Centre for Contact Lens Research I School of Optometry & Vision Science I University of Waterloo

American Academy of Optometry 2016
Anaheim, USA

E-abstract # 160101

In vitro eye model to simulate the impact of blinking on contact lens deposition and drug delivery

Hendrik Walther,[1] Chau-Minh Phan,[1] Han Qiao,[1] YiBo Liu,[2] Lakshman Subbaraman,[1] Lyndon Jones[1]

[1]Centre for Contact Lens Research, School of Optometry and Vision Science, University of Waterloo
[2]University of Waterloo Department of Chemistry

PURPOSE: Our group recently reported on the development of an in vitro platform to mimic various ocular parameters (tear volume & flow, air exposure & mechanical rubbing) that play a crucial role in the interaction of the tear film (TF) and contact lenses (CLs) for ocular drug delivery and deposition.[1,2] However, this model did not truly mimic the blink; thus, the aim of this project was to develop a model to simulate the natural blink motion and produce a layered TF structure.

METHODS: The model is designed as a two-piece system, consisting of an 'eyeball' and 'eyelid' component, constructed using 3-D printing. To mimic the natural blink, a set of adaptable bands are attached to the eyelid to keep it in a 'closed' position. The 'open' lid position is achieved using a mechanical actuator, which pulls the front margin of the eyelid piece upwards. The rapid inactivation and reactivation of the actuator causes the lid to close and retract back to the open position. Two ducts are integrated within the eyelid piece and tubing is positioned superiorly on the eyeball piece, which are all attached to a microfluidic delivery system.

RESULTS: The artificial TF structure is achieved by injecting the eyelid ducts with the lipid components of the TF, while simultaneously injecting the aqueous component through the eyeball tubing. The thin layer of artificial TF is replenished each time the mechanical blink is executed. Tear break up occurs during the inter-blink period. The speed of the blink motion and the inter-blink interval are fully controllable.

CONCLUSION: This novel and highly advanced in vitro platform is the first of its kind that simulates the physiological blink motion and distribution of the TF to the eye. This model will help better predict the on eye performance of CL materials, as well as other smart CL applications, including drug delivery and bio-sensing opportunities.

[1]Phan CM, et al. *J Vis Exp.* 2016

[2]Bajgrowicz M, et al. *Invest Ophthalmol Vis Sci.* 2015

UNIVERSITY OF WATERLOO | CCLR