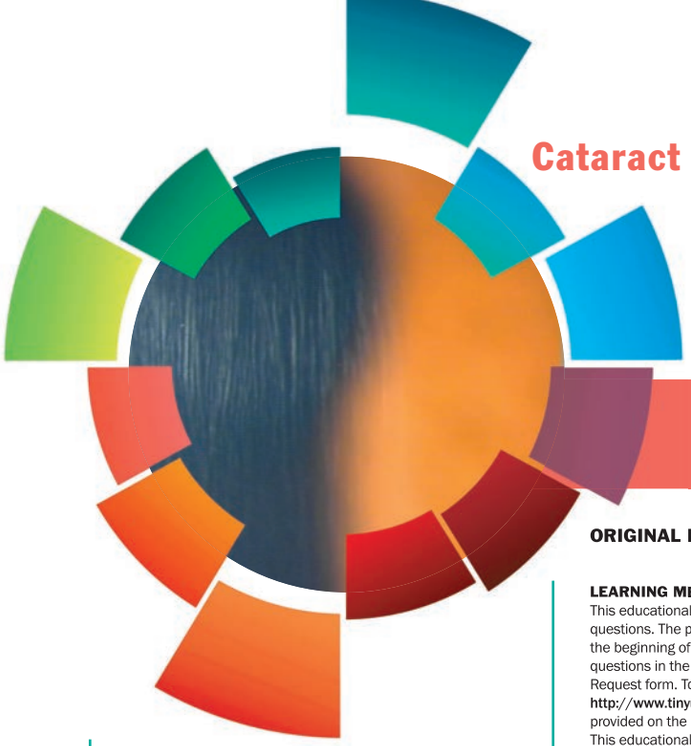

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Cataract Case of the Month CME Series

EYE ON CATARACT™

CHALLENGING CASES MADE ROUTINE

This Month's Case *Cataract Surgery in a Patient With Keratoconus*

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CONTENT SOURCE
This continuing medical education (CME) activity captures content from an expert roundtable discussion held in San Diego, California, on April 16, 2015.

ACTIVITY DESCRIPTION
Cataract surgery is the most commonly performed surgery among adults in the United States, and the number of patients undergoing this procedure is continuing to increase. For patients who are identified as candidates for cataract surgery, optimization of the ocular surface is critical for obtaining optimal patient outcomes. A host of new tools can help cataract surgeons with their preoperative evaluations. Among these are several tests that are useful adjuncts for diagnosing dry eye/meibomian gland dysfunction. The purpose of this activity is to update ophthalmologists on recent advances in the care of patients with cataracts.

TARGET AUDIENCE
This activity is intended for ophthalmologists.

LEARNING OBJECTIVES
Upon completion of this activity, participants will be better able to:
- Manage preoperative ocular surface conditions, with the potential to affect surgical outcomes in patients with cataracts
- Demonstrate optimal IOL selection, knowledge of appropriate refractive targets, and understanding of strategies for achieving intended goals
- Discuss the risks and benefits of cataract surgery with patients
- Describe the benefits of new diagnostic and surgical technologies with application to cataract surgery

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CME Activity

Cataract Surgery in a Patient With Keratoconus

John Sheppard, MD, MMSc; Anthony J. Aldave, MD; Deepinder K. Dhaliwal, MD, LAc; Bonnie An Henderson, MD; Jay S. Pepose, MD, PhD; William B. Trattler, MD

Case from the files of John Sheppard, MD, MMSc

A 51-year-old man with a 20-year history of keratoconus presents with complaints of glare and decreased vision. The glare first developed approximately 1 year ago and is now severe. He needs rigid gas permeable (RGP) contact lenses for vision correction and has been wearing them successfully for 12 years. He has progressive posterior subcapsular cataracts (PSCs) OU, which were first diagnosed 3 years ago. His history also includes seasonal allergic rhinoconjunctivitis, for which he has been using intranasal fluticasone and oral loratadine. In addition, he has hypertension that is being treated with a thiazide diuretic.

On examination, his best corrected visual acuity (measured while wearing RGP contact lenses) is 20/40 OD and 20/50 OS, 20/60 OD and 20/100 OS on manifest refraction, and 20/100 OD and > 20/400 OS with glare (brightness acuity testing). His intraocular pressure is 11 mm Hg OD and 10 mm Hg OS. Digital contact pachymetry measurements are 428 µm OD and 388 µm OS.

Endothelial cell counts by specular microscopy are 1800 cells/mm² OD and 1500 cells/mm² OS. Tear osmolarity is elevated at 308 mOsm/L OD and 317 mOsm/L OS. The matrix metalloproteinase-9 assay is negative OU.

Eversion of the superior lids reveals 2+ tarsal papillae OU. Slit-lamp examination shows 1+ corneal striae OD and an early corneal scar OS (Figure 1), along with 1+ PSC OU. Despite corneal scarring only in the left eye, the patient is more bothered by his vision in the right eye because of dominance. His posterior segment examination is normal.

On slit-lamp topography, done 1 month after the patient stopped wearing his RGP contact lenses, sim K values (K_{max}/K_{min}) are 46.8/44.3 D OD and 51.6/44.2 D OS (Figure 2). Corneal pachymetry measured by optical low-coherence reflectometry (OLCR) is 490 µm OD and 473 µm OS. Wavefront aberrometry shows significantly more total

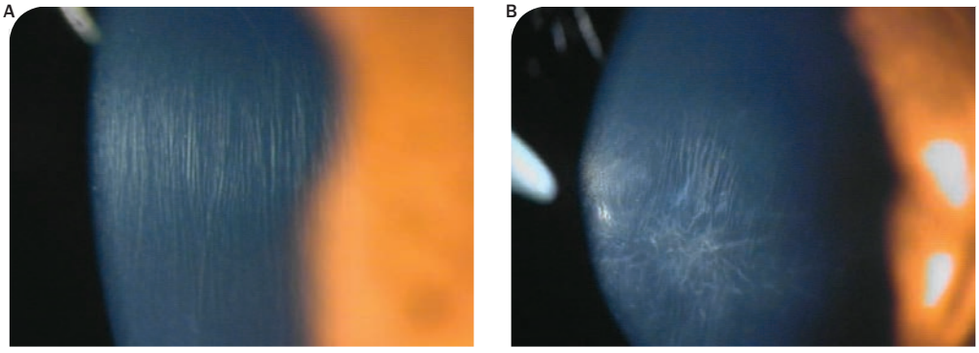

Figure 1. Vertical deep stromal Vogt striae OD (A) and moderate diffuse apical stromal scarring OS (B), which are classic for moderately advanced keratoconus

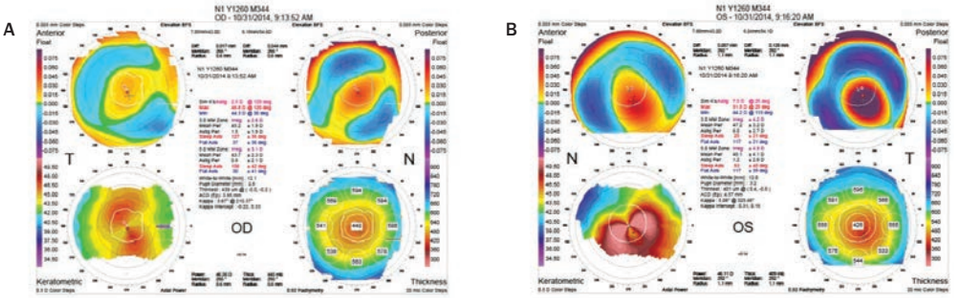

Figure 2. Topography reveals steeper keratometry, more distortion in the central 3- and 5-mm zones, thinner central pachymetry, and accentuated steepening of the posterior float in the left eye (B) compared with the right eye (A). This asymmetry is consistent with the topographic picture that is classically seen in most patients with keratoconus.

Images Courtesy of John Sheppard, MD, MMSc

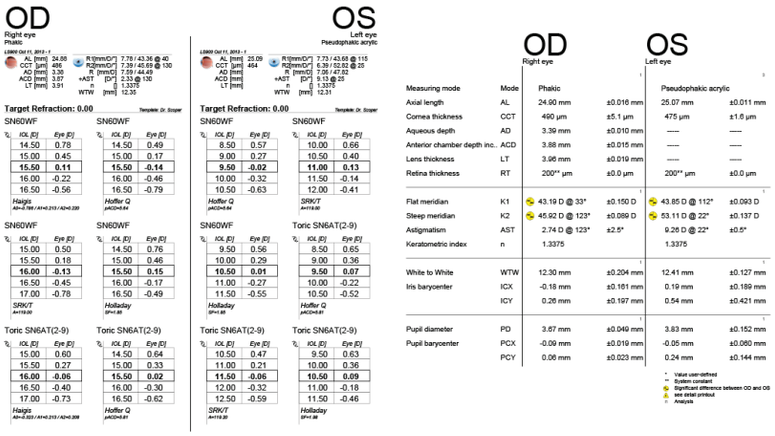

Figure 3. Intraocular lens calculator reveals anisometropia of approximately 5 D. The biometry shows steeper keratometry, more astigmatism, and a longer axial length in the left eye than in the right eye. The biometry is consistent with moderate keratoconus OD and advanced keratoconus OS.

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corneal higher-order aberration OS than OD (0.878 µm vs 0.299 µm) and particularly higher total coma OS than OD (0.790 µm vs 0.017 µm).

Astigmatism measurements obtained with 4 different methods (manual keratometry, automated keratometry, topography, and OLCR) are fairly consistent in the right eye for magnitude (range, 2.57-3.5 D) and axis (117°-123°), but the range of magnitude values is wider in the left eye (7.5-9.26 D).

Intraocular lens (IOL) calculations (Figure 3) performed using the OLCR IOL calculator with a target refraction of 0.00 D generates spherical power values of 15.5 or 16.0 D OD using different formulas and recommends a toric IOL with 3.75 D cylinder power at the IOL plane. The recommended spherical powers for the left eye range from 9.5 to 11.5 D, and even with implantation of a toric IOL with 6.0 D cylinder, the patient is left with 5 D of residual astigmatism.

A variety of issues necessitates particular attention when patients with keratoconus need cataract surgery. These pertain to the challenges of IOL calculations, correction of astigmatism, long-term biometric stability, and need for concurrent or future management of the keratoconus.

INTRAOCULAR LENS CONSIDERATIONS

Predictability of IOL power selection in eyes with keratoconus is limited by the difficulty in accurately determining corneal power and obtaining accurate astigmatic axis measurements if a toric IOL is considered. Regardless of the type of IOL chosen, it is important to allow for reversal of contact lens–induced corneal warpage prior to obtaining measurements that will be used for the IOL power calculation.

No established guidelines on the length of time to wait after discontinuation of contact lens wear exist. The interval is longer for RGP contact lenses than for soft contact lenses because RGP contact lenses cause more pronounced corneal changes.[1] Length of RGP lens wear is a predictive factor, but interpatient variability also occurs. Some surgeons recommend waiting 1 week for every year of lens wear. Documenting agreement between consecutive readings performed a few weeks apart will give the surgeon greater confidence that the cornea is stable and the measured values are accurate. In general, clinicians accept a 2-week washout period for soft contact lenses and a 4-week washout period for RGP contact lenses.

Several groups have analyzed their refractive results using various strategies to determine IOL power in eyes with keratoconus. One small study reported better refractive predictability was achieved using the SRK-II formula than the SRK-T or SRK formulas, but found poorer predictability overall in eyes with moderate or severe keratoconus vs those with only mild disease.[2]

Another paper reviewing refractive outcomes after cataract surgery in eyes with keratoconus reported good results using actual keratometry (K) values and targeting low myopia in eyes with mild (n = 35) or moderate (n = 40) keratoconus.[3] Use of actual K values with a mean target refraction of -5.4 D in 8 of 17 eyes with severe keratoconus (defined as mean K > 55 D) resulted in a large hyperopic biometry prediction error (mean, +6.8 D). For the remaining eyes with severe keratoconus, use of a standard K value of 43.25 D and a mean target refraction of -1.8 D yielded much better results (mean biometry predicted error, +0.6 D).

In a study including 23 eyes, surgeons evaluating outcomes with toric IOL implantation reported the best results were achieved using (1) corneal topography-derived K values and the SRK-T formula in eyes with mild and moderate keratoconus and (2) K values from corneal topography and manual keratometry using the SRK-T and SRK II formulas in those with severe keratoconus.[4] Although toric IOLs are generally recommended for cylinder reduction in eyes with regular astigmatism, good refractive and functional outcomes were achieved with toric IOL implantation in those patients with stable keratoconus.

Similarly, others have reported favorable results with toric IOL implantation in eyes with stable keratoconus.[5-8] Therefore, it appears that a toric IOL might be a reasonable choice if, preoperatively, there is good congruity of the axis using multiple methods of measurement. However, a toric IOL should only be considered to correct astigmatism if the patient will not be using RGP contact lenses postoperatively. In addition, for patients with keratoconus who have been happy wearing RGP contact lenses, and particularly if they would be left with significant astigmatism after toric IOL implantation, a monofocal IOL with an RGP contact lens for astigmatism correction may be the preferred option because it will likely provide the best overall quality of vision.

If it seems probable that the keratoconus will progress to necessitate corneal transplantation, any astigmatic correction rendered at the time of earlier cataract surgery would be irrelevant, an unnecessary expense, and possibly counterproductive because it may contribute to excessive cylinder error postkeratoplasty.

Thus, IOL selection is more complicated in the setting of a younger patient whose keratoconus may be progressing or in patients with significant corneal scarring because these individuals may become candidates for keratoplasty.

A low-power IOL will be needed in an eye with keratoconus undergoing cataract surgery because of the steepness of the keratoconic cornea. If keratoplasty is performed in the future, the eye will be left with a significant refractive error due to a reduction in the K value after the transplant. When future keratoplasty is a possibility and the patient is willing to continue RGP contact lens wear after cataract surgery, consideration can be given to using the predicted postkeratoplasty K value in IOL power calculations. As a general guide, in eyes with axial myopia, which constitute most patients with keratoconus, keratoplasty with a 0.25-mm donor-to-host diameter disparity will induce an additional 2 to 4 D of myopia.[9] Use of the same size donor and host trephination significantly flattens the keratometry and induces significantly less myopia than use of disparate donors.[10]

KERATOCONUS MANAGEMENT

Corneal cross-linking (CXL) can be performed to stabilize mild-to-moderate keratoconus. When CXL is performed prior to cataract surgery, surgeons should ideally wait at least 6 months for the topography to stabilize before obtaining measurements for IOL power calculation, although stabilization may occur earlier in some patients. Because change in refraction after CXL can continue for years, patients should be counseled that continued contact lens use may be likely even after successful, uncomplicated cataract surgery.

Corneal cross-linking performed after cataract surgery is well tolerated and often induces minimal spherical shift. Once again, however, individual responses are variable, and refraction can continue to change long-term. Considering the potential for CXL to cause a hyperopic shift, which is usually approximately 1 D after 1 year,[11] surgeons may wish to target at least 1 to 2 D of myopia in a patient who is anticipated to undergo CXL after cataract surgery.

ALLERGY MANAGEMENT AND OCULAR SURFACE OPTIMIZATION

This case is a reminder that ocular allergies, including allergic conjunctivitis and vernal keratoconjunctivitis, are often associated with keratoconus.[12,13] Thus, clinicians managing patients with keratoconus should attend to preventive and therapeutic measures for allergy management and ocular surface optimization prior to any surgical planning. In a patient with keratoconus, optimizing the condition of the ocular surface may also be important for enabling successful RGP contact lens wear postoperatively.

The patient in this case presents with several issues that can be affecting the condition of his ocular surface, including long-term contact lens wear, use of medications that can cause ocular dryness (an oral antihistamine and an oral diuretic),[14] and allergic conjunctivitis.

When there is concern about the effects of any systemic medication on dry eye, the ophthalmologist should speak to the prescribing physician about finding an alternative treatment or safe dosage reduction.

Oral antihistamines used to treat an allergy are well-substantiated risk factors for dry eye.[15] Options for managing significant allergic rhinitis that do not cause ocular dryness include an intranasal corticosteroid, an intranasal antihistamine, and the oral leukotriene receptor antagonist montelukast. Although intranasal corticosteroids are generally considered to have a better ocular safety profile than ophthalmic or systemic corticosteroids, they have been associated with the development of a PSC.[16,17] As the bottom line, however, any corticosteroid used in or around the eye may have ocular side effects, so ophthalmologists need to carefully monitor all patients being treated with these medications.

Allergen avoidance, when possible, is one of the most effective interventions for controlling allergic disease. Allergy testing can now be performed in the ophthalmologist's office with a US Food and Drug Administration–approved skin test for 60 common allergens, and patients often appreciate the convenience of this testing.[18,19]

SURGICAL DECISION

This patient urgently needed to have cataract surgery to continue functioning in his daily activities and drive safely at night. Thus, it was decided that performing CXL for the keratoconus in his right eye would not meet his needs.

The patient was offered cataract surgery with a toric IOL for the more symptomatic dominant right eye. A toric IOL was deemed acceptable in the context of his having reliably reproduced keratometric axis measurements from 4 different devices and a normal healthy endothelium with minimal corneal scarring.

First, however, the patient was treated to rehabilitate his ocular surface. He underwent allergy skin testing and, on the basis of the findings, practiced allergen avoidance, which, together with use of topical antiallergy medications, resulted in an improvement of his allergy signs and symptoms. He was able to discontinue the oral antihistamine.

Furthermore, his dry eye improved with modification of his oral antihypertensive medication and an aggressive dry eye management regimen that included topical loteprednol, punctal plugs, and an oral nutritional supplement containing omega fatty acids, antioxidants, and other nutrients. His tear osmolarity decreased to 300 mOsm/L OD and 299 mOsm/L OS. His topographic parameters after ocular surface rehabilitation did not change.

One week after undergoing uneventful phacoemulsification with implantation of a 15.5 D single piece hydrophobic acrylic aspheric IOL with 2.57 D cylinder power at the corneal plane (3.75 D cylinder power at the IOL plane) at 121°, the patient was pleased to see 20/25-2 uncorrected OD. With his improved vision, the patient was able to function without his RGP contact lens OD whenever convenience dictated and binocularity was not required. Most of the time, however, he continued wearing his RGP contact lenses OU because they provided better overall binocular vision. The patient eventually underwent successful monofocal IOL implantation OS with a target of -2.0 D myopia.

For more information on ocular surface management, see ***A Patient With Mixed Aqueous Deficiency/Evaporative Dry Eye Disease*** at **http://mededicus.com/downloads/Eye_on_Cataract_Monograph.pdf**.

SUMMARY

Cataract surgery will eventually be required in some eyes with keratoconus, and the presence of PSCs at a relatively young age in this patient and other patients with keratoconus may be associated with the use of corticosteroid medications to control allergic disease.

The decision of whether to perform cataract surgery alone or combined with CXL or keratoplasty will need to be individualized, taking into account the keratoconus stage and topographic stability, along with the patient's goals and preferences. Cataract surgeons must recognize the complexities of IOL power selection in eyes with keratoconus, along with the benefits and limitations of correcting astigmatism with a toric IOL, and discuss these issues with patients for shared decision making. As in all patients undergoing cataract surgery, optimization of the ocular surface prior to obtaining preoperative biometry is mandatory for maximizing the refractive outcome and patient satisfaction. Control of the ocular surface disease and allergy should be initiated prior to biometry and throughout the perioperative period, and then with adequate maintenance doses indefinitely thereafter.

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