Tear Film Lipids and Successful Contact Lens Wear

Careful lens selection and clear patient counseling can reduce lipid deposition in contact lens wear.

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The lipid layer is crucial to normal tear film function: it limits aqueous evaporation, creates a smooth, stable refracting surface, and provides a barrier to foreign materials. Itself a complex structure, the lipid layer is composed of a thin layer of polar lipids that stabilizes the thicker layer of nonpolar lipids that rides above it (and which acts as a barrier to the environment). This polar lipid interface adheres the nonpolar lipids to the aqueous compartment and allows the lipid layer to spread evenly across the polar aqueous portion of the tear film.1

LENS-TEAR FILM DYNAMICS

When a contact lens is placed on the eye, it changes the physical chemistry of the ocular environment, altering mucin production, decreasing tear film stability and increasing tear osmolality.2 The contact lens divides the tear volume, creating a pre-lens tear film on the surface of the lens and a post-lens tear film between the lens and the cornea. The average, non-disrupted tear film is around 4 microns thick, but the pre-lens tear film is only about 2.5 microns.2

A thinner tear film is less stable, and a thinner lipid layer is associated with reduced tear-film breakup time (TFBUT): Over a contact lens, the TFBUT is typically about 5 to 10 seconds, compared to 20 to 30 seconds without a lens in place.3

Tear lipids can adhere to microscopic hydrophobic domains on a silicone hydrogel lens surface. When exposed to light and oxygen for prolonged periods, these adhered lipids can degrade, further reducing lens wettability. Tear film instability, lens deposition, and reduced lens wettability can all contribute to symptoms of dryness and irritation in wearers.

IMPACT OF LENS MATERIAL

Patient-to-patient differences in tear film chemistry account for some of the variation in patients’ ability to tolerate a soft contact lens material; the other important factor is the hydrophobicity of the lens surface.

Both “conventional” hydroxyethyl methacrylate (HEMA)-based lenses and silicone hydrogel lenses contain both hydrophilic and hydrophobic polymer chains. These polymer chains tend to orient themselves according to their environment. Dryness in the environment of the lens—eg, from a TFBUT shorter than the inter-blink interval—will draw the hydrophobic (lipophilic) chains of the lens polymer toward the lens surface, which can further disrupt tear spreading and lead to lipid deposition.

The chemistry of silicone insures that silicone hydrogel lenses have far more hydrophobic polymer chains than HEMA-based lenses; and, as a result, silicone hydrogel lenses must rely on surface modifications to “sequester” these hydrophobic chains. Such modifications include plasma treatment, changing the composition and length of the polymer chains, and adding wetting agents (either to the lens itself or to the soaking solution). Each of these techniques produces a different surface environment, and, consequently a different degree of resistance to lipid deposition.1

IN THE CLINIC

On the surface of the lens, the effects of lipid deposits can range from decreased wettability and TFBUT to frank, visible fouling and a decrease in optical clarity. When I see a patient with heavily lipid-deposited lenses, I take a comprehensive look at their lens material, lens solution, care regimen, and eyelid hygiene. I identify and address blepharitis and any associated meibomian gland dysfunction in order to ensure a baseline tear film quality.

If a patient can’t (or doesn’t want to) wear a daily disposable lens, I select a reusable contact lens material with a highly wettable surface, and pair it with a solution that will effectively reduce lipid deposits and help maintain surface wettability. I also counsel patients carefully about their lens care routines, emphasizing the importance of digital rubbing to help dislodge deposits.

Ultimately, my goal is to keep patients’ eyes healthy, seeing well, and feeling comfortable. Contact lens wear affects the ocular surface in many ways, and certainly impacts tear film stability. But choosing a lens and care system that can keep the lens surface wettable—while reducing lipid deposition—should help maintain patients’ tear film stability and lens wearing satisfaction.

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REFERENCES