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The Journey to Superior Outcomes Starts at the Ocular Surface

CRST interviewed Christopher E. Starr, MD, FACS, in March 2020.

Multiple algorithms for symptomatic dry eye disease (DED) exist. However, a survey of the American Society of Cataract and Refractive Surgery (ASCRS) membership revealed what was already known: most surgeons weren't treating DED prior to surgery because it seemed too complex and time-intensive to easily integrate into their current preoperative practice routines.

In 2019, the ASCRS Cornea Clinical Committee (CCC) published a new consensus-based algorithm for the management of Ocular Surface Disease (OSD) in the preoperative setting. Christopher E. Starr, MD, FACS, said, "We set out to create an algorithm that could be followed by technicians and office staff, and therefore be integrated into the preoperative surgical visit in a quick and seamless way."

When performing highly precise refractive procedures that involve notable out-of-pocket costs to patients, excellent visual outcomes are universally expected. Identifying and treating Visually Significant OSD (VS-OSD) prior to cataract or refractive surgery can make the difference between satisfied or dissatisfied patients. Dr. Starr said, "Patients have increasingly higher expectations, particularly those electing a premium cataract or refractive procedure."

Point-of-care tests (osmolarity and tear inflammation) are in-office laboratory tests and modernize a DED/OSD practice for both surgical and nonsurgical patients. These tests provide immediate, objective data that are applied toward an ocular surface health assessment, enabling the clinician to better determine which subset of OSD is present.

SIGNIFICANT UNDER-DIAGNOSIS OF OSD

The majority of patients in the cataract population have some form of OSD, yet it often remains underdiagnosed and undertreated.[1,2] Multiple studies have demonstrated that the prevalence in asymptomatic cataract surgery candidates is higher than previously thought. One study[2] found that over 60% of routine cataract patients were asymptomatic, however, half of these patients had central corneal staining. In another study,[1] the incidence of OSD in patients presenting for cataract surgery was over 80%, and more than half of the asymptomatic patients had an abnormal tear osmolarity or matrix metalloproteinase-9 (MMP-9) level. Dr. Starr stated, "We know that the prevalence is extraordinarily high, but patients are often asymptomatic. Older patients don't necessarily complain about symptoms associated with OSD."

ASSESS ALL SURGICAL PATIENTS FOR OSD

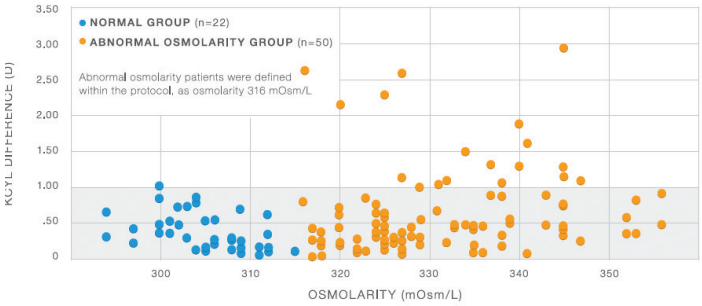
The most common postsurgical complaint is related to OSD.[1] Due to the potential adverse impact of OSD on surgical outcomes and patient satisfaction—and given that a large proportion of cataract patients are asymptomatic—the ASCRS CCC has recommended that all preoperative refractive patients undergo a comprehensive ocular surface examination.

Consequences of performing surgery on a patient with Visually Significant OSD

- IOL calculation errors and refractive surprises
- Unsatisfactory postsurgical visual outcomes
- New or worsened OSD signs and symptoms[3]
- Postoperative infection (if OSD is bacterial)

IMPACT OF TEAR FILM INSTABILITY

The tear film is the most anterior surface of the eye, thus approximately 70% of the total refractive power of the eye occurs at the tear film.[4] An unstable tear film reduces the accuracy of preoperative measurements which can lead to refractive misses, suboptimal visual performance, exacerbated or new OSD signs and symptoms, and potentially postoperative infection.[5]



17% of eyes with abnormal osmolarity had >1 D (diopter) of difference in keratometry cylinder values between two pre-surgical visits.

10% of eyes with abnormal osmolarity had >0.5 D (diopter) of change in calculated IOL power (based on average K).

Figure 1. Abnormal osmolarity can affect presurgical keratometry measurements.[6]

In a study by Epitropolous et al[6], it was found that 17% of eyes with abnormal osmolarity had more than a difference of 1.00 D in keratometry cylinder values between two presurgical visits (Figure 1). Within this group of abnormal osmolarity patients, a different IOL power was selected for one out of 10 patients, but only after it was established that DED was impacting their presurgical measurements.

THE GOAL OF ASSESSING OSD

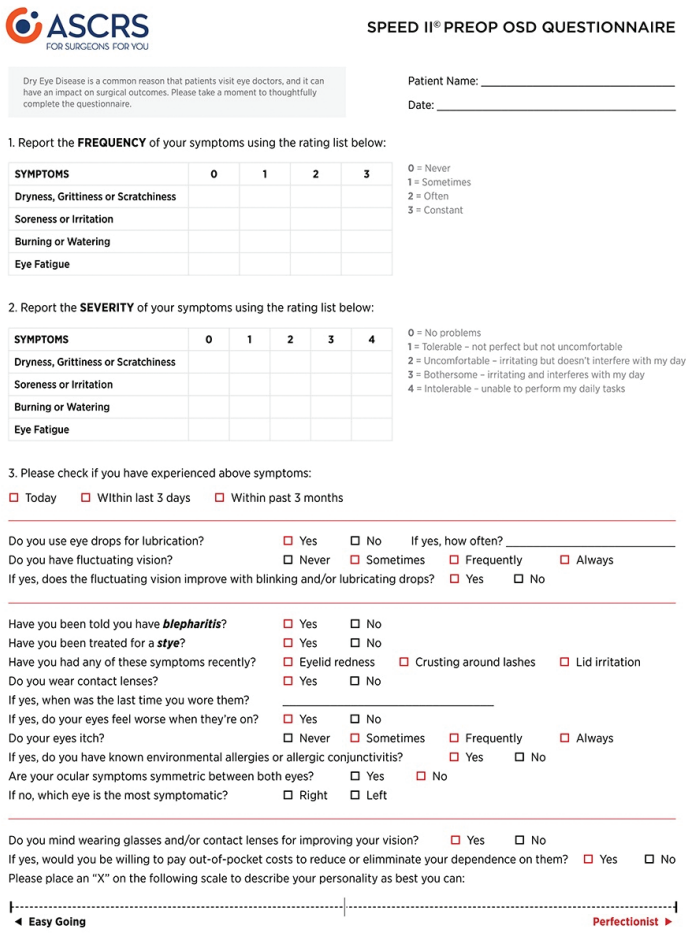
Dr. Starr reminds us that, "Many busy surgical practices have not established protocols for addressing OSD during the already complex and time-consuming preoperative surgical visit. But to avoid postsurgical complications arising from OSD, it is important to identify and treat all significant OSD subtypes prior to surgery. And it doesn't have to add much surgeon chair time."

Using the new algorithm and testing recommendations, a surgical plan can be mapped out according to "Essential" or "Optional" tests and steps where a "diagnosis" or a "clinical decision" needs to be made. The aim is to establish whether a patient has VS-OSD and, if so, to treat aggressively so that surgery can proceed as soon as the ocular surface is healthy.

NEW MODIFIED SPEED II PATIENT QUESTIONNAIRE

An important outcome of the committee is a modified and enhanced version of the SPEED questionnaire. While the Ocular Surface Disease Index (OSDI) or the original Standard Patient Evaluation of Eye Dryness (SPEED) are indicative of DED, cataract patients often have advanced signs of OSD but do not report symptoms.[1,2]

SPEED II goes beyond just OSD and includes questions to help understand patients' expectations, their willingness to pay out-of-pocket expenses, and their ratings of themselves as patients (from easy-going to perfectionist) (Figure 2). Easily tallied by a technician, the result is something that can quickly be scanned by the surgeon prior to seeing the patient. "The questionnaire data are hugely important for any preoperative visit. Knowing the severity and type of symptoms can help determine the presence of OSD subtypes, and knowing the patient's surgical expectations and personality type before you walk in the door ultimately saves you a lot of chair time and can help guide your treatment plans," said Dr. Starr.



ASCRS FOR SURGEONS FOR YOU

SPEED II® PREOP OSD QUESTIONNAIRE

Dry Eye Disease is a common reason that patients visit eye doctors, and it can have an impact on surgical outcomes. Please take a moment to thoughtfully complete the questionnaire.

Patient Name: _____

Date: _____

1. Report the **FREQUENCY** of your symptoms using the rating list below:

SYMPTOMS	0	1	2	3
Dryness, Grittiness or Scratchiness				
Soreness or Irritation				
Burning or Watering				
Eye Fatigue				

0 = Never
1 = Sometimes
2 = Often
3 = Constant

2. Report the **SEVERITY** of your symptoms using the rating list below:

SYMPTOMS	0	1	2	3	4
Dryness, Grittiness or Scratchiness					
Soreness or Irritation					
Burning or Watering					
Eye Fatigue					

0 = No problems
1 = Tolerable – not perfect but not uncomfortable
2 = Uncomfortable – irritating but doesn't interfere with my day
3 = Bothersome – irritating and interferes with my day
4 = Intolerable – unable to perform my daily tasks

3. Please check if you have experienced above symptoms:

☐ Today ☐ WIthin last 3 days ☐ Within past 3 months

Do you use eye drops for lubrication? ☐ Yes ☐ No If yes, how often? _____
Do you have fluctuating vision? ☐ Never ☐ Sometimes ☐ Frequently ☐ Always
If yes, does the fluctuating vision improve with blinking and/or lubricating drops? ☐ Yes ☐ No

Have you been told you have ***blepharitis***? ☐ Yes ☐ No
Have you been treated for a ***stye***? ☐ Yes ☐ No
Have you had any of these symptoms recently? ☐ Eyelid redness ☐ Crusting around lashes ☐ Lid irritation
Do you wear contact lenses? ☐ Yes ☐ No
If yes, when was the last time you wore them? _____
If yes, do your eyes feel worse when they're on? ☐ Yes ☐ No
Do your eyes itch? ☐ Never ☐ Sometimes ☐ Frequently ☐ Always
If yes, do you have known environmental allergies or allergic conjunctivitis? ☐ Yes ☐ No
Are your ocular symptoms symmetric between both eyes? ☐ Yes ☐ No
If no, which eye is the most symptomatic? ☐ Right ☐ Left

Do you mind wearing glasses and/or contact lenses for improving your vision? ☐ Yes ☐ No
If yes, would you be willing to pay out-of-pocket costs to reduce or elimminate your dependence on them? ☐ Yes ☐ No
Please place an "X" on the following scale to describe your personality as best you can:

◄ Easy Going — Perfectionist ►

Figure 2. ASCRS SPEED II preoperative OSD questionnaire.

POINT-OF-CARE TESTS ARE ESSENTIAL

Recognizing that preoperative visits are already complicated and time-intensive, Dr. Starr and the committee specifically developed a "technician and objective data-driven algorithm for the quick and effective management of OSD," said Dr. Starr. The ASCRS algorithm recommends an essential battery of diagnostic tests including both tear osmolarity and inflammatory markers (MMP-9) point-of-care tests (Figure 3). Used together, these tests can be helpful in a differential diagnosis when other signs and symptoms of the various subsets are the same.

"I've always been a huge believer in the objective data, and I use these tests in my own practice with surgical and regular patients," said Starr. "They enable surgeons to incorporate the objective data in the diagnosis of OSD, severity, subtypes, treatment, and counselling of patients appropriately prior to surgery."

OSD Diagnosis, Telemedicine & COVID-19

In the unprecedented time of COVID-19, be efficient and save time by getting the data you need before you see patients.

Complete the OSD questionnaire at home—Telemedicine facilitates at-home data collection ahead of the office visit.

Utilize point-of-care tests— Osmolarity and MMP-9 tests can be performed by technicians prior to the clinical examination, resulting in practice efficiencies. Physician chair time is reduced as laboratory-style point-of-care tests aid in a faster diagnosis. In addition, these tests are single-use and disposable, adding to patient and technician safety.

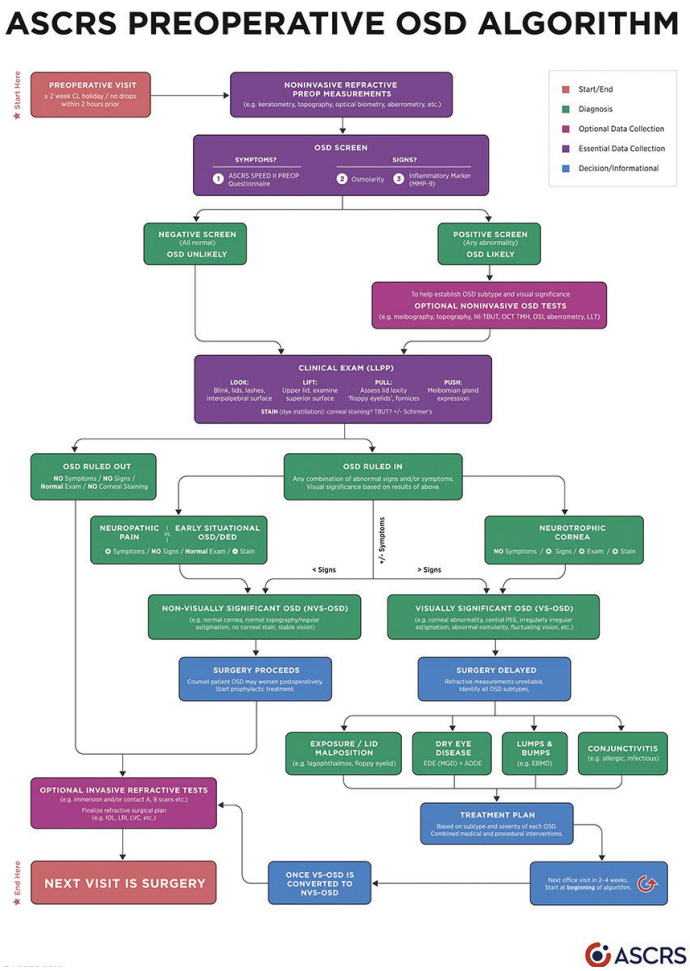


Figure 3. ASCRS Preoperative OSD Algorithm.

Technician-driven tests streamline the process and reduce the burden on the physician. Before the doctor is ever involved with the patient, validated data is available to provide immediate insights into a patient's ocular health.

WHY TEST OSMOLARITY?

Osmolarity testing is an essential preoperative diagnostic test that is important in detecting the presence, or absence, of DED.[3] Osmolarity testing evaluates the tear film using an objective and physiologic marker rather than relying on subjective signs, such as staining or tear breakup time. Importantly, osmolarity allows for the early detection of DED as changes in osmolarity may precede other clinical signs.[7]

Hyperosmolarity is the mechanism of DED that triggers inflammatory events at the ocular surface[8] causing an increase in corneal epithelial cell death, loss of goblet cells, and disturbance of mucin expression, all of which may undermine surgical outcomes. Hyperosmolarity increases EMMPRIN expression, which is associated with an increase in MMP-9 and a loss of epithelial cells[9], and causes loss of microplicae on the corneal epithelium. In all types of DED, hyperosmolarity is present.[10,11]

Modern technology brings osmolarity testing to the point of care. The TearLab Osmolarity System (TearLab Corp.) is an FDA-approved device proven to deliver precise and predictive measurements of DED (Figure 4).[12] A test card is placed in the lower lateral tear meniscus to collect a 50 nL tear sample (the size of a pin tip). Results are available in seconds. Repeated osmolarity testing of patients undergoing therapy is also a reliable indicator of whether DED has improved enough to proceed to surgery.

NORMAL VERSUS ABNORMAL OSMOLARITY

"We certainly need to know the osmolarity numbers," Dr. Starr said. "They tell you if dry eye is present and how severe it is. The higher the number, the more severe the DED," said Dr. Starr. Normal subjects have tears in proper homeostasis and exhibit low and stable osmolarity ranging from about 280-295 mOsm/L. Dry eye patients exhibit elevated and unstable osmolarity. An osmolarity value of 308 mOsm/L or greater indicates normal and mild to moderate DED.[13] A mean osmolarity of 315 mOsm/L indicates mild to moderate DED, and severe DED has a mean value of 336 mOsm/L.

Dry eye disease is characterized by a loss of homeostasis including variability and inter-eye differences. A bilateral and often asymmetrical disease, an inter-eye difference of more than 8 mOsm/L is indicative of tear film instability.[14]

Normal osmolarity in symptomatic eyes may also be an indicator of other underlying conditions, including partially treated DED, conjunctival chalasis, CL and/or solution irritation, mild allergic conjunctivitis, epithelial basement membrane dystrophy, pinguecula/early pterygia infection, anterior blepharitis, or demodex.[15]

Figure 4. The TearLab Osmolarity System.

WHY TEST MMP-9?

MMP-9 is an enzyme that is released during an inflammatory response and plays a role in breaking down the intercellular matrix of epithelial cells. Elevated levels of MMP-9 have been found in patients with different types of OSD, including Sjögren syndrome and MGD.[16] Inflammatory mediators released into the tears cause tear film instability, and an unstable tear film will cause image fluctuations that can impair vision for one or more lines on the eye chart.

CRITICAL DIAGNOSIS: VS-OSD VERSUS NON-VISUALLY SIGNIFICANT OSD

OSD is not an absolute contraindication of surgery since many in the cataract population will have it. According to Dr. Starr, the committee fine-tuned the algorithm to "account for all the various subtypes and severities of OSD."

With this in mind, the ASCRS algorithm introduced new terminology for classifying any OSD into two important presurgical categories: Non-VS-OSD (NVS-OSD) and VS-OSD. The clinician must determine the category of OSD after the clinical examination.

VS-OSD	NVS-OSD
Can impact preoperative measurements and postsurgical outcomes	Does not impact preoperative measurements or postsurgical refractive outcomes
Surgery delayed 2-4 weeks	Surgery proceeds
Requires intensive, rapid OSD treatment	Prophylactic treatment

NVS-OSD

NVS-OSD could include diagnoses such as early, preclinical, or situational DED; mild conjunctivochalasis with a normal cornea; nonobvious meibomian gland disease; pinguecula; and more.[3] NVS-OSD is not an indicator to postpone final refractive measurements and surgery. However, "if you mention OSD to the patient before surgery it is a pre-existing condition rather than a complication of the surgery. That's the importance of diagnosing it and discussing it prior to surgery," explains Starr.

VS-OSD

VS-OSD needs attention before proceeding with surgery to avoid reduced visual quality and potential errors in preoperative measurements (topography, keratometry, refraction, aberrometry).[3] "Delay surgery if you cannot get it under control in the time frame you are working with," said Starr.

Any OSD that results in corneal staining or abnormal osmolarity (e.g., DED, meibomian gland dysfunction, neurotrophic or exposure keratitis), irregular astigmatism (e.g., epithelial basement membrane dystrophy, pterygium, Salzmann nodules) and/or increases the risk for surgical infection (e.g., infectious conjunctivitis, staphylococcal blepharitis, etc.) is deemed VS-OSD. When VS-OSD is identified, aggressive multifaceted treatment should be initiated and surgery delayed if there is inadequate time to reverse it. The algorithm is repeated at each follow-up appointment until OSD is resolved or converted to NVS-OSD.

CONCLUSION

OSD is commonly inadequately diagnosed and treated prior to refractive surgery even though it can have a significant impact on refractive outcomes and patient satisfaction. Therefore, all patients should be carefully assessed for OSD preoperatively. Osmolarity and MMP-9 tests have improved sensitivity and specificity in the diagnosis of DED. In combination, they have a high positive predictive value of OSD, which becomes valuable in identifying OSD in asymptomatic preoperative cataract surgery patients.

The combination of osmolarity and MMP-9 testing can provide a rapid diagnosis of OSD and its severity and, along with the other tests, contribute toward a more comprehensive and accurate surgical plan, ultimately leading to improved outcomes. ■

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