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The TearLab Osmolarity System

Abnormal osmolarity in symptomatic and asymptomatic patients may result in postoperative complications.

BY CHRISTOPHER E. STARR, MD; OMID KERMANI, MD; ERIK L. MERTENS, MD; GUY SMITH, MD; and LUCA VIGO, MD

This article highlights key topics discussed during a symposium on the TearLab Osmolarity System.

I have used the TearLab Osmolarity System for 7 years. When I first got the test I was very excited to use it, but I made assumptions about dry eye disease (DED). I thought a diagnosis was determined by patients' symptoms and slit-lamp examination. When the osmolarity measurements that I obtained were clinically confusing, I thought the device was malfunctioning. I thought I was right, and the device was wrong. Then I began learning about eye-to-eye variability in DED. DED is not a simple disease. The osmolarity test opened my eyes to what a mistake it is to diagnose every symptom of scratchiness, irritation, and dryness as DED and simply prescribe artificial tears. It was my "aha" moment.

—Christopher E. Starr, MD

Christopher E. Starr, MD: Let us discuss how you began with TearLab and any growing pains that you experienced.

Omid Kermani, MD: In Cologne, patients often present with red eyes and other symptoms, yet have normal osmolarity. In summer, it is hot and humid, and in winter, it is smoggy. These conditions have a strong effect on patients' tear film. Is it allergies, inflammation, stress, or sleeplessness? Many factors affect patients' tear film. If patients have abnormal osmolarity, then surgery is not an option. The TearLab Osmolarity System is a helpful differential diagnosis tool. If a patient is asymptomatic with abnormal osmolarity, then I address it.

Audience: After you treat refractive patients' abnormal osmolarity, do you take biometry and topography measurements again at their 6-week follow-up?

Dr. Kermani: It depends on the values. I retake measurements if it is a severe case of abnormal osmolarity. I would not recommend surgery. I would refer the patient to supportive therapy. These patients are usually happy because they are now aware of the problem. Tear film deficiency and DED are all over the Internet. I address the problem with objective testing, which patients understand and find helpful.

Audience: Are there published or peer-reviewed data showing that abnormal osmolarity needs to be addressed before performing LASIK or refractive procedures?

Dr. Starr: A paper was published in the *Journal of Cataract and Refractive Surgery* by Epitropoulos looking at osmolarity in preoperative cataract patients.[1] Abnormal osmolarity in those patients correlated to an IOL calculation error of anywhere from a 0.50 D to 1.00 D. The patients with normal osmolarity had no variation. If abnormal osmolarity is not addressed preoperatively, then an IOL calculation error may occur.

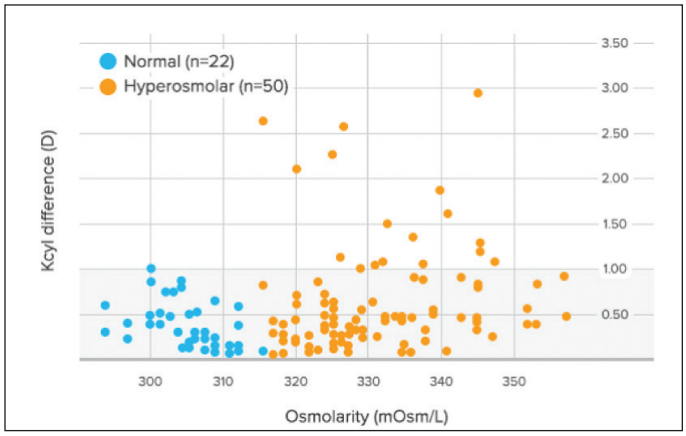

Figure 1. In the Epitropoulos study, 17% of eyes with abnormal osmolarity had >1.00 D of difference in keratometry cylinder values between 2 presurgical visits, and 10% of eyes with abnormal osmolarity had >0.50 D of change in calculated IOL power (based on average K).

Many of you are asking about whether or not to perform surgery. I tell patients who have ocular surface disease, DED, and abnormal osmolarity preoperatively that I cannot choose with accuracy the lens that will give them the best visual outcome without wearing glasses. I *can* treat their DED aggressively. After the ocular surface is optimized, the topography, keratometry, and IOL power calculations will be more accurate. If you spend extra time initially, you will save yourself a lot of time afterward. Patients do not want a refractive surprise or to spend an enormous amount of chair time postoperatively discussing piggyback lenses, IOL exchanges, LASIK, etc. If it is diagnosed postoperatively, DED is viewed as a surgical complication. If you diagnose and address it preoperatively, you are a hero.

Guy Smith, MD: In the Epitropoulos study, 10% of patients experienced an IOL refractive surprise of more than 0.50 D (Figure 1).

Audience: Is it sphere or astigmatism?

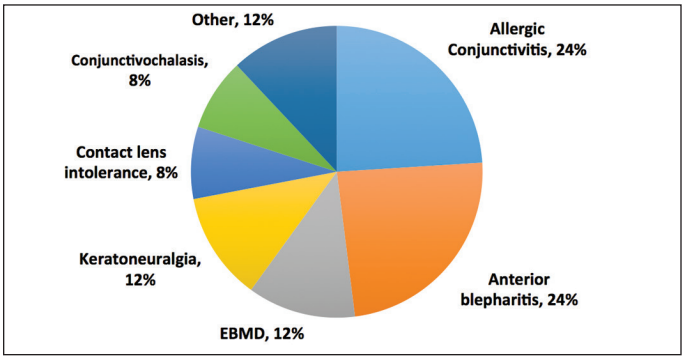

Figure 2. Diagnosis of patients who were symptomatic with normal osmolarity.

Dr. Smith: Spherical equivalent. The highest refractive surprise was 5.50 D, which is difficult to explain to a patient.

Dr. Starr: I presented a poster at the 2016 Tear Film & Ocular Surface Society conference about a prospective study of 50 patients who were symptomatic with normal osmolarity.[2] The diagnosis for the vast majority of those patients was either allergic conjunctivitis or anterior blepharitis (Figure 2). Itching is not just allergies, it can be DED too. Dryness is not just DED, it can also be allergies or other things. If you are relying on symptoms alone, you are going to miss a diagnosis. Other diagnoses were conjunctivochalasis, epithelial basement membrane dystrophy, keratoneuralgia, and contact lens intolerance. You can determine if a patient has any of these conditions rather than DED because you are driven to them by the normal osmolarity. Without the normal osmolarity test, many of these patients would likely be misdiagnosed and mistreated as simple DED.

What if a patient has minimal symptoms or is asymptomatic, but has severely abnormal osmolarity? Is that a sign of early disease that will most likely progress? I am sure you have all seen in your practices that it gets worse if not treated.

Luca Vigo, MD: Do you think that the osmolarity measurement will help us determine the treatment?

Dr. Starr: Absolutely. The higher the osmolarity number, the more aggressive you want to be with your treatment in order to reverse that number as quickly as possible. I find that it is much better to make this diagnosis preoperatively, because postoperatively patients are on steroids, NSAIDs, and the surgery itself has affected the tears. The osmolarity measurement is not accurate if patients have used drops within 2 hours of testing.

Erik L. Mertens: I want to hop in here. I am a surgeon. We all know that keratometry is the most important factor to determine the correct IOL power. If you are off slightly, it has a huge impact on your power calculations. It was indeed the work of Epitropoulos that showed that patients with abnormal osmolarity had a statistically significant difference in IOL power calculations. In 17% of the eyes with abnormal osmolarity, there was a difference of more than 1.00 D in IOL power calculations. We often discuss DED, but not the impact it has on our surgical precision. We would like to have a certain percentage of eyes within ±0.50 D, but most of us do not give enough attention to patients' abnormal osmolarity.

Dr. Mertens: I began using this device 2 years ago, but it was very confusing. What do I do if I find symptomatic or asymptomatic eyes with abnormal osmolarity? So, I returned the device. Then, TearLab taught me how to use the device. It is not the symptoms that determine if a patient has abnormal osmolarity, and asymptomatic patients do not necessarily have normal osmolarity.

When it comes to IOL power calculations, especially with toric IOLs, this can become a key issue. The accuracy of corneal radii measurements depends on the tear film quality. Placido-based diagnostic devices usually reveal tear film deficiency by poor reflectance. With diagnostic devices that take only two or four points as a reference, it can be difficult to determine tear film deficiency. The mismatch of values taken with different diagnostic machines is a strong hint that the tear film may not be in good condition. ■

1. Epitropoulos AT, Matossian C, Berdy GJ, et al. Effect of tear osmolarity on repeatability of keratometry for cataract surgery planning. *J Cataract Refract Surg.* 2015;41(8):1672-1677.
2. Brissette A, Bohm K, Drinkwater O, Starr C. The diagnostic utility of a normal tear osmolarity test in patients with dry eye disease-like symptoms: A prospective analysis. Poster presented at: 2016 Tear Film & Ocular Surface Society conference; Sept. 7-10, 2016; Montpellier, France.

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