Dry Eye: Beyond the Usual Suspects

Digging deeper into the types of patients who get dry eye and the situations that can bring it on.

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You may have noticed the recent wave of advertisements regarding dry-eye awareness. Despite the central focus of these campaigns suggesting that only women over 40 years of age get the disease, it's worth remembering that other people get dry eye, too. Granted, many of the risk factors associated with dry eye, such as Sjögren's syndrome or systemic lupus erythematosus, are more common in women than in men. And we know that the protective effects of estrogens against dry eye underlie a surge in prevalence among post-menopausal women; all these phenomena lead to a clear gender bias. But along with its greater prevalence in women, another fundamental truism regarding dry eye is that it is underdiagnosed, and many of those overlooked patients are men, or they are young, or they are otherwise not of the same demographic group targeted in these advertising efforts. This issue is part of the larger problem faced in dry-eye diagnosis: While many patients have recognizable risk factors or co-morbidities, the challenge is that many of these undiagnosed or underdiagnosed patients may be part-timers: They are transiently symptomatic, or have what we refer to as situational dry eye.

It turns out that many of the factors that confound diagnosis and increase symptom severity can cause dry eye in people who don't have a chronic or ongoing condition. This month we take a new look at situational dry eye, specifically, its causes, treatments and what we believe is key to dealing with the condition: situational awareness. Confounding factors can be extrinsic or intrinsic, so it's important for us to be aware of both our environment and ourselves.

A Disease and a Condition

The signs of dry-eye disease result from a breakdown of the tear film involving one or more of its component layers (aqueous, lipid or mu-

Long-duration visual tasking, such as computer use or studying sets of images, can strain tear film homeostatic mechanisms and compromise the ocular surface.

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cin) and subsequent damage to the epithelial surface.[1-3] Factors leading to this surface damage include lacrimal or meibomian gland dysfunction, adverse responses to surgical procedures, irregular blinking and/or chronic ocular inflammation. Damage to the ocular surface ultimately impairs visual function, eliciting the characteristic dry-eye symptoms of burning, dryness and blurred vision, so these underlying causes of tear-film breakdown must be addressed as part of a comprehensive treatment.

Layered onto these internal issues are environmental and behavioral conditions that may either exacerbate ongoing dry eye or elicit situational dry eye. When faced with mounting adverse external stimuli, the homeostatic mechanisms that control a normal, healthy tear film are overwhelmed, leaving the ocular surface exposed. These environmental conditions include wind and low humidity, or particulates such as dust, pollen or pollution.[4,5] Indoor environments, especially where forced hot air is used for heating, present a low-humidity environment similar to the atmosphere in commercial airplane cabins, and can cause dry eye. The impact of reduced humidity on the tear film is twofold: It increases evaporation and reduces tear-film stability as measured by tear-film breakup times. Interestingly, it doesn't appear that the osmolarity of the tear film is significantly impacted.[6]

The importance of environmental factors in dry eye is underscored by the development of a useful clinical model, the controlled adverse environment.[7] In the CAE it's possible to modify relative humidity, air velocity and visual tasking under controlled conditions, using the triggers of situational dry eye to exacerbate the disease state in a precise and reproducible manner. Use of this CAE allows us to identify patients with significant, modifiable disease and to establish conditions under which we can precisely assess the ability of therapies to alleviate their signs and symptoms.

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When faced with conditions of high wind or glare, sunglasses or goggles are a good idea for everyone.

Most ophthalmologists would agree that dry eye is worse in winter, and a number of recent studies are confirming this empirical observation. Our own work has shown a significant seasonal difference for diary-reported ocular discomfort in clinical trials, with patients experiencing higher levels of symptoms during the winter. *(Ousler GW, et al. IOVS 2015;56:ARVO E-abstract 4462)* Others have shown a similar seasonality, although the underlying mechanisms may have some geographical variability.[8] The unifying theme is the impact that the environment can have on dry eye, and demonstration that natural (or artificial) environmental conditions can promote situations where dry eye becomes more prevalent and more severe.

Problems of Human Origin

One of the most significant extrinsic factors in situational dry eye is air pollution. In many parts of the world, air quality is so poor it can induce severe dry eye in eyes with even the healthiest of tear films. Ocular exposure to atmospheric pollutants such as ozone, automobile emissions and other byproducts of fossil fuel combustion causes both a physical and a chemical irritation that leads to elevated levels of free radicals and damage to ocular surface cell constituents.[9] A Korean study showed a strong correlation between increases in ozone levels and the symptoms of dry eye in a population of almost 17,000.[10] They also found a significant correlation between dry-eye symptoms and nitrogen dioxide, an airborne pollutant associated with automobile exhaust. These same pollutants are also known to elicit inflammatory responses in epithelial cells, including the corneal epithelium. This may be an important facet of pollution-induced dry eye.

One of the main issues dry-eye patients report is difficulty or discomfort associated with reading. Recent studies have focused on the causal relationships between dry eye and various visual tasks, including both traditional reading and the use of electronic visual media such as computers, tablets and smartphones.[11-13] Our own studies have shown that subjects with dry eye exhibit increases in blink frequency as a compensatory response while reading. In addition, many

dry-eye patients report an association between situational triggers such as wind, humidity and time of day with greater difficulty and discomfort with reading. *(Watson M, et al. IOVS 2014;55:ARVO E-abstract 1997)*

What about the impact of electronic media on dry eye? This is new territory in our understanding of both chronic and situational dry eye. It's worth noting that the first iPhone was released in June of 2007, after the publication of the seminal Dry Eye Workshop report.[4] One of the most interesting studies in this area, published last year, reported on the relationship between dry eye and smartphone use in school-age children.[14] The study looked at two groups of children, one from an urban environment and one from a rural area, and found significantly higher rates of dry eye in the urban group based upon the criteria of corneal staining, tear-film breakup and Ocular Surface Disease Index scores. A surprisingly high number of children (50 of 612; 8.2 percent) in the urban group were diagnosed with dry eye, while only 2.8 percent of 286 in the rural group met the same diagnostic criteria. The study also found significantly higher smartphone use in the urban group, and the average duration of phone use was significantly higher in those children diagnosed with dry eye. Perhaps the most noteworthy result from this study was that when children in the dry-eye group stopped using their phones for four weeks, the dry eye resolved completely: Tear-film breakup times improved significantly, corneal staining was reduced to negligible levels, and OSDI scores decreased from 30.74 ±13.36 points to 14.53 ±2.23 points ($p<0.001$). This suggests that their dry eye was situational, and that excessive visual tasking can act in the same way as wind, low humidity and pollutants in that it overwhelms the capacity of the tear film to protect against dry eye.

Responding to the Situation

There are a number of ways we can address the factors that lead to situational dry eye. Any activity or travel associated with exposure to wind or dust should trigger the use of protective eyewear such as sunglasses or goggles. For those of us living in northern climates, winter means lower humidity: wood stoves and fireplaces; and hot-air vents in homes, offices and cars. Humidifiers can make these closed environments more hospitable to a healthy ocular surface. Also remember that ocular allergy and dry eye often go hand in hand,[15] so any efforts to minimize dust, dander and pollen can alleviate both conditions.

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Beyond these extrinsic factors, other lifestyle modifications can ameliorate situational dry eye. Many medications, such as antihistamines, decongestants or pain relievers have ocular drying effects.[16] Hydration may be a factor, and one simple approach is to maintain an overall fluid balance.[17] Also, as demonstrated by the study of children and smartphones, it's important to be aware of the effects of visual tasking on your eyes; take breaks, alternate tasks and otherwise try to reduce long stretches spent staring at a video display. Despite advertising campaigns designed to target a single demographic, we're all potentially susceptible to dry eye. It just depends on the situation. REVIEW

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