

# A DAY IN THE LIFE OF AN OPHTHALMIC SURGEON

## Expert Recommendations for Optimal Cataract and Refractive Outcomes



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#### CONTENT SOURCE

This continuing medical education (CME) activity captures content from a CME symposium held on October 16, 2016, in Chicago, Illinois.

#### ACTIVITY DESCRIPTION

Proper intraocular lens selection, recognition and management of ocular surface disease, and prevention of postoperative endophthalmitis and inflammation are important factors for maximizing cataract surgery outcomes. Advances in diagnostic techniques, surgical technologies, and pharmaceutical products are enabling surgeons to meet these needs and the increasing expectations that patients have for good uncorrected vision without glasses. Using case histories that exemplify common challenges, members of an expert panel discuss the latest developments in preoperative, intraoperative, and postoperative strategies for optimizing cataract surgery success and patient satisfaction.

#### TARGET AUDIENCE

This educational activity is intended for ophthalmologists.

#### LEARNING OBJECTIVES

Upon completion of this activity, participants will be better able to:

- Manage ocular surface conditions preoperatively in patients undergoing cataract surgery
- Select appropriate medication regimens for inflammation and infection control in patients undergoing cataract surgery
- Describe factors for optimal intraocular lens selection
- Compare and contrast standard and femtosecond cataract surgery technology

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# A DAY IN THE LIFE OF AN OPHTHALMIC SURGEON

## Expert Recommendations for Optimal Cataract and Refractive Outcomes

## INTRODUCTION

Cataract surgery is one of the safest and most successful surgical procedures, but an understanding of the issues that can compromise outcomes is essential for meeting the expectations of today's demanding patient population. In this case-based program, expert faculty discuss some common challenges encountered by cataract surgeons and provide insights for minimizing complications and optimizing refractive and functional results.

## CASE 1: CATARACT SURGERY IN THE POST-LASIK PATIENT

### From the Files of Eric D. Donnenfeld, MD

A 58-year-old woman presents with visually significant cataract. At age 45, she had LASIK to correct +4 D hyperopia. **Figure 1** shows her current topography.

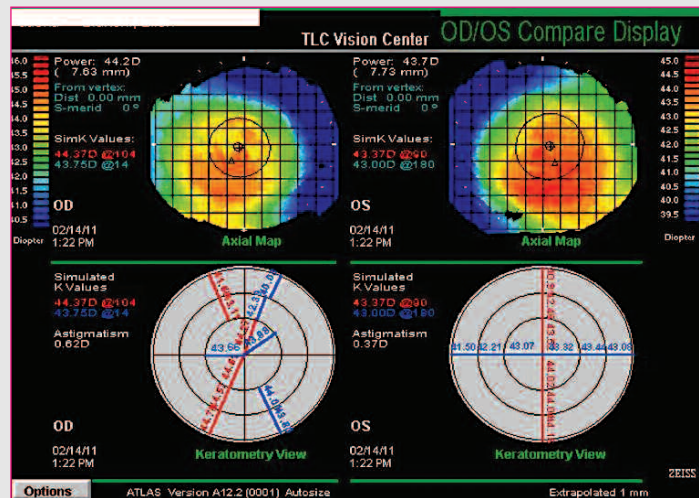


Figure 1. Topography of a patient following hyperopic LASIK. Image courtesy of Eric D. Donnenfeld, MD



## Keratometry and Intraocular Lens Power Calculation

**Dr Donnenfeld:** We are expecting to see an avalanche of patients who have a history of LASIK presenting for cataract surgery. Dr Chu, what do you look at when reviewing the topography maps of these patients?

**Dr Chu:** First, I confirm the type of LASIK. An eye treated for hyperopia will have a red central area of steepening and a blue ring of flattening nasally, whereas a post-myopic LASIK eye will have a central blue zone of flattening. I also want to see if the ablation is well-centered.

**Dr Donnenfeld:** We can also check the type of LASIK by looking at the K reading. If it is  $< 40$  D, the patient probably had myopic LASIK, and if it is  $> 45$  D, the procedure was probably hyperopic LASIK. If the K value is anywhere in between, however, it is not possible to tell. Axial length also provides a clue about whether the patient was a hyperope or a myope. Dr Tyson, what are special considerations for biometry in post-LASIK eyes?

**Dr Tyson:** There are no concerns for using optical biometry to measure axial length, but there are issues with using it for keratometry and then with using the keratometry value for intraocular lens (IOL) power calculation.

Optical biometers and topographers measure a small central area of the anterior cornea and use a standard index of refraction of 1.3375 to convert the anterior surface measurement to the total corneal dioptric power based on the assumption that there is a fixed relationship between the anterior and posterior corneal curvatures.<sup>1</sup> This assumption is no longer valid after a laser vision correction procedure that alters the anterior cornea, and the keratometry measurement provided by these instruments is overestimated after myopic LASIK and underestimated after hyperopic LASIK.<sup>1,2</sup>

There is also a problem using third- or fourth-generation theoretical formulas, such as the Holladay 1, SRK/T, and Hoffer Q, to calculate IOL power. These formulas use the keratometry and axial length measurements to determine the effective lens position (ELP), and they assume that the longer the axial length or the steeper the K value, the deeper the anterior chamber.<sup>2</sup>

Recognizing these problems, multiple formulas using different data and calculation strategies have been developed to calculate IOL power for eyes that have had keratorefractive surgery. Rather than trying to run several formulas on their own, surgeons can access the American Society of Cataract and Refractive Surgery (ASCRS) online calculator (<http://iolcalc.org>) and input whatever pre- and post-LASIK data they have available.

**Dr Donnenfeld:** Accurate IOL power calculation is especially critical for post-LASIK patients who can be

particularly demanding about having excellent uncorrected vision after cataract surgery. Using the keratometry value measured post-LASIK with optical biometry or topography in the older regression formulas will underestimate ELP in a post-myopic LASIK eye and overestimate ELP in a post-hyperopic LASIK eye.<sup>2</sup> Consequently, there is a tendency to leave the post-myopic patients hyperopic and the post-hyperopic patients myopic. The magnitude of the error is generally lower in the post-hyperopic LASIK eyes, but leaving someone with  $-1.0$  D of myopia is not nearly as insidious as making that person a  $+1.0$  D hyperope. Is anyone using the ASCRS online calculator?

**Dr Desai:** I was, but I stopped after I began using intraoperative aberrometry, which I find invaluable.

**Dr Donnenfeld:** I also like intraoperative aberrometry in these cases, but I think the ASCRS online calculator is a good tool for surgeons who do not have aberrometry. You can still get a range of results with the ASCRS calculator, and, in the past, I would have chosen the middle value. Recently, however, I have been relying more on the results of the Hill RBF, Haigis-L, and Barrett True-K.

**Dr Chu:** I have found the ASCRS online calculator to be helpful in post-LASIK eyes. I also use the Holladay IOL Consultant in these cases because comparing multiple formulas can be helpful as well.

I have not gotten consistent results with intraoperative aberrometry, and I think a lot of variables affect the readings, such as the ocular surface condition, intraocular pressure (IOP), and whether the patient moves. Measurements can vary when repeated, and I do not know which value to trust.

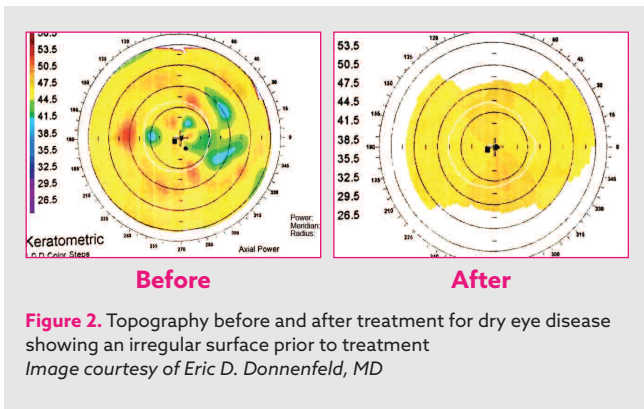
**Dr Tyson:** There is a learning curve for using intraoperative aberrometry and a checklist of items to go through to account for the variables that can affect the result.

**Dr Donnenfeld:** I have also been using intraoperative aberrometry for a long time. Although I think it is very good, it is not perfect. Occasionally, the refractive outcome can be way off, and there are times when I simply decide not to follow the intraoperative reading. Better technology for measuring the posterior and anterior cornea preoperatively is needed, and that is coming.

## Dry Eye Disease

**Dr Donnenfeld:** Topography can also be helpful for identifying dry eye disease (DED) in patients needing cataract surgery. The corneal surface will appear irregular when there is DED (Figure 2), and there can be a huge difference in the K readings in a small area that will make it impossible to get an accurate keratometry measurement and therefore an accurate IOL power calculation.





**Figure 2.** Topography before and after treatment for dry eye disease showing an irregular surface prior to treatment  
Image courtesy of Eric D. Donnenfeld, MD

In my experience, treatment with a topical corticosteroid is the fastest way to rehabilitate an ocular surface that is abnormal because of DED. I like to use loteprednol gel 3 or 4 times a day for 1 or 2 weeks because loteprednol has a favorable safety profile and the gel vehicle is formulated to enhance patient comfort.<sup>3</sup> I also use fluorometholone and prednisolone acetate, 0.12%, suspension in this situation. Artificial tears, oral supplementation with omega-3 fatty acids, and anti-inflammatory treatment with topical lifitegrast or cyclosporine can also be used for these patients as maintenance therapy, but the topical corticosteroid improves the ocular surface most rapidly, whether DED is associated with meibomian gland dysfunction or aqueous deficiency.

**Dr Chu:** In patients with dry eye, topical nonsteroidal anti-inflammatory drugs (NSAIDs) should be used cautiously because of the potential risk of corneal melting. I also use a mild topical corticosteroid, such as loteprednol, along with cyclosporine. Recently, I began using lifitegrast, with good results.

**Dr Donnenfeld:** Does anyone else have experience with lifitegrast?

**Dr Desai:** I have started to use it, especially in patients who have previously tried and failed to achieve relief with cyclosporine or simply did not tolerate it. Lifitegrast seems to have a faster onset of benefit than does topical cyclosporine. In clinical trials, lifitegrast was associated with significant improvements in some dry eye symptoms and signs after 14 days.<sup>4-6</sup> Uniquely, lifitegrast is reported to cause a poor aftertaste within minutes after instillation, but this effect seems to disappear after a few days or weeks of use.<sup>4-6</sup>

**Dr Donnenfeld:** There are no data yet to say whether cyclosporine or lifitegrast is better, but the take-home message here is about the need to manage dry eye before performing cataract surgery. I also like using loteprednol when I am starting topical cyclosporine or lifitegrast; pretreatment with loteprednol has been shown to help mitigate burning and stinging in patients started on topical cyclosporine.<sup>7</sup> In my experience, it is also helpful for reducing the side effects associated with lifitegrast.

## Issues With Intraocular Lens Selection

**Dr Donnenfeld:** LASIK changes corneal spherical aberration (SA), and hyperopic LASIK induces negative SA.<sup>8</sup> Adding more negative SA by implanting a negative SA IOL will cause glare and halo. A positive SA IOL can offset negative SA in the cornea. Both negative and positive SA IOLs will induce higher-order aberrations, specifically coma and astigmatism, if they are not centered, and this is a particular concern in post-hyperopic LASIK eyes, in which the ablation is very commonly decentered off of the optical axis.

Therefore, I strongly prefer a zero SA IOL for post-hyperopic LASIK eyes, and I particularly like the zero SA accommodating IOL for patients seeking presbyopia correction. Reading vision with this lens is better in post-hyperopic LASIK eyes because they have a prolate cornea that gives an increased depth of field, and the zero SA accommodating IOL also has great centration because of its 4-point fixation. I like multifocal IOLs for patients who want presbyopia correction, but all of the multifocal options available in the United States have negative SA, so I would not use them for this patient.

**Dr Chu:** For any post-LASIK eye, an aberration-free IOL that has zero SA will give the best quality of vision if there is any tilt of the IOL or if the IOL or ablation is decentered.<sup>9</sup>

**Dr Donnenfeld:** The patient in this case has approximately 2 D of corneal cylinder. Would you choose a toric IOL?

**Dr Desai:** If the patient wants to reduce spectacle dependence at all distances, I would choose the accommodating toric IOL. It is aberration free and has great rotational stability because of its 4-point fixation. It can also be easily rotated clockwise or counterclockwise, which enables easy and precise final alignment.

**Dr Donnenfeld:** How do you get the best results when using a toric IOL?

**Dr Tyson:** From the work done by Koch and colleagues, the importance of taking into account posterior cornea astigmatism to determine total corneal astigmatism is known.<sup>10,11</sup> Some diagnostic technologies measure both the anterior and posterior cornea surfaces, or surgeons can use IOL power calculation nomograms that take posterior cornea astigmatism into account according to a population average. In addition, intraoperative aberrometry is helpful for checking IOL alignment and power.

Femtosecond laser limbal-relaxing incisions can also be used for mild-to-moderate astigmatic correction. Toric IOL implantation allows correction of higher amounts of astigmatism and provides more predictable results. With incisional techniques, whether manual or using a laser, individual variability in wound healing influences the final result.

I use an image-guided system with intraoperative aberrometry when implanting toric IOLs.

Whether I am implanting the accommodating toric IOL or the nontoric model, I like to make a 6.00-mm capsulorhexis and use a capsule tension ring. This is an off-label use for the capsule tension ring, but I find it really helps me hit and maintain my target refraction by preventing Z syndrome. It is also important to make sure that all 4 of the IOL haptics are in the equator and not caught up on the posterior capsule.

**Dr Donnenfeld:** Using aberrometry also minimizes the chance that patients will be coming back for an enhancement to correct residual refractive error. I think that astigmatic correction is an area in which more cataract surgeons can do better. Leaving the eye with less than 0.5 D of residual cylinder can make the difference between a happy and an unhappy patient.

## CASE 2: DIAGNOSING AND MANAGING OCULAR SURFACE DISEASE

*From the Files of Neel R. Desai, MD*

*A 52-year-old man with presbyopia presents with itching and eye rubbing. He was in contact lens monovision but developed contact lens intolerance and would like to be free from glasses and contact lenses. He now takes his glasses off to read. His manifest refraction in his right eye is  $-3.00 +1.50 \times 87$ . Sim Ks on topography are 40.91/32.31 (1.4 D at 76), and keratometry with optical biometry is 41.20/43.50 (2.3 D at 105).*

### Ocular Surface Disease Assessments

**Dr Donnenfeld:** Which keratometry reading would you rely on?

**Dr Desai:** The topographer used for this patient combines Placido disc and dual Scheimpflug imaging and gives a picture of both the anterior and posterior cornea. Older optical biometers, which take a limited number of measurements in the paracentral cornea, did not always provide an accurate assessment of oblique astigmatism, were prone to errors caused by ocular surface disease (OSD), and provided no information about the posterior corneal topography.

Variability and discrepancies between readings obtained with different biometric measurement modalities are indicators of significant OSD that may be dry eye, epithelial basement membrane dystrophy (EBMD), or Salzmann nodular degeneration. Given the significant lack of agreement between keratometry readings in this particular case, I would not trust any of the data enough to plan surgical intervention.

**Dr Donnenfeld:** I agree that I would not rely on the keratometry reading obtained with an older optical biometer, and I never use manual keratometry anymore. The reading I get using the IOLMaster 500 or 700 is my go-to number, but because of the size of the discrepancy in both cylinder magnitude and axis in this patient, I would bring him back for repeat measurements.

**Dr Tyson:** I do not use manual keratometry either, but it is also important to keep in mind that the keratometry reading obtained with optical biometers is an average value from the anterior surface. The number of points measured differs depending on the device, but I think it is important to look at the whole eye topography map to understand the situation.

**Dr Donnenfeld:** Because this patient was successful with monovision, he might be a good candidate for LASIK or photorefractive keratectomy monovision. His symptomatic complaints, however, raise concern about ocular surface problems that might affect the decision to perform an excimer laser procedure. Further workup is needed. Considering his complaint about itching, I think allergy testing is warranted. Dr Desai, are you using the allergy skin test that was developed for ophthalmic practices?

**Dr Desai:** I am using it a lot because it allows me to determine if an allergy is the cause for red, itchy, uncomfortable eyes and to provide targeted treatment based on that diagnosis rather than on what I believe is a far too common, knee-jerk response of prescribing a topical corticosteroid antibiotic. Although many patients tell me they had testing done by an allergist, allergists do not use regionally specific or ocular-specific antigen panels. The test system developed for ophthalmologists has 39 regionally specific panels, each with 58 ocular-specific antigens.<sup>12</sup>

**Dr Donnenfeld:** Understanding what a patient is allergic to allows for specific recommendations about allergen avoidance and treatment. For example, people who are allergic to dust mites can be told to wash their bedding often and to use their allergy medication at night, whereas those with hay fever can be told to keep their windows closed, use air conditioning, and use their medication before going out in the morning. Patients also like to have a better understanding of their disease, which they can get with the results of allergy testing.

**Dr Tyson:** Oral antihistamines that patients may be using to control an allergy can cause eye dryness as a side effect. How do you deal with that?

**Dr Donnenfeld:** I find topical therapy to be better than systemic therapy for managing allergic conjunctivitis, but when patients need oral medication to control allergic rhinitis, a second-generation antihistamine, such as cetirizine, desloratadine, or fexofenadine, will generally cause less ocular dryness than a first-generation medication, such as diphenhydramine or chlorpheniramine.<sup>13</sup>

**Dr Tyson:** Some of the ophthalmic antihistamine medications can also cause dryness. I like to emphasize allergen avoidance and recommend using artificial tears, which help to flush allergens from the ocular surface.

**Dr Donnenfeld:** Artificial tears certainly play a role, and I think ocular dryness is not that much of a problem when using one of the newer ophthalmic antihistamines that are dosed just once or twice a day. All patients undergoing



cataract surgery should also be evaluated for DED. In the Prospective Health Assessment of Cataract Patients' Ocular Surface study, more than 30% of patients reported symptoms associated with DED, almost two-thirds had an abnormal tear breakup time, and half had positive central corneal staining.<sup>14</sup> Some patients with DED are not symptomatic, however, because they are compensating for tear film abnormalities by increasing their blink rate. The situation may change after cataract surgery that severs corneal nerves; then, patients may blame the surgery and the surgeon for their symptoms.

Newer diagnostic tests for DED include tear osmolarity, the matrix metalloproteinase-9 (MMP-9) assay, and meibomian gland imaging. I measure tear osmolarity in all of my cataract surgery patients because I think it can identify DED before there is corneal staining. According to the manufacturer, the result is abnormal if the level is  $> 308$  mOsm/L or differs by  $> 10$  mOsm/L between eyes.<sup>15</sup> Either finding is a sign of loss of homeostatic control of tear osmolarity. MMP-9 is a marker of inflammation, and a positive result with the MMP-9 assay was reported to have 85% sensitivity and 94% specificity for discriminating patients with DED.<sup>16</sup>

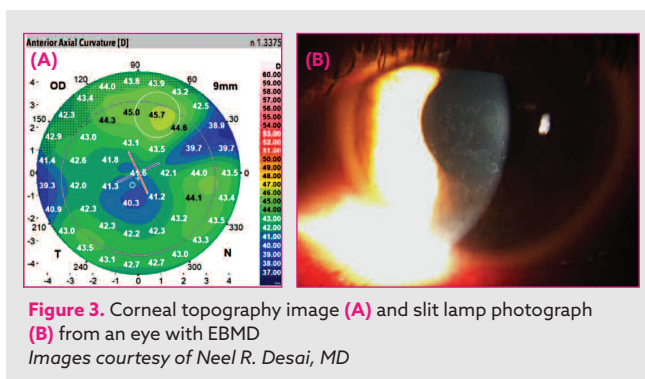
**Dr Desai:** A study by Epitropoulos and colleagues showed how DED in eyes needing cataract surgery can affect keratometry and IOL power calculations.<sup>17</sup> Compared with eyes having normal tear osmolarity, eyes with a hyperosmolar tear film ( $> 316$  mOsm/L) had significantly higher variability in their average K reading and were significantly more likely to have a  $> 0.5$  D difference in IOL power as a result of the different K readings.

**Dr Tyson:** Not all cataract surgeons have access to all of the new diagnostic tests for OSD. Which do you consider most essential?

**Dr Desai:** In this era of refractive cataract surgery, I think it is important to have a topographer to accurately assess astigmatism because the image can be a good indicator for clinically significant OSD. It would be very helpful if the topographer also provides a wavefront analysis of the cornea. If the root mean square for corneal aberrations is  $> 0.4$   $\mu\text{m}$ , I consider it a sign of ocular surface abnormality that may affect accurate IOL power selection.

I think surgeons might also consider adding tear osmolarity or the MMP-9 assay to their preoperative diagnostics. I like the MMP-9 assay in particular because it has applications beyond screening for DED. Elevated MMP-9 can also be seen in eyes with EBMD and Salzmann nodular degeneration.<sup>18</sup> In addition, there is recent evidence of a correlation between elevated MMP-9 and kerectasia progression.<sup>19</sup> I use MMP-9 in all of my patients with kerectasia as a means to assess the need and urgency of collagen cross-linking to prevent disease progression.

**Dr Donnenfeld:** You can learn a lot from just topography, and if it is regular, the higher-order aberrations are almost always regular as well. I also consider osmolarity a linchpin. Dr Desai, what diagnosis did you suspect looking at your patient's axial map image (Figure 3A)?



**Dr Desai:** The irregularity with spotty islands of flattening and huge variation of up to 5 D in the keratometry readings is consistent with EBMD, which corresponds with the appearance at the slit lamp (Figure 3B). In many cases, irregularity in the anterior axial map on topography triggers a closer slit-lamp examination for previously unrecognized OSD. It is easy to miss or underestimate the deleterious effect of EBMD, especially when it appears to be mild or concentrated in the paracentral or peripheral cornea.

**Dr Donnenfeld:** How common is EBMD in the cataract surgery population?

**Dr Desai:** Werblin and colleagues reported that up to 76% of patients aged older than 50 years have signs of EBMD.<sup>20</sup> Trattler and colleagues found that among 400 consecutive cataract surgery patients, approximately 25% had signs of moderate-to-severe dry eye and 9% had irregular astigmatism consistent with dry eye, EBMD, or another cause.<sup>21</sup>

**Dr Donnenfeld:** How does the finding of EBMD affect your choice of a refractive solution for this patient?

**Dr Desai:** I would not want to do LASIK monovision because an eye with EBMD is at an increased risk for epithelial sloughing and postoperative complications, including epithelial in-growth.<sup>22</sup> Refractive lens exchange is a possibility, but because the ocular surface irregularity creates optical aberrations, this patient would not have good-quality vision with a multifocal IOL. The extended-range-of-vision IOL that elongates the focus and corrects both chromatic and spherical aberration is newer technology for presbyopia correction.<sup>23</sup> Although it is technically not a multifocal optic, I believe that patients with preexisting OSD who are implanted with the extended-range-of-vision IOL will not be immune to the dysphotopsias that can occur with conventional multifocal IOLs, such as rings, halos, and auras around lights at night. An accommodating IOL might be a better, more forgiving option, but the EBMD needs to be treated first in order to get an accurate keratometry measurement and guide IOL power selection.

**Dr Donnenfeld:** How do you manage EBMD before cataract or refractive lens exchange surgery?

**Dr Tyson:** I want the ocular surface to be as smooth as possible. I would be aggressive with ocular surface lubrication, and I may start lifitegrast or cyclosporine.

**Dr Chu:** I am conservative with these patients, and if there are no symptoms, I would use artificial tears alone. Thorough counseling is important too. These patients need to know that surgery could trigger recurrent corneal erosion.

**Dr Donnenfeld:** The first thing I would do for an eye like this would be to scrape off the epithelium with a blunt blade, making certain I remove the aberrant basement membrane. I would offer lubrication with artificial tears as an alternative, but I do not expect it will be adequate because the ocular surface is so irregular.

I had a patient like this recently. Her visual acuity improved from 20/50 before scraping to 20/30+ after reepithelialization, and she felt she no longer needed cataract surgery.

**Dr Tyson:** What do you use to cover the eye after the scraping?

**Dr Donnenfeld:** I use a bandage contact lens and/or the self-retaining cryopreserved amniotic membrane. I find a bandage contact lens is more comfortable, so I like to use it at least for the first day. I also prescribe bromfenac, 0.07%, because I find it provides very effective pain relief and needs to be administered only once a day. Some other NSAID products are also very effective for controlling pain. Because they are formulated in vehicles that prolong contact time, however, they may stay sequestered under a bandage contact lens, and they have been linked to cases of poor epithelial healing after photorefractive keratectomy, as described in a 2013 medication alert from the ASCRS.<sup>24</sup> I am not aware of any such reports with bromfenac, 0.07%. Ketorolac tromethamine is another option that is effective for controlling pain. Only the product that contains 0.45% of the active ingredient and carboxymethylcellulose sodium in its vehicle has been reported to interfere with epithelial healing.<sup>24</sup>

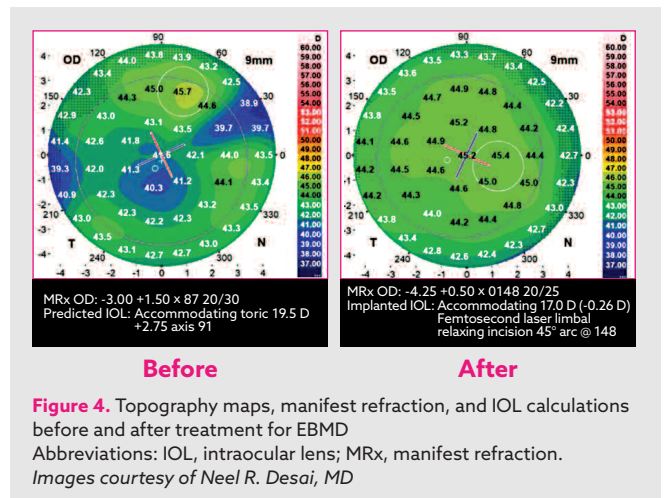
I start the NSAID before the scraping to provide the best pain control. The trauma from the scraping triggers the release of arachidonic acid. Having the NSAID present inhibits the pathway leading to prostaglandin production.

**Dr Desai:** I conducted a study evaluating 21 eyes with EBMD before and after ocular surface optimization using the self-retaining cryopreserved amniotic membrane for 3 to 5 days, and I am aware that Elizabeth Yeu, MD, and Gary Wortz, MD, have done similar research. Comparing the pretreatment values with data obtained after 1 month in patients in my study, I found that average K changed by > 1 D in 19% of eyes and by 0.5 D in almost 70% of eyes, and the predicted IOL power changed for 52% of eyes. As Dr Donnenfeld noted, vision in eyes with EBMD can improve with ocular surface optimization, even without cataract surgery. In my study, 57% of eyes had some improvement in best corrected visual acuity (BCVA)

and 29% gained more than 2 lines after superficial keratectomy and cryopreserved amniotic membrane placement alone prior to cataract surgery.

We created a systematic protocol aimed at helping surgeons efficiently identify and treat OSD before refractive cataract surgery. If the patient has mild dry eye with mild keratitis, treatment is started with the typical medical therapies, and the cryopreserved self-retaining amniotic membrane is placed for 3 to 5 days. Superficial keratectomy is done first if there is evidence of EBMD. Patients are brought back to be remeasured after 4 to 6 weeks. With this approach, erroneous IOL recommendations and selection in these patients can be avoided and refractive options can be offered to a greater swath of patients who may not have been otherwise eligible.

The patient underwent superficial keratectomy and amniotic membrane placement. At 1 month, BCVA improved from 20/30 to 20/25, and his cylinder was reduced (**Figure 4**) so that it was no longer necessary to use a toric IOL. The patient underwent femtosecond laser-assisted cataract surgery (FLACS), including use of the laser for limbal-relaxing incisions, and he was implanted with an accommodating IOL.



**Figure 4.** Topography maps, manifest refraction, and IOL calculations before and after treatment for EBMD  
Abbreviations: IOL, intraocular lens; MRx, manifest refraction.  
Images courtesy of Neel R. Desai, MD

## Femtosecond Laser-Assisted Cataract Surgery

**Dr Donnenfeld:** Does FLACS have advantages over standard phacoemulsification?

**Dr Tyson:** A burgeoning amount of data supports its benefits for certain steps. Certainly, capsulotomy centration is better when using the femtosecond laser, and this would be expected to improve ELP predictability.<sup>25</sup>

**Dr Desai:** In addition, laser fragmentation of the nucleus has been shown to reduce phacoemulsification time and endothelial cell loss across all grades of cataract density.<sup>26,27</sup>

**Dr Donnenfeld:** The benefits of FLACS are controversial, but I agree that there is no question it improves capsulotomy precision and reduces phacoemulsification energy use, along with endothelial cell loss. A benefit for



improving refractive results based on more predictable ELP has not been proven. Use of the femtosecond laser to create arcuate incisions may be an attractive technique for surgeons who are not comfortable with manual astigmatic incisions. Femtosecond laser-assisted keratotomy has been shown to be a safe and effective way to correct preexisting astigmatism.<sup>28</sup>

### CASE 3: PREVENTING POSTOPERATIVE ENDOPHTHALMITIS AND INFLAMMATION

**From the Files of Eric D. Donnenfeld, MD**

An 81-year-old monocular male physician presents with reduced BCVA (20/70) in his right eye associated with a cataract. His left eye was lost to endophthalmitis, and he requests cataract surgery, but states, "Please do everything you can to make certain I do not get another infection."

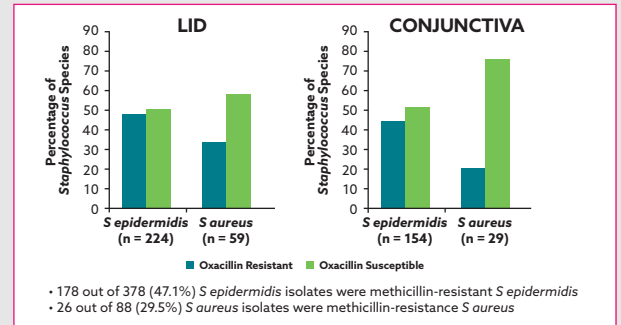
#### Endophthalmitis Prophylaxis

**Dr Donnenfeld:** Implementing strategies for reducing endophthalmitis risk necessitates understanding of the cause. It is known that the pathogens isolated in eyes with postcataract surgery endophthalmitis arise from external bacterial flora.<sup>29</sup> This is why surgical preparation includes taping the lashes and performing a povidone-iodine scrub, which has been shown to significantly reduce the incidence of endophthalmitis.<sup>30</sup>

In a study in which bacterial flora on the ocular and periocular surfaces of routine cataract surgery patients were evaluated, *Staphylococcus epidermidis* was overwhelmingly the most frequently isolated organism, being found on the lids and conjunctiva in nearly two-thirds of the 399 patients studied.<sup>31</sup> *Staphylococcus aureus* was the second most common. It was isolated from the lids in 15% of patients and from the conjunctiva in 12%. Susceptibility testing showed that 47% of *S epidermidis* and 29.5% of *S aureus* strains were methicillin resistant (Figure 5), and the likelihood of finding methicillin-resistant staphylococci increased with increasing age. Methicillin-resistant staphylococci isolates were cultured from approximately one-half of patients aged 80 years and older.

I already mentioned using povidone-iodine as a disinfectant. There may be a role for a new product that contains hypochlorous acid, 0.01%. Hypochlorous acid is released by neutrophils and monocytes as part of the innate immune system response to infection, and it has broad-spectrum, rapid antimicrobial activity.<sup>32,33</sup> Compared with povidone-iodine, 7.5%, hypochlorous acid, 0.01%, is much less cytotoxic and is faster acting.<sup>33</sup> What other strategies are there for endophthalmitis prophylaxis?

**Dr Desai:** I prescribe topical besifloxacin because according to the most recent data from the ARMOR (Antibiotic Resistance Monitoring in Ocular Microorganisms) surveillance study, besifloxacin and the 2 other newer fluoroquinolones, gatifloxacin and moxifloxacin, had better activity against methicillin-susceptible and methicillin-resistant *S aureus* isolates than



**Figure 5.** Oxacillin (methicillin) susceptibility patterns of *S epidermidis* and *S aureus* isolates from 399 cataract surgery patients<sup>31</sup>

did older fluoroquinolones, whereas besifloxacin seemed to be the most potent of the fluoroquinolones (Table).<sup>34</sup> There is likely also less bacterial resistance to besifloxacin than to other fluoroquinolones because it is the only one that is not used systemically. I am amazed by how many of my patients know about the threat of methicillin-resistant staphylococci, and this makes it easy for me to explain why I am writing the prescription for this particular agent.

**Table.** Antibiotic MIC<sub>90</sub> Values Against Staphylococcal Species<sup>34</sup>

Antibiotic	MSSA	MRSA	MSCoNS	MRCoNS
Vancomycin	1	1	2	2
Besifloxacin	0.25	2	0.25	4
Gatifloxacin	2	16	2	32
Moxifloxacin	1	16	1	32
Ciprofloxacin	8	256	8	64
Tobramycin	1	> 256	4	16
Azithromycin	> 512	> 512	> 512	> 512
Levofloxacin	4	128	4	128
Ofloxacin	8	> 8	8	> 8

Abbreviations: MIC, minimum inhibitory constant; MRCoNS, methicillin-resistant coagulase-negative staphylococci; MRSA, methicillin-resistant *Staphylococcus aureus*; MSCoNS, methicillin-susceptible coagulase-negative staphylococci; MSSA, methicillin-susceptible *Staphylococcus aureus*.

**Dr Donnenfeld:** Vancomycin has more potent activity against methicillin-resistant staphylococci, but there are no commercially available options.

**Dr Chu:** I use povidone-iodine before and after the procedure, besifloxacin as my topical antibiotic, and intracameral moxifloxacin. I think there is growing evidence supporting the efficacy of intraocular antibiotics, and, in the past, I added vancomycin to the irrigating solution. Now, however, I am reluctant to use vancomycin because of the reports associating it with hemorrhagic occlusive retinal vasculitis (HORV).<sup>35,36</sup> Endophthalmitis can be treated, but there is no treatment for HORV.

I also have experience with intravitreal injection of the triamcinolone-moxifloxacin combination, delivering it transzonularly or through the pars plana. I believe this can be an effective regimen and especially useful in certain patients, including those who might have a hard time using drops, such as those with severe arthritis, or who are in nursing homes or assisted care facilities.

**Dr Donnenfeld:** I also like to use intracameral antibiotics, and good evidence shows that they reduce the risk of postoperative endophthalmitis. In the randomized study conducted by the European Society of Cataract and Refractive Surgeons, use of intracameral cefuroxime reduced the risk of endophthalmitis 5-fold compared with topical drops.<sup>37</sup> Retrospective studies from Japan and India reported 3- and 4-fold reductions in the endophthalmitis rate, respectively, associated with use of intracameral moxifloxacin.<sup>38,39</sup> Surgeons at Kaiser Permanente in California reported a 6-fold decrease in the rate of endophthalmitis when using only intracameral vancomycin, moxifloxacin, or cefuroxime compared with using topical antibiotics alone.<sup>40</sup>

In 2014, half of the surgeons who completed the ASCRS clinical survey indicated they were using an intracameral antibiotic in cataract surgery, mostly either moxifloxacin or vancomycin.<sup>41</sup>

Although vancomycin is an excellent choice because of its activity against the common endophthalmitis pathogens, I also am worried about HORV. Even though the risk seems to be very low, HORV can be devastating. Of the 36 eyes included in the ASCRS report, half developed neovascular glaucoma, 61% had visual acuity of 20/200 or worse, and 22% had no light perception vision.<sup>36</sup> HORV-related vision loss has a delayed onset and may not develop in the first eye until after vancomycin is used in the second eye surgery. Of the 22 patients included in the ASCRS report, 14 were affected bilaterally.

### Anti-Inflammatory Medications

**Dr Donnenfeld:** A topical NSAID is another component of the cataract surgery medication regimen. It reduces pain and inflammation after cataract surgery, but I think it is also important to start an NSAID preoperatively to minimize intraoperative pupil constriction. In a randomized study, starting topical ketorolac 1 or 3 days before surgery significantly reduced the amount of intraoperative pupil constriction compared with starting treatment 1 hour before surgery or using placebo.<sup>42</sup> Consistent with this benefit, mean ultrasound time was significantly less when the NSAID was started 1 to 3 days preoperatively. Minimizing pupil constriction allows for faster surgery.

On the topic of controlling inflammation, it is worth mentioning a study by Chang and colleagues that evaluated the risk of an IOP response to corticosteroid treatment after cataract surgery.<sup>43</sup> This retrospective chart review evaluated associations with patient age and axial length and found the risk was increased in younger patients and in those with longer eyes. Patients aged < 65 years with an axial length  $\geq 29$  mm had a 35-fold increased risk for developing IOP  $\geq 34$  mm Hg. For high-risk patients, defined as those with an axial length  $\geq 27$  mm, Chang and colleagues suggested using an NSAID alone or a shortened course of either loteprednol or fluorometholone when using a corticosteroid because they are less likely than other corticosteroids to increase IOP.

## TAKE-HOME POINTS

Intraocular lens selection in eyes with a history of refractive cornea surgery necessitates understanding of the challenges in power calculation and knowledge of the induced corneal aberrations.

**Ocular surface disease is common in patients undergoing cataract surgery and must be diagnosed and treated to optimize refractive and functional outcomes.**

- Dry eye disease and allergy are the most common OSDs, and newer diagnostic tests help with their identification.
- EBMD is also common, and its management may necessitate superficial keratectomy.

**Prevention of endophthalmitis after cataract surgery necessitates knowledge of the causative pathogens and the activity and safety profiles of antimicrobial options.**

- Staphylococci from the ocular and periocular surfaces are the most common isolates, and the lids and conjunctiva are commonly colonized by methicillin-resistant staphylococci.
- Besifloxacin has the best activity against methicillin-resistant staphylococci among the topical fluoroquinolones.
- Vancomycin has excellent activity against endophthalmitis pathogens, but has been associated with HORV when used intracamerally.

**Topical NSAIDs have multiple roles in medication regimens for cataract surgery, including:**

- Treatment of OSD preoperatively
- Minimization of intraoperative pupil constriction
- Control of postoperative inflammation and pain

**Topical corticosteroids are useful for treating OSD before cataract surgery and for controlling postoperative inflammation.**

- The agent and regimen selected should consider potency, safety, and the patient's risk for a steroid response.

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## CME POST TEST QUESTIONS

1. What type of SA is most often present in the cornea in eyes with a history of hyperopic LASIK?
  - A. It depends on the microkeratome and excimer laser system used
  - B. Negative SA
  - C. Positive SA
  - D. Zero SA
2. Which of the following formulas would be the best choice for IOL power calculation in an eye with a history of LASIK?
  - A. Haigis-L
  - B. Holladay 1
  - C. Hoffer Q
  - D. SRK/T
3. A patient presents with complaints of decreased and fluctuating vision. On examination, he has 2+ NS cataracts OU, his topography shows small areas of dropout, and he is found to have dry eye with moderate fluorescein corneal staining. He is eager to proceed with surgery. What would you do?
  - A. Repeat the topography after instilling an artificial tear product and plan surgery
  - B. Recommend surgery with intraoperative aberrometry to check IOL power
  - C. Treat the dry eye with a mild topical corticosteroid and bring the patient back for another preoperative evaluation in 2 weeks
  - D. Treat the dry eye with topical cyclosporine and bring the patient back for another preoperative evaluation in 2 weeks
4. Compared with a manual technique for creating the anterior capsulotomy, use of the femtosecond laser:
  - A. Decreases the risk of anterior capsule tears
  - B. Improves centration
  - C. Increases the risk of anterior capsule tears
  - D. Is not an option in eyes with small pupils
5. Compared with cataract surgery performed using manual techniques, cataract surgery using the femtosecond laser has been proven to:
  - A. Improve surgical workflow
  - B. Increase refractive outcome predictability
  - C. Minimize intraoperative miosis risk
  - D. Reduce ultrasound energy use
6. What bacteria is most commonly found on the eyelid and conjunctiva in the general cataract surgery population?
  - A. *Pseudomonas aeruginosa*
  - B. *Staphylococcus aureus*
  - C. *Staphylococcus epidermidis*
  - D. *Streptococcus pneumoniae*
7. Methicillin-resistant staphylococci may be isolated from the lids and conjunctiva in what percentage of cataract surgery patients?
  - A. 1% to 5%
  - B. 6% to 10%
  - C. 11% to 20%
  - D. More than 20%
8. When administered into the anterior chamber for intracameral endophthalmitis prophylaxis, which antibiotic has been associated with postoperative HORV?
  - A. Cefuroxime
  - B. Gatifloxacin
  - C. Moxifloxacin
  - D. Vancomycin
9. Why might you consider initiating a topical NSAID 3 days prior to cataract surgery rather than waiting until after surgery?
  - A. Because the patient plans to have the prescription filled with a generic medication
  - B. To improve the ocular surface in a patient with DED
  - C. To minimize intraoperative pupil constriction
  - D. To reduce postoperative inflammation, but only if a topical corticosteroid is not being used postoperatively
10. According to a study by Chang and colleagues, which of the following findings is a risk factor for IOP elevation with corticosteroid use?
  - A. Age  $\geq$  65 years
  - B. Female sex
  - C. Axial length  $\geq$  29.0 mm
  - D. Myopia  $\geq$  -6.0 D