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CME MONOGRAPH

The Pursuit of PERFECT VISION

Essential Elements for Achieving Optimal Cataract and Refractive Surgery Outcomes

Highlights From a Roundtable Discussion

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CONTENT SOURCE

This continuing medical education (CME) activity captures content from a roundtable discussion held on January 22, 2013, in Waikoloa, Hawaii.

ACTIVITY DESCRIPTION

Even with many advances in cataract and refractive surgery, success is not guaranteed for every patient. New technologies and new strategies for inflammation management can help improve results. This educational activity offers experts' insights and practical approaches for managing aspects of cataract and refractive surgery that can improve the consistency of good visual outcomes for patients.

TARGET AUDIENCE

This activity is intended for ophthalmologists.

LEARNING OBJECTIVES

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

- Identify vision-limiting ocular comorbidities with preoperative examinations in patients undergoing cataract surgery
- Recognize, evaluate, and treat ocular surface disorders prior to cataract and refractive surgery
- Consistently select the appropriate intraocular lens (IOL) and IOL power in patients undergoing cataract surgery
- Apply anti-inflammatory regimens to prevent inflammation in patients undergoing cataract and refractive surgery

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This activity includes off-label discussion of the following agents: topical azithromycin for meibomian gland dysfunction (MGD), loteprednol etabonate gel and ointment for inflammation other than that related to cataract surgery, tetracyclines for MGD, topical cyclosporine for preventing dry eye after LASIK (laser-assisted in situ keratomileusis). Please refer to the official prescribing information for discussion of approved indications, contraindications, and warnings.

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PURSUING PERFECT VISION IN CATARACT SURGERY WITH ADVANCED TECHNOLOGY IOLs

Patients choosing advanced technology intraocular lenses (IOLs) for pseudophakia and those undergoing laser refractive surgery demand excellent outcomes. Recently, a panel of leading cataract and refractive surgeons convened to talk about the challenges ophthalmic surgeons face in pursuing the provision of perfect vision for these individuals as well as ways to surmount those challenges, including strategies for optimizing our diagnostic evaluation and the use of newer anti-inflammatory medications to control perioperative inflammation.

This continuing medical education activity presents the highlights of our discussion and a summary of current pharmacologic options for inflammation control (**Tables 1 and 2, page 7**). We sincerely hope that readers will find the information it contains useful for providing optimal care in behalf of patients in their clinical practice.

—Terrence P. O'Brien, MD

CASE 1

A 73-year-old woman has been using monovision contact lenses successfully for many years to correct her presbyopic hyperopia. Six months after being diagnosed with bilateral cataracts by her optometrist, she presents reporting increasing contact lens intolerance along with deterioration of vision, dulling of color perception, and increasing glare. Both eyes are affected, but the left eye more than the right. She is eager to proceed with cataract surgery and hopes to have the same IOL that allows a friend of hers freedom from spectacles or contact lenses.

Consistent with her cataracts, her examination shows best corrected visual acuity of 20/30– OD, decreasing to 20/100 with glare, and 20/50– OS, decreasing to 20/200 with glare. Schirmer I test results at 5 minutes are 8 mm OD and 7 mm OS, and tear film break-up time is less than 4 seconds. Clinical examination shows inspissation of the meibomian glands with surrounding telangiectasia, staining of the conjunctiva and inferior cornea with Rose Bengal, and a foamy tear film **(Figure 1A-C)**.

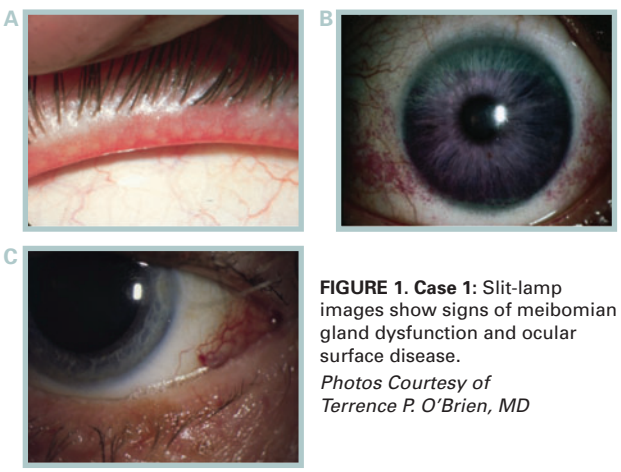

FIGURE 1. Case 1: Slit-lamp images show signs of meibomian gland dysfunction and ocular surface disease.
Photos Courtesy of Terrence P. O'Brien, MD

CHALLENGE 1—Ocular Surface Disease

This is a patient who will have high expectations for successful surgery with a presbyopia-correcting IOL, but the presence of ocular surface disease (OSD) raises some concerns. How common is OSD in the cataract surgery population, and what is the most common etiology?

DR SHEPPARD: It has been reported that approximately three-fourths of patients anticipating cataract surgery have significant OSD,[1] and in my practice, more than half of patients aged older than 50 years have significant OSD. Evaporative dry eye associated with meibomian gland dysfunction (MGD) is the most common etiology, followed by a mixed pattern of MGD and aqueous tear deficiency,[2] which appears to be present in this patient.

DR DONNENFELD: Because OSD is so common among patients needing cataract surgery, surgeons must recognize that managing the ocular surface is as important as performing quality surgery for achieving quality visual outcomes.

DR O'BRIEN: We all strive for efficiencies in clinical practice, but have to be careful that patients receive a thorough preoperative evaluation and appropriate management such that they are not brought to surgery too quickly. How do you handle screening for OSD?

DR SHEPPARD: We assume every patient who presents for elective surgery has OSD until proved otherwise. The technicians who do the initial screening know to look for the relevant signs and symptoms, and patients with positive findings are seen by the surgeon prior to placement of any drops that might confound the diagnosis. Tear film osmolarity and the Ocular Surface Disease Index (OSDI) are excellent technician-driven screening tools.

DR HOLLAND: Dr Sheppard has brought up an important point about having a system in place so that the technicians who first see patients identify clues of OSD. Otherwise, when the surgeon sees the patient, it might be assumed that the patient's vision problems are cataract-related and that any conjunctival redness and staining was caused by the anesthetic and dilating drops.

MGD is a straightforward diagnosis for cornea specialists, but it may be the most underdiagnosed, undertreated, and underappreciated disease in eye care worldwide.[3] Expression of the meibomian glands and examination of the secretions should be a routine part of the diagnostic evaluation to identify MGD. I perform the external examination using cotton-tip applicators, which provide a tool for gland expression, are cleaner than the fingers, and enable lifting of the lid to examine the palpebral conjunctiva.

DR DONNENFELD: All our patients complete a questionnaire that is a modification of the OSDI, and the answers are reviewed by a technician. If there is concern about OSD, the patient undergoes tear osmolarity testing, which is the most sensitive diagnostic test for dry eye disease.[4]

We also obtain topography in all cataract patients prior to instilling any drops. Loss of data in the visual axis on the topographic image is a sign that the patient's ocular surface is not ready for cataract surgery because it will be impossible to get an accurate keratometry measurement.

I also examine patients prior to instillation of any drops, and based on the findings, might perform tear film interferometry, which is helpful for diagnosing MGD.

DR O'BRIEN: I think we all agree that there has to be a heightened awareness to screen patients efficiently and thoroughly for OSD while being cognizant of the potential for adverse consequences if the condition is not controlled preoperatively. What approach can be used to rapidly prepare the ocular surface to withstand the challenge of surgery?

DR DONNENFELD: Anti-inflammatory treatment is needed for rapid resolution of OSD, and a short course of a topical corticosteroid can be useful for improving MGD and aqueous-deficient dry eye disease.[5,6]

Lid margin and dry eye disease, however, are chronic conditions, so patients also require a long-term solution. For MGD, we use hot compresses, lid hygiene, and oral nutritional therapy for maintenance therapy, but we start all these measures preoperatively.

DR HOLLAND: It is important to look at the severity of the OSD and to consider the patient's expectations. For me, clinical signs of corneal disease, either marginal keratitis and/or significant corneal staining, represent sufficient severity to postpone surgery and aggressively manage the patient using a corticosteroid for acute treatment of lid inflammation and secondary keratoconjunctivitis.

DR O'BRIEN: Detecting the signs of inflammation preoperatively is an essential step toward launching appropriate measures to stabilize OSD in advance of surgery. We all agree that corticosteroids provide us with the best mechanism, potency, and rapid onset of action to achieve this control in a short period of time before surgery. Have there been recent advances in ophthalmic corticosteroids that help to achieve our goals preoperatively?

DR HOLLAND: There are a number of topical corticosteroids to use. I consider the new gel preparation of loteprednol a good option for corticosteroid treatment in these patients. The gel is designed to have increased ocular surface retention and has a pH, demulcents, and a low concentration of benzalkonium chloride that make it comfortable and ocular surface-friendly.[7] For patients who are very symptomatic, I add loteprednol ointment for bedtime use. The ointment is preservative-free and provides even longer contact time on the lids and ocular surface than does the gel. There are some fixed-combination corticosteroid-antibiotic ointments, most of which contain an aminoglycoside. However, the antimicrobial effect of such ointments is usually not needed for these patients, and the aminoglycoside antibiotics in the products can be toxic to the ocular surface.

I think thermal pulsation therapy is much more effective than warm compresses and lid hygiene for delivering hyperthermia therapy and relieving meibomian gland obstruction. Nutritional supplementation with omega-3 fatty acids also is very important, but it serves as maintenance therapy because the onset of efficacy takes several weeks. Patients must choose products that are the triglyceride form of omega-3s to assure good absorption.[8] I recommend a daily dose of 4 to 6 g.

DR DONNENFELD: Thermal pulsation therapy used preoperatively in conjunction with pharmaceuticals can expedite recovery of a normal tear film, and we use it commonly in patients with MGD and cataracts. The only time I prescribe a corticosteroid-antibiotic combination for patients with OSD is for the small minority with anterior blepharitis in which *Staphylococcus* is often involved.[9]

DR SHEPPARD: And preferably, patients should be treated well in advance of surgery, probably 4 to 6 weeks.

For patients with MGD, I prescribe an oral tetracycline in addition to the steroid and a nutritional supplement, and sometimes add thermal pulsation therapy or warm compresses. Tetracyclines have an anti-inflammatory effect and restore the lipid properties of the meibum.[10] For the supplement, I prefer a product that contains gamma-linolenic acid as well as omega-3s. In a randomized, controlled, prospective, multicenter, masked trial, we augmented and confirmed the work of other investigators, showing that patients with keratoconjunctivitis sicca and concomitant MGD taking this combination benefit, with significant improvements in clinical signs, symptoms, and stabilization of ocular surface inflammatory biomarkers.[11,12] I wait at least 3 weeks to reevaluate the keratometry and

staining. Once inflammation is controlled, I place a collagen punctal plug to last at least through the period of the cataract surgery.

DR DONNENFELD: I usually wait to add oral doxycycline or topical azithromycin, but if patients are eager for rapid resolution, I start oral doxycycline 50 mg twice daily and then reduce the dose to 50 mg once daily after 2 weeks in order to minimize side effects.

DR HOLLAND: I also like topical azithromycin and might prescribe doxycycline 50 mg/d, although I use doxycycline less often now that I have been using dietary supplements and a good topical corticosteroid.

CHALLENGE 2—Vision-Limiting Comorbidities

DR O'BRIEN: Comorbid conditions limiting visual potential represent another challenge to the pursuit of perfect vision after cataract surgery. Certainly, a cataract can obscure visualization of posterior ocular structures, including the optic nerve and retina.

Suppose the preoperative optical coherence tomography (OCT) in the patient I discussed revealed an epiretinal membrane. How would you manage her ocular comorbidities?

DR SHEPPARD: Optical coherence tomography is a key component of our pre-cataract evaluation, particularly for patients using multifocal IOLs. In our practice, we consider an epiretinal membrane an absolute contraindication for a multifocal lens. However, accommodating IOLs, toric lenses, or monovision lenses are still viable options because they do not introduce significant aberration to the visual axis.

In today's environment and in this patient's best interest, I think referral for further evaluation by a retina specialist is mandatory. The retina specialist decides on the need for additional testing and treatment.

DR HOLLAND: I agree that OCT should be standard preoperative screening for patients seeking a multifocal IOL because any existing retinal pathology may amplify the decreased contrast sensitivity inherent with multifocal IOLs and could increase the likelihood of patient dissatisfaction. However, we have had very good outcomes with toric lenses and monovision in patients with retinal pathology.

In our multispecialty practice, patients with an epiretinal membrane are referred to one of our retina specialists. If retinal surgery is necessary, it is performed by the retina specialist during a combined procedure with the cataract surgery.

DR O'BRIEN: How do you manage a patient with a mild, nonvisually significant epiretinal membrane?

DR DONNENFELD: We make the patient aware that his or her visual rehabilitation may take longer, that there is increased risk for retinal sequelae after cataract surgery, and that the visual outcome may not be as optimal as he or she would like.

In addition, we are much more aggressive with our medical management in patients who are at increased risk for postsurgical cystoid macular edema (CME). While they may not require retinal surgery, they still require expert cataract surgery done with appropriate anti-inflammatory therapy to prevent inflammation and its adverse sequelae.

In a patient who is at increased risk for CME, I start a nonsteroidal anti-inflammatory drug (NSAID) 1 week prior to surgery and begin a pulsed-dose regimen of a corticosteroid 2 hours before surgery. Then I continue both medications with an aggressive postoperative regimen. For the NSAID in these at-risk patients, I have been prescribing bromfenac, 0.09%, twice daily rather than at the recommended dose of once daily, and I use difluprednate for the corticosteroid because of its potency. In a prospective, randomized trial, we found difluprednate was more effective than prednisolone acetate for controlling inflammation after cataract surgery.[13]

DR SHEPPARD: Topical steroids can have benefit for preventing inflammation in the posterior pole,[13] and I also prescribe an NSAID. I have been prescribing bromfenac once a day in routine cases and bromfenac, 0.09%, twice daily or nepafenac, 0.1%, 3 times a day in patients at high risk for CME (eg, those with diabetes or uveitis). Now we have new formulations of both of these NSAIDs, with the approval of nepafenac, 0.3%, and bromfenac, 0.07%. Keeping in mind that the risk for CME peaks at 4 to 6 weeks postoperatively,[14] I agree with the recommendation to extend the duration of NSAID therapy into and beyond that period for high-risk patients.[15]

DR O'BRIEN: We all consider routine addition of an NSAID important in our postoperative regimens in patients with diabetes or uveitis because of their high risk for developing postoperative CME. Singh and colleagues recently corroborated this practice in a study of patients with nonproliferative diabetic retinopathy undergoing cataract surgery. The group randomized to receive a corticosteroid for 2 weeks plus nepafenac for 3 months postoperatively had significantly less macular edema on OCT than the controls treated with the same corticosteroid regimen and vehicle.[16] Per product labeling, all NSAIDs are recommended to be used for only 2 weeks after cataract surgery. Today, with optimized drug formulations compared with those of earlier NSAIDs, we see fewer complications and we consider these medications quite safe. There have been occasional reports, however, of adverse corneal effects, and extended use of an NSAID in susceptible patients may result in such complications as epithelial breakdown, corneal thinning, corneal erosion, corneal ulceration, or corneal perforation.

Now, consider a patient with a family history of glaucoma and cup-to-disc ratios of 0.4 OD and 0.6 OS. The intraocular pressure (IOP) is 14 mm Hg in both eyes. How would you approach the preoperative evaluation?

DR SHEPPARD: The inter-eye difference in cup-to-disc ratio may just be a physiologic difference, but the family history indicates glaucoma risk, and the patient's chart should be carefully reviewed. Additionally, OCT may be done to look for asymmetry in retinal nerve fiber layer (RNFL) thickness, and the patient should have a visual field, gonioscopy, and pachymetry.

DR DONNENFELD: My surgical decision would be predicated by the RNFL thickness and visual field. If the RNFL thickness is close to normal or if the visual field is not significantly constricted, I am very comfortable implanting a multifocal IOL. If RNFL thickness is significantly decreased or if there is significant visual field loss, then the loss of contrast sensitivity inherent with a multifocal IOL will be amplified.

Lindstrom and colleagues reported that patients with mild glaucoma may do very well with a multifocal IOL,[17] but an informed consent discussion will guide the decision for each patient.

For patients with glaucoma, I would reinforce the importance of considering the potential for a steroid-induced IOP response when prescribing anti-inflammatory treatment. According to Chang and colleagues, an agent with less potential to raise IOP also should be considered in younger patients and in those with high myopia because these patients are at increased risk for a steroid-induced IOP response.[18] The corticosteroids suggested by the researchers that minimize the potential for IOP elevation were loteprednol and fluorometholone. For alternatives, they suggested using a topical NSAID alone or a shortened course of corticosteroid treatment.

CHALLENGE 3—Achieving Refractive Accuracy

DR O'BRIEN: With monofocal IOLs, it was considered reasonable or even desirable to have a low residual ametropia, particularly low myopic astigmatism. Can we tolerate significant astigmatism with multifocal IOLs?

DR DONNENFELD: Patients with multifocal IOLs cannot do well with residual refractive error. The general rule is that half a diopter of astigmatism is visually significant, although I have seen cases in which even that is too much. Surgeons implanting multifocal IOLs have to be willing and able to use all the tools available to correct astigmatism.

DR O'BRIEN: Because of the challenges of IOL power calculation, achieving refractive accuracy after cataract surgery is a particular problem in patients who had prior keratorefractive surgery. Are you finding that this subgroup of patients has an increased interest in presbyopia-correcting IOLs?

DR DONNENFELD: Overwhelmingly, these patients are asking for an accommodating or multifocal IOL. After being spectacle-free for years, they are strongly opposed to needing eyeglasses again.

DR SHEPPARD: Patients who had radial keratotomy were the first postrefractive surgery patients to come to us for cataract surgery, and they presented challenges far and above those in patients who had photorefractive keratectomy (PRK) or LASIK (laser-assisted in situ keratomileusis). Post-radial keratotomy patients need to know there is a very high risk for needing an IOL exchange because of high residual refractive error. If you can manage that expectation and convincingly dissuade these patients from having a multifocal IOL, you have a chance of giving them good uncorrected vision with monofocal monovision or managing their astigmatism to some extent.

DR HOLLAND: The first challenge in the postrefractive surgery patient is to determine the appropriate implant. The second challenge is obtaining accurate biometry to use in the IOL power calculation. There are multiple IOL power formulas available, but intraoperative aberrometry really helps us select the right IOL power, and performing it adds less than 1 minute to the procedure. I recommend it for all my postrefractive surgery patients.

CHALLENGE 4—Suppressing Surgically Induced Inflammation

DR O'BRIEN: Even with major technological advances that have made surgery less traumatic, and even in the hands of the most skilled surgeons, ophthalmic surgery still causes inflammation. What can we do in the operating room to minimize inflammation?

DR HOLLAND: The obvious consideration is to be as good a surgeon as possible in terms of minimizing tissue trauma and complications. Protecting against ocular surface dessication is important for avoiding an epithelial defect and subsequent inflammation. With the intent to minimize the risk for epithelial trauma during surgery, we instruct patients to keep their eyes closed while awaiting the procedure in the preoperative area, and reinforce this directive with any accompanying family members and the attending staff. Then, I place a dispersive viscoelastic on the cornea at the start of the case; it both protects the epithelium and improves my visibility if the patient has some subtle epithelial changes.

DR O'BRIEN: I would add that when applying viscoelastic for ocular surface protection, we have to be careful to apply it *after* the antiseptic preparation in order not to interfere with the action of the antiseptic.

DR SHEPPARD: Other measures for minimizing epithelial trauma and inflammation include avoiding excessive drops in the eyes, limiting preservative exposure, not placing the speculum too early, not opening the eye too wide, and not having the microscope at full power during the entire case. Limiting the number of incisions is helpful, too. Placing the main incision on the steep axis may eliminate the need for at least 1 limbal relaxing incision. Additionally, use of the femtosecond laser for lens fragmentation offers an opportunity to limit the amount of surgically induced inflammation by reducing phacoemulsification time and operative time.[19]

Finally, I apply a bandage contact lens in all my premium IOL patients, patients with basement membrane dystrophies, and in anyone who sustains an epithelial defect during surgery: a bandage contact lens accelerates healing and limits pain.

DR HOLLAND: Use of a femtosecond laser to make arcuate incisions instead of limbal relaxing incisions with a diamond or steel blade is advantageous for reducing ocular surface trauma, and it can also limit neuropathic changes because the incisions can be made shorter and a little more centrally located.

DR DONNENFELD: When performing femto-cataract surgery, it is important that the cataract surgery begin quickly after the femtosecond laser treatment, optimally within 20 minutes, in order to minimize prostaglandin release, pupil constriction, declining anesthetic effect, and ocular surface drying.

We have discovered that, surprisingly, patients who have femto-cataract surgery overwhelmingly have more postoperative discomfort than those having conventional cataract surgery. The simple explanation is that femto-cataract surgery patients almost always have arcuate incisions, and they experience inflammation and irritation from those incisions. To suppress inflammation and to control pain in these patients, it is helpful to have a strong corticosteroid and the ability to extend contact time on the ocular surface and to support the cornea. I think loteprednol gel may be useful for these procedures.

DR O'BRIEN: What are your considerations for controlling inflammation postoperatively?

DR SHEPPARD: Controlling inflammation *post*operatively begins with *pre*operative treatment. One thing to realize is that, according to labeling, many corticosteroids used in cataract surgery carry a recommendation for the agent to be started on the day after surgery. However, based on results of a preclinical study we conducted,[20] I believe it is much more advantageous to treat preoperatively, beginning at least the day before surgery, to optimally downregulate the inflammatory cascade that is activated by the surgical procedure.

DR HOLLAND: We have to be aggressive with medications to suppress postoperative inflammation. Treatment efficacy, however, depends on the patient using the medication as directed, including following instructions to shake the bottle when using a suspension. A study involving a corticosteroid suspension found that even when patients were specifically instructed to read the label that stated "shake well," compliance was poor.[21] Furthermore, even when a branded corticosteroid suspension bottle is shaken, dose uniformity is poor.[22] Initially, the dose dispensed tends to be less than 100% of the labeled concentration; and the problems with dose uniformity are worse with a generic agent.[22] Today, with difluprednate emulsion and loteprednol gel, we have corticosteroid formulations providing good dose uniformity without any need for shaking the container.[7,21]

PURSUING PERFECT VISION AFTER LASIK

CASE 2

A 49-year-old perimenopausal woman with hyperopia and astigmatism presents with contact lens intolerance. She undergoes bilateral femtosecond laser-assisted LASIK with an excellent refractive outcome and unaided visual acuity of 20/20. She returns several months later, very dissatisfied, however. As observed with Rose Bengal, she has 4+ staining of the inferior cornea extending centrally **(Figure 2)**. Her Schirmer 1 test result is 2 mm and tear film break-up time is 2 seconds. What are the most common causes of patient dissatisfaction after laser vision correction? What might explain this patient's outcome?

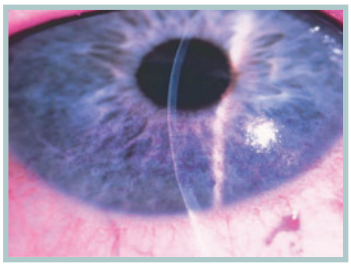

FIGURE 2: Case 2: Slit-lamp photograph after Rose Bengal instillation discloses marked diffuse punctate erosions across the LASIK flap surface and filament formation on the inferior conjunctiva.

Photo Courtesy of Terrence P. O'Brien, MD

DR DONNENFELD: Dry eye remains the most significant problem after LASIK, but we are getting much better about identifying and managing it. After reviewing the world's literature on LASIK to determine patient satisfaction and quality of life following LASIK, the Joint LASIK Study Task Force made the important recommendation that all patients who present for LASIK should undergo a thorough screening for dry eye and be treated aggressively preoperatively if it is found to be present.[23]

This patient had a "perfect storm" of conditions for developing dry eye-related problems after LASIK. She was perimenopausal and likely had preexisting dry eye, and she was undergoing a hyperopic ablation, which causes more nerve damage with its larger flap and ablation area.

Because hyperopic patients seeking laser vision correction tend to be older, I am extremely cognizant of the concern for dry eye, and so am aggressive with my management both in terms of therapy and in terms of patient expectations. Clear lens extraction is often a better surgical option than keratorefractive surgery for these patients.

DR HOLLAND: This case patient also presented with contact lens intolerance prior to LASIK, which was another clue to serious OSD.

Contact lens intolerance is one of the most common reasons patients want refractive surgery, and dry eye is the most common cause of contact lens intolerance. While myopic LASIK causes a little less dryness than does hyperopic treatment, this patient still would have the same postoperative problems because of her preexisting dry eye.

I agree that for a hyperopic patient in the presbyopic age group, clear lens exchange is a preferred procedure. However, if the patient still wants laser vision correction, I would strongly advocate delaying surgery and aggressively treating the OSD first. This patient probably has mixed aqueous tear deficiency and evaporative dry eye. Topical cyclosporine plus a corticosteroid is an excellent treatment for acute management. Cyclosporine addresses the aqueous tear deficiency, but the corticosteroid acts more rapidly than cyclosporine to control inflammation and will improve the tolerability of the cyclosporine.[24] Still, it will probably take 6 to 8 weeks before the ocular surface is in the right condition for surgery.

DR O'BRIEN: Educating these patients about the reasons for postponing surgery is important. They are usually eager to proceed, and so it is incumbent upon the staff to support the decision to delay with proper counseling.

DR HOLLAND: Patients with no corneal staining can schedule their surgery without waiting to optimize the ocular surface, but I also start cyclosporine with loteprednol in them right away, with the goal of protecting against postoperative aqueous deficiency. Since there is usually a 3- to 4-week delay until they undergo the procedure, the patients achieve the benefit of cyclosporine early postoperatively.

DR O'BRIEN: We hope to see minimal inflammation after LASIK, but occasionally patients have more than the anticipated level. What are the consequences of uncontrolled inflammation?

DR SHEPPARD: Uncontrolled inflammation can lead to regression, particularly in PRK patients, setting the stage for haze, irregular astigmatism, glare, and haloes, thus requiring an enhancement procedure.

DR DONNENFELD: Patients with atopic disease are at the highest risk for inflammation following LASIK and they have a much greater risk for suboptimal refractive results and for diffuse lamellar keratitis. They need to be treated very aggressively. The preoperative use of a corticosteroid plus an antihistamine can make a big difference in refractive outcomes for these patients.

DR O'BRIEN: We published a severity-based preoperative treatment algorithm for optimizing the ocular surface prior to LASIK in patients with allergy, and it recommends use of a dual-acting antihistamine/mast cell stabilizer for anyone with mild or more severe disease.[25] Regarding the issue of dry eye and LASIK, however, it is important to choose a product that has selective activity for the histamine-1 receptor and low affinity for the receptors that mediate dry eye, a product such as bepotastine or epinastine.

NSAIDs were first demonstrated to be effective in reducing pain after excimer laser phototherapeutic keratectomy. Dr Sheppard, do you use an ophthalmic NSAID in LASIK patients?

DR SHEPPARD: I think the combination of a topical NSAID and a topical steroid is relevant to LASIK surgery and has a particular role in PRK patients. It is well known to PRK surgeons who have used systemic steroids for postoperative pain management—as well as to any physician caring for trauma patients who require aggressive systemic steroids—that steroids also have potent analgesic activity.

DR DONNENFELD: Because NSAIDs act by inhibiting prostaglandin production, I start treatment in surface ablation cases with 1 drop before surgery and 1 drop on top of the bandage contact lens at the end of surgery, and I instruct the patient to instill 1 drop daily for 2 more days. I start a corticosteroid immediately following placement of the bandage contact lens and continue it for 4 to 6 weeks after surface ablation, a much longer period than that prescribed for following lamellar surgery. Keeping in mind the risk for a steroid-induced IOP response during this prolonged course of treatment, I prescribe loteprednol gel because of its low potential to elevate IOP.[26] Reducing exposure to benzalkonium chloride also is desirable in surface ablation cases.

DR O'BRIEN: In summary, I think we concur that there are multiple issues to consider as we aim to provide the best outcomes for our refractive cataract surgery and laser vision correction patients. It is important to be comprehensive with our preoperative screening; to be careful to delay surgery, as needed, while managing preexisting conditions that can compromise outcomes; to be cognizant of the challenges of IOL power calculations in patients with a history of refractive surgery; and to be aggressive in controlling surgically induced inflammation by using an appropriate medication regimen incorporating optimal agents.

Table 1. Corticosteroid Options for Cataract and Refractive Surgery[a]

Product (trade name)	Formulation[b]	Indication[c]	Preservative	Comments
Difluprednate, 0.05% (Durezol™)	Emulsion	Pain and inflammation after ocular surgery	Sorbic acid, 0.1%	A prodrug of difluoroprednisolone butyrate with rapid corneal penetration. Superior to prednisolone acetate for reducing inflammation after cataract surgery[13]
Loteprednol etabonate, 0.5% (Lotemax®)	Gel	Pain and inflammation after ocular surgery	BAK, 0.003%	Vehicle contains 2 demulcents, favors ocular surface retention without visual blur[27]
	Ointment	Pain and inflammation after ocular surgery	None	Only preservative-free corticosteroid ophthalmic ointment
	Suspension	Inflammation after ocular surgery	BAK, 0.01%	Similar to prednisolone acetate, 1%, for controlling inflammation after ocular surgery with less effect on IOP[28]
Rimexolone, 0.1% (Vexol®)	Suspension	Inflammation after ocular surgery	BAK, 0.01%	Similar to prednisolone acetate, 1%, for controlling inflammation after ocular surgery with similar effects on IOP[29,30]

[a] The products listed have indications for treatment of postoperative inflammation or of postoperative inflammation and pain. Other ophthalmic corticosteroids used for postoperative inflammation control include prednisolone acetate, 1%, suspension (Pred Forte® and generic), dexamethasone, 0.1%, suspension (Maxidex®), dexamethasone sodium phosphate, 0.1%, solution (generic), fluorometholone acetate, 0.1%, suspension (Flarex®), fluorometholone, 0.1%, ointment and suspension (FML®), and fluorometholone, 0.25%, suspension (FML Forte®).

[b] Emulsion, gel, and ointment provide dose uniformity without shaking.

[c] All products are recommended for 4-times-daily dosing.

BAK=benzalkonium chloride.

Table 2. NSAID Options for Cataract and Refractive Surgery[a]

Product (trade name)	Formulation[b]	Indication	Dosing	Preservative	Comments
Bromfenac, 0.07% (Prolensa™)	Solution	Inflammation and pain after cataract surgery	1x/d	BAK, 0.005%	New formulation bromfenac (approved April 2013) features an advanced lower pH vehicle that improves bromfenac corneal penetration[31,32]
Bromfenac, 0.09% (Bromday™)	Solution	Inflammation and pain after cataract surgery	1x/d	BAK, 0.005%	
Bromfenac, 0.09% (generic)	Solution	Inflammation and pain after cataract surgery	2x/d	BAK, 0.005%	
Diclofenac, 0.1% (Voltaren Ophthalmic®, generics)	Solution	Inflammation after cataract surgery. Temporary relief of pain and photophobia after corneal refractive surgery	4x/d	Sorbic acid, 0.2%	
Nepafenac, 0.1% (Nevanac®)	Suspension	Pain and inflammation associated with cataract surgery	3x/d	BAK, 0.005%	Prodrug of amfenac that rapidly penetrates the cornea. Approved in the European Union for reduction in the risk for postoperative macular edema associated with cataract surgery in diabetic patients
Nepafenac, 0.3% (Ilevro™)	Suspension	Pain and inflammation associated with cataract surgery	1x/d	BAK, 0.005%	New formulation (approved October 2012) that contains guar gum, carboxymethylcellulose sodium, and propylene glycol and allows once-daily dosing
Ketorolac tromethamine, 0.4% (Acular LS®, generics)	Solution	Reduction of ocular pain and burning/ stinging after corneal refractive surgery	4x/d	BAK, 0.006%	
Ketorolac tromethamine, 0.45% (Acuvail®)	Solution	Pain and inflammation after cataract surgery	2x/d	None	Vehicle promotes ketorolac bioavailability, ocular surface adherence, and comfort[33]
Ketorolac tromethamine, 0.5% (Acular®, generics)	Solution	Inflammation after cataract surgery	4x/d	BAK, 0.01%	

[a] The products listed have indications for treatment of postoperative inflammation or of postoperative inflammation and pain. Flurbiprofen sodium, 0.03%, solution (Ocufen®) is indicated for the inhibition of intraoperative miosis.

[b] Solutions provide dose uniformity without shaking.

BAK=benzalkonium chloride.

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