Supplement to

May/June 2020

MODERN OPTOMETRY

EVOLVING CONCEPTS IN ANTERIOR SEGMENT OUTCOMES:

TACKLING OCULAR SURFACE DISEASE, COMANAGING PREMIUM IOL PATIENTS, AND IDENTIFYING NEW KERATOCONUS TREATMENTS

This activity is supported by unrestricted educational grants from Alcon, Carl Zeiss Meditec, Glaukos, and Johnson & Johnson Vision.

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Distributed with *Modern Optometry.*

Release Date: May 15, 2020
COPE Expiration Date: April 26, 2023

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Evolving Concepts in Anterior Segment Outcomes: Tackling Ocular Surface Disease, Comanaging Premium IOL Patients, and Identifying New Keratoconus Treatments

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ACTIVITY DESCRIPTION:

The pathways for surgical comanagement may not be clearly defined for cataract, refractive, and corneal patients. The health of the ocular surface is important for patient comfort and is essential for accurate preoperative measurements, so optometrists must accurately diagnose and treat various levels of ocular surface disease (OSD) and meibomian gland dysfunction. Understanding the various intraocular lens options is essential when counselling cataract patients, managing their expectations, and optimizing their postoperative outcomes. Knowing how to diagnose, monitor, and treat corneal disorders is essential in the modern surgical practice.

This educational activity provides real-world examples of how optometrists in a cataract refractive surgical setting can appropriately set preoperative expectations, manage OSDs and corneal disorders, and manage postoperative care, all of which contribute to patient satisfaction and visual outcomes following surgical procedures.

TARGET AUDIENCE:

This educational activity is intended for optometrists.

LEARNING OBJECTIVES:

Upon completion of this program participants will be better able to:

- Identify methods to improve surgical, ocular surface and corneal disease outcomes through comanagement of cataract, refractive, and corneal patients.
- Review diagnostic tests and therapeutic decisions for OSD patients based on disease classification.
- Evaluate standardized preoperative evaluation and postoperative outcomes assessment for patients with presbyopia- and/or astigmatism-correcting intraocular lenses.
- Describe diagnosis and treatment strategies for patients with keratoconus, including corneal crosslinking.

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Course ID Number: 67981-AS
Activity Number: 119427

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1. An effective way to determine a patient's typical reading distance is to _____.
a. Drop a reading card on the floor and ask the patient to pick it up and read it.
b. Offer patients options on a questionnaire.
c. Ask family members to observe the patient.
d. Use the brightness acuity tester.

2. _____ was reported to be part of an effective treatment strategy for patients with meibomian gland dysfunction who plan to have cataract surgery or corneal refractive surgery soon.
a. Punctal plugs
b. Ocular lubricants
c. Lid scrubs
d. Thermal pulsation

3. The following is a key message for patients who are contemplating presbyopic IOLs: Presbyopic IOLs will _____.
a. Eliminate their need for glasses
b. Reduce their need for glasses
c. Eliminate night vision disturbances
d. Restore the vision they had in their 20s

4. Consistent tear breakup in the same area on corneal staining was reported to indicate _____.
a. Ocular allergies
b. Keratoconus
c. Epithelial basement membrane dystrophy
d. Sjögren syndrome

5. Epithelium-off corneal crosslinking _____.
a. Eliminates the need for scleral contact lenses in patients with keratoconus
b. Can be used during pregnancy in patients with keratoconus
c. Cures keratoconus
d. Can halt progression of keratoconus

OCULAR SURFACE DISEASE: CONQUERING A MAJOR BARRIER TO PATIENT SATISFACTION

Innovative tools and skills help doctors deliver optimal postoperative outcomes.

BY DOUGLAS K. DEVRIES, OD

We play an important role in preparing patients for cataract and refractive surgery and postoperative management. In many cases, postoperative difficulties after cataract or refractive surgery are caused by dry eye. Therefore, we need a strong set of strategies to diagnose and treat ocular surface disease and resolve these problems so patients can achieve the postoperative outcomes they expect.

CASE 1: PRK CANDIDATE AFTER CATARACT SURGERY

A 68-year-old candidate for a photorefractive keratectomy (PRK) touchup had cataract surgery in both eyes 3 months previously. She elected not to have a toric intraocular lens (IOL).

Her spectacle-corrected visual acuity (VA) was 20/30 OD, 20/25 OS, and 20/25 OU. Her manifest refraction was +0.50 -1.25 x 170 and +0.50-1.00 x 025. Her tear osmolarity readings were 299 and 291 mOsmol/L, which were normal. She had mildly positive MMP-9 results.

Meibography showed some dropout, segmentation, and dilation of meibomian glands (Figure 1), indicating that the meibomian glands are trying to release meibum but having difficulty. Her meibum was discolored and turbid, which reduced tear breakup time. Meibomian gland dysfunction (MGD) and keratoconjunctivitis sicca (KCS) were diagnosed.

Ray-tracing wavefront and corneal topography showed a slightly skewed axis on one eye and inferior steepening, so we initially questioned whether this patient would be a suitable PRK candidate (Figure 2).

When assessing patients for cataract surgery, we need to not only set their expectations, but determine whether laser vision correction can be used for a postoperative touchup. If patients have abnormal or thin corneas or irregular astigmatism, they need to know that an enhancement cannot be performed after cataract surgery. This could influence the decision to have a higher technology IOL.

We have a broadening range of options to treat MGD. These include warm compresses, omega fatty acid supplements, lifitegrast, cyclosporine, intense pulsed light, and more.

With thermal pulsation (Johnson & Johnson Vision), single-use activators are applied to the eyelids, which heat and massage the meibomian glands to liquefy the meibum and relieve the obstruction. If your practice does not own thermal pulsation technology, consider co-owning it with other doctors. Each practice can perform its own scans and schedule thermal pulsation during its particular time slot with the device.

Another device, a wearable software-controlled technology (Sight Sciences), applies targeted thermal energy to the meibomian glands. The patient's natural blinking and the device facilitate expression of melted meibum from the glands. An additional technology, a handheld device, applies light-based heat to melt the meibum (Alcon); then compression is applied to express meibum from the glands. Blepharoexfoliation also can be used to debride the lid margin and remove biofilm.

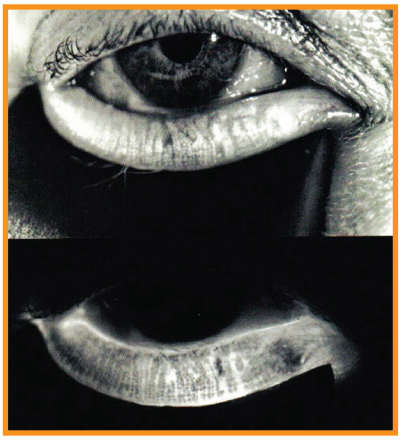

Figure 1. Case 1: Meibography showing dropout and dilation of meibomian glands.

Before this patient underwent laser vision correction, we treated her MGD and KCS with cyclosporine drops, blepharoexfoliation, and thermal pulsation.

Treatment normalized her refraction and corneal topography so we could perform PRK to correct her vision. Patients should be reminded that ongoing ocular surface treatment is necessary after the procedure.

When prescribing lifitegrast and cyclosporine, it's important to understand the difference between them. Lifitegrast is an LFA-1 antagonist and cyclosporine is an immunosuppressant. They are two different classes of drugs and seem to have a synergistic effect in my experience. I have had tremendous success using them together in patients with more advanced disease. I document that patients felt better using the combination rather than a single drug in order to obtain insurance authorization.

If a patient wants to have surgery soon, I treat aggressively, beginning with one of the dry eye drugs and performing thermal pulsation, which achieves results quickly, usually within 3 weeks.

Discomfort may lead patients to stop wearing their contact lenses. I assess these patients with tear osmolarity and meibography. Studies have shown that a single thermal pulsation treatment increases contact lens wear time by 4 hours in patients experiencing discomfort from contact lenses.[1]

I use this strategy to normalize and stabilize the patient's refraction prior to cataract or refractive surgery.

If a patient is using rigid gas-permeable contact lenses and desires refractive surgery, the refraction is stable when the cornea stops changing. Repeat corneal topography scans are the same and we can achieve a good corrected refraction. In some cases, it takes a long time to rehabilitate the corneas, but we need to stay the course until we achieve a normalized refraction and corneal topography.

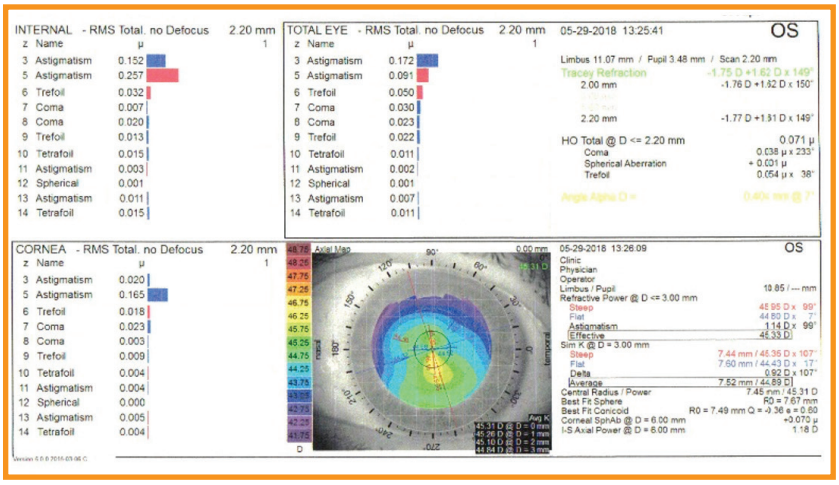

Figure 2. Case 1: Ray tracing and corneal topography.

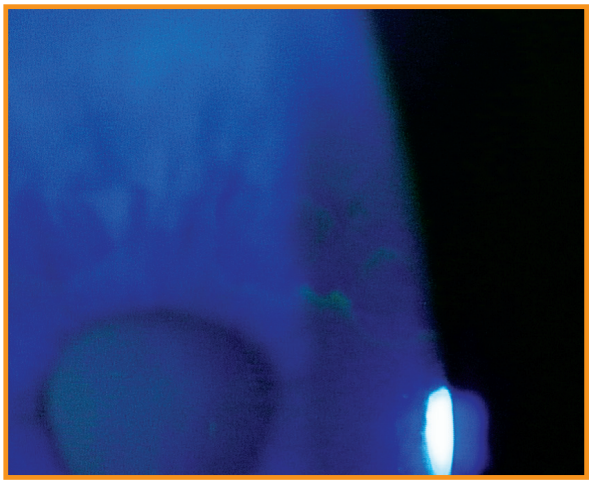

Figure 3. Case 2: Tear breakup occurred in the same area each time the patient blinked.

CASE 2: EBMD

This case exemplifies a fairly common referral I receive, where doctors have mistakenly diagnosed epithelial basement membrane dystrophy (EBMD) as dry eye. They will treat the inflammation, but the patient does not improve as they would expect them to.

A 72-year-old woman had scratchy, dry, burning eyes. Tear osmolarity was 306 and 302 mOsmol/L, which was within 8 mOsmol/L and the normal range. MMP-9 results showed moderate to severe inflammation in both eyes.

The patient also showed trace micro-punctate epithelial keratopathy. Meibography showed shortened glands and inflammation. When the patient blinked during corneal staining, tear breakup occurred in the same pattern and same area each time (Figure 3); tear breakup is usually more random.

Under the white light and magnification, it appeared normal. The patient's symptoms typically occurred in the morning, so we determined that it was early EBMD, which repels tears, causing breakup in the same spot each time. A stressed epithelium releases MMP-9, causing high MMP-9 readings.

As a result, we categorized the case as ocular surface disease rather than dry eye alone. In such cases, we explain to patients that our goal is to reduce inflammation to slow down progression of the EBMD and control dry eye. We emphasize that we are going to control but we cannot cure either. When we can no longer control it and it affects the patient's vision, we use biologic means. Patients usually respond well to tissue debridement, superficial keratectomy, and an amniotic membrane. I also use this option for recalcitrant punctate epithelial keratopathy (PEK) in patients who are preparing for surgery or who have had no response to treatment. However, patients need to understand that this treatment is not comfortable.

We treated this patient with preservative-free ocular lubricant drops 4 times a day, which have an oncotic pressure (Eyevance) and draw out some swelling to reduce symptoms. We also prescribed lifitegrast twice a day, omega fatty acid supplements, and lipid-replenishing emulsion eye drops.

1. Blackie CA, Coleman CA, Nichols KK, et al. A single vectored thermal pulsation treatment for meibomian gland dysfunction increases mean comfortable contact lens wearing time by approximately 4 hours per day. *Clin Ophthalmol.* 2018; 12:169-183.

PRESBYOPIC IOLS CAN HELP PATIENTS ENJOY A GREATER RANGE OF ACTIVITIES WITHOUT GLASSES

Understanding a patient's way of life should be considered when discussing refractive intraocular lens options.

BY MARC R. BLOOMENSTEIN, OD, FAAO

Optometrists play an integral role in helping patients achieve the vision they expect from refractive intraocular lenses (IOLs).

Seniors are active and engage in more active pursuits than previous generations. To identify the best IOL options for our patients, we need to learn which activities are most important to them, where they prefer to hold their reading materials, for which activities they are willing to use glasses, as well as their other visual needs.

CASE 1: SECOND OPINION

A 67-year-old retiree travels and drives for a ride-sharing service. She only drove during the day because it was harder for her to see at

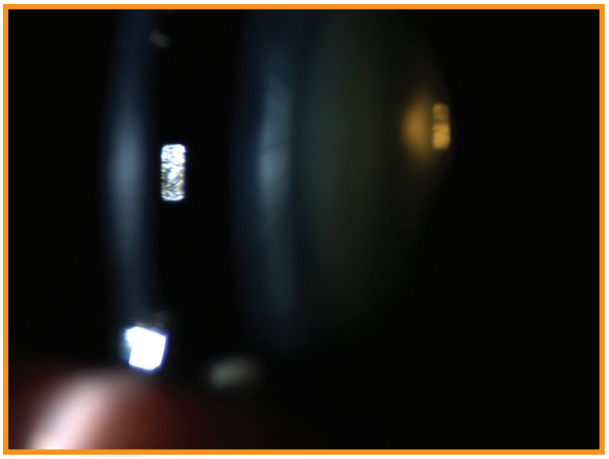

Figure 1. Case 1. Dysfunctional Lens Grade III: ACC and NSC.

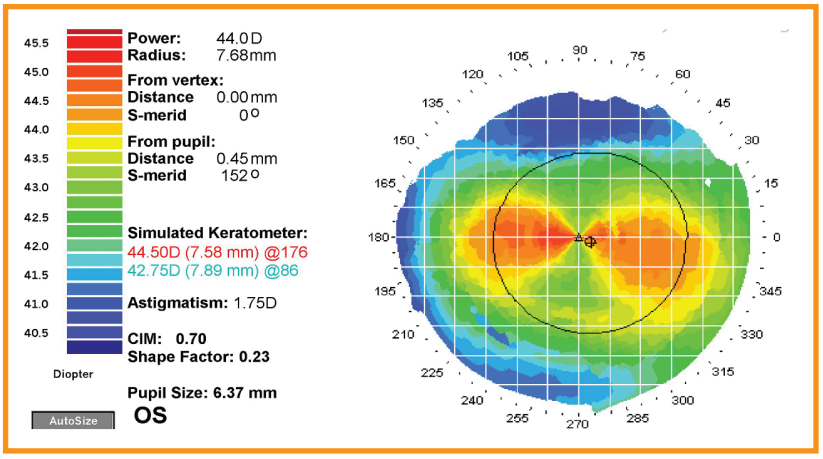

Figure 2. Case 2. Left eye corneal topography.

night. She enjoys reading paperback books, playing computer poker, and line dancing. To meet her lifestyle requirements, she needs good distance vision and close vision. She has a small frame and short arms.

She came to our office for a second opinion because her optometrist suggested she wait for cataract extraction.

Her manifest refraction was -1.25 +0.25 x 90, 20/25 OD; -1.00 +0.50 x 90, 20/20 OS. Corneal topography was normal. Glare testing was high 20/100 OD, high 20/50 OS. Slit-lamp examination showed 2+ milky nuclear sclerotic cataract (NSC)/anterior cortical cataract (ACC) OD (Figure 1); 1+ milky NSC/ACC OS. Posterior examination was within normal limits.

We need to resolve our patients' night vision problems, and glasses will not help. Furthermore, we need to consider how nuclear sclerosis or anterior cortical changes impact their functional vision. Visual acuity (VA) is not the only determiner for cataract extraction. If a patient reduces to greater than 20/40 VA when we use a brightness acuity tester, we indeed have dysfunction. I explain to patients that the "dysfunctional lens" is affecting their vision quality, impacting nighttime vision, inducing more glare, and changing their computer use. Cataract surgery is the procedure where we remove the dysfunctional lens and replace it with an implant. I describe how this surgery can help improve their vision and allow them to enjoy their daily activities while reducing their dependence on glasses.

In a competitive ophthalmic market, you always want to be an early adopter, and we were first in our area to implant extended depth of focus lenses (EDOFs), offering our patients a continuous range of vision. When EDOFs were introduced, it was believed taller patients with long arms were the best candidates because their reach extended their depth of focus. Our first patient was 6'4" with 20/15 postoperative distance vision, J1+ near vision, and intermediate vision at the computer. To say he was very pleased with his results is an understatement.

Our second EDOF patient, a photographer, had a previous multifocal IOL in the fellow eye. The EDOF reverses chromatic aberrations, enhancing colors, which are important to this patient's work. I remember him placing his hand over each eye, one at time, to compare vision in each eye. He proclaimed how great the colors were in the EDOF lens and lamented his color choices before this lens.

When you personalize vision, you can implant an EDOF in the dominant eye for good distance vision and assess the near needs of your patient before surgery on the second eye. If more near or intermediate vision is needed, a low or midrange multifocal in the other eye will allow seamless vision. In fact, our line-dancing, ride-sharing driver who loves to read paperbacks was a perfect candidate for personalized vision. With her short stature and desire to have near vision and maintain good distance, we were able to meet all her needs.

CASE 2: MYOPIA CORRECTION

A 69-year-old myopic engineer enjoyed a full range of pastimes—making flies for fishing, skiing, and running marathons—and he wanted to reduce his dependence on glasses.

His manifest refraction was -3.75 + 0.50 x 85, 20/20 OD; and -3.50 + 0.50 x 105, 20/50 OS.

Corneal topography showed significant astigmatism, although his refraction was almost spherical (Figure 2). When dealing with cataracts or astigmatism, it is better to provide patients with too much information rather than too little. We need to take the extra few seconds to explain corneal cylinder in contrast to lenticular astigmatism. In the absence of this explainer, patients can lose trust in their referring OD or question the importance of treating corneal astigmatism.

We also need to keep in mind that myopic patients can be challenging. Myopic patients are accustomed to having good near vision; thus, we need to discuss what they will gain and lose with presbyopia-correcting IOLs. Although we may under correct the nondominant eye in most myopes, they may not be fully corrected in the distance eye. The lens often may add to their near vision; thus, after cataract surgery with monovision, the results do not always match their preoperative contact lenses. As with any patient, but more importantly with myopes, we also must ask them for which activities they may be willing to wear glasses. To simulate their postoperative vision, I ask them to wear their glasses after pupil dilation, looking through the distance correction. I explain that this approximates their postoperative vision with a standard IOL or toric IOL.

After we discussed the risks versus benefits, this patient wanted

the best distance vision possible, with limited night vision disruptions. Bilateral toric EDOFs were implanted, giving him 20/20 uncorrected VA OU with J2 at near and 20/20 intermediate. In good light, he said, he can almost make out the feathers on his flies, but a 1.00 OTC reader makes it "crystal."

PREMIUM LENS PEARLS

Patient education is an important part of this process, and it is helpful for patients to bring a family member for the discussion. We tell them that today's IOL technology can help them function without glasses or contact lenses, outlining the risks versus benefits compared with monofocal IOLs and the potential need to fine-tune their vision postoperatively.

Administering a questionnaire is a useful way to learn about their activities, what they are seeking from surgery, and for which activities they are more willing to use glasses. We need to explain that EDOFs provide a range of vision and create less glare and halos at night, but they will not restore the vision they had in their 20s and they may need +1.00 glasses for small print. We will not be able to meet unrealistic expectations—so we should not try.

To identify a patient's typical reading distance, I modified a tip from a Canadian colleague: I drop the reading card on the floor and have them pick it up and read it.

If we prepare patients in advance, they will feel confident when they arrive at the surgical center, knowing what to expect from their cataract surgery. Optometrists may not actually perform the surgery, but we can reduce unexpected outcomes by setting patients' expectations ahead of time.

INDIVIDUALIZING CROSSLINKING TREATMENTS: CASE APPLICATIONS

Crosslinking can halt progression of keratoconus and improve spectacle-corrected vision.

GLORIA B. CHIU, OD, FAAO, FSLS

Epithelium-off corneal crosslinking (Glaukos) was approved by the FDA in 2016 for progressive keratoconus and post-LASIK ectasia.

Crosslinking (CXL) not only can halt progression of keratoconus, it can also improve spectacle-corrected vision. Some patients, however, may still require correction with contact lenses after CXL.

In this procedure, the corneal epithelium is debrided approximately 9 mm centrally. It takes about 1 hour to complete. Riboflavin drops are applied at 2-minute intervals for 30 minutes. When a 400-µm minimum intraoperative thickness is confirmed, the clinician continues applying drops while exposing the cornea to UVA light (365 nm, 3.0 mW/cm^2).[1]

In FDA clinical trials in patients with progressive keratoconus, CXL-treated eyes (Avedro) showed increasing improvement in K_{max} from months 3 through 12, with average reduction in K_{max} of 1.4 D in study 1 (single-center study) and 1.7 D in study 2 (multicenter study) at month 12. Sham eyes demonstrated steepening of $_{Kmax}$, with average K_{max} increases of 0.5 D in Study 1 and 0.6 D in Study 2 at month 12.

CASE 1: KERATOCONUS PROGRESSION AFTER PREGNANCY

A 35-year-old radiologist noticed keratoconus progression in her left eye several months after her first pregnancy; her right eye remained stable. As her keratoconus was mild, she had no corneal scars or striae. Corneal topography is helpful to identify keratoconus when clinical signs are not obvious. Anterior segment optical coherence tomography (AS-OCT) is also useful to verify areas of thinning and irregularities.

When wearing soft contact lenses, she experienced discomfort due to allergies and shadows from irregular astigmatism mainly in the left eye. Her incoming spectacle prescription was -5.00 + 1.00 x 110 OD and -4.25 +1.25 x 052 OS with respective acuities of 20/20 and 20/30. Four months later, we performed CXL in her left eye only.

Three months after CXL, her refraction had changed, but even with a toric soft contact lens in her left eye, she was unhappy with the glare and shadows caused by her irregular cornea (Figure 1) because they interfered with her work.

We have a variety of corrective options for keratoconus patients: glasses, soft contact lenses, rigid contact lenses, or scleral lenses. Because changes occur in the cornea and therefore affect vision, it is important to monitor the patient's refraction every few months until it is stable and offer the best corrective modality for their needs and lifestyle.

I eventually fit her with a scleral lens in the left eye that resolved the shadows and provided crisp vision, but she felt the additional care and handling required were cumbersome.

Her keratometry readings have been consistent for approximately 2 years following CXL. She is pregnant with her second child and relieved that she had CXL so her risk for keratoconus progression during this pregnancy is much less. She wears soft lenses and glasses most of the time and her scleral lens as needed at work.

Hormonal changes during pregnancy can affect keratoconus, reducing corneal stiffness and resulting in steepening or decreased sensation and thickness.[2] As a result, keratoconus may manifest during pregnancy in those who are predisposed, and some patients may show progression even after being stable. Therefore, patients

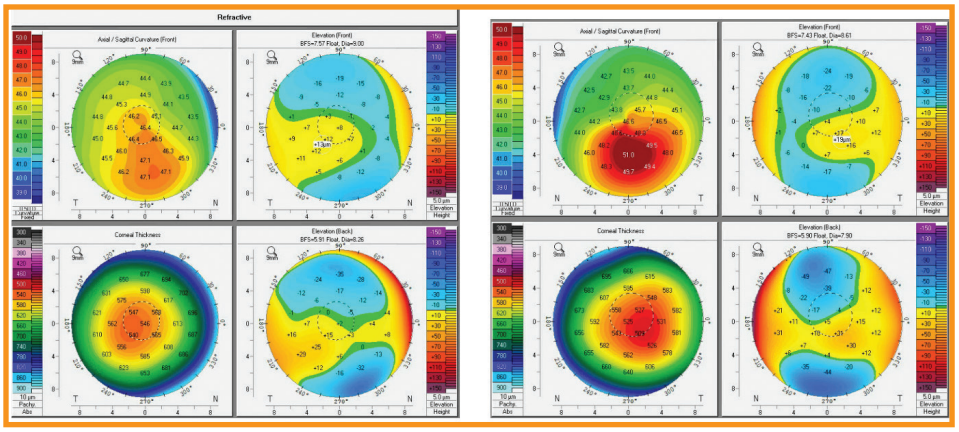

Figure 1. Case 1. Three months post-CXL OS. Average K-values OD: 45.3/46.4 D; OS: 45.5/47.2 D.

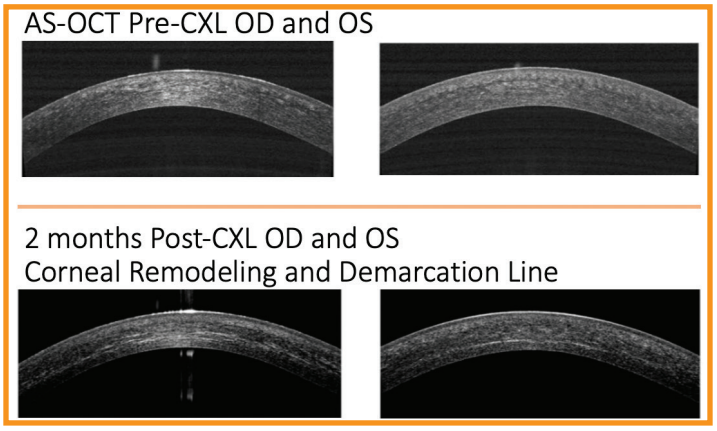

Figure 2. Case 2. Pre-CXL and 2 months post-CXL OU. Demonstrating corneal remodeling changes and demarcation line.

should have regular eye examinations before pregnancy, focusing on changes in their manifest refraction, visual acuities, and corneal topographies. CXL may be considered in high-risk patients before or after pregnancy, but it is not recommended during pregnancy.

CASE 2: POST-LASIK ECTASIA

A 54-year-old woman with a history of LASIK in 2000 presented with declining VA due to progressing ectasia over time. She had 7.25 D cylinder in the right eye and 5.50 D cylinder in the left eye with suboptimal spectacle-corrected vision and dry eye from lagophthalmos.

CXL was performed in her right eye and 1 month later in her left eye.

Patients can be fit for contact lenses before or after CXL, but vision may change during stromal and corneal remodeling. I successfully fit her with a scleral lens 1 month after CXL in her right eye and before CXL in her left eye. I was able to finalize both lenses within the allowed global fitting period and ultimately designed scleral lenses with back and front surface toricity to optimize both the scleral alignment and visual optics.

On anterior-segment optical coherence tomography before CXL, the stromal tissue was relatively smooth and structurally organized in both eyes. Two months after CXL, changes in stromal reflectivity can be observed as the tissue is remodeling; a demarcation line is also apparent, which may indicate depth of the CXL effect (Figure 2).[3]

During the course of 1.5 years, her astigmatism was greatly reduced on manifest refraction and her best-corrected VA with spectacles also improved significantly.

PEARLS FOR PRACTICE

Patients with a family history of moderate to severe keratoconus are at high risk of development themselves. We need to identify this condition early so we can stop progression. In addition, if patients chronically rub their eyes, they may be candidates for CXL because eye rubbing may exacerbate progression.

We should monitor changes in manifest refraction, best-corrected visual acuity, and corneal topography. We need to look for asymmetry on corneal topography and focus on where progression is observed.

Patients need to meet corneal thickness requirements for CXL, which is currently a minimum of 400 µm intraoperatively. The best candidates may often have clear corneas on slit lamp examination, but we need to check carefully for corneal striae, thinning, Fleischer rings, and/or scars on more advanced cases to monitor changes over time.

When in doubt, doctors should refer patients out for further evaluation. Haze may be seen within the first few months after CXL, but it generally clears within 6 months.

In patients with rigid gas-permeable or scleral lenses who have stable and good corrected vision, we still need to remove lenses to perform a refraction and examine the cornea because the contact lens may mask corneal changes. We should see young patients, especially teenagers, every 6 months, and repeat corneal topography.

CXL management presents a unique opportunity to collaborate with and strengthen relationships with ophthalmologists and other eye care providers in your community. It is also very rewarding to change the course of disease progression in these patients and help them achieve stable and optimal vision. ■

1. Photrexa Viscous (riboflavin 5â•Ž-phosphate in 20% dextran ophthalmic solution) 0.146% and Photrexa (riboflavin 5â•Ž-phosphate ophthalmic solution) 0.146% [Prescribing Information]. Waltham, MA: Avedro Inc.; 2016.
2. Naderan M, Jahanrad A. Topographic, tomographic and biomechanical corneal changes during pregnancy in patients with keratoconus: A cohort study. *Acta Ophthalmologica.* 2017; 95:e291–e296.
3. Spadea L, Tonti E, Vingolo EM. Corneal stromal demarcation line after collagen cross-linking in corneal ectatic diseases: a review of the literature. *Clin Ophthalmol.* 2016; 10:1803–1810.

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