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OCULAR SURFACE DISEASE: ETIOLOGIES AND TREATMENT MODALITIES

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Ocular Surface Disease: Etiologies and Treatment Modalities

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CONTENT SOURCE

This continuing medical education (CME/CE) activity captures content from a roundtable discussion.

ACTIVITY DESCRIPTION

Nearly 33% of patients in eye care clinics present with complaints about dry eye signs and symptoms. Clinicians remain challenged with both the diagnosis and best treatment options for dry eye disease (DED) because, to date, multiple causes of the disorder have been identified. This activity will help to inform clinicians on methods to improve the care of patients with DED.

TARGET AUDIENCE

This certified CE/CME activity is designed for eye care providers who care for patients with ocular surface disease.

LEARNING OBJECTIVES

Upon completion of this activity, the participant should be able to:

- **Differentiate** between DED and meibomian gland dysfunction (MGD) and **summarize** the risk factors for DED and MGD
- **Explain** the role of inflammatory processes in these diseases
- **Recognize** the signs and symptoms in patients with ocular surface complaints
- **Appraise** the differences between traditional and new diagnostic tests for DED and MGD
- **Compare** the newest treatments for DED and MGD with first-generation treatments indicated for those conditions.

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PRETEST QUESTIONS

PLEASE COMPLETE PRIOR TO ACCESSING THE MATERIAL AND SUBMIT WITH POSTTEST/ACTIVITY EVALUATION/SATISFACTION MEASURES FOR CE/CME CREDIT.

1. Please rate your confidence in your ability to recognize the signs and symptoms in patients with ocular surface complaints (based on a scale of 1 to 5, with 1 being not at all confident and 5 being extremely confident).

a. 1
b. 2
c. 3
d. 4
e. 5

2. Please rate how often you use advanced ocular surface disease (OSD) treatments (based on a scale of 1 to 5, with 1 being never and 5 being always).

a. 1
b. 2
c. 3
d. 4
e. 5

3. A 75-year-old male was referred for cataract surgery by a community optometrist. He has visually significant cataracts that are impairing his ability to drive. He is on medication for hypertension and type 2 diabetes. The patient reports a sand-like feeling in his eyes that worsens throughout the day. Staff administered the OSDI questionnaire, which was 23 out of a possible 100. Look, lift, push, pull (LLPP) examination revealed that the meibomian glands required moderate pressure to express, he has moderate corneal staining, and a tear breakup time of 5. How do you proceed?

a. Only schedule the patient for cataract surgery immediately, as it is visually significant and impairing his day-to-day activities.
b. Only prescribe short-term topical corticosteroids and then schedule the cataract surgery.
c. Prescribe both short-term topical corticosteroids and 4 weeks of either cyclosporine or lifitegrast to manage the inflammation and improve the ocular surface before scheduling surgery.
d. Recommend only thermal pulsation therapy for his meibomian gland disease before scheduling surgery.

4. A 38-year-old female with a 20-year history of soft contact use, changed monthly, presents for a routine eye exam. She complains of blurry vision and assumes she needs a stronger prescription but is interested in the benefits of LASIK. She complains of being unable to tolerate contacts for more than a few hours, especially during workdays in which she spends the majority of time at her computer. She reports no symptoms of dry eye—no grittiness, no foreign body sensation, no burning or stinging. Her VA is the same as it was last year, 20/60 in both eyes, and she is on no new medications. What do you recommend for this patient?

a. Switch her to daily contact lenses and recommend she use a dry eye friendly solution to mitigate dryness.
b. Explain that she has computer vision syndrome and needs to limit her use of screens.
c. Refer her for a LASIK evaluation.
d. Keep her prescription and contact choices as is and give her a full dry eye workup, paying particular attention to the meibomian glands.

5. A 27-year-old male had refractive surgery 3 months ago. He complains that his vision fluctuates during the day and that his eyes feel gritty. You find no issues with his LASIK flaps, and he is 20/25 in both eyes. Despite the seemingly successful surgery, he is convinced the procedure was compromised in some way. He has moderate corneal staining and a tear breakup time (TBUT) of 7 seconds. How can you help this patient?

a. Touch up the LASIK with the hope of improving the vision to 20/20
b. Perform the LLPP examination to determine if meibomian gland dysfunction (MGD) may be exacerbated postsurgery
c. Increase artificial tears and hope that the patient gains relief
d. Start patient on lid hygiene therapy and consider use of an immunomodulating dry eye medication
e. Both B and D

6. What is the most common type of dry eye?

a. Mixed mechanism
b. Evaporative
c. MGD
d. Aqueous deficient

7. According to the ASCRS algorithm, what is the first dry eye evaluation a patient should have upon presentation and follow up?

a. A standard visual exam, asking them if their vision improves upon blinking
b. A dry eye questionnaire
c. Meibography
d. Osmolarity

8. What percentage of patients have dry eye?

a. 20%
b. 30%
c. 40%
d. 50%

9. What is the primary reason for contact lens drop out?

a. Aqueous deficient dry eye
b. Poor contact lens fit
c. MGD
d. Excessive computer use

10. Fill in the blanks. According to the PHACO study, _____ of patients had previously diagnosed dry eye, but _____ had a TBUT of ≤ 7 seconds.

a. 30%, 50%
b. 25%, 80%
c. 80%, 100%
d. 40%, 75%

11. In the TFOS DEWS II report, an initial screening evaluation for mild DED should include any of the following diagnostic tests except:

a. Corneal aesthesiometer
b. Dry eye questionnaire such as SPEED or OSDI
c. Meibography
d. Tear film osmolarity

12. What is the most common environmental factor for the development of dry eye?

a. Rapid change in altitude (ie, mountain hiking)
b. High humidity
c. Low humidity
d. Fluctuating outdoor temperatures

Ocular Surface Disease: Etiologies and Treatment Modalities

Dry eye is a multifactorial ocular surface disease (OSD) characterized by hyperosmolarity and an unstable tear film, leading to inflammation and damage to the ocular surface.[1] Dry eye has an adverse impact on patient eye health and quality of life, causing blurry vision, reflex tearing, photophobia, and chronic sensations of burning, stinging, and dryness.[2] It's the most common reason for contact lens drop-out and negatively impacts the outcomes of cataract and refractive surgery.[3-5] OSD and dry eye are already extremely common—up to 50% of the global population has dry eye symptoms—yet their prevalence is increasing.[6] In the era of COVID-19, increased screen time, decreased blink rates, and air leakage from ill-fitting face masks are ushering in a new dry eye epidemic.[7-10] The following roundtable brings together experts to discuss OSD diagnosis, treatment, and management.

— Jennifer Loh, MD, Moderator

THE ROLE AND IMPACT OF OSD ON REFRACTIVE SUCCESS AND PATIENT SATISFACTION

DEFINING DRY EYE

Q | JENNIFER LOH, MD: The phrase "dry eye" is often a catch-all for a wide variety of ocular surface issues. In 2017, the Tear Film & Ocular Surface Society Dry Eye Workshop II (TFOS DEWS) provided much-needed clarity and updated the definition of dry eye to "a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles."[1] What is dry eye, and how do you describe it to a patient?

Marc Bloomenstein, OD, FAAO: That is the million-dollar question. The utterance of the phrase "dry eye" is often confusing to patients because of the emotional attachment to the word "dry"; patients will internalize their own perception of what they think that should mean. I start by explaining to patients that dry eye is a disease state that is predicated on changing the quality of their tears, which impacts the quality of their vision.[11,12]

Our daily lives, from using computers and other screens to the environment we live in, have a profound impact on the quality of our tears. Computer vision syndrome, which can develop if screens are used for more than 3 hours per day, causes eye strain, irritation, burning sensation, redness, and blurred and double vision due to decreased and incomplete blinks.[13-16] Adverse environmental conductions, such as air pollution, low humidity, and air conditioning use, can be significant contributing factors to OSD.[17,18] We know that aging changes the quality of the tear film, largely due to the increased expression of inflammatory molecules such as interleukin (IL)-8, IL-6, and matrix metalloproteinase-1 (MMP-1), which leads to immune homeostasis, tissue remodeling, and dysregulation of the ocular surface.[19] Systemic diseases, such as diabetes, Sjögren syndrome, rheumatoid arthritis, and systemic lupus erythematosus, also change the quality of the tear film.[20-23]

When you don't have quality tears, you don't have quality vision. I describe dry eye as something that will ultimately affect the quality of their vision in everything they want to accomplish.

Dr. Loh: We know that there are different etiologies of dry eye, including aqueous deficient, evaporative, meibomian gland dysfunction (MGD), and even a mixed mechanism. How do you differentiate between them?

Francis Mah, MD: The natural human tear is made up of many components: an aqueous component, a lipid component, and a mucin component. The aqueous and lipid components are the most variable. When people think of dry eyes, they often assume it's an aqueous deficient issue. However, in reality 90% of dry eye is mixed mechanism.[1] There's a lipid component that's either MGD or blepharitis resulting in evaporative dry eye,[24] and then there's aqueous deficient, which is associated with the accessory lacrimal glands and that system.[25]

Leslie O'Dell, OD, FAAO: The updated TFOS DEWS II classification system blended aqueous deficient and evaporative dry eye. They are no longer considered two separate types of dry eye; instead, they exist together on continuum.[1] I agree with this reclassification; the majority of dry eye I see is mixed mechanism. Cases are typically more heavily weighted in either an aqueous direction or meibomian gland/evaporative direction. Ancillary testing such as tear film osmolarity, inflammatory biomarkers, and meibomian gland imaging helps me determine the primary component and my treatment plan, which tends to be a combined approach.[26]

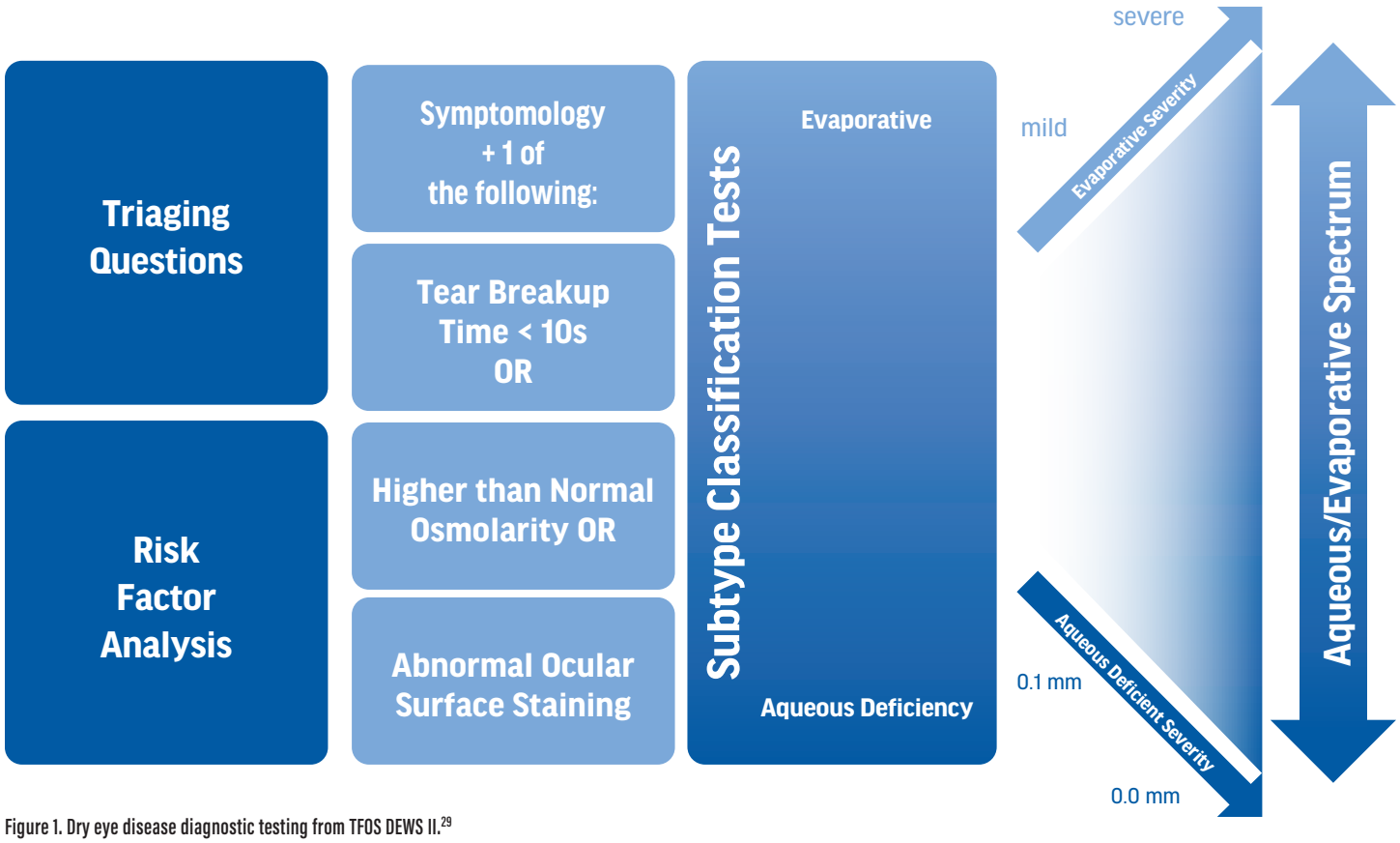


Figure 1. Dry eye disease diagnostic testing from TFOS DEWS II.[29]

HOW OSD AND MGD IMPACT CONTACT LENS WEAR AND DROP OUT

Q | DR. LOH: Contact lens drop-out (CLD) rates are as high as 27%, with half of contact lens wears dropping out in the first 3 years.[3,27] What is the cause of this drop-out?

Dr. O'Dell: I think a lot of drop-out is contributed to MGD, but many of our colleagues simply accept CLD and don't look for a reason. My first question to a physician, when evaluating a patient who has abandoned contact lenses, is what did their glands look like? If you don't have healthy meibomian glands, you don't have a healthy lipid layer. Then you're putting a prosthetic device onto the ocular surface, splitting the tears. If you're using contact lenses in an unhealthy environment to begin with, it's going to be more of a challenge for patients to have successful contact lens wear. But if you can improve the quality of the tear that you're placing the contact lens on, you can have successful wearability, even beyond the presbyopic years. We have great technology now with multifocal contact lenses. Some patients can tolerate lenses well into their 70s if we really pay attention to the tear film.

Dr. Bloomenstein: The conventional way of thinking about CLD was to blame the lens material or the solution; we looked to everything except the environment the lens was sitting on. Contacts are a medically controlled device that sit on a very fragile area, and we expect our patients to maintain it. Dumbleton et al conducted a CLD study and found that the percentage of patients dropping out at around 40 to 50 years old didn't change between the 1990s and 2000s. About 23% of those surveyed had discontinued contact use permanently due to discomfort and dryness. To Dr. O'Dell's point, MGD plays a large role in the drop-out rate.[28]

Dr. Loh: How do you manage a patient who comes to you and says their contacts are no longer comfortable? Do you switch brands and suggest a different solution, or do you give them a dry eye workup?

Dr. Bloomenstein: Every contact lens assessment should be a dry eye evaluation. I don't see how you can differentiate the two. If you want great results from contact lenses, you have to know if the environment can withstand it. The assessment should include a general slit lamp biomicroscopic examination, eyelid assessment, ocular surface examination, and evaluation of the tear film and lipid layer (Figure 1).[29]

Dr. Loh: After you tell a patient they have OSD or MGD, they often say they've worn contact lenses for 25 years and never had a problem. How do you explain why this change is happening to them now?

Dr. Bloomenstein: I explain that the things we're doing to our eyes, especially sitting in front of a screen for hours at a time, were not

available to us 20 to 30 years ago. The modern-day demands on our eyes have increased inflammation. We're not blinking as often as we should while using computers, and that affects layers of our tear film.

Estimates on blink rate decline vary, but it is significant.[30] A study from Patel et al found that patients had a mean 18.4 blinks a minute at baseline before using a computer, which dropped to 3.6 blinks a minute during computer use.[31] Tsubota et al studied the blink rates of office workers, finding 22 blinks a minute at baseline, which was reduced to 7 blinks per minute while viewing an electronic display.[32]

THE OCULAR SURFACE AND REFRACTIVE SURGERY

Q | DR. LOH: Do you often have patients consult with you for refractive surgery because they are no longer able to tolerate their contact lenses? And, as a follow-up, do you attribute most of this to dry eye disease (DED)?

Dr. Mah: The real emphasis for dry eye research and for the concentrated efforts in trying to address dry eyes, in my opinion, was refractive surgery. Dry eye has always been in the background, but it wasn't critical to surgeons until refractive surgery. Refractive surgery can exacerbate dry eye.[33-35] Patients will have great results, but the one major complaint is dry eye.[36] This pushed and motivated people into looking for better therapies for dry eye, as well as to identify people at risk for dry eye. I do think there is a huge population of people who can no longer wear contacts. This is pushing them into the optometrist, ophthalmologist, or refractive surgeon's office because they don't want to wear glasses.

That said, dry eye is not the only cause of CLD. Patients can have a bad case of giant papillary conjunctivitis or a strange fit.[37] There are various issues that bring people into the refractive surgeon's office.

Dr. Bloomenstein: Patients perceive that if they want to have LASIK, that they can't wear their contacts. However, the Patient Reported Outcomes with LASIK (PROWL) study, which was reported a couple of years ago, found that most patients improved their dry eye symptoms after LASIK, as opposed to before LASIK.[38] I believe there are more issues with the tear film than we think, which is inhibiting patients from achieving comfortable, good vision with their contacts.

Preeya K. Gupta, MD: I cannot agree more with these comments. An optimal tear film, especially in the perioperative setting, is a critical component to surgical success. We have access to so much technology today, both in cataract and refractive surgery, but without that healthy tear film, we really can't take advantage of it.

The PHACO study showed us that our patients are coming in with a lot of corneal staining and reduced tear breakup time (TBUT).[5] Mean TBUT was 4.95 seconds; more than 80% of patients had a TBUT of 7 seconds or less. Additionally, about 77% of patients were positive for fluorescein staining, and 50% showed positive central staining as well. Fewer than 25% of patients had been previously diagnosed with DED at presentation for cataract surgery, but 30% reported at least occasional dry eye symptoms.

My colleagues and I published a study about 2 years ago on the prevalence of OSD in patients presenting for cataract surgery evaluation.[39] The study included 120 patients, 69% of whom were women, with a mean age of 69. A total of 80% of the patients had at least one sign of OSD based on their corneal exam with fluorescein, tear osmolarity, and/or tear MMP-9 levels. We've all had a patient who has cataract surgery and is technically 20/20 postoperatively, but who says they can't see. That is a classic patient who has decompensated DED and became symptomatic postoperatively. We need to assume that every patient has some form of OSD when they present for cataract surgery evaluation.

Dr. Loh: Dr. Bloomenstein, you work in a large laser refractive center. How are your patients' refractive surgery results affected by OSD?

Dr. Bloomenstein: Interestingly enough, when we first started doing refractive surgery 20 or 30 years ago, we didn't understand the importance of the tear film or the quality of the tears and how they affected refractive outcomes. I had patients who felt they needed an enhancement or that their surgical results weren't as optimal as they hoped. I'd look at their corneas and see superficial punctate staining. I'd examine their meibomian glands and see blepharitis consistent with DED. Treating and managing those issues made a huge difference in their vision.

The PHACO study elucidated that patients referred for cataract surgery often have fluctuating vision. We need to be looking at typography or tomography. We need to watch the tear film as it's evaporating and assess how it's changing the quality of that image. That's one of the first tests that we can do with patients. We need to prepare the ocular surface before conducting any preoperative testing, and then really emphasize the postoperative treatment to sustain and maintain the good quality of vision that our patients expect.

Dr. O'Dell: I was very excited to see the studies by Trattler et al and Dr. Gupta; both studies clearly illustrated the problem. Patients with DED are referred to us, and oftentimes they don't know they have DED. This leads to further delays in care, which can be very frustrating from a surgeon's perspective. Optometrists need to conduct a presurgical dry eye exam on all patients before sending them for surgical referral so that surgeons are working with an optimal ocular surface and the best looking lids without care delays. Preoperative measures will be accurate, and you'll feel confident that you've hit the mark on your postsurgical outcomes.

Q | DR. LOH: That's great advice. Having patients prepare before their cataract or refractive surgery evaluation is critical. How does surgery affect dry eye?

Dr. Mah: Everything we do during surgery, the eye drops, the incision, the saline solution, causes an acute inflammatory reaction, which potentially exacerbates the OSD. We've all had patients who are 20/20 postoperatively and complain that something happened during surgery. They believe something has been left in their eye during surgery that feels like a grain of sand, or the lens is moving, or the incision is not completely closed. They swear something is wrong, even if everything looks good from our perspective. The

drops, the incision, and the inflammation caused by cataract surgery or LASIK, pushes people with OSD over the edge, even if they've never experienced dry eye symptoms. In order to address the dry eye afterward, you must get in front of the problem before surgery.

Dr. Loh: As you mentioned, patients swear up and down that they did not have DED before the surgery and now they do. I think that is a typical response from a lot of people. How do you explain this change to patients, that the DED was already there?

Dr. Gupta: It's difficult when they don't know about their DED ahead of time. We need do to everything possible so they understand they have two conditions: cataracts plus DED. That's the best position to be in from a physician perspective. If you don't have that conversation with them ahead of time because it wasn't diagnosed or it was an outside referral, the next strategy is to depersonalize it, take out the upset feelings, and explain that dry eye is a chronic disease.

There's also a difference between short-term and long-term symptoms. As mentioned, there are many aspects of the actual surgical procedure that can exacerbate dry eye—topical medications, benzalkonium chloride exposure, temporary neurotropism caused by surgical incisions, and so on. I try to set realistic expectations. Based on the available literature, it takes about 3 to 6 months for patients to be back to where they were before surgery.[34] What can we do to rehabilitate the ocular surface? If it's within the first month after surgery, I take the offending medications away. I also aggressively lubricate the eye. I have a very low threshold to switch to nonpreserved molecules, whether that's in tears or other topical medications. Modulating inflammation and addressing untreated MGD can play important roles in treating these patients.

Dr. Bloomenstein: The mantra of every eye clinician, regardless of how, who, or what they treat, is to assume the patient has DED. We're seeing this condition in younger and younger patients. A study of dry eye in pediatric patients by Dr. Gupta found a high level of mild meibomian gland atrophy in patients age 4 to 17 years.[40] Moderate to severe meibomian gland atrophy was present in this population as well.

Another important point is that when you talk about a side effect before surgery, that becomes an expectation. When something happens and you don't mention it, then it becomes a complication. I tell my patients that we may see more OSD, or dysfunctional tears, after surgery, which we may have to address. I also explain that they should start to feel better after about a month, but if not, there may be other issues we have to work on. The assumption is that the OSD is there beforehand.

Dr. Loh: We have to diagnose OSD and DED in advance, otherwise it's hard to explain afterward.

TOOLS TO DIAGNOSE DRY EYE AND MGD

Q | **DR. LOH:** I'd like to discuss more about how to incorporate dry eye diagnostics into our practice. What do you do in order to start that conversation for dry eye?

Dr. O'Dell: I like to screen all patients, and I do like to use a questionnaire. There are several questionnaires available (Table 1). I use a questionnaire for follow-up appointments as well, because it helps me see where we are on the symptom scale and if the treatments are working. Of course, I want to see that the clinical endpoints improve, but patients do care about their symptoms. If, for some reason, the survey is worse than it was during the previous appointment, I try to determine what has changed; it could be something in their lifestyle, a new medication, or environmental.

I also lean heavily on point-of-care testing. We perform osmolarity and MMP-9 on all of our patients and continue to follow that during follow-up appointments. Meibography, which provides a visual of the meibomian glands, is incredible technology.[41] Seeing is believing. When I show those images to patients, they get it and become more invested in their treatment. Even if you only have access to anterior segment cameras, it really helps paint the picture for what you're seeing clinically.

Dr. Loh: What are your two most utilized dry eye diagnostics?

Dr. O'Dell: I really love lissamine green for dye staining because I uncover a lot of hidden inflammation.[29] Meibography is a favorite of mine as well.

Dr. Bloomenstein: I like meibography, too, because a picture is worth a thousand words. I'm not as excited about lissamine green as Dr. O'Dell. I don't believe it gives me enough information. What I really enjoy doing is having a patient look at topography and ask them point blank if their vision is clearer when they blink or if I put artificial tears in their eyes.

Dr. Loh: Technology certainly plays a large role in how we diagnose patients, but one of the easiest, simplest, free things you can do is just check a patient's vision and ask the history. You can take it back to the basics without expensive diagnostic equipment. Along those lines, do you use your staff for dry eye testing or are you testing patients in the moment?

Dr. Gupta: In an ideal world, the testing would be conducted by staff and I would interpret the data and explain it to patients in a salient way, so they understand my thought process and logic as to why I'm making a DED diagnosis. Like Dr. O'Dell, I like to have patients fill out a questionnaire at each appointment. Patients are not the best historians, so it helps to have a snapshot of their symptoms when they were in the office as a data point. We also do a standard examination, checking vision and pressure.

I also think that meibography makes me a better clinician. I've often been fooled, assuming a patient did not have gland atrophy only to find on their meibography that severe atrophy is present. The treatment urgency in that case is much higher than in someone without gland atrophy. It also helps me set expectations with patients and educate them on their disease. I try to break patients of linear thinking where they believe DED is something that can be cured; it's a chronic disease that needs constant treatment over time.

TABLE 1. EXAMPLES OF DRY EYE QUESTIONNAIRES

Questionnaire	Goal	Scale	Cut-off Value
OSDI[42]	Symptoms, HRQL, severity	0–100 (for the total score and each subscale)	Mild 13–22; moderate 23–32; severe 33–100
IDEEL[43]	Symptoms, HRQL, treatment satisfaction	0–100 (for each module)	None
NEI VFQ–25[44]	Visual function, HRQL	0–100 (for each question)	None
DEQ[45]	Symptoms, HRQL, severity	N/A	None
SPEED[46]	Symptoms, frequency	0–28	None
DEQ-5[47]	Symptoms, severity	0–22	>6 suspected dry eye; >12 suspected Sjogren's syndrome
SANDE[48]	Symptoms, frequency, severity	0–100	None
McMonnies[49]	Symptom, screening, risk factors	0–45	14.5
CLDEQ-8[50]	Symptoms with soft contact lens	0–37	12

OSDI, Ocular Surface Disease Index; IDEEL, Impact of Dry Eye in Everyday Life; NEI VFQ–25, National Eye Institute Visual Function Questionnaire; DEQ, Dry Eye Questionnaire; SPEED, Standardized Patient Evaluation of Eye Dryness; DEQ-5, Dry Eye Questionnaire-5; SANDE, Symptom Assessment Questionnaire in Dry Eye; McMonnies, McMonnies Questionnaire; CLDEQ-8, Contact Lens Dry Eye Questionnaire

I also like MMP-9 and osmolarity testing. You can evaluate patients without these tools, but they can be very helpful to identify different subtypes of OSD. For example, a normal osmolarity in a setting of typical dry eye symptoms should point you to other conditions like ocular allergy or recurrent erosion, which may require more screening tests until you have a complete understanding of the picture of what's going on.[51,52]

I like to use the American Society of Cataract and Refractive Surgery (ASCRS) algorithms and LLPP—look, lift, pull, push—because I think it very efficiently makes me look at all of the different components of the ocular surface, including how the patient is blinking and the quality of their meibum (Figure 2).[53] Look at the eyelids and tear quality and quantity. Look for signs of blepharitis, of discharge and mucus, and of conjunctival scarring. Lift and pull up on the upper eyelid. Push on the lower eyelid and express the meibomian glands to assess the quality and flow of the meibum. In addition to dry eye, this algorithm can also show signs for less common conditions like superior limbic keratoconjunctivitis or anterior basement membrane dystrophy with erosions.

Dr. Mah: I agree with everyone that meibography has established itself as the one test that not only gives us vital information as clinicians but is also a great educational tool for patients. I also like osmolarity and MMP-9. Again, a simple vision evaluation is a really effective dry eye test. The other thing that's important for patients to know is we can actually improve their vision by treating their DED. Finally, clinicians need a dry eye algorithm, even if it's your own.

Dr. Gupta: The ASCRS Corneal Clinical Committee algorithm includes five basic steps. The first step is taking noninvasive refractive preoperative measurements like keratometry, topography, optical biometry, and aberrometry. Step 2 is OSD tear film testing, including osmolarity and inflammatory marker testing, followed by a symptom assessment using the ASCRS SPEED II questionnaire. Step 3 is an exam to look for visually significant OSD, using LLPP. In Step 4, you determine if the patient has OSD, and if so, whether it is visually significant or not. Finally, Step 5 is treatment of DED when present.[53]

The algorithm is not meant to be a hard stop. However, we recommend assessing symptoms with a questionnaire and using point-of-care testing. If you don't have access to point-of-care testing, you can still participate in the algorithm. My favorite inexpensive piece of equipment is actually just strips of fluorescein. You can measure TBUT, you can see corneal and conjunctival staining, and you can look at the pattern of tear degradation on the corneal surface to see if there's excessive breakdown. There are lots of ways to participate. It's meant to be inclusive, and it doesn't have to be difficult.

Dr. Mah: I agree. Clinicians often see an algorithm and think they can't participate if they don't have the recommended equipment. The goal of the ASCRS algorithm was to develop something reproducible and proven. The underlying goal was to have clinicians consider it and then incorporate what they could.

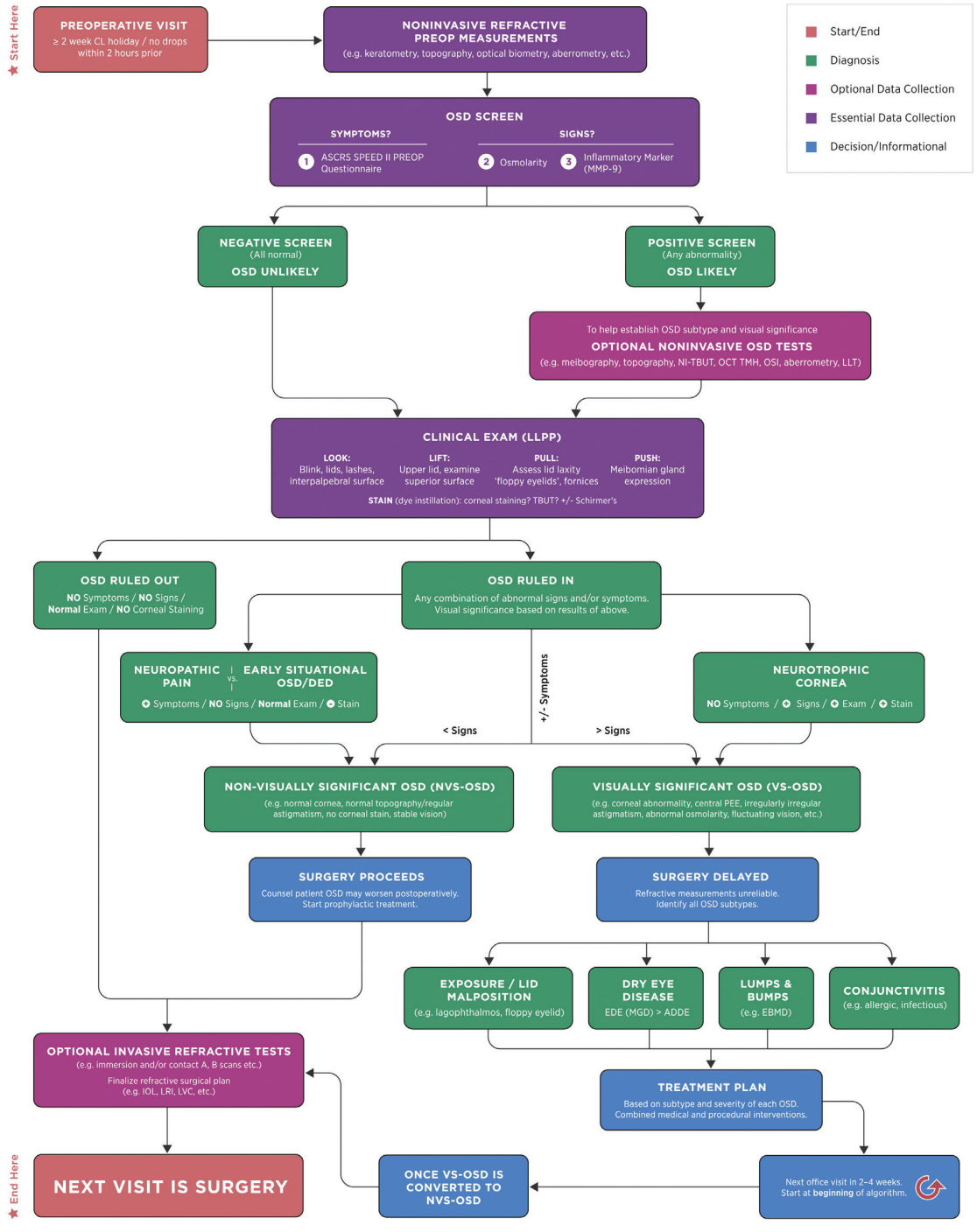
Dr. Bloomenstein: You can't cookie cut this multifactorial disease state. Sometimes doctors get overwhelmed and feel they can't meet the expectations, so they revert back to the old school method of diagnosing dry eye, which is to let patients tell us if they have it or not. Algorithms are designed to give you a framework that each clinician needs to personalize for their own patients. The sooner we start treating OSD, the better off the patient will be. It's not as complicated or as challenging as a lot of our colleagues think it is.

TREATING OSD AND MGD WITH CURRENT TREATMENTS & THERAPIES

Q | **DR. LOH:** Say a new patient with a history of dry eye presents in your office. She has a decreased TBUT and stage 2 MGD. She's tried artificial tears, but no prescription medications. Where do you start the conversation?

Dr. O'Dell: Often a new patient will present who has never been on physician-directed therapy; they've self-medicated with artificial tears. I start the conversation by laying a good foundation of what

ASCRS PREOPERATIVE OSD ALGORITHM



ASCRS FOR SURGEONS. FOR YOU.

(ADDE Z aqueous-deficient dry eye; CL Z contact lens; DED Z dry-eye disease; EBMD Z epithelial basement membrane dystrophy; EDE Z evaporative dry eye; IOL Z intraocular lens; LLPP Z Look, Lift, Pull, Push; LLT Z lipid layer thickness; LRI Z limbal relaxing incisions; LVC Z laser vision correction; MGD Z meibomian gland dysfunction; MMP-9 Z matrix metalloproteinase-9; NI-TBUT Z noninvasive tear breakup time; NVS-OSD Z nonvisually significant ocular surface disease; OCT Z optical coherence tomography; OSD Z ocular surface disease; OSI Z ocular scatter index; SPEED Z Standard Patient Evaluation of Eye Dryness; TBUT Z tear breakup time;TMH Z tear meniscus height; VS-OSD Z visually significant ocular surface disease).

Figure 2. ASCRS Preoperative Ocular Surface Disease Algorithm.[53]

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the disease state is. I also educate them on the role inflammation plays in DED, whether we are dealing with aqueous or evaporative. I start with short-term treatments that target the inflammation, then move on to long-term medications like cyclosporine and lifitegrast.

Cyclosporine is not a quick fix; it can take up to 6 months to achieve maximum clinical benefit.[54] Side effects include stinging and burning.[55] It can be taken once daily if the side effects are bothersome, but it is most effective up to four times daily. Lifitegrast is a twice-daily medication that reduces inflammation by inhibiting lymphocyte function-associated antigen 1. Side effects include eye irradiation and blurred vision.[56]

In a patient with severe MGD, I also discuss the importance of therapeutic at-home maintenance with a heat mask and the use of omega-3 fatty acid supplements to help the secretions of the glands. The evidence on omega-3s for dry eye is inconsistent, but a large trial of 32,000 women did find that women who consumed the most omega-3s from fish had a 17% lower risk of dry eye compared with women who didn't.[57]

Other in-office options are thermal pulsation, intense pulsed light, or other new treatments (Table 2). These include a handheld device that applies heat and compression via a sterile, single-patient use disposable tip under direct visualization to treat MGD; a thermal pulsation system for MGD consisting of a console and a single-use sterile device; and an electrothermal controller that delivers regulated and adjustable heat via single-use devices that are affixed to the upper and lower lids.[58,59]

Thermal pulsation is a one-two punch of heat and pressure that liquefies the meibum and clears the glands. The effects can last up to a year.[60]

My conversation goes back to what we were saying earlier: This is a multifactorial disease. Patients often want to know what's the one thing that caused their DED, but there's not one thing. It could be their age. They could have started on a new medication.[61] It could be that putting contact lenses in for many years disrupted goblet cells on the conjunctiva.[62] Those things will impact the way that their tears are produced and the quality of those tears. Their environment and lifestyle choices also play a big role. Screen time, computer use, cosmetics—all of these things contribute.[63] I discuss all those factors with the patient and how we're going to work toward a solid anti-inflammatory foundation so we can build upon that with a meibomian gland clearing treatment.

Dr. Bloomenstein: I like to engage the patient in their treatment so they understand why they're doing it. I tell patients that we have a chicken and egg scenario. When looking at the meibomian gland, for example, we have obstruction, we may start to see atrophy or tortuosity, and there may be a capped gland. The obstruction is inducing inflammation. On one hand, the meibomian gland secretion must improve. We'll talk about home remedies like warm compresses and moist heat. I'll recommend incorporating lid hygiene, rinsing the lashes with warm water, and removing all eye makeup. If those things aren't efficacious, we'll discuss thermal pulsation. But these treatments are only for the obstruction, not the inflammation. I also reach for an antiinflammatory immunomodulatory such as cyclosporine or lifitegrast. The goal is to reduce the inflammation in addition to improving the obstruction. I give them a road map of what to expect.

TABLE 2. IN-OFFICE TECHNOLOGIES TO MANAGE DED / MGD

iLux MGD Treatment System (Alcon Vision)	A handheld device that applies heat and compression via sterile, disposable pads that slip on either side of the eyelid during heating and compression.
TearScience LipiFlow Thermal Pulsation System (Johnson & Johnson Vision)	The system consists of a console, reusable cable and a single-use sterile device, which cradles the upper and lower eyelid as heat and pressure is applied to the meibomian glands.
TearCare System (Sight Sciences)	Wearable, single-use devices that are affixed to the upper and lower lids that deliver regulated and adjustable heat while allowing the eyelids to blink naturally.
Optima IPL (Lumenis)	Intense pulses of noncoherent light distributed over a range of wavelengths that treats periocular inflammatory conditions.
Eye-Light (Topcon)	This device offers intense pulses and also low-level light therapy.

Dr. Loh: We know that many patients have mixed mechanism OSD. They are coming in with meibomian gland issues, aqueous deficiency, and some inflammation. If you have a patient like this, what is your first step? Do you prefer more of a medication, or do you prefer more of a procedural-based approach?

Dr. Mah: I have come up with a strategy to address all the different components of their disease. I treat them with everything. Many people who come in don't know they have OSD, either because it's their first visit or because they've been misdiagnosed with allergies, conjunctivitis, or an infection.

I start with warm compresses, using a bean bag or gel mask that is heated in the microwave for about 10 seconds. The compress should be 105° to 110°. They should mask twice a day, every day, for 10 to 15 minutes.[64] I also focus on hygiene and ask them to clean their lashes with products that contain hypochlorous acid. They also need 2,000 mg of omega-3 fatty acids daily. I'll recommend artificial tears if they aren't using it already; if they are, I'll consider a prescription medication. Finally, I'll sometimes recommend ointment at night for any lagophthalmos. Now, if the patient has already done these things, then I'll recommend thermal technology and medication.

Q | DR. LOH: A patient comes to you with mature cataracts who needs surgery. The cataracts are affecting their vision; they aren't able to drive. They also have significant OSD. What is your treatment strategy?

Dr. Gupta: It depends on where the patient is starting from. One of the most frustrating symptoms for patients with DED is blurred or fluctuating vision. Many cataract patients come in complaining of this, which is an indicator of dry eye. It's easy to follow up and ask if it's a constant blur or a fluctuating blur. If they have fluctuation, you know to look for OSD.

If they have preexisting OSD, I'll initiate a rapid treatment. I'll also look at them long term and assess if they are at higher risk for decompensating after surgery. We want to get the best biometry. We want the tear film to be healthy, preoperatively for all those reasons. But we also want patients to feel like they don't have DED symptoms after surgery.

If a patient has corneal staining, I'll put them on a topical steroid because it works very quickly.[65] For patients with corneal staining and DED, I'll initiate an antiinflammatory that can be used chronically; cyclosporine and lifitegrast are all good options. These molecules take weeks to months to build full levels, so I initiate them along with a topical steroid. For patients with MGD, I think it's very important to address it preoperatively. MGD is a very common condition; it has a direct impact on the TBUT. The new therapies mentioned earlier are all great therapies for MGD; they are centered around relieving the obstruction in the meibomian gland. They're all equally performed in clinic, but some are a bit more titratable. For example, if using an electrothermal controller that delivers regulated and adjustable heat to the upper and lower lids, after the heating treatment is complete, you can use expression forceps to titrate along which segments might be more obstructed.[59]

Dr. Loh: Say a patient has perfect cataract or refractive surgery, and you're seeing them postoperatively. They were appropriately treated for dry eye ahead of time, but the surgery initiated dry eye symptoms, like you expected and explained in advance. How do you treat them?

Dr. Bloomenstein: One thing we haven't mentioned is the use of artificial tears. Over-the-counter artificial tears are an important component of treatment as a short-term, quick fix.[66] Steroids are also effective in reducing inflammation quickly. In addition to the short-term treatments, I'll prescribe cyclosporine or lifitegrast, twice a day, to enhance their tear quality in the long term.

Q | DR. LOH: Dr. O'Dell, you're a TFOS ambassador, and you work extensively with the committee. How do you relate DEWS II with dry eye?

Dr. O'Dell: TFOS DEWS II gave us a treatment goal, which was very valuable.[29] We're now working toward a common goal; it doesn't matter what test we use to get there. It also forced us to make sure we haven't misdiagnosed the patient by employing the LLPP. Sometimes what we think is dry eye isn't dry eye; it's basic membrane disease or *Demodex* mites.[67] If we're not looking at a closed lid or having the patient look down, we might not see the collarettes or the cylindrical dandruff consistent with *Demodex* mites.

TFOS DEWS II also made it simple with the signs and symptoms. Symptoms can be validated though a questionnaire.[68] Signs can be assessed through a simple fluorescein strip, looking for TBUT or a staining pattern consistent with DED. Finally, osmolarity can help you determine if the DED is more aqueous or more evaporative in nature. These algorithms make my job a little easier. It shows me that I'm on the right path. These are what the lead experts are saying we should be looking for, so I use them in my day-to-day clinic.

Dr. Loh: I want to thank everyone for your time and insights. I've learned a lot; thank you for the excellent discussion. ■

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OCULAR SURFACE DISEASE: ETIOLOGIES AND TREATMENT MODALITIES

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DEMOGRAPHIC INFORMATION

Profession
___ MD/DO
___ OD
___ NP
___ Nurse/APN
___ PA
___ Other

Years in Practice
___ >20
___ 11-20
___ 6-10
___ 1-5
___ <1

Patients Seen Per Week (with the disease targeted in this activity)
___ 0
___ 1-15
___ 16-30
___ 31-50
___ 51+

Region
___ Northeast
___ Northwest
___ Midwest
___ Southeast
___ Southwest

Setting
___ Solo Practice
___ Community Hospital
___ Government or VA
___ Group Practice
___ Other
___ I do not actively practice

Models of Care
___ Fee for Service
___ ACO
___ Patient-Centered Medical Home
___ Capitation
___ Bundled Payments
___ Other

LEARNING OBJECTIVES

Did the program meet the following educational objectives?	Agree	Neutral	Disagree
Differentiate between dry eye disease (DED) and meibomian gland dysfunction (MGD) and **summarize** the risk factors for DED and MGD	_____	_____	_____
Explain the role of inflammatory processes in these diseases	_____	_____	_____
Recognize the signs and symptoms in patients with ocular surface complaints	_____	_____	_____
Appraise the differences between traditional and new diagnostic tests for DED and MGD	_____	_____	_____
Compare the newest treatments for DED and MGD with first-generation treatments indicated for those conditions	_____	_____	_____

PLEASE COMPLETE AT THE CONCLUSION OF THE PROGRAM.

1. Based on this activity, please rate your confidence in your ability to recognize the signs and symptoms in patients with ocular surface complaints (based on a scale of 1 to 5, with 1 being not at all confident and 5 being extremely confident).

a. 1
b. 2
c. 3
d. 4
e. 5

2. Based on this activity, please rate how often you use advanced ocular surface disease (OSD) treatments (based on a scale of 1 to 5, with 1 being never and 5 being always).

a. 1
b. 2
c. 3
d. 4
e. 5

3. A 75-year-old male was referred for cataract surgery by a community optometrist. He has visually significant cataracts that are impairing his ability to drive. He is on medication for hypertension and type 2 diabetes. The patient reports a sand-like feeling in his eyes that worsens throughout the day. Staff administered the OSDI questionnaire, which was 23 out of a possible 100. Look, lift, push, pull examination revealed that the meibomian glands required moderate pressure to express, he has moderate corneal staining, and a tear breakup time of 5. How do you proceed?

a. Only schedule the patient for cataract surgery immediately, as it is visually significant and impairing his day-to-day activities.
b. Only prescribe short-term topical corticosteroids and then schedule the cataract surgery.
c. Prescribe both short-term topical corticosteroids and 4 weeks of either cyclosporine or lifitegrast to manage the inflammation and improve the ocular surface before scheduling surgery.
d. Recommend only thermal pulsation therapy for his meibomian gland disease before scheduling surgery.

4. A 38-year-old female with a 20-year history of soft contact use, changed monthly, presents for a routine eye exam. She complains of blurry vision and assumes she needs a stronger prescription but is interested in the benefits of LASIK. She complains of being unable to tolerate contacts for more than a few hours, especially during workdays in which she spends the majority of time at her computer. She reports no symptoms of dry eye—no grittiness, no foreign body sensation, no burning or stinging. Her VA is the same as it was last year, 20/60 in both eyes, and she is on no new medications. What do you recommend for this patient?

a. Switch her to daily contact lenses and recommend she use a dry eye friendly solution to mitigate dryness.
b. Explain that she has computer vision syndrome and needs to limit her use of screens.
c. Refer her for a LASIK evaluation.
d. Keep her prescription and contact choices as is and give her a full dry eye workup, paying particular attention to the meibomian glands.

5. A 27-year-old male had refractive surgery 3 months ago. He complains that his vision fluctuates during the day and that his eyes feel gritty. You find no issues with his LASIK flaps, and he is 20/25 in both eyes. Despite the seemingly successful surgery, he is convinced the procedure was compromised in some way. He has moderate corneal staining and a tear breakup time (TBUT) of 7 seconds. How can you help this patient?

a. Touch up the LASIK with the hope of improving the vision to 20/20
b. Perform the Look, lift, push, examination to determine if meibomian gland dysfunction (MGD) may be exacerbated post-surgery
c. Increase artificial tears and hope that the patient gains relief
d. Start patient on lid hygiene therapy and consider use of an immunomodulating dry eye medication
e. Both B and D

6. What is the most common type of dry eye?

a. Mixed mechanism
b. Evaporative
c. MGD
d. Aqueous deficient

7. According to the ASCRS algorithm, what is the first dry eye evaluation a patient should have upon presentation and follow up?

a. A standard visual exam, asking them if their vision improves upon blinking
b. A dry eye questionnaire
c. Meibography
d. Osmolarity

8. What percentage of patients have dry eye?

a. 20%
b. 30%
c. 40%
d. 50%

9. What is the primary reason for contact lens drop out?

a. Aqueous deficient dry eye
b. Poor contact lens fit
c. MGD
d. Excessive computer use

10. Fill in the blanks. According to the PHACO study, _____ of patients had previously diagnosed dry eye, but _____ had a TBUT of ≤ 7 seconds.

a. 30%, 50%
b. 25%, 80%
c. 80%, 100%
d. 40%, 75%

11. In the TFOS DEWS II report, an initial screening evaluation for mild DED should include any of the following diagnostic tests except:

a. Corneal aesthesiometer
b. Dry eye questionnaire such as SPEED or OSDI
c. Meibography
d. Tear film osmolarity

12. What is the most common environmental factor for the development of dry eye?

a. Rapid change in altitude (ie, mountain hiking)
b. High humidity
c. Low humidity
d. Fluctuating outdoor temperatures

ACTIVITY EVALUATION/SATISFACTION MEASURES

Your responses to the questions below will help us evaluate this CE/CME activity. They will provide us with evidence that improvements were made in patient care as a result of this activity.

Rate your knowledge/skill level prior to participating in this course: 5 = High, 1 = Low _____

Rate your knowledge/skill level after participating in this course: 5 = High, 1 = Low _____

This activity improved my competence in managing patients with this disease/condition/symptom _____ Yes _____ No

Probability of changing practice behavior based on this activity: _____ Yes _____ No _____No change needed

If you plan to change your practice behavior, what type of changes do you plan to implement? (check all that apply)

_____ Change in pharmaceutical therapy
_____ Change in diagnostic testing
_____ Change in current practice for referral
_____ My practice has been reinforced
_____ Change in nonpharmaceutical therapy
_____ Choice of treatment/management approach
_____ Change in differential diagnosis
_____ I do not plan to implement any new changes in practice

Please identify any barriers to change (check all that apply):

_____ Cost
_____ Lack of consensus or professional guidelines
_____ Lack of administrative support
_____ Lack of experience
_____ Lack of time to assess/counsel patients
_____ Lack of opportunity (patients)
_____ Reimbursement/insurance issues
_____ Lack of resources (equipment)
_____ Patient compliance issues
_____ No barriers
_____ Other. Please specify: _____
_____

The design of the program was effective for the content conveyed. ___ Yes ___ No

The content supported the identified learning objectives. ___ Yes ___ No

The content was free of commercial bias. ___ Yes ___ No

The content was relative to your practice. ___ Yes ___ No

The faculty was effective. ___ Yes ___ No

You were satisfied overall with the activity. ___ Yes ___ No

Would you recommend this program to your colleagues? ___ Yes ___ No

Please check the Core Competencies (as defined by the Accreditation Council for Graduate Medical Education) that were enhanced through your participation in this activity:

_____ Patient Care
_____ Practice-Based Learning and Improvement
_____ Professionalism
_____ Medical Knowledge
_____ Interpersonal and Communication Skills
_____ System-Based Practice

Additional comments:
_____

_____ I certify that I have participated in this entire activity.

This information will help evaluate this CME activity; may we contact you by email in 3 months to see if you have made this change? If so, please provide your email address _____

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