Evaluating lysozyme deposition on contemporary daily disposable contact lenses in a novel *in vitro* blink model

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Introduction

- Current *in vitro* eye models used in contact lens (CL) deposition studies are still rudimentary.
- Most are performed in a simplistic, static glass vial with the lens submerged in a solution.[1,2,3]
- Limits the ability to mimic the complexity of the ocular environment.[1,2,3]
- Our *in vitro* model is designed to physiologically mimic representative tear flow, tear volume, air exposure, and the mechanical rubbing produced during blinking.

Purpose

- To evaluate total lysozyme deposition on daily disposable (DD) CLs using a novel *in vitro* eye-blink model.

Methods

- An *ex vivo* lysozyme deposition study was used as a reference for the blink model[4] (Table 1).
- Three conventional hydrogel (CH) (etafilcon A, omafilcon A, nelfilcon A) and three silicone hydrogel (SH) (delefilcon A, senofilcon A, somofilcon A) DD CL materials were tested.
- The device blink rate was set to 6 blinks/min with a tear flow rate of 1 µL/min using an artificial tear solution (ATS) containing lysozyme and other typical tear film components.
- After incubation of 2, 4 or 8 hours the lenses were removed, and the lysozyme extracted using acetonitrile: 0.2% trifluoroacetic acid (n=3).
- A separate experiment was conducted with lenses incubated in a vial containing 480 µL of ATS on an orbital shaker at 60 rpm for 8 hours (n=3).
- Lysozyme activity was measured using a spectrophotometric assay.

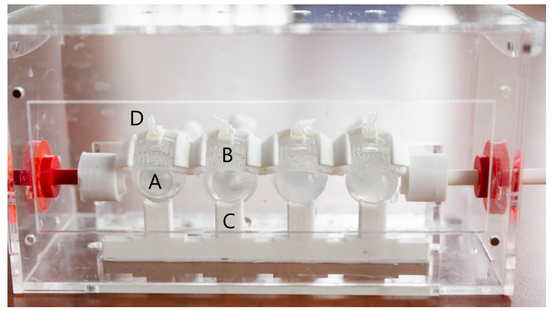

Figure 1 *In vitro* eye blink model used in this study. (A) Polyvinyl alcohol (PVA) eyeball (B) PVA eyelid with 3D-printed support structure (C) 3D-printed lower eyelid (D) tubing connector for fluid input.

Results

- Etafilcon A deposited significantly higher amounts of active lysozyme (402 ± 102 µg/lens, Figure 2) compared to other lens materials after 8 hours ($p < 0.0001$, Figure 3).
- Etafilcon A had a higher amount of active lysozyme using the blink model (Figure 1) compared to the static vial at 8 hours ($p = 0.0435$).
- Somofilcon A ($p = 0.0076$) and senofilcon A ($p = 0.0019$) had a higher amount of lysozyme activity in the vial compared to the blink model.

Table 1 Active lysozyme deposition comparison between an *ex vivo* study[4] and the blink model on etafilcon A DD CLs.

Active lysozyme deposition (µg/lens)	2 hours	4 hours	8 hours
***Ex vivo* study[4]**	122 ± 1	225 ± 5	342 ± 14
Blink model	137 ± 14	201 ± 155	401 ± 102

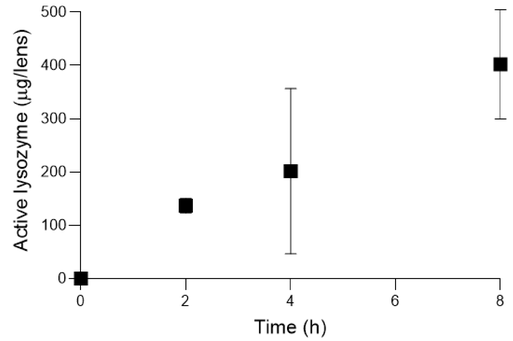

Figure 2 Active lysozyme per lens for etafilcon A over 8 hours on the blink model.

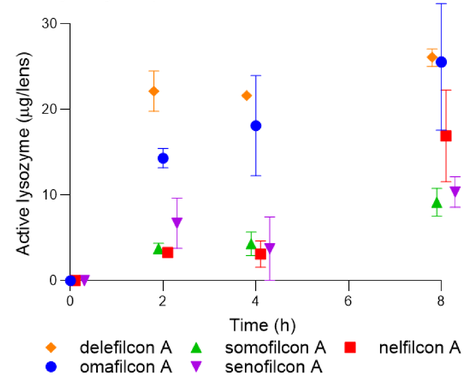

Figure 3 Active lysozyme per lens over 8 hours for omafilcon A, nelfilcon A, somofilcon A, senofilcon A, and delefilcon A on the blink model.

Conclusions

- The blink model can be tuned to provide quantitative data that closely mimics *ex vivo* studies and can be used to model deposition of lysozyme on CL materials.

References and Funding

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