Ocular Surface Health in Contact Lens Wear

The Ocular Surface and Successful Contact Lens Wear

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Managing Ocular Surface Conditions That Can Impact Contact Lens Success

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Placing a contact lens on the ocular surface initiates multiple interactions with the eye that will ultimately determine the success or failure of lens wear. Giving patients the best possible chance to succeed in lens wear and to enjoy a lifetime of comfortable vision requires that we do our best to maintain a healthy ocular surface.

Whether or not an individual wears contact lenses, a healthy ocular surface is critical for ocular comfort and visual quality. Although there is as yet no precise definition of ocular surface wellness, in functional terms a healthy ocular surface is one that refracts well and performs in a way that causes no negative awareness of the eye, while maintaining a healthy cosmesis. The patient with a healthy ocular surface is able to experience clear vision because the tear film is functioning optimally to create a smooth, optically clear refracting surface. And if refractive error is present, the patient’s vision can be corrected with glasses or contact lenses.

CONTACT LENS DISCOMFORT

For many Americans, contact lenses are the preferred method of vision correction. Those of us who fit contact lenses know how strongly attached our patients can be to their lenses. Yet despite the many optical, recreational, and appearance-enhancing benefits of contact lenses, studies report 12–51% of contact lens wearers abandon their lenses each year.1 In most cases, these patients do so because the lenses have stopped being comfortable.2 The consequences of this contact lens dropout include great disappointment for patients and significant economic loss for practitioners and the contact lens industry as a whole.

To lay the basis for developing solutions to the problem of contact lens discomfort and dropout, the Tear Film and Ocular Surface Society (TFOS) recently convened a large international panel to explore and characterize contact lens discomfort, and to uncover its causes. The group, the TFOS International Workshop on Contact Lens Discomfort, defined contact lens discomfort as:

... a condition characterized by episodic or persistent adverse ocular sensations related to lens wear, either with or without visual disturbance, resulting from reduced compatibility between the contact lens and the ocular environment, which can lead to decreased wearing time and discontinuation of contact lens wear.1

A key element in this definition is “reduced compatibility between the contact lens and the ocular environment.” In essence, a contact lens incites a series of ocular events that, in some patients, result in perceived discomfort. But after careful review of a massive body of research, the TFOS Workshop’s expert panel could not identify a single primary factor responsible for this lens/eye incompatibility. Instead, there are multiple—probably interacting—sources of incompatibility. The TFOS Workshop categorized these as contact lens factors (material, design, fit and wear, and lens care) and environmental factors (inherent patient factors, modifiable patient factors, ocular environment, and external environment) and explored the potential contributions of each.1

THE TEAR FILM IN LENS WEAR

A critical element in the lens/eye interaction is the impact of a contact lens on the tear film. Even in a healthy eye with no experience of lens wear, the tear film is a thin sheet of liquid challenged by evaporation and other physical forces; in the best of circumstances, the tear film can only maintain stability for a limited time between blinks. When a contact lens is placed on the eye, the tiny volume of tears is divided into two compartments: a pre-lens tear film and a post-lens tear film. This division affects the tear film in multiple ways, changing both the biophysical and biochemical environments of the ocular surface.

The tear film is responsible for maintaining a smooth, wet, lubricant surface over which the lid can glide during blink. Importantly, the lipid layer—one of whose functions is to prevent tear evaporation—is thinned on top of a contact lens, likely because the aqueous layer is also thinned and less able to support the lipid layer’s spread.3
If the aqueous layer gets too thin, the lipids in the tear film may get close enough to the lens surface to interact with and deposit on the lens. This removes needed lipid from the tear film and speeds the breakup of tears over the lens. There is good evidence that tear film evaporation is increased in the presence of a contact lens. The TFOS Workshop notes that “the physical presence of a [contact lens] disrupts the normal tear film structure, and in particular the lipid layer, facilitating a more rapid loss of tear fluid by evaporation.” But the lubricity provided by the tear film is necessary for the eyelid to slide smoothly over the contact lens.

EYELIDS AND MEIBOMIAN GLANDS

What about the effect of lens wear on the meibomian glands that produce the tear film lipid? Here again there is no certainty, although there are some intriguing clues. With respect to the prevalence of meibomian gland dysfunction in contact lens wearers vs non-wearers, studies have disagreed, with a literature review meta analysis finding no significant association between lens wear and MGD. The TFOS Workshop found this data impressive enough to state that lens wear is a potential cause of alteration in the meibomian glands and may cause meibomian gland dysfunction.

In recent years we have gained a better (although not complete) understanding of the interaction between the eyelid and the cornea (or contact lens, if one is being worn). The area of the lid just posterior to the mucocutaneous junction, coming in direct contact with the cornea (or contact lens) during blink, is known as the lid wiper, through analogy with a windshield wiper. Donald Korb and colleagues have reported a link between changes in the lid wiper epithelium and ocular dryness symptoms.

These investigators have suggested that when the tear film over the cornea or a contact lens becomes unstable between blinks, the lid wiper is exposed to relative dry patches and increased frictional forces that over time lead to an epitheliopathy that is visible with vital stains. The association between lid wiper epitheliopathy and problems with contact lens wear is supported by reports that lid wiper epitheliopathy is found in 67% to 80% of symptomatic lens wearers, but only 13% to 32% of asymptomatic lens wearers.

Although there is no definitive answer yet as to what causes contact lens discomfort, issues around friction and lubricity likely play a very significant role. Maintaining a healthy ocular surface to ensure an effective lipid layer and a lubricant tear film are key issues in preserving contact lens comfort.

THE CONTACT LENS EXAM

Given that problems with wetting and lubrication likely contribute significantly to contact lens discomfort, a good way to do something positive for patients would be to look for ocular surface problems—especially nascent ones—at every contact lens exam.

Unfortunately, practitioners do not always conduct a thorough examination of the ocular surface prior to prescribing contact lenses. In part, this may be because a large proportion of the patients who present for contact lenses are healthy teens or young adults, who have neither symptoms nor readily discernable signs of ocular surface disturbance. There may, however, be value in having more complete baseline data on the ocular surface than can be obtained from a standard slit lamp examination and fluorescein staining of the cornea.

For example, although we are taught to evert the eyelids to look for signs of inflammation prior to the initiation of contact lens wear, that step may be skipped if the eye looks healthy and the patient has no relevant complaints. Similarly, meibomian gland expression and a look at the meibum secreted takes very little time and can tell us a great deal about the condition of the glands—and the likely condition of the ocular surface—but this too is often skipped.

Recent studies tell us that meibomian gland dysfunction is a driver of dry eye. Routine gland warming and expression would allow us to spot patients at risk for evaporative dry eye before they become symptomatic and the condition affects their comfort and wearing time.

For patients past their teen years, it becomes increasingly important to evert eyelids and to express meibomian glands. It is reasonable to hope that early detection of ocular surface problems would lead to early treatment to reduce symptoms and enable longer and more comfortable contact lens wear.

ALLERGY

In my experience, the patients with contact lens discomfort, and perhaps underlying dry eye symptoms or meibomian gland dysfunction, are often also allergy sufferers. Although not well understood, there appears to be a link between these ocular surface conditions. For example, in the clinic we often see that dry eye patients will experience an exacerbation of their symptoms at the onset of allergy season.

In addition, there is a strong similarity between the way dry eye and allergy patients describe their symptoms: Dryness, irritation, discomfort, itching, burning, and stinging are used to describe multiple ocular surface conditions. Itching, while considered the hallmark of allergy, is also very frequently reported as a symptom of dry eye. The bottom line is that it is hard to determine the relative contributions of dryness and allergy to a patient’s
symptoms, and clinicians tend to agree that a contact lens wearer who has preexisting allergy will report worse symptoms while wearing contact lenses.

This may require a different lens wear strategy during allergy season, such as a switch to daily disposables, a reduction in wearing time, and/or the use of topical anti-itch medications instilled at least 10 minutes prior to lens insertion. In addition, patients on systemic allergy medications need to be alert for medication-induced dryness and possibly add contact lens rewetting drops to their regimen.

**PREVENTION**

Whether the patient has blepharitis, meibomian gland dysfunction, or allergy, counseling and appropriate action to treat the underlying condition are important for successful contact lens wear. Making that a reality begins with preventative evaluation of the meibomian glands and other elements of the lids and ocular surface both prior to beginning lens wear and at routine examinations thereafter. This preventive exam should include both a careful history and an evaluation of the lids, cornea, and conjunctiva.

Patient motivation is also an important factor in contact lens wear, particularly with respect to compliance. The importance of adherence to contact lens wear, care, and replacement instructions should be discussed with patients as they initiate what they likely hope will be long-term contact lens wear. Preexisting conditions such as meibomian gland dysfunction, anterior blepharitis, or allergy, should also be preventatively managed before, or concurrent with, contact lens wear. If any of these conditions are significant, treatment and/or at least partial resolution may be warranted before starting lens wear.

In our profession there is a tendency to think of contact lens wear as one thing and medical management of anterior segment conditions something separate and distinct. But a contact lens is a medical device with impacts on ocular biochemistry, anatomy, and physiology. Successful lens wear is more than a matter of refraction and fit. It requires our medical knowledge as well.

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Managing Ocular Surface Conditions That Can Impact Contact Lens Success

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To set patients up for success in contact lens wear requires identifying and addressing the ocular surface conditions that can limit their comfort, vision, or ocular appearance.

Contact lens veterans and novices alike need a healthy tear film and ocular surface to see, feel, and look their best in contact lenses. Even a normal tear film can be challenged by contact lens wear, which divides the miniscule tear volume into pre- and post-lens compartments and causes changes that increase tear evaporation. The presence of additional challenges from ocular surface conditions such as allergic conjunctivitis, anterior blepharitis, meibomian gland dysfunction, or dry eye can make contact lens wear uncomfortable or frankly intolerable.

This paper will review the prevalence, diagnosis, and pathophysiology of these common conditions, with a focus on pearls for identifying them in current or prospective contact lens wearers.

ALLERGIC CONJUNCTIVITIS

At least a third of the US population is affected by allergy. In one recent large-scale study, 40% of respondents from the general population had experienced ocular allergy symptoms at least once in the preceding 12 months. Among patients with allergic rhinitis, the most common allergic manifestation, 50% to 75% experience ocular symptoms.

Compared to allergic rhinitis, however, allergic conjunctivitis is underdiagnosed, and undertreated, even though it may have significant impact on patient quality of life and productivity. For those who wish to wear contact lenses, untreated ocular allergy can be a huge barrier to success—making lens wear uncomfortable (at best) and potentially exacerbating the allergic response. An atopic patient who is minimally symptomatic when wearing spectacles may experience significant exacerbation of signs and symptoms when contact lenses are worn. It is imperative to identify and treat ocular allergy before beginning contact lens wear.

SYMPTOMS AND SIGNS

The hallmark symptom of allergic conjunctivitis is itching, which may also be accompanied by burning or stinging, as well as excessive tearing. The eyelids and periocular area may itch and be edematous. Conjunctival chemosis and injection, as well as the presence of a white, stringy discharge, are common signs (Figure 1). Even in the absence of active signs and symptoms, it is imperative to question patients regarding a history of allergic conjunctivitis or other atopic disease prior to initiating contact lens wear.

Atopy, the predisposition to allergy, is to some extent hereditary, so patients should be asked about a personal and immediate family history of allergic conjunctivitis, rhinitis, dermatitis, and asthma. Seasonal allergy symptoms occur most commonly in spring and fall, and are usually recognized as such by patients; but unless we inquire, individuals sitting comfortably in the chair in February are unlikely to volunteer (or even remember) the itching and sneezing they experienced in October.

In addition to obtaining a general and family history of allergy, I take a careful history of ocular allergy symptoms, specifically inquiring about their nature, onset, and duration, as well as about any over-the-counter treatments the patient may have tried to manage symptoms.
EXAMINATION
A careful slit lamp examination provides a wealth of information about the status of the patient’s ocular surface; in addition to looking for chemosis, lid swelling, and injection, it is important to routinely evert the upper and lower lids to determine the presence or absence of papillae. Biomicroscopy of the palpebral conjunctiva can also help differentiate between infectious and allergic conjunctivitis. As a general rule, the palpebral conjunctiva in allergic disease appears milky-pink and swollen; in contrast, in infectious conjunctivitis, it appears beef-red and velvety.2
Vital dye staining is useful to visualize papillae, identify any areas of corneal or conjunctival epitheliopathy, and measure tear film breakup time (TFBUT). There is notable overlap between the symptoms of allergic conjunctivitis and dry eye, and evidence even suggests that allergic conjunctivitis may destabilize the tear film and precipitate dryness.5,6
When dry eye and allergy coexist, a reduced tear volume and decreased turnover may increase the concentration of allergens on the ocular surface and exacerbate the allergic response.2,5,6 Patients using first- and second-generation oral antihistamines to control nasal or other allergy symptoms may experience ocular dryness as a side effect; these patients may benefit from the addition of artificial tears.

ALLERGY AND CONTACT LENSES
Ocular allergy need not rule out contact lens wear, but may curtail or disrupt it. With proper treatment, patient education, and the selection of appropriate contact lens materials, care solution, and modality of wear, allergy sufferers may continue to successfully wear lenses. Allergic patients must understand that inadequate tear turnover, infrequent lens replacement, and failure to clean lenses thoroughly can increase adhered allergens and tear film deposits, exacerbating the deleterious impact of allergy on lens wear.8 As is discussed at length in another section of this report, a highly wettable daily disposable contact lens is optimal for patients whose allergic conjunctivitis can be controlled.8
Depending on the severity of the presentation and the patient’s motivation to wear contact lenses, a more or less aggressive treatment approach may be warranted. It is also helpful to provide patients with a basic explanation of allergy, to help them understand how lifestyle changes (eg, frequent washing of sheets, pets, and hair) and nonpharmaceutical measures (eg, preservative-free artificial tears, cold compresses) can potentially reduce the signs and symptoms related to ocular allergy.

DRY EYE
A multifactorial ocular surface condition resulting from inadequate production and/or excessive evaporation of tears, dry eye is characterized by tear film hyperosmolarity and instability; ocular surface inflammation and tissue damage; and patient discomfort and visual disturbance.9
Overall estimates of dry eye prevalence are highly variable and inconsistent, due to use of different definitions and criteria, and to the frequent discord between symptoms and clinical signs. Nonetheless, the last decade has seen significant progress in identifying dry eye patients and in understanding this complex condition.10 A common condition in the general eye care population, the signs and symptoms of dry eye are especially noticeable in contact lens wearers.11-13
In our practice, we estimate that 35% to 40% of contact lens wearers under age 45 have dry eye symptoms; and in lens wearers over 45, approximately 50% to 60% have some form of ocular dryness. Multiple factors, including age-related hormonal changes, polypharmacy in older adults, increased incidence of systemic diseases linked to ocular dryness (eg, diabetes, thyroid disease) are thought to contribute to the increased prevalence of dry eye.9,11,14 Because a number of widely used systemic drugs have recognized or potential impact on the eye and ocular surface including dryness, our

PATHOPHYSIOLOGY OF OCULAR ALLERGY
Allergic conjunctivitis is characterized primarily by a type I hypersensitivity response, in which B lymphocytes, activated by allergens, release immunoglobulin-E (IgE). IgE binds to the surface of mast cells, causing degranulation and the release of pre-formed mediators, including histamine, tryptase, chymase, and chemotactic factors.7 Of these, histamine is widely recognized as the prime allergic mediator. Histamine acts on H1 receptors on conjunctival blood vessels to cause vasodilation and increased vascular permeability, while also acting on conjunctival nerves to trigger itching.7
In addition to the release of histamine and other preformed mediators, mast cell degranulation initiates the formation of prostaglandins and leukotrienes from the release of membrane phospholipids. These synthesized mediators add to the inflammation on the ocular surface.
practice maintains an up-to-date list of each patient’s prescription and over-the-counter medications and supplements. Contact lens wear can exacerbate preexisting dry eye symptoms and cause subclinical cases to become overtly symptomatic, putting contact lens wearers with dry eye at a significant disadvantage with respect to comfort, vision, and the prospect of long-term comfortable wear. The contact lens material, as well as wetting agents introduced from the packaging or cleaning and disinfecting solution, can mitigate some of these effects.

**HISTORY AND EXAMINATION**

We ask all contact lens wearers and any other patient with significant risk factors for, or reported symptoms of, dry eye a series of carefully worded questions to determine exactly when and how dryness symptoms impact their lives. For returning contact lens wearers, in particular, asking specific, open-ended questions is critical. I ask patients, “About how long do you wear your contact lenses before they start to become uncomfortable or blurry?”

This not only gives patients permission to complain, but also gives us a picture of their average lens-wearing day and helps us determine, for example, whether discomfort or blurred vision is the chief complaint. Episodic decrease in visual quality toward the end of the day is a reported complaint in dry eye patients due to a poorly wetting and thus poorly refracting tear film.

Patients’ responses to our questions help determine which tests to perform. We routinely perform biomicroscopy before and after staining the ocular surface with fluorescein and/or lissamine green dye, paying particular attention to the lid wiper for signs of epitheliopathy. After staining, we sometimes assess tear film breakup time (TFBUT).

It is occasionally useful to perform TFBUT while the lens is on the eye; these breakup times are typically very brief. In some cases, performing TFBUT with the lens in place allows one to visualize small deposits on the lens surface that would not otherwise be visible. After removing the lens, we can often see a ring of staining around the cornea, matching the diameter of the contact lens.

The ocular surface examination of symptomatic dry eye patients (both lens wearers and nonwearers) can be totally unremarkable. Numerous studies have demonstrated the value of tear film osmolarity as a valid and reliable means of identifying dry eye in asymptomatic and symptomatic individuals. We often evaluate tear film osmolarity in lens wearers, even when they have no specific complaints.

Finally, and perhaps most importantly, we express the meibomian glands to evaluate their patency and the quantity and quality of their secretions. We know that obstructive meibomian gland dysfunction (MGD)—an important cause of evaporative dry eye—can be present in lids that appear normal. Gland expression is a simple test to identify and address “nonobvious” MGD, a condition that may be more widespread than frank MGD. In contact lens wearers especially, as many as 90% of those with dryness symptoms, and about 40% of those without symptoms, may have some degree of MGD.

**EYELID MARGIN DISEASE**

Blepharitis, a term that encompasses eyelid inflammation with a range of etiologies, is among the most widely encountered conditions in an eye care practice. Lid inflammation can affect the posterior lid margin and meibomian glands and/or the anterior lid margin and eyelashes; etiologies can be infectious, inflammatory, or both. Indeed, the complex pathophysiology of blepharitis typically involves some interaction between the microflora of the lid margin and the eyelid secretions. While more commonly seen in older people, blepharitis can affect patients of any age, including children. And regardless of patient age, any inflammatory condition such as blepharitis that impacts tear film quality must be managed on a long-term basis to promote successful contact lens wear.

In patients with anterior blepharitis, bacteria such as *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Propionibacterium acnes* colonize the lids in greater numbers than occur in patients without blepharitis. These bacteria produce lytic enzymes that break down tear film lipids, irritating and inflaming the lids and ocular surface. *Demodex folliculorum* and *Demodex brevis*, arachnid mites commonly found in human hair follicles and sebaceous glands, respectively, have also been implicated in blepharitis. *Demodex*-related inflammation can be due to the direct action of the mites (consuming follicular epithelial cells, obstructing meibomian glands) and/or a reaction to the mites’ own colonizing bacteria and waste products.

**PREPARE FOR LENS WEAR**

Patients with acute blepharitis may complain of burning, itching, sore or sticky eyelids (particularly upon waking), and, if they are contact lens wearers, discomfort and reduced wearing time. Their lid margins are often red and swollen, with visible telangiectasia and lash scurf, collarettes, and debris. Cylindrical cuffs of dandruff about the lashes are commonly associated with *Propionibacterium* infestation (demodicosis). Over time, eyelashes may become broken, misdirected, or lose pigment.

If left untreated, blepharitis can eventually affect the conjunctiva and cornea, either by precipitating a dry eye condition due to reduced meibomian lipids, and/or by direct irritative action of staphylococcal enzymes. In cases where blepharitis is associated with significant inflammation, conjunctival injection, and marginal keratitis, prescribing a steroid and/or antibiotic can help quiet the lids. When demodicosis is suspected, microscopic
examination of one or more epilated lashes can confirm the diagnosis. Commercially prepared tea tree oil preparations are available to manage this condition. Unfortunately, it often recurs and may require chronic therapy.

General eyelid hygiene is perhaps the most important facet of blepharitis management. I explain to patients that blepharitis is frequently chronic and recurring—and that routine eyelid hygiene, like regular brushing and flossing, is necessary to keep the lids and ocular surface healthy. Patients who want to wear contact lenses need to understand the vital relationship between eyelid and ocular surface health and the long-term success and comfort of contact lens wear.

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