3rd edition. Philadelphia. Wolters Kluwer/Lippincott Williams & Wilkins. 2009:557-575.
9. Caiazzo F, Palazzo GS, Pasquino R, et al. Comparative study of the microbial flora on contact lenses, in lens cases and in maintenance liquids. Int Contact Lens Clin. 1996 Mar;23(2):55-8.
10. Lakkis C, Harding AS, Brennan NA. Case contamination with hydrogel lens wear. Clin Exp Optom. 1997 May/June;111.
11. Bennett ES. *Acanthamoeba* keratitis in 2007: stay informed but calm. Contact Lens Spect. 2007 June;22(7):50-2.
12. Woods C. The MAPLE Study: A summary. Presented at the CIBA Vision Educators Meeting. Santa Fe, NM, March 2009.