Research Highlight

The Evaporation Barrier of the Tear Film Lipid Layer

P. Ewen King-Smith

The Ohio State University College of Optometry, Columbus, Ohio, United States; king-smith.1@osu.edu

The article about instability and break-up of model tear films by Bhamla et al.[1] helps to clarify a longstanding puzzle about the evaporation resistance of the tear film lipid layer (TFLL). In a classic study, Mishima and Maurice[2] concluded that the TFLL reduced evaporation rate by a factor of approximately 15. However, Brown and Dervichian[3] found that meibum (meibomian gland lipid), spread on a beaker of saline, produced no detectable reduction in evaporation rate, and their finding has been confirmed several times. Thus, either the conclusion of Mishima and Maurice is incorrect[4] or else meibum spread on saline differs from the in vivo TFLL.

Bhamla et al.[1] generated a model tear film by raising an upward-facing contact lens through the surface of an artificial tear solution covered by a thin layer of meibum. Initially, the tear film drained due to gravity, but as it thinned, flow from gravity was reduced greatly by viscous drag, so thinning was controlled mainly by evaporation. An imaging system was incorporated to view optical interference in this model tear film; initially interference showed the structure of the superficial lipid layer, but at a later stage, interference could be observed in the aqueous layer. The important findings were that small regions of aqueous tear film remained long after other regions had dried from evaporation, and these small regions were correlated with the observed lipid pattern. Therefore, the results support the conclusion that the TFLL is an effective barrier to evaporation.[1] However, when meibum is spread on a beaker of saline, only small areas are effective evaporation barriers, so any reduction in evaporation rate is not detectable. Thus, compared to the in vivo TFLL, the in vitro meibum layer has a reduced ability to spread and form a continuous evaporation barrier over an aqueous substrate.

References

1. Bhamla MS, Chai C, Rabiah N, Fuller GG. Instability and break-up of model tear films. *Invest Ophthalmol Vis Sci*. 2016;57:949–958.
2. Mishima S, Maurice DM. The oily layer of the tear film and evaporation from the corneal surface. *Exp Eye Res*. 1961;1:39–45.
3. Brown SI, Dervichian DG. The oils of the meibomian glands. Physical and surface characteristics. *Arch Ophthalmol*. 1969;82:537–540.
4. Georgiev GA, Yokoi N, Ivanova S, Tonchev V, Nencheva Y, Krastev R. Surface relaxations as a tool to distinguish the dynamic interfacial properties of films formed by normal and diseased meibomian lipids. *Soft Matter*. 2014;10:5579–5588.

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