Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

In vitro spoilation of silicone hydrogel soft contact lenses in a model-blink cell

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Tear biomolecules like lipids and proteins begin to deposit onto contact lenses shortly after a patient inserts their contact lenses.[1-4] Deposits are a significant concern to both the clinician and patient because they have been associated with decreased vision, decreased ocular comfort, and pathological conditions like giant papillary conjunctivitis – consequences that may lead to a decrease in wear time or even contact lens dropout.[5, 6]

Understanding contact lens deposits and their consequences has been a major interest to the scientific community.[1-7] In general, studies related to contact lens deposition have taken either *ex vivo* or *in vitro* approaches.[3] *Ex vivo* (human-based) studies are appealing because they allow researchers to study the full complexity of tear biomolecules deposited onto contact lenses and because ex vivo studies better represent real life conditions, which tend to involve a range of adherence to good contact lens care and compliance practices.[3,7,8] *In vitro* (laboratory-based) studies can be advantageous because they allow for much greater experiential control (ability to manipulate a single biomolecule and less variability) and because many contact lenses can be studied at the same time.[2, 3] *In vitro* studies also allow for analysis methods that are incompatible with research involving human subjects.[1]

In vitro studies have historically been performed by incubating contact lenses in representative tear solutions or in solutions that contain a single biomolecule for a set amount of time after which downstream analysis is performed to understand the outcome of interest.[1-3] While these approaches have offered many insights, basic incubation experiments do not fully represent the on-eye contact lens wearing experience.[3] Furthermore, these simple incubation methods are especially problematic for studies involving lipid-containing solutions, because lipids are insoluble in water, which may lead to the lipids within these solutions having limited interaction with the contact lens.[3]

Along with the inherent advantages of in vitro analyses, the above limitations have compelled investigators like Peng et al. to develop better in vitro devices for studying contact lens biomolecule deposition.[3]

Peng CC, Fajardo NP, Razunguzwa T, Radke CJ. In vitro spoilation of silicone-hydrogel soft contact lenses in a model-blink cell. Optom Vis Sci 2015;92: 768-780.

An in vitro model-blink cell that mimics break-up of the tear lipid layer

Peng *et al.* developed an in vitro model-blink cell that closely represents how the tear lipid layer breaks up over the contact lens during a blink.[3] Their model-blink cell works by first placing a soft contact lens in a Teflon mold that leaves the anterior surface of the contact lens exposed to the treatment conditions.[3] The investigators then

add an aqueous layer with a mixture of proteins to the chamber, which is followed by a layer of artificial-tear lipid solution.[3] The blink is then simulated by removing the aqueous layer until there is a break in the aqueous layer, which results in the lipid layer making contact with the contact lens.[3] The aqueous solution is then replaced, and the process repeated to simulate normal contact lens wear.[3]

Validation of their apparatus demonstrated that the device was able to produce lipid deposition patterns similar to that of human worn contact lenses.[3] Peng *et al.*'s apparatus and downstream advanced microscopic analysis was also able to provide additional information about contact lens biomolecule deposition.[3]

Lipids and proteins within the same deposits

Specifically, Peng et al. found that both lipids and proteins exist in the same deposits, though their distributions within the deposits were not uniform.[3] They also found that lipids penetrate into the matrix of silicone hydrogel contact lenses while there was limited lipid penetration into the matrix of hydrogel contact lenses.[3]

Overall, the community currently has a good understanding of contact lens deposition and how contact lens deposits affect the patient's experience.[1-7] Nevertheless, we still have much to learn about how individual contact lens deposits affect the ocular system and deposition patterns across the multitude of contact lens materials on the market. Similarly, there will always be some uncertainty in this field because new contact lens materials are continually being introduced. Peng et al.'s model-blink cell and similar devices will play a significant role in the field because they will be critical for bridging these knowledge gaps. Ultimately the knowledge gained from these devices will help improve contact lens designs and the overall contact lens wearing experience.[3]

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