

Understanding Dry Eye Disease

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"The whole is greater than the sum of its parts" - Aristotle

Dry eye disease is one of the most prevalent ocular conditions worldwide and is emerging as a leading reason for visits to eye care professionals. What was first defined as a condition due to a decrease in the water content of tears, is now considered a puzzling and multifactorial condition with associations to everything from lifestyle to general health issues. It was first coined as a medical condition in the 1950s by Swedish ophthalmologist Henrik S. C. Sjogren, who named it keratoconjunctivitis sicca, or "dry inflammation of the cornea and conjunctiva". Though used interchangeably with the term Dry Eye Disease (DED), however, keratoconjunctivitis sicca more specifically denotes dry eyes secondary to decreased tear production as seen with aging changes, autoimmune conditions such as rheumatoid arthritis, Sjogren's syndrome, systemic lupus erythematosus, sarcoidosis, postradiation fibrosis and certain types of medications.

As our understanding, not to mention acceptance, of DED has evolved, so has the nomenclature of its etiological factors...keratoconjunctivitis sicca, meibomian gland dysfunction, posterior lid margin disease, blepharitis, the terms used to define a cause of the dryness. Though it all sounds very confusing, it makes sense that DED is a multifactorial and complex condition, wherein no one treatment is the magical cure. We hope to take some of the mystery out of this diagnosis for our readers by breaking the sum down into its various parts, so to speak. Let's start off by remembering the components of our natural tear film: aqueous or water, oil and mucin. Water is by far the largest part of the tear film but both the other components, though making up approximately 4-6% of the tear film, are equally important in ensuring a good "quality" tear film. The oil in tears prevents excessive or rapid evaporation of tears, and the mucin layer holds the tear film across the surface of the eye. If even one of the components is deficient, the tear film is considered "poor quality" and is ineffective at eye lubrication, resulting in dry eyes.

So what makes dry eyes so complex and multifactorial?

DED is more than simply a supply and demand issue... quality is just as important in this case as is quantity. We know this from the advances we have made in the study of the tear film and its components. To make matters a little more complicated, let us introduce yet another factor for consideration: Distribution!

Demand:

In some cases, dry eyes develop due to an increase in demand. Many times this is due to a change in the position of the eyeball or the eyelids, resulting in increased exposure of ocular surfaces to the elements and to evaporation. Conditions such as thyroid eye disease, orbital tumors, eyelid malpositions, apraxia, eyelid laxity and scarring can

result in increased exposure. Besides medical conditions, lifestyle factors can also increase evaporation of the tear film resulting in dryness, such as decreased blinking from watching TV, computer reading, driving, poorly regulated humidity in temperature-controlled environments (such as office, car air conditioning).

Supply:

This is where quality and quantity both play an important role.

A decrease in quantity can be seen with ageing, postmenopausally in women, in orbital inflammatory conditions such as thyroid eye disease, sarcoidosis, Sjogren's syndrome, lupus, and other autoimmune conditions. Sometimes this decrease in aqueous production can be secondary to medical treatments such as postradiation fibrosis, medications such as anti-histamines, sedatives, diuretics, beta-blockers, oral contraceptives, nasal decongestants and opiates, to name a few. Another medically-induced cause of DED is laser refractive surgery, where corneal nerves are cut during the surgical process, leaving the cornea less sensitive to dryness. As tear production is inherently driven by corneal stimulation, this can result in decreased tear production through decreased feedback from the corneal nerves. In most cases, this is short-lived but in some it can result in more permanent dryness.

As mentioned earlier, any change in the balance of the 3 components of the tear film will result in "poor quality" and thus DED. Such as having less oil in the tear film will cause it to evaporate faster, thus making it ineffective in lubricating ocular surfaces. In these cases, though the cornea up-regulates tear production, the new tears formed continue to be poor quality and so a vicious cycle starts, resulting in more volume of these tears. This increase can, in turn, overwhelm the tear drainage system that cannot right away accommodate the volume and so the residual tears will find their way out of the eye by flowing down the cheek, resulting in tearing. That probably sounds counterintuitive but is known to be a big factor in tearing issues.

Conditions that decrease the amount of oil or mucin in the tear film, and in turn the quality, include blepharitis, rosacea, meibomian gland dysfunction and ocular surface inflammatory conditions. Other factors such as apraxia, incomplete eyelid blink and lagophthalmos (incomplete eye closure) can result in decreased oil being pumped out of otherwise normal oil glands into the tear film.

Distribution:

Just like in any situation of supply and demand, even if the supply is appropriate, an equally adequate distribution is important. This is where our eyelids and our lifestyles come into play. Though we attribute so many aesthetic and emotive characteristics to eyelids, their *raison d'être* is simply and succinctly...eye protection. They not only cover the eyes but also distribute tears across the ocular surface with each blink and then pump the remaining tears and debris down the lacrimal drainage system. For eyelids to function in this way, they must have a brisk and complete blink response and the conditions that can affect this are eyelid malposition, spasms, apraxia, eyelid laxity and scarring. In these situations, the tear film is not properly distributed to all ocular

surfaces. Also, as these tears are not pumped down the tear drain properly by the poorly functioning eyelids, they can result in...tearing!

Our lifestyles play an important role in adequate tear-film distribution as well. Activities like extended computer use, television viewing, reading and driving can all result in a delayed and poor blink response. Also, with decreased blinking, the oil glands do not pump out oil into the tear film as effectively and we end up with a poor quality tear film as well.

Having explained the various factors that can result in DED, we hope readers find it easier to understand its complex nature, varied presentation and extreme variability even within the same person. The fact that not only can each one of us identify several causes of DED in our lives and that most of these factors only get worse with age, certainly does not help in dealing with this intricate disease process. It is critical for eye doctors to elicit a careful history of DED presentation and associated factors, a detailed examination with testing of tear film quality and quantity when necessary and possible referral to an ocular surface specialist when needed for surgical management...all before permanent damage to the ocular surfaces is sustained due to DED.

In the setting of blepharospasm, it is imperative for patients and treating physicians to recognize the strong association between BEB and DED. The causal relationship, that is, does one promote the other, is still poorly defined, but what remains clear is that appropriate recognition and treatment of DED will decrease severity of blepharospasm and so should always be undertaken simultaneously to ensure best treatment results. Also, as both dry eyes and blepharospasm are known to worsen with increasing age, it makes sense to periodically re-evaluate the treatment plans for both conditions.

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