

Supplement to

# Cataract & Refractive Surgery TODAY

May 2008

## Dry Eye Treatment as a Surgical Tool



**"ALL VISION TRULY STARTS WITH THE TEAR FILM."**

This continuing medical education activity is jointly sponsored by

 THE DULANEY  
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Cataract & Refractive Surgery  
TODAY

# Dry Eye Treatment as a Surgical Tool



**"ALL VISION TRULY STARTS WITH THE TEAR FILM."**

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### STATEMENT OF NEED

Based on research,\* the preoperative existence of ocular surface disease as well as the development of dry eye symptoms after cataract and refractive surgery may be a clinically significant phenomenon with measurable impact on patients' quality of life. This educational roundtable discussion and supplement reviews current research related to delivering optimal surgical outcomes, with a particular focus on topical cyclosporine A and its possible application as a therapy to address preexisting and surgically induced dry eye in cataract and refractive patients.

### TARGET AUDIENCE

This activity is designed for anterior segment ophthalmic surgeons and other ophthalmologists.

### LEARNING OBJECTIVES

Upon successfully completing this learning program, participants should be able to:

- understand the mechanisms of dry eye and its impact on cataract and refractive surgical outcomes
- describe the importance of preoperative screening for dry eye
- review current therapies and practices for optimizing the ocular surface for cataract and refractive surgery
- discuss the role of therapeutic dry eye treatments in cataract and refractive surgery

\* See references 1,2,4,9, and 10 on page 14.



## METHOD OF INSTRUCTION

Participants should read the learning objectives and continuing medical education (CME) activity in their entirety. After reviewing the material, please complete the self-assessment test, which consists of a series of multiple-choice questions. To answer these questions online and receive real-time results, please visit [www.dulaneyfoundation.org](http://www.dulaneyfoundation.org) and click "Online Courses."

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Upon completing the activity and achieving a passing score of over 70% on the self-assessment test, you may print out a CME credit letter awarding 1 *AMA PRA Category 1 Credit*.™ The estimated time to complete this activity is 1 hour.

## ACCREDITATION

This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of The Dulaney Foundation and Bryn Mawr Communications LLC, publisher of *Cataract & Refractive Surgery Today*. The Dulaney Foundation is accredited by the ACCME to provide continuing education for physicians. The Dulaney Foundation designates this medical education activity for a maximum of 1 *AMA PRA Category 1 Credit*.™ Physicians should only claim credit commensurate with the extent of their participation in the activity.

## DISCLOSURE

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## FACULTY DISCLOSURE DECLARATIONS

Elizabeth A. Davis, MD, is a speaker and investigator for Allergan, Inc., and she is a consultant for Bausch & Lomb, Advanced Medical Optics, Inc., Ista Pharmaceuticals, Inc., STAAR Surgical Company, and Inspire Pharmaceuticals, Inc.

Steven J. Dell, MD, is a consultant for Advanced Medical Optics, Inc., Allergan, Inc., and Bausch & Lomb.

Uday Devgan, MD, receives research and grant support from Allergan, Inc., Advanced Medical Optics, Inc., and Bausch & Lomb; he is a consultant for Allergan, Inc., Advanced Medical Optics, Inc., Bausch & Lomb, STAAR Surgical Company, and Ista Pharmaceuticals, Inc.; he is on the speakers list of Allergan, Inc., Advanced Medical Optics, Inc., Bausch & Lomb, STAAR Surgical Company, Ista Pharmaceuticals, Inc., and Pfizer Inc.; and he holds stock in STAAR Surgical Company and Ista Pharmaceuticals, Inc.

Eric D. Donnenfeld, MD, receives research and grant support from and is a consultant to Advanced Medical Optics, Inc., Alcon Laboratories, Inc., Allergan, Inc., Bausch & Lomb, Inspire Pharmaceuticals, Inc., Insite Vision Incorporated, and Advanced Vision Research.

Roger F. Steinert, MD, is a consultant for Advanced Medical Optics, Inc.

Robert Weinstock, MD, medical reviewer, is a consultant to Allergan, Inc., and Bausch & Lomb; is on the speakers bureau of Vistakon and Ista Pharmaceuticals, Inc.; and holds stock in TruVision, Inc.

All those involved in the planning and editing of this educational activity have indicated that they have no financial relationships to disclose. ■

**OPENING COMMENTS**

**Dr. Donnenfeld:** In this roundtable, we will discuss the impact of ocular surface disease and dry eye on surgical rehabilitation after cataract and refractive surgery. As surgeons, we are acutely aware that all vision truly starts with the tear film. The ocular surface is the refracting surface of the eye. Chronic dry eye affects 10% to 15% of the elderly population<sup>1,2</sup> and greatly impacts these individuals' daily quality of life by interfering with their ability to perform everyday activities such as driving, reading, and using the computer. Clinically, ocular surface disease and dry eye interfere with a full and successful visual rehabilitation after cataract and refractive surgery. Therefore, it behooves the surgeon to evaluate the patient's tear film preoperatively and institute an improvement strategy that aims to optimize refractive and visual results. Postoperatively, we must work with at-risk patients to develop a treatment plan that minimizes postsurgical dry eye and improves the tear film in order to stabilize their quality of vision.

With these considerations in mind, I will open the discussion to our panel. How common is dry eye in the population and in your individual practices?

**Dr. Devgan:** I practice in Los Angeles, where the climate is semi-arid. Dry eye is very common, particularly in older patients and after lenticular procedures. These patients already have lower tear production than younger patients and those who have not undergone lenticular surgery, so it is important to address their symptoms.

**Dr. Dell:** During the past year or so, I have begun raising the point that factors beyond our control are increasing the rate of dry eye in our patients. In 2002, a group of cardiologists revealed the results of the huge Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT) clinical trial, which studied the efficacy of calcium channel blockers and ACE inhibitors versus thiazide diuretics in lowering the incidence of cardiac disease.<sup>3</sup> One of the study's conclusions was that the clinical outcomes of patients treated with calcium channel blockers and ACE inhibitors were worse than those of the patients treated with thiazide diuretics. Thus, during the last 6 years, cardiologists have been switching patients back to the old thiazide diuretics that were formerly out of fashion. These medications have increased the incidence of dry eye in my patient population.

"We are seeing a greater incidence of dry eye, and we need to be more vigilant for it on a regular basis."

—Eric D. Donnenfeld, MD

**Dr. Donnenfeld:** I believe there is an epidemic of dry eye occurring in the US due to three primary stimuli that are affecting all age groups. The first is aging. The baby boomers are moving into their 50s and 60s and experiencing a greater prevalence of dry eye. Second, as Dr. Dell mentioned, many of these patients are being prescribed thiazide diuretics, which decrease tear production. Finally, I strongly believe that our society's dietary changes over the last several decades (ie, the increased consumption of processed foods) have severely limited our intake of anti-inflammatory omega-3 fatty acids and greatly increased our ingestion of proinflammatory omega-6 fatty acids. This nutritional imbalance causes our bodies to produce more cytokines, degrades the quality of meibomian gland secretions, and inflames the tear film. For all these reasons, we are seeing a greater incidence of dry eye, and we need to be more vigilant for it on a regular basis.

**Dr. Steinert:** I agree with everything you said and would add that there is a fourth contributing factor, which is the increasing occurrence of artificially dehumidified environments in the US and most developed countries. Today, every car and building is air conditioned, and I believe this is exacerbating the dry eye problem.

**Dr. Davis:** Along the lines of medications, more people are taking antidepressants and using antihistamines more often, which both increase the incidence of dry eye. They are also doing a lot more computer work, which reduces blinking rates. However, I think the number-one risk factor for dry eye is female gender. Female patients aged 30 or older are almost guaranteed to have dry eye.

**Dr. Donnenfeld:** Absolutely. The side effects of medications are something we all need to be aware of. Medications such as antihistamines, antidepressants, birth control pills, and diuretics have become so pervasive in



our culture that patients often do not consider them as drugs and forget to include them in a patient history.

**Dr. Dell:** Many acid blockers also have an effect on dry eye, and they are now available over the counter.

“It is important to differentiate between symptoms that begin early in the day and those that become worse throughout the day.”

—Steven J. Dell, MD

**Dr. Steinert:** Another contributing factor to this problem may be that ophthalmologists have never developed a reliable, objective test for dry eye, and evaluating medications for this side effect is marginally effective at best. As a result, many over-the-counter and prescription medications may actually have provable roles in dry eye of which we are unaware.

## SCREENING

**Dr. Donnenfeld:** Dr. Steinert raises a very important point that I would like to discuss further. In medical school, we were trained to take a patient history that includes asking about signs and symptoms that may lead to a diagnosis of dry eye. Let’s first discuss our evaluations of patients who seek refractive surgery. What do you look for in screening for patients who may be at risk of developing dry eye?

**Dr. Devgan:** My screening usually begins with gender and age. Females and older patients automatically have lower tear production.

**Dr. Davis:** Patients often complain of intermittent blurry vision, foreign body sensation, or discomfort with their contact lenses. Usually, they say that their eyes grow tired by the end of the day, making it difficult to read. These symptoms are actually dry eye.

**Dr. Dell:** It is important to differentiate between symptoms that begin early in the day and those that become worse throughout the day. Patients who wake up with scratchy, gritty eyes often have inflammatory blepharitis, meibomianitis, or even recurrent erosions, and those symptoms tend to improve as the day goes

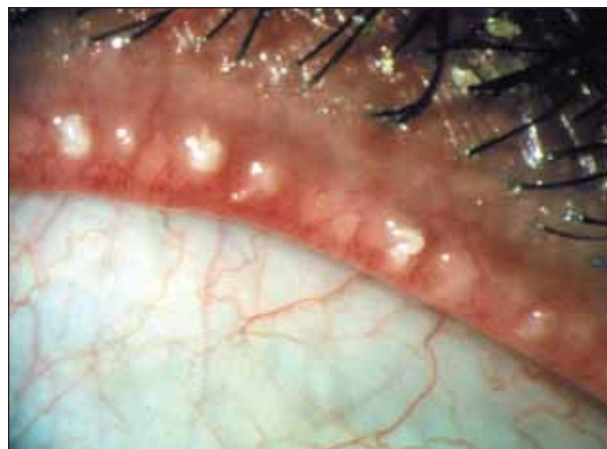
on. Patients whose eyes worsen during the day usually have aqueous deficiency.

**Dr. Donnenfeld:** Many patients have both problems. Seventy percent of all dry eye is due to meibomian gland disease<sup>4</sup> (Figure 1), which is associated with bimodal distribution and changing cycles of dryness during the course of the day. These eyes will be irritated in the morning due to lipid buildup during the night. They may feel comfortable by midday, but then they suffer aqueous deficiency in the evening.

**Dr. Dell:** I would like to address a point that Dr. Davis brought up, which is fluctuating vision. This phenomenon is especially common after IOL surgery, with patients often describing vision that is alternatively good and bad. This complaint immediately suggests dry eye as the etiology.

**Dr. Donnenfeld:** I could not agree more. When post-surgical patients come in complaining about fluctuating vision, they often attribute their symptoms to a problem with the surgery or the implant. Usually, the problem is clearly related to the tear film. Visual fluctuation can mean different things to different patients. It can be vision that fluctuates between blinks, over the course of the day, or during prolonged visual tasks. Patients who have visual fluctuations (unless they have undergone radial keratotomy) by definition have ocular surface disease; for me, this is the most important symptom for pursuing a dry eye treatment regimen.

**Dr. Steinert:** Another challenge with treating dry eye



(Courtesy of Eric D. Donnenfeld, MD.)

**Figure 1.** Meibomian gland inspissations are visible along the upper lash line.

is that this label is not a very good description of the symptoms attributed to it. The term encompasses a larger set of issues, especially meibomian gland disease and problems such as seborrheic and staphylococcal blepharitis, lagophthalmos, and reduced corneal innervation. The patient who is classically aqueous deficient should experience grittiness and foreign body sensation. I think few people actually have pure aqueous deficiency that affects their visual acuity. This distinction has been vaguely acknowledged but not readily addressed until now, as expectations and demands have risen for superior visual function, particularly with the advent of multifocal lenses and to some degree with refractive surgery. All of a sudden, these visual issues are dominating our practices.

“Fluorescein will only stain when exposed to the basement membrane. It will not show disease in the cell membrane.”

—Roger F. Steinert, MD

**Dr. Dell:** In the past few years, attendance at courses on limbal relaxing incisions (LRIs) at the ASCRS meeting has exploded. A high percentage of IOL patients—especially premium refractive IOL patients—receive LRIs, which render parts of the cornea neurotrophic and put it at a much greater risk of dryness. I would add this phenomenon to the list of factors contributing to dry eye in our patients.

**Dr. Donnenfeld:** The number-one reason that patients seek a refractive consultation is contact lens intolerance, and the most common reason for this intolerance is dry eye disease. Thus, we are preselecting patients at risk for dry eye just by the very nature of the disease. Usually, treating these individuals’ ocular surface disease successfully resolves the problem and allows them to return to wearing contact lenses without their needing or desiring surgery. Clinicians should keep this in mind during refractive consultations.

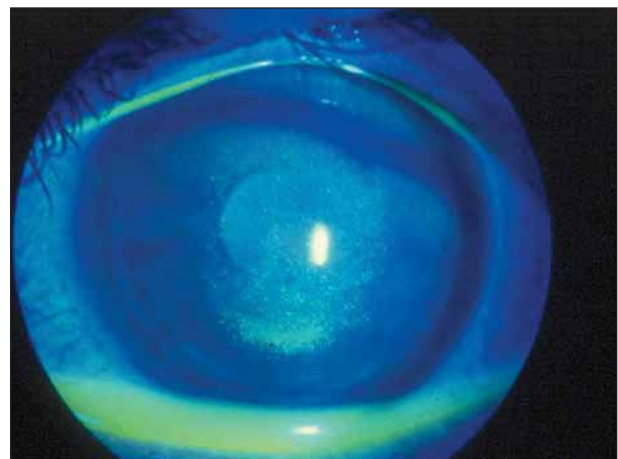
**PHYSICAL FINDINGS OF DRY EYE**

**Dr. Donnenfeld:** Let’s talk about the physical signs associated with dry eye. What do you look for in a preoperative patient that motivates you to treat him for dry eye?

**Dr. Davis:** First, as you talk to a patient, you want to study his face for any rosacea or dilated blood vessels. Fair-skinned individuals often suffer from blepharitis, although it can occur in people with darker skin coloration. Then, examine the patient’s eyelids for signs of meibomianitis, crusting of the lashes, and poor lid apposition. The next step is to look at the conjunctiva and then the cornea for any signs of infection or inflammation. Then, there is tear-film breakup time and corneal staining, for which you may want to use various vital dyes. Next, check the tear lake to see if it is oily, and make certain that the bottom lid margin of tear strip is about 1 mm. Although some physicians include Schirmer testing, I am not a huge fan of that method, because I feel its outcomes are quite variable. Numerous articles have shown that it is not a very reliable test.<sup>5-7</sup>

**Dr. Donnenfeld:** I do not rely on Schirmer testing either, except to document rheumatoid disease, where it is important to know if the Schirmer value is very low. Incidentally, rheumatoid disease is another risk factor for dry eye syndrome. Dr. Davis mentioned supravital dyes, of which there are three: fluorescein, rose bengal, and Lissamine Green (Accutome, Inc., Malvern, PA). Dr. Steinert, please talk about these dyes, what they reveal, and what the clinician should look for.

**Dr. Steinert:** Fluorescein, which is the most commonly available and widely used supravital stain, will only stain when exposed to the basement membrane (Figure 2). It will not show disease in the cell membrane. Rose bengal has been out considerably longer than Lissamine Green, but these two dyes are largely interchangeable. Patients



(Courtesy of Eric D. Donnenfeld, MD)

**Figure 2.** Fluorescein staining of the cornea reveals dry eye disease.



often experience stinging with rose bengal, whereas Lissamine Green is more comfortable. Also, I find rose bengal annoying to use, because its paper strip is hydrophobic, and the only way I can get it to work is to peel back its paper part way, leaving it partially wrapped, and then to place balanced salt or saline solution against the exposed area. This technique seems to help the dye absorb better into the eye and defeats the problems with surface tension. I think the paper strips deliver variable concentration, and I frankly prefer the liquid drop form of Lissamine Green.

Again, it is best to use either Lissamine Green or rose bengal for corneal staining for dry eye, because they will reveal damage on the external cell membranes, which is where dry eye classically presents. Similarly, the occasional case of superior lipid keratitis is only visible with one of these dyes. I diagnose this condition about once per year; when all routine treatments fail and the patient is still suffering miserably from dry eye, the culprit is usually superior limbal keratitis.

**Dr. Donnenfeld:** Robert Feenstra, MD, and Stanley Tseng, MD, make the point that Lissamine Green and rose bengal reveal mucin deficiency.<sup>8</sup> Dr. Dell, do you use either of those dyes in your clinical practice?

**Dr. Dell:** I use rose bengal.

**Dr. Donnenfeld:** What do you look for when you instill it?

**Dr. Dell:** I examine the tear film itself, the conjunctiva and cornea, and especially the interpalpebral conjunctiva. I look for dye uptake. I also look for signs of chronic dry eye, pingueculae, small pterygium, and little Salzmann's nodules beginning to develop in the periphery of the cornea. Also, I am curious if anyone on the panel has had experience measuring tear-film osmolarity, which I think is going to become more important in the near future.

**Dr. Donnenfeld:** My staff and I have experience with measuring tear-film osmolarity as well as tear-film lactoferrin levels. These are effective research tools that I think may be used more widely in the future.

**Dr. Devgan:** I prefer Lissamine Green staining, because it identifies dry eye easily. In Los Angeles, a large number of people undergo blepharoplasties and subsequently develop some degree of lagophthalmos, which obviously leads to corneal dryness.

**Dr. Donnenfeld:** I think Lissamine Green and rose bengal are terrific. If I had to rely on one method to identify dry eye, it would be supravital staining with Lissamine Green and rose bengal, because they identify tissue damage caused by dry eye disease. To me, any degree of tissue damage from dryness warrants pharmaceutical intervention before I consider proceeding with either cataract or refractive surgery. I have a knee-jerk reaction; as soon as I see evidence of ocular surface damage caused by dry eye disease, I know that surgery will worsen the problem, and I want to correct it before proceeding.

“Chronic dry eye causes a relative corneal anesthesia with a loss of sensation that reduces the feedback loop to the brain stem to produce tears.”

—Eric D. Donnenfeld, MD

**Dr. Steinert:** Along those lines, the only time I find Schirmer testing valuable is in monitoring a patient's dry eye treatment progress; for example, I see patients' Schirmer values increase when I prescribe topical cyclosporine A (Restasis; Allergan, Inc., Irvine, CA). This use, however, requires performing the test in a consistent way. In essence, each detection method has limited value. Although I agree with everything the panel has said about the supravital dyes, the symptoms often are wildly disproportionate to the degree of staining preoperatively. I have seen some very symptomatic eyes have almost no staining and some eyes with a lot of staining but relatively few symptoms. Frankly, I do not understand what causes the variance in results.

**Dr. Donnenfeld:** I agree that patients' complaints do not always correlate with symptoms of irritation and foreign body sensation. This may be due to the fact that chronic dry eye causes a relative corneal anesthesia with a loss of sensation that reduces the feedback loop to the brain stem to produce tears. Inflammatory cytokines reduce corneal sensation, so the eyes do not feel the dryness and produce fewer tears. I think clinical findings and visual complaints correlate strongly, however, and I believe we have to focus not only on patients' subjective complaints but also their quality of vision. I see a definitive link between preoperative corneal fluorescein staining and



patients' fluctuating or even loss of vision after surgery. Why do refractive and cataract surgery make dry eye worse, and how much worse do they make it?

**EFFECTS OF SURGERY**

**Dr. Dell:** Let's talk first about laser refractive surgery. There is a debate about the effects of dry eye and surface ablation versus flap cases. There is no question in my mind that dry eye caused by the creation of the LASIK flap (Figure 3) is very different from the type of dry eye seen after surface surgery. Many patients diagnosed with dry eye actually have recurring corneal erosions. During the Hansatome (Bausch & Lomb, Rochester, NY) heyday of LASIK, when we were creating larger, deeper flaps, we were often causing significant neurotrophgia.

Regarding cataracts, we mentioned how LRIs can render parts of the cornea neurotrophic. Add to this the fact that we place postoperative patients on numerous pharmaceuticals for a fairly long period of time—for high-risk patients, we prescribe NSAIDs for 1 and maybe even 2 months—thus, we are insulting a cornea that is already under attack.

**Dr. Devgan:** Lenticular surgery also induces intraocular inflammation, which does not help a dry eye at all. I perform equal parts LASIK and lens-based surgery, and with both groups, the patients' primary focus is a good outcome. They do not want to know about the little nuances, they just want to see well. Failing to preoperatively optimize the ocular surface is as negligent as not treating the full refractive error or the astigmatism or

overlooking macular pathology. You need to optimize everything, because patients need the entire package to achieve the vision that they desire.

“Failing to preoperatively optimize the ocular surface is as negligent as not treating the full refractive error or the astigmatism or overlooking macular pathology.”

—Uday Devgan, MD

**Dr. Donnenfeld:** I certainly agree. In LASIK, for example, the flap severs the corneal nerve trunks, and then the photoablation destroys the neuroplexus and creates a relative corneal anesthesia. There is evidence now that we can take steps to reduce these effects, such as making the flap as small as possible to preserve more corneal nerve and making the flap hinge as large as possible to act as a conduit for neural supply. Also, despite some controversy, there is evidence that nasal hinges may be slightly better than superior hinges at maintaining corneal sensation. Daniel Durrie, MD, conducted a study that showed that (1) very thin flaps may sever fewer nerves because they do not cut the neuroplexus as deeply and (2) there is a marked return of corneal sensation with thin-flap LASIK surgery compared with deep flaps. So, I always try to make my flap as small and thin as possible, with the hinge as large as possible.<sup>9,10</sup>

Pharmaceuticals can also have an impact on the ocular surface, and therefore we need to use the least toxic medications available. The best pharmaceuticals are those that have a long track record. Other aspects of surgery that can affect dry eye include the suction from the microkeratome or the IntraLase device (Advanced Medical Optics, Inc., Santa Ana, CA), which can damage goblet cells, and the change in the corneal curvature, which alters the way the eyelid meets the tear film. These myriad assaults illustrate the importance of preparing the eye for cataract and refractive surgery. Dr. Dell, which do you think exacerbates dry eye more, LASIK or cataract surgery?

**Dr. Dell:** LASIK, no question. I would like to further address a point you just touched on, which is the change in corneal curvature. I think we all recognize that further steepening a 46.00 D cornea that is already susceptible to dryness will most likely produce central



Figure 3. Symptoms of dry eye underneath a LASIK flap are visible at the slit lamp.

(Courtesy of Eric D. Donnenfeld, MD.)



staining. I think we are going to encounter this issue more often as multifocal ablations, which are being performed outside the US right now, gain traction. In addition to the one-to-one steepening ratio per diopter generated by the refractive effect, this type of surgery produces an additional diopter of steepening for the multifocal effect. Some of these patients actually have twice the corneal steepening expected from their multifocal ablation, and such steep corneas could potentially be exceedingly dry centrally.

## MANAGEMENT APPROACH

### Stepwise Strategy

**Dr. Donnenfeld:** During the past 5 years, there has been a trend in cataract and refractive surgery of higher patient expectations. Dr. Devgan was absolutely right, that patients do not care why they see poorly, they simply want improvement, and we have to deliver better results. I believe managing the tear film during all stages of surgery gives us the best chance of delivering the quality of vision patients want. We want our patients to be ecstatic right from the beginning. Whether a patient has dry eye preoperatively or if I suspect that surgery will induce this syndrome, I tend to treat the ocular surface aggressively preoperatively. Dr. Steinert, please tell us how you approach mild preoperative dry eye.

**Dr. Steinert:** The first step is to determine what type of dry eye the patient has, whether it is aqueous deficiency, meibomian gland disease, lipid-layer abnormality, exposure, or a mixture of these problems. In many cases, treatment will include a regimen of massaging the meibomian glands with warm compresses. If the eyes have a buildup of debris, I will add a lid scrub to the warm compresses. At a minimum, depending on the severity of the condition, I will prescribe artificial tears or instruct the patient to increase his use of artificial tears (many patients admit to using these drops only once or twice per day). I also recommend nutritional supplementation with omega-3 fatty acids. This group of strategies is my level-1 treatment approach.

For a level-2 treatment, I initiate topical cyclosporine A. If that is not adequate, then I will try punctal occlusion, unless I find significant inflammation in the tear film.

If punctal occlusion fails, I will try more aggressive pharmacological treatments such as steroids. In my experience, this "level-3" strategy is rarely needed. Unless an eye is bone dry, these staged, fundamental treatments often improve the ocular surface substantially.

**Dr. Donnenfeld:** When cyclosporine A was first approved by the FDA, clinicians often reserved it for the worst cases of dry eye. With time, we found that the milder cases responded nicely to this treatment. When I am planning surgery on a patient with preoperative dry eye, I pretreat the ocular surface aggressively to try to prevent the procedure from worsening the condition. Dr. Dell, how aggressively do you treat dry eye patients preoperatively?

"A few years ago, we thought cyclosporine A required months of application before showing effect. Fortunately, just a few weeks can show benefit in many eyes, especially for the mild-to-moderate cases."

—Elizabeth A. Davis, MD

**Dr. Dell:** My approach differs somewhat from Dr. Steinert's in that, instead of a level 1, I have a level zero. Virtually every patient who enters my practice for IOL surgery is placed on topical artificial tears, and most are also prescribed daily doses of omega-3 fatty acids. My staff executes this strategy well before the patient is measured for surgery, because I believe that the most important day in the life of a cornea is the day it is measured for surgery, not the day that it undergoes surgery. The cornea must be perfect, because the corneal measurements we take are the basis for our astigmatic planning. Good topographic data are crucial to planning for a toric IOL or an LRI.

Also, as accurate as axial-length determination has become with laser interferometry, my weakest link in an IOL calculation is now the keratometric data. So, I demand excellent keratometric data as well as great astigmatic magnitude and axis data. The only way to achieve such accurate measurements is by making the cornea as healthy as possible. So, after my baseline therapy of oral omega-3 fatty acids and topical artificial tears, I have a very low threshold for prescribing topical cyclosporine A, especially because there is some lag time before that drug generates a clinical effect.

**Dr. Davis:** A few years ago, we thought cyclosporine A required months of application before showing effect. Fortunately, clinical experience has demonstrated that just a few weeks can show benefit in many eyes, especially for the mild-to-moderate cases.

**Dr. Donnenfeld:** Dr. Davis, what are the physical findings you look for when determining whether a patient needs to be aggressively treated for dry eye, and what are your criteria for starting patients on cyclosporine A?

**Dr. Davis:** If a patient has symptoms of dry eye but not necessarily signs (ie, punctate keratopathy, staining, or decreased tear-film breakup time), then I would probably begin with preservative-free lubricants, omega-3 fatty acids, lid scrubbing if necessary, and advise the patient of the possibility of the condition worsening after surgery. Then, I would take an observant approach. If an examination revealed punctate keratitis or an abnormal tear film, I would likely prescribe cyclosporine A preoperatively and continue it postoperatively. I think a lot of patients are receptive to delaying surgery for dry eye treatment. They usually appreciate your conscientiousness in not proceeding until you have made certain that their eyes are optimized for a superior outcome.

**Treat Early and Aggressively**

**Dr. Devgan:** My pearl for preoperative evaluation of the ocular surface is, when in doubt, treat. If you treat dry eye after surgery, patients perceive that the procedure induced the problem. Treating for dry eye before surgery sends the message that their dry eye was a preoperative condition, and it also gives you the opportunity to stress that the symptoms may worsen after the procedure.

**Dr. Davis:** Also, as Dr. Steinert alluded, patients will be more diligent postoperatively about using their drops more frequently than just once per day.

**Dr. Steinert:** I think Dr. Devgan’s point is important. If you do not treat a patient’s ocular condition preoperatively, it would be logical for him to assume that the surgery caused the problem. Furthermore, almost all corneal disease is harder to treat as it becomes worse. You have to get ahead of it and stay ahead. If it progresses too much, epithelial defects and other complications can occur. It is much better to be aggressive and start out favorably.

**Dr. Davis:** In most cases, dry eye is an inflammatory disease, and rebound inflammation is a lot harder to treat than a low-grade inflammation.

**Dr. Dell:** I cannot recall a situation in which I regretted being too aggressive treating dry eye preoperatively,

but I have had many cases where I have wished I’d been more aggressive.

“Diffractive multifocal IOLs are almost triple amplifiers of any surface problem on the cornea.”  
—Steven J. Dell, MD

**Dr. Donnenfeld:** I perceive an important change in the relationship between patients and physicians wherein they now want to partner with each other. I find it very effective to make my patients part of my team in understanding ocular surface disease. I convey the notion that it is important for them to treat themselves so that we as a team can achieve the best postoperative surgical results. When patients hear an explanation of why it is so important for them to use artificial tears, nutritional supplements, and cyclosporine A (which is my mainstay), they become involved in their own care and more responsible for their own surgical results, and they are happier.

**Dry Eye and Premium Refractive IOLs**

**Dr. Donnenfeld:** Dr. Dell, I have heard you liken achieving good refractive outcomes with multifocal and refractive IOLs to landing an airplane on a narrow landing strip—meaning that these lenses require perfect results. How does optimizing the tear film affect the landing strip for recipients of these IOLs in terms of refractive outcomes and patient satisfaction?

**Dr. Dell:** Diffractive multifocal IOLs are almost triple amplifiers of any surface problem on the cornea, whether it is astigmatism or superficial punctate keratitis, simply because these implants also have an irregular refracting surface. In some ways, diffractive multifocal IOLs require rarified conditions. Everything from the macula to the cornea and everything in between needs to be absolutely perfect. The monofocal optic of lenses like the Crystalens Accommodating IOL (Bausch & Lomb, Rochester, NY) are much more forgiving of imperfect ocular conditions. All refractive IOL recipients have very high expectations for their outcomes because they are paying for the procedure out of pocket. They will view dry eye-related problems as a surgical complication.



## THERAPEUTIC TREATMENTS

**Dr. Donnenfeld:** My staff and I preoperatively place all of our multifocal IOL patients on artificial tears, nutritional supplements, and cyclosporine A, because we want to give them the opportunity to achieve their best vision with the initial procedure, rather than having to correct them postoperatively. I presented a paper at the 2007 ASCRS meeting<sup>11</sup> that showed that using cyclosporine A for 1 month before surgery and for 3 months after surgery improved patients' contrast sensitivity and Snellen visual acuity by one full line, which is rare. Also, the patients subjectively preferred the vision in their cyclosporine-treated eye versus their control eye. This suggests that anything we surgeons can do to improve the quality of the tear film will increase the percentage of patients who are happy with their surgical results.

**Dr. Dell:** If users of cyclosporine A experience discomfort, it may be helpful for the clinician to add a weak topical steroid to the cyclosporine regimen. The steroid will mitigate any irritation.

**Dr. Devgan:** My staff and I do that with loteprednol or fluorometholone.

**Dr. Donnenfeld:** Colleagues and I presented a paper at the 2007 AAO meeting with exactly that finding,<sup>12</sup> that using low-dose loteprednol in conjunction with cyclosporine A significantly reduced the ocular surface disease index symptomatology and alleviated the burning and stinging associated with the cyclosporine A. In the study, we discontinued the loteprednol after 6 weeks. In addition, patients' postoperative quality of vision and comfort improved faster. We called this effect *combined immunomodulation*, because it fuses two mechanisms of action to improve the quality of vision.

**Dr. Dell:** You may not even need the steroid for that long.

**Dr. Donnenfeld:** You may not; it is most important to introduce the two drugs at the same time immediately postoperatively in order to minimize discomfort and promote healing. We do not use the strategy in all our patients, but we like it for those who may not tolerate cyclosporine alone.

**Dr. Devgan:** It is clear that more and more clinicians are using these premium refractive lenses, which absolutely demand a pristine ocular surface. If the tear film

is not optimized, then the final visual goal will not be met. Remember basic ophthalmic science: the tear film has a large role in focusing light.

“By treating the ocular surface, not only does patients' vision improve quantitatively and qualitatively, but their refractive error improves as well.”

—Elizabeth A. Davis, MD

**Dr. Dell:** Also, there has been a clear shift toward customized laser vision correction. I believe that a healthy ocular surface will not only substantially improve tiny corneal aberrations, but it will also optimize the measurements of refractive status that form the basis of our laser treatments.

## AVOIDING POSTOPERATIVE ENHANCEMENTS

**Dr. Donnenfeld:** Have any of you eliminated a patient's need or request for a postoperative enhancement simply by treating their ocular surface disease?

**All:** Absolutely.

**Dr. Donnenfeld:** How do these patients present, what are their complaints, and how do you respond to their concerns?

**Dr. Davis:** Frequently, the patient has an issue with quality of vision or fluctuating vision. I have seen some patients experience ghosting of images or even some diplopia or punctate keratitis. Sometimes, these tear-film problems will manifest as a little bit of regression. By treating the ocular surface, not only does patients' vision improve quantitatively and qualitatively, but their refractive error improves as well.

**Dr. Dell:** All clinicians who have a mature laser vision correction population are experiencing an influx of patients who were treated 10 years ago while in their 40s, and now that these patients are in their 50s, they have an entirely new set of ophthalmic challenges. Some of them have early-onset nuclear sclerosis, some have significant dry eye, but they attribute all of their symptoms to their 10-year-old LASIK surgery. We need to be prepared to maintain or optimize these patients' vision.

**Dr. Donnenfeld:** My staff and I have encountered patients asking for surgical enhancements when their problem was really caused by ocular surface disease. If clinicians do not recognize these symptoms, performing surgical enhancements will often make their dry eye worse. The key is to manage patients for ocular surface disease before performing any type of surgical enhancement. I never perform enhancements on patients who display active corneal staining until I have resolved that problem, because the last thing I want to do is make their disease worse. Sometimes, you just have to say no.

**Dr. Steinert:** An extreme example of falling into that trap is diagnosing on topography what appears to be inferior steepening when the true cause is dryness. The clinician may suspect ectasia or coma and proceed with a customized retreatment, which will only exacerbate the patient's symptoms if the topographical abnormality was really due to dryness.

**Dr. Donnenfeld:** It is generally estimated that between 10% and 12% of multifocal and premium refractive IOL patients will need secondary excimer laser ablation to treat their residual refractive error. Again, both surgeries will exacerbate dry eye, so aggressive management is important.

What are the topographic findings of dry eye disease in addition to inferior steepening that surgeons might miss?

**Dr. Steinert:** On the color map, a drop-out or other quirky irregularity is almost always an indication of something wrong with the ocular surface (Figure 4). Both Placido-disk- and scanning-slit-based topographic devices really measure the tear film, not the cornea. I like to print out the Placido disk image to compare it against the color image for questionable findings.

**Dr. Dell:** That's a great point: viewing a photokeratoscope image is a lost art in ophthalmology. Those of us who were trained before topography was widespread gained an enormous amount of information by looking at those photokeratoscope rings, and I think we can gain a good amount of information by going back to those data sources.

(Courtesy of Elizabeth A. Davis, MD.)

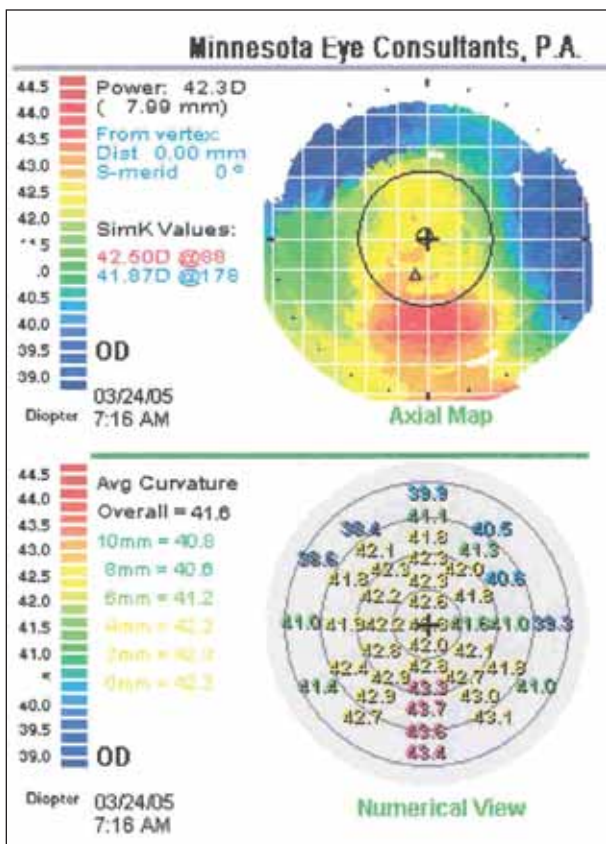


Figure 4. This topographical map shows a post-LASIK eye (OD) with punctate keratopathy inferiorly that looks like ectasia. After treating the keratopathy with topical lubricants and cyclosporine A, the topography normalized.

**CATARACT SURGERY**

**Dr. Donnenfeld:** Let's talk about conventional cataract surgery, which is the most common procedure we perform. With all our technological advances, we sometimes forget that quality of vision depends on the tear film. For the conventional cataract patient, I think we clinicians need to be more aggressive about managing ocular surface disease. What percentage of patients following routine cataract surgery have at least some form of transient dry eye disease?

**Dr. Devgan:** At least half. The percentage is large, because cataract patients are older and generally are less physiologically capable of enduring the postoperative inflammatory challenges of the surgery. The incisions cause neurotrophic changes, and so do LRIs if they are needed.

**Dr. Steinert:** I do not think that microincisions sever as many nerve fibers, but, LRIs absolutely do. On top of that, we poison these patients' corneas with a lot of medication.

**Dr. Devgan:** Three different postoperative drops ...

**Dr. Steinert:** Also, steroids and antibiotics contain preservatives, and antibiotics are fairly toxic in their own



right ... then, to make sure they are really miserable, we add betadine to the ocular surface at the start of surgery. Thus, the goblet cells and the ocular surface withstand a lot of stress. Patients start off in the hole, so to speak.

“In this new era of multifocal lenses, aspheric IOLs, and customized corneal ablations, submicron differences matter, and the tear film matters, too.”

—Roger F. Steinert, MD

**Dr. Donnenfeld:** It is estimated that 15% of the population over the age of 70 has dry eye disease.<sup>1</sup> Most patients, however, are only marginally compromised and not labeled as having dry eye. As soon as these patients undergo cataract surgery, they incur frank dry eye disease and begin a cycle of worsening symptoms that is difficult to stop. Dr. Steinert astutely commented that once ocular surface disease begins, it is very difficult to stop.

**Dr. Dell:** If 15% of the population over age 70 has dry eye, then about 65% of the population over 70 has “forme fruste” dry eye. They are teetering right on the edge.

**Dr. Donnenfeld:** I think we all acknowledge that dry eye is a very common problem made worse by cataract surgery. Although we may adequately address the problem with our premium refractive IOL patients and our LASIK patients, we must be more aggressive about treating all of our patients to achieve the optimal results they desire.

## CLOSING COMMENTS

**Dr. Davis:** Over the past 2 years, ophthalmologists have come to recognize how important the tear film is in preoperative evaluations all the way up through postoperative outcomes, and we now pay much more attention to it as one of the refracting surfaces of the eye. The surgeon needs to be very aggressive if not overly so in treating ocular surface disease.

**Dr. Steinert:** As residents, we were asked the trick question of “what is the principle optical element of the eye?” The answer is the tear film. In this new era of

multifocal lenses, aspheric IOLs, and customized corneal ablations, submicron differences matter, and the tear film matters, too. We all need to appreciate the tear film’s importance as we go for the ultimate in visual quality.

**Dr. Dell:** Our patients are getting older, they are on more medications than ever, and many have undergone cosmetic lid surgery that alters the lid-globe relationship. In addition, we are now offering exotic IOLs to a group of patients that expects perfection. These factors require us to pay closer attention to the tear film.

**Dr. Devgan:** It is important to treat the underlying inflammation, not just the symptoms. I think the majority of patients we see have borderline ocular surface disease that produces subtle signs of tear-film deficiency that are difficult to detect. In those situations, it is wise to overtreat to ensure excellent postsurgical results. The penalty for undertreating is bad vision, an unhappy patient, and increased inflammation. The penalty for overtreating is simply cost.

**Dr. Donnenfeld:** The key to successful patient care is to exceed their expectations. Optimizing the tear film is the simplest and safest way we can surpass our patients’ demands for excellent-quality vision with no downsides. I think tear-film management is one of the most important things we do in our practices on a daily basis, and I feel this discussion has made the case for all ophthalmologists to practice it more routinely and aggressively. ■

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**CME QUESTIONS**

**1. Which of the following did the panelists not name as a primary stimulus of dry eye in the US?**

- a. age
- b. gender
- c. medications
- d. previous ocular surgery
- e. lowered dietary omega-3 fatty acids
- f. artificially dry environments (heating and air conditioning)

**2. What are some common ocular complaints from dry eye patients?**

- a. grittiness
- b. foreign body sensation
- c. blurry vision
- d. "tired" eyes or difficulty reading
- e. all of the above

**3. Aqueous deficiency is characterized by which pattern of symptoms?**

- a. progressive worsening throughout the day
- b. morning grittiness, midday improvement, and evening fatigue

**4. It is not possible to have both aqueous deficiency and inflammatory blepharitis or meibomianitis.**

- a. true
- b. false

**5. What did Dr. Donnenfeld state was the number-one reason patients schedule a refractive surgery consultation?**

- a. fluctuating vision
- b. contact lens intolerance
- c. presbyopia
- d. none of the above

**6. Which supravital dye will only show corneal disease in the basement membrane?**

- a. Lissamine Green
- b. rose Bengal
- c. fluorescein

**7. What two strategies of LASIK flap creation are thought to decrease the drying effect of laser surgery?**

- a. a small flap and small hinge
- b. a small flap and large hinge
- c. a large flap and large hinge
- d. a large flap and small hinge

**8. Topical cyclosporine A starts showing improvement in the tear film in**

- a. days
- b. weeks
- c. months

**9. What additional therapy do the panelists recommend for easing the initial discomfort of topical cyclosporine A?**

- a. a topical antibiotic
- b. an NSAID
- c. a weak topical steroid

**10. What was the duration of the topical cyclosporine A regimen used in Dr. Donnenfeld's 2007 study?**

- a. preoperatively for 3 weeks and postoperatively for 1 month
- b. preoperatively for 1 month and postoperatively for 3 months
- c. preoperatively for 1 month and postoperatively for 1 month
- d. preoperatively for 1 month and postoperatively for 3 weeks

