Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

Contact Lens Wettability, Cleaning, Disinfection and Interactions with Tears

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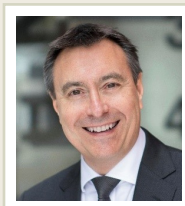

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Willcox M, Keir N, Maseedupally V, et al. CLEAR – Contact lens wettability, cleaning, disinfection and interactions with tears. Cont Lens Anterior Eye 2021;44:157-91

The purpose of this report was to investigate the complex interactions that occur between contact lens materials, the tear film and disinfection solution and establish their respective roles in contact lens comfort and biocompatibility with the ocular surface.[1]

A critical component to contact lens comfort relates to wettability of the lens on eye. What exactly is “wettability” and what factors impact it? Well, its complicated! When a contact lens is placed on the eye, the tear film and the air “compete” for the contact lens surface, and the extent of the surface that is covered by the tear film reflects the wettability of the lens material. Wetting of any interface involves the three phases of matter (air, liquid, and solid). To understand the interaction between these three phases, the surface free energy of the solid (the lens) and the surface tension of the liquid (tear film or solution) have to be taken into consideration. Wettability is enhanced by having a relatively high surface free energy of the contact lens surface and a relatively low surface tension of the tear film or contact lens solution. The wettability of the lens is influenced by a number of factors, especially the chemistry of the contact lens material, any surface coatings/treatments, and the addition of internal or releasable wetting agents. This inherent material wettability may be modified by the solutions that the lens is exposed to. For daily disposable lenses this can be impacted by the composition of the blister-pack solution and for reusable lenses the composition of the lens care solution the lens is exposed to each night may also play a role. One final factor to consider relates to the components of the tear film, with proteins, lipids and mucin species all modifying material wettability.

How can we assess wettability? There are essentially two differing ways to do this. The first relates to assessment of wettability in the laboratory, which is largely undertaken by determination of the contact angle. The contact angle provides an inverse measure of wettability: higher angles correspond to lower wettability and vice versa. There are several methods available, depending upon whether the angle is measured in air or in the fluid phase. The second method relates to measuring the material wettability on-eye. This is primarily undertaken by determination of the break-up time of the tear film over the front surface of the lens, typically by projecting a grid onto the lens and visualising its distortion after blinking. To-date, the importance of either methodology to relate wettability to comfort remains somewhat controversial, with very few papers being able to link in vitro or in vivo wettability with end of day comfort.

How can we improve material wettability? Contact lens materials can be manufactured with wetting agents which may be embedded into the contact lens (internal wetting agents), embedded on its surface (surface wetting

agents), or may be progressively released from the contact lens during wear (released wetting agents). Many papers describe the incorporation of these agents and show supportive data of their value in promoting in-eye performance and each has its merits. Is one methodology preferred over another? A review of the evidence would suggest that no one method is preferred for all wearers.

How can wettability be maintained over time? Publications on this topic are many and varied and encompass alterations to the composition of the blister packaging solution, blinking exercises to promote more complete and frequent blinks, application of rewetting drops over the lens surface and modifications to the compositions of these in-situ drops, concurrent use of prescription dry eye products with lens wear and use of various lens care solutions. Despite these many options, there appears to be inconsistent evidence that rewetting drops or lens care solutions can significantly impact or maintain lens wettability during wear. This suggests that the very presence of the lens itself and/or the quality of an individual's tear film may be the predominant factors, despite certain combinations of products or wetting agents apparently performing better than others for certain wearers.

What is the impact of contact lens solutions on lens performance? Contact lens solutions remain an important part of contemporary contact lens practice, being used by at least 50% of all contact lens wearers globally. The composition of these systems remains highly complex, incorporating a wide variety of antimicrobials (also referred to as disinfectants, preservatives or biocides), surfactants, buffering, chelating and wetting agents and the overall formulation substantially impacts their performance with certain lens materials or lens wearers. A substantial number of publications have examined the clinical performance of these products in terms of their disinfection efficacy, cleaning efficiency with respect to their ability to remove tear film components from lens materials, compliance, uptake and release of solution components from various materials, corneal staining and comfort. Soft lens materials invariably take up and subsequently release certain components of disinfecting solutions onto the ocular surface. This may affect tear film stability and the normal ocular microbiome, and further research is needed in this area to determine whether this has any affect on comfort. Certain combinations of lens materials and care systems do appear to provide improved comfort for certain wearers, but this "best" combination differs for different people and there appears to be no overall "winner".

Finally, do contact lenses alter the composition of the tear film? The overall summary from a substantial body of work suggests that alterations in tear proteins, lipids, mucins and tear inflammatory mediators does occur, but there is significant contradictory data on what impact lens wear has on tear film composition and also its relevance to lens comfort. Elucidating the relationship between these biochemical changes and their clinical relevance is hampered by the use of different classification schemes for symptomatic and asymptomatic lens wearers, differences between studies in wear modalities, lens materials and care systems and differences in the biochemical techniques used to examine tear film changes.

In summary, contact lens wettability remains a crucially important part of biocompatibility and the overall performance of lenses. However, there remains no clear association between contact lens wettability and comfort, making it challenging to determine whether improving wettability will be of significant clinical benefit. Contact lenses do uptake components from blister pack packing solutions and disinfecting solutions, and the uptake and release of these chemicals can alter comfort. Contact lens materials do sorb components of the tear film, and these interactions are complex and may change the biochemistry of the tear film, which in turn may affect comfort. The exact role of the tear film and whether this can be altered to improve biocompatibility and comfort during wear requires significant further research. Standardisation of the way in which wearers are classified into being symptomatic or asymptomatic, in addition to the biochemical and biophysical methods to study the tears, will be important for future research to yield meaningful results.

REFERENCES:

1. Willcox M, Keir N, Maseedupally V, *et al*. CLEAR – Contact lens wettability, cleaning, disinfection and interactions with tears. *Cont*

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